CASTLE ROCK PLANNING COMMISSION

Regular Meeting and Public Hearings: Tuesday, June 17, 2025
6:00 PM

Location
Castle Rock Senior Center
222 Second Ave SW
Castle Rock, WA 98611

AGENDA

To join this meeting from your computer, tablet or smartphone: https://meet.goto.com/216918261
To join this meeting using your phone: +1 (224) 501-3412 **Access Code:** 216-918-261 (Press *6 to speak)
New to GoToMeeting? Get the app now and be ready: https://global.gotomeeting.com/install/216918261

1. CALL TO ORDER

a. Roll Call

2. CITIZEN COMMENTS

3. REPORTS

4. PUBLIC HEARING - Landing on the Cowlitz (LOTC) Stormwater Outfall

a.

1. Call to Order
2. Open the Agenda Topic
3. Staff Presentation
4. Applicant Presentation
5. Public Testimony
6. Close Public Testimony
7. Commission Questions & Discussion
8. Close Public Hearing
9. Decision or Recommendation

5. PUBLIC HEARING - River's Edge at the Landing Subdivision

a.

1. Call to Order
2. Open the Agenda Topic
3. Staff Report
4. Applicant Presentation
5. Public Testimony
6. Close Public Testimony
7. Commission Questions & Discussion
8. Close Public Hearing
9. Decision or Recommendation

6. CONSENT AGENDA

a. Approval of Minutes - May 20, 2025 Planning Commission Regular Meeting Minutes

7. OLD BUSINESS

8. NEW BUSINESS

9. ADJOURNMENT

UPCOMING MEETINGS:
July 15, 2025 - CANCELED
July 29, 2025
August 19, 2025
September 16, 2025

Non-Discrimination Statement: This institution is an equal opportunity provider and employer. If you wish to file a Civil Rights program complaint of discrimination, complete the USDA Program Discrimination Complaint Form, found online at https://www.ascr.usda.gov/sites/default/files/Complain_combined_6_8_12_508_0.pdf or at any USDA office, or call 866.632.9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter by mail to USDA, Office of the Assistant Secretary for Civil Rights, 1400 Independence Ave, SW, Stop 9410, Washington, DC 20250-9410 or email to program.intake@usda.gov or by fax (202) 690-7442.

Title VI: The City of Castle Rock ensures compliance with Title VI of the Civil Rights Act of 1964 and American Disabilities Act of 1990 by prohibiting discrimination against any person on the basis of race, color, national origin, sex or disabilities in the provision of benefits and services from its federal assisted programs and activities. If you need special accommodations to participate in this meeting, please contact Karlene Akesson at 360.274.8181 by 9:00 a.m. three days prior to the meeting.

Planning Commission may add and take action on other items not listed on this Agenda.

City of Castle Rock
PO Box 370
Castle Rock, WA 98611

City of Castle Rock

STAFF REPORT

Substantial Shoreline Development Permit

Landing on the Cowlitz

To: Members of the City of Castle Rock Planning Commission
From: Rachel Granrath, Contract Planner
Date: June 13, 2025
Subject: *Public Hearing*: Substantial Shoreline Development Permit to Construct Stormwater Outfall

---

Summary of Request and Recommendation

Project Description: The applicant has submitted a Substantial Shoreline Development Permit (SSDP) and SEPA Checklist to the City of Castle Rock to construct the stormwater outfall in order to support the first phase of development within the approved Landing on the Cowlitz (LOTC) Master Plan. The project consists of installing a stormwater outfall within a portion of the Cowlitz River's shoreline buffer and shoreline jurisdiction.

- **Stormwater Outfall Installation**: Phase 1a of the LOTC Master Plan includes constructing a stormwater outfall within the Cowlitz River's shoreline buffer to discharge treated runoff from onsite and offsite systems using 30" and 48" pipes.
- **Treatment and Conveyance Systems**: Runoff will be treated with devices such as bioretention planters, mechanical filtration (e.g., catch basins) and biofiltration swales before being conveyed to the outfall using a combination of closed pipe networks and a ditch system for both the onsite and offsite basins.
- **Construction Methods and Access**: Trenching will be used for pipeline installation; outfall construction begins landward from the river's ordinary high-water mark (OHWM), and construction traffic will access the site via Huntington Avenue S, avoiding Larson Lane SW.
- **Floodplain Impacts**: Minimal impact to the floodway and 100-year floodplain is anticipated, with a net cut of 8 cubic yards and overall grading roughly balanced.
- **Future Phases**: A future permit will address installation of a temporary gravel road and storm pipe (outside critical areas) to support later phases; the road will be removed after construction and mitigation are complete.

Staff Recommendation: Staff recommends approval of this application, with conditions.

General Information

Project Location: The site is located within the Recreation designated portion of the approved LOTC Master Plan, formally Parcel 3 (#6143802), adjusted per Boundary Line Adjustment (CR-BLA-24-01 – AFN#3762029). The Castle Rock Landing on the Cowlitz Master Planned Mixed Use Development site is accessed from I-5 at Exit #48 and is located on the south side of Huntington Avenue S, approximately 0.5 mile west of the exit. The site is located within the Recreation designated portion of the approved Landing on the Cowlitz Master Plan.

Proponent: CT6, LLC
Project Representative: Ingrid Friedberg, Special Projects Manager

Vicinity Map

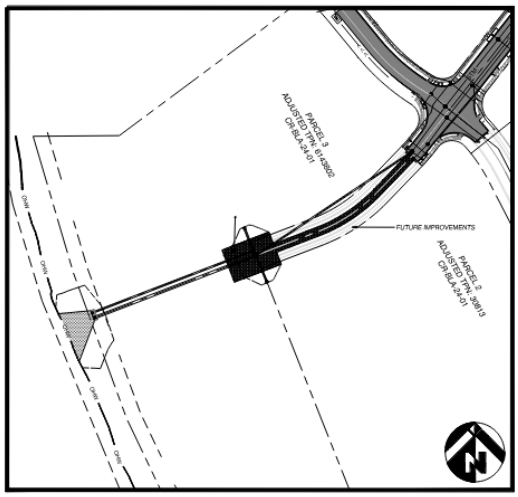


Figure 1: Vicinity Map

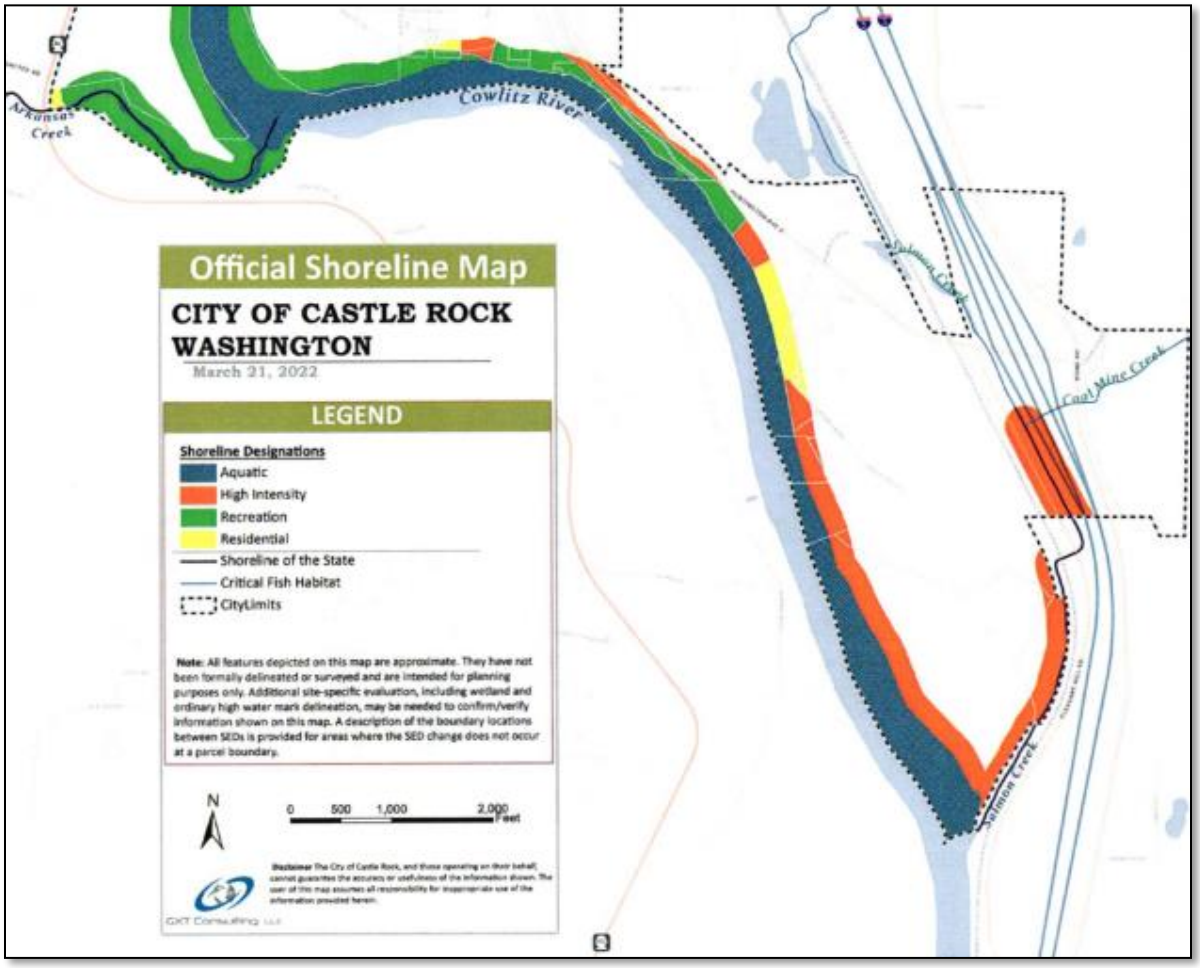


Figure 2: Shoreline Master Program Map

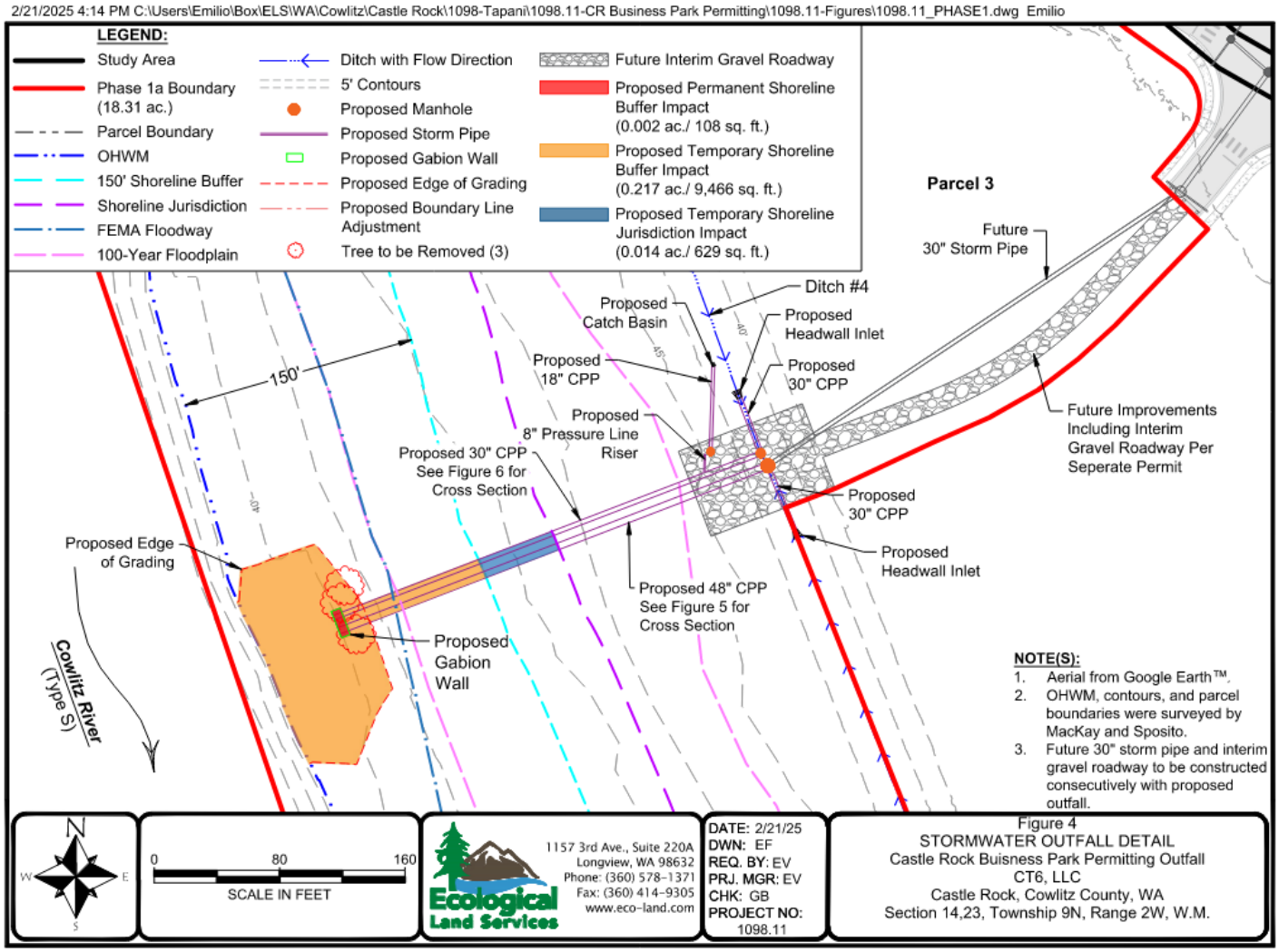


Figure 3: Stormwater Outfall Detail

Shoreline Master Program (SMP) Consistency

Section 5.4.1 defines and classifies the purpose and policies of the high intensity environment, which the subject site is designated.

Purpose

The purpose of the high-intensity shoreline environment designation is to provide for high intensity, water-oriented commercial, transportation, and industrial uses while protecting existing ecological functions and seeking to restore ecological functions in areas that have been previously degraded.

Management Policies

A. Priority should be given to water-dependent, water-related, and water-enjoyment uses in that order of preference. Non-water-oriented uses within the High-Intensity shoreline environment designation are appropriate on sites where there is no direct access to the shoreline because of another property separating it from the shoreline or an intervening public right-of-way.

B. Non-water-oriented uses on sites adjacent to the water should provide public benefit in the form of ecological enhancement and/or public access in compliance with the provisions of this Program.

C. Where unavoidable impacts to ecological functions occur, appropriate mitigation should be provided in accordance with this Program to achieve no-net-loss. Where applicable, development should include environmental cleanup and restoration of the shoreline in accordance with relevant state and federal law.
D. Visual and/or physical public access should be provided, where feasible.
E. Aesthetic objectives of this Program should be in character with high intensity development and include height limits, screening, and other standards consistent with the primary purpose of accommodating high intensity uses.
F. Existing urban areas appropriate for intensive development should be fully utilized before expanding intensive development into other areas.

Utilities is a permitted use in the high intensity through a Substantial Shoreline Development Permit (SSDP).

Shoreline Substantial Development Permit

As identified in the Shoreline Master Program, applications for an SSDP will be reviewed against the following criteria that the "Proposed use or development on shorelines of the state must be consistent with the policy and provisions of the Act and this Program." Staff has outlined the standards in the table below, along with referenced chapters.

Table 1: General Shoreline Regulations: Section 6 of Castle Rock SMP

Standard	Site Design	Reference	Requirement Met
No net loss of ecological function	Onsite mitigation to ensure no net loss of ecological functions meet the vegetation conservation standards in the SMP and include both permanent impact mitigation and temporary impacts mitigation along with tree removal and mitigation at a 4:1 ratio.	SMP Chapter 6.1	Yes, as conditioned
Archaeological, Cultural, and Historic Resources	An inadvertent discovery is required as a condition of approval and is required as part of the Master Plan Development Agreement	SMP Chapter 6.2	Yes, as conditioned
Critical Areas Protection	See flood prevention below, the only critical area impacted by this proposal is the floodplain.	SMP Chapter 6.3	Yes, as conditioned
Flood Prevention and Flood Damage Minimization	The floodplain and floodway are noted on the plans and will be disturbed as part of the stormwater outfall construction. The physical outfall and gravel road is out of the floodplain, but the pipe outfall is in the floodplain.	SMP Chapter 6.4	Yes, as conditioned
Public Access	This application does not prevent public access and is part of a larger master planned development with various phases including recreation, housing, and commercial/industrial mixed uses	SMP Chapter 6.5	N/A

Vegetation Conservation	2:1 permanent mitigation ratio 1:1 temporary mitigation ratio 4:1 tree removal and replacement Combination of restoration and enhancement with native grass, seed, shrubs and trees.	SMP Chapter 6.6	Yes, as conditioned
Water Quality and Quantity	Stormwater management structures are located outside of the floodplain and mitigation/buffers are proposed to minimize the disturbance and enhance the site accordingly	SMP Chapter 6.7	Yes, as conditioned

Procedural Requirements

The process is outlined by the following steps in accordance with the Castle Rock Municipal Code CRMC 18.08, CRMC 18.04, Castle Rock Shoreline Master Program.

Table 2: Shoreline Substantial Development Permit: Key Dates and Milestones

Procedure Action Item	Date
Pre-Application Meeting	November 6, 2024
Application Submittal	March 31, 2025
Letter of Complete	March 13, 2025
Agency Notice	May 20, 2025
SEPA/Public Notice	May 20, 2025 – Comment period ended June 10, 2025
Public Hearing	Tuesday, June 17, 2025

Agency and Public Comment

Comments from the City Engineer and City Public Works are summarized below and included in the conditions of approval. Agency comment was issued on May 20th, no agency comments were received.
Public comment was issued on June 3rd and comment period ends the date of the public hearing. At the time of this report, staff has received two public comments, summarized below.

Table 4: Pubic and Agency Comments Received

Commenter	**Nature of Comment(s)**
Tom Gower, Gibbs & Olson – City Engineer	Various Comments on plan set, Stormwater Master Plan TIR and in letter on engineering approach and design
Dave Vorse, Castle Rock Public Works	April 7, 2025, letter detailing TIR and Stormwater Outfall revisions for city approval
Sheryl Adams – Public Comment	Concern on habitat and animal impact of development
Roy Henson – Public Comment	Concern on stormwater design, drainage, and encroachment

Conclusions

Staff finds that the application materials, as conditioned have met the requirements outlined in CRMC 18.08, CRMC 18.04, Castle Rock Shoreline Master Program and Castle Rock Engineering Standards for Public Works Construction.

Planning Commission Action

CRMC 17.77.040 (8) describes this action as a Type VIII – Environmental Permit. A Type VIII development review process is used for critical areas permits (CRMC 18.10.080), shoreline permits and decisions (Chapter 18.08 CRMC), and SEPA (Chapter 18.04 CRMC) reviews required in conjunction with the review of an underlying development activity. Substantial reports will be required and so a preapplication meeting is recommended to help understand the challenges and define the scope of the reports. Public notice and/or a public hearing is required.

Planning Commission shall hold the public hearing, and make a recommendation to City Council to approve, approve with conditions, or deny the substantial development permit.

Recommendation

As conditioned below, the application does not appear to be detrimental to the general public health, safety or welfare and meets the basic intent and criteria in Castle Rock Municipal Code, City Engineering and Public Works Standards, and the Master Planned Development Agreement.

Recommended Conditions of Approval

1. **Cultural Resources**: Should ground disturbing or other activities related to the proposed subdivision result in the inadvertent discovery of cultural resources or archaeological materials, work shall be stopped in the immediate area and contact be made with the Washington State Department of Archaeology and Historic Preservation (DAHP) and the Cowlitz Indian Tribe. Work shall remain suspended until the findings are assessed, and appropriate consultation is conducted. Should human remains be inadvertently discovered, as dictated by Washington State RCW 27.44.055, work shall be immediately halted in the area and contact made with the coroner and local law enforcement in the most expeditious manner possible.

2. **Dedication of Improvements:** Upon completion of construction, all site improvements and associated rights-of-way and easements shall be dedicated to the City.

3. **Storm Event Mitigation:** Due to the location of the improvements, the applicant shall implement mitigation measures to address impacts during peak storm events and periods of high water as required by stormwater regulations, standards, codes and subject to approval by the City.

4. **General Construction Stormwater Permit Compliance:** The applicant shall either amend the existing General Construction Stormwater Permit (GCSP) for the mass grading project or obtain a new permit to cover construction activities related to site access, utilities, and the stormwater outfall. Compliance with this requirement may be included as a condition of the Mitigated Determination of Nonsignificance (MDNS).

5. Applicant will comply with provisions in the Castle Rock Shoreline Master Program (SMP) and WAC 173-27-090.
    a. Construction activities shall commence, or where no construction activities are involved, the use or activity shall commence within two (2) years of the effective date of an SSDP.
    b. The period for commencement of construction or use may be extended once for a one (1)-year period if a request based on reasonable factors is filed before the expiration date and notice of the proposed extension is given to parties of record.

c. The authorization to conduct certain development activities (see WAC 173-27-090) shall terminate five (5) years after the effective date of an SSDP.
d. The authorization period to conduct development activities may be extended once for a one (1)-year period if a request based on reasonable factors is filed before the expiration date and notice of the proposed extension is given to parties of record and the department.
e. The time periods in Sections 1 through 4, above, do not include the time during which a use or activity was not actually pursued due to the pendency of administrative appeals or legal actions or due to the need to obtain any other government permits and approvals for the development that authorize the development to proceed, including all reasonably related administrative or legal actions on any such permits or approvals.

6. The applicant will remain compliant with the Master Planned Development Agreement and conditions associated.

7. Comments from Tom Gower, Gibbs & Olson– City Engineer and David Vorse – Castle Rock Public Works Director, dated April 7, 2025, on the "Landing on the Cowlitz Stormwater Outfall" dated 2/12/2025 consisting of 12 drawings and the "Landing on the Cowlitz Stormwater Master Plan Technical Information Report" dated 3/10/2025 consisting of 757 pages and associated redlines.

8. The applicant is responsible for compliance with all applicable local, state, and federal rules and regulations, and must obtain all appropriate permits and approvals.

9. All conditions of the SEPA MDNS issued on June 20, 2025, shall be met.

Exhibits:

Exhibit A: Application Materials

Exhibit B: Noticing Materials

Exhibit C: SEPA MDNS

Exhibit D: Comments Received

Exhibit A: Application Materials

1. Stormwater Outfall SSDP Application Submittals Overview
2. Signed Master Application Forms (CRP-25-007/CRP-25-008 & CR-24-051)
3. Application Narratives (CRP-25-007/CRP-25-008 & CR-24-051)
4. SEPA Checklist
5. Stormwater Outfall Plans
6. Stormwater Pollution Prevention Plan (SWPPP) - CR-24-051
7. Stormwater Drainage Report (TIR) – CR-24-051
8. Habitat Management – Mitigation & Monitoring Plan (CRP-25-007/CRP-25-008)
9. Ordinary High Water Mark Memo
10. Excavation & Grade Addendum – LOTC Stormwater Outfall (CR-24-051)
11. Letter of Completeness (CRP-25-007/CRP-25-008)

SUBMITTAL OVERVIEW

CT6, LLC

DATE: March 5, 2025

PROJECT NO.: 163.2
CITY PROJECT NO.:
RECEIVED BY:

SUBMITTAL TITLE: Landing on the Cowlitz Stormwater Outfall
Shoreline Substantial Development Permit Application

SUBMITTED BY: Ingrid Friedberg, Special Projects Manager
CT6, LLC
P.O. Box 1419
Battle Ground, WA 98604

SUBMITTED VIA: Online Share Drive

SUBMITTED TO: **City of Castle Rock**
Attn. Karlene Akesson, Building/Planning Clerk
P.O. Box 370
Castle Rock, WA 98611

SUBMITTAL CONTENTS:	ITEM DESCRIPTION	RECEIVED
1.	**Application Submittal Overview**	☐
2.	**Signed Master Application Form**	☐
3.	**Narrative**	☐
4.	**SEPA Checklist**	☐
5.	**Habitat Management, Mitigation and Monitoring Plan dated February 19, 2025, by Ecological Land Services**	☐
6.	**Ordinary High Water Mark Memo dated December 4, 2024, by Ecological Land Services**	☐
7.	**Check in the amount of $1,500.00 made payable to the City of Castle Rock (to be hand delivered).**	☐

Docusign Envelope ID: 377442C0-0BDE-4614-AC30-735214B2B063

City of Castle Rock

Department Of Building and Planning

City Hall, PO Box 370 / 141 'A' St SW, Castle Rock, WA 98611

Phone: 360.274.8181 / Email: finance@ci.castle-rock.wa.us

CR _____

PLEASE PRINT IN INK OR TYPE

MASTER APPLICATION

PROPERTY INFORMATION

Project Address: N/A City: Castle Rock Parcel #: 308120500

Short Plat/Subdivision: _____ Block: _____ Lot: _____

OWNER/APPLICANT INFORMATION

Applicant/Authorized Agent: Shane Tapani on behalf of CT6, LLC Phone: 360.687.1148

Mailing Address: PO Box 1419 City: Battle Ground State: WA Zip: 98604

Property Owner: Same as Applicant Phone: _____

Mailing Address: _____ City: _____ State: _____ Zip: _____

Contractor: Tapani Inc. Lic #: TAPANI*88OE Phone: 360.907.7615

Mailing Address: PO Box 1419 City: Battle Ground State: WA Zip: 98604

Lender Name: N/A Phone: _____

Lender's Address: _____

PROJECT INFORMATION

Building/Construction

- ☐ Building Permit
- ☐ Excavation & Grading Permit
- ☐ Manufactured/Structure Placement
- ☐ Mechanical Permit
- ☐ Plumbing Permit
- ☐ Roofing Permit
- ☐ Signage Permit
- ☐ Other _____

Planning

- ☐ Critical Areas
- ☐ Flood Plain
- ☐ Master Plan
- ☐ Mobile Home Park
- ☐ Plat (Preliminary)
- ☐ Plat (Final)
- ☐ Short Plat
- ☐ Site Plan (Preliminary)
- ☐ Site Plan (Final)

Environmental

- ☐ Critical Areas
- ☐ Flood Plain Permits
- ☐ SEPA
- ☐ Surface Mining
- ■ Other Shoreline Substantial Development Permit SEPA Checklist

PROJECT DESCRIPTION

Occupancy Group: N/A **Type of Construction:** N/A **Sq. Ft.** N/A **No. of Stories:** N/A **No. of Bedrooms:** N/A

Is there any grading, filling, or excavation associated with this project? Yes Quantity (cubic yards): 121cubic yard (cy) cut & 113 cy fill

(Including grading for road construction, site preparation, and landscaping.) ***NO SITE WORK MAY BE DONE PRIOR TO CRITICAL AREAS DETERMINATION.***

Water Supply: N/A **Sewage Disposal:** N/A **Type of Heat:** N/A **Fair Market Value:** N/A

Does project involve Asbestos? ☐ YES ■ NO

PLEASE PROVIDE A BASIC DESCRIPTION OF THE PROPOSED PROJECT:

Stormwater outfall for the Phase 1 infrastructure of the Landing on the Cowlitz Master Plan (ref. CR-24-051).

I hereby certify that I am the owner or duly authorized agent of the owner for the purposes of this application. Further, I grant permission from the owner to any and all employees and representatives of the City of Castle Rock and other governmental agencies to enter upon and inspect said property as reasonably necessary to process this application. I further certify that I have read and examined this application and know the same to be true and correct. If any of the information provided on this application is incorrect, the permit or approval may be revoked.

APPLICANT'S SIGNATURE: DocuSigned by: Shane Tapani 8ADCF0136D1B439... DATE: 3/6/2025 | 1:01 PM PST

APPLICATION ACCEPTED BY: _____ DATE: _____

APPLICATION APPROVED BY: _____ DATE: _____

PERMIT NUMBER CR _____

Docusign Envelope ID: D8A7998A-225A-4279-9E00-60F6EB42FD11

City of Castle Rock

Building & Planning Department

141 A St SW / PO Box 370
Castle Rock, WA 98611
Phone: (360) 274-8181
finance@ci.castle-rock.wa.us

General Land Use Application

OFFICIAL USE ONLY

Case # _____ Related File # _____ Received By: _____

One or more of the following **Supplements** must be attached to this **General Land Use Application**:

TITLE 16 SUBDIVISIONS

- ☐ Binding Site Plan
- ☐ Boundary Line Adjustment
- ☐ Condominium Subdivision
- ☐ Final Plat (Subdivision)
- ☐ Final Short Plat
- ☐ Preliminary Plat (Subdivision)
- ☐ Preliminary Short Plat

TITLE 18 ENVIRONMENTAL PROTECTION

- ☐ Critical Areas Determination
- ☐ Critical Areas Permit
- ☐ Environmental Questionnaire
- ■ SEPA Checklist
- ☐ Shorelines Conditional Use
- ■ Shorelines Substantial Development
- ☐ Shorelines Variance

TITLE 17 ZONING

- ☐ Annexation
- ☐ Bed & Breakfast – (CUP)
- ☐ Comprehensive Plan Amendment
- ☐ Conditional Use Permit = (CUP)
- ☐ Home Occupancy Business License
- ☐ Home Occupancy in an Accessory Building – (CUP)
- ☐ Manufactured Home Park
- ☐ Recreational Vehicle Park – (CUP)
- ☐ Request for Clarification
- ☐ Rezone
- ☐ Similar Use Authorization
- ☐ Special Use Permit
- ☐ Variance

OTHER

- ☐ Request for Pre-Application Meeting
- ☐ Wireless Communications Facilities - (CUP)
- ☐ Other _____

Project Name: Landing on the Cowlitz (LOTC) Stormwater Outfall

Project Address: No site address. Location is within the approved LOTC Master Plan.

Applicant: CT6, LLC
Phone : PO Box 1419
E-mail Address: shanet@tapani.com; ingridf@tapani.com

Mailing Address: Same as Applicant.

Owner: Same as Applicant.
(If other than applicant)
Phone : _____
E-mail Address: _____

Mailing Address: Same as Applicant.

Docusign Envelope ID: D8A7998A-225A-4279-9E00-60F6EB42FD11

Other Authorized Representative (if any): Not Applicable.

Mailing Address: _____

Phone: _____

E-mail Address: _____

Project Description: This proposal includes a stormwater outfall for the Phase 1 infrastructure for the approved Landing on the Cowlitz Master Plan.

Size of Project Site: Parcel Size is approximately 15.37 acres.

Assessor Tax Parcel Number(s): 308120500

Full Legal Description of Subject Property (Attached ☐):

Zoning: Industrial (City); Recreation and Open Space (LOTC Master Plan)

Special Areas On or Near Site (show areas on site plan):

■ Creek, Stream or River (name): Cowlitz River

☐ Wetland ■ Flood Hazard Area

☐ Steep Slopes/Draw/Gully/Ravine ☐ None

Water Service

Existing pipe size and material: _____

Proposed pipe size and material: _____

Sewage Disposal

Existing: _____

Proposed: _____

Access

Name of Street(s) from which access will be gained: Access shall be via the temporary site access gravel road, later replaced by the Phase 1 access roadway which shall connect to a temporary access easement & road.

Owner's Consent and Authorization

I affirm that I am the owner of the subject site and all answers, statements, and information submitted with this application are correct and accurate to the best of my knowledge. Further, I grant permission from the owner to any and all employees and representatives of the City of Castle Rock and other governmental agencies to enter upon and inspect said property as reasonably necessary to process this application.

I agree to pay all fees of the City that apply to this application.

Shane Tapani
Owner's Name (Print Name)

DocuSigned by:
Shane Tapani
8ADCF0136D1B439...
Owner's Signature

3/6/2025 | 4:46 PM PST
Date

EXHIBIT "A"

Legal Description

For APN/Parcel ID(s): 308120500

A PARCEL OF PROPERTY LOCATED IN A PORTION OF THE BENJAMIN HUNTINGTON D.L.C. AND THE NORTH HALF OF SECTION 23, TOWNSHIP 9 NORTH, RANGE 2 WEST OF THE WILLAMETTE MERIDIAN IN THE CITY OF CASTLE ROCK, COWLITZ COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

COMMENCING AT THE CORNER COMMON TO SECTION 13, 14, 23 AND 24, TOWNSHIP 9 NORTH, RANGE 2 WEST, AS SHOWN ON RECORD-OF-SURVEY RECORDED IN VOLUME 43, PAGES 120-121 OF THE WILLAMETTE MERIDIAN, COWLITZ COUNTY, WASHINGTON;

THENCE NORTH 88°18'41" WEST ALONG THE NORTH LINE OF THE NORTHEAST QUARTER OF SAID SECTION 23, A DISTANCE OF 1956.09 FEET;

THENCE SOUTH 01°41'19" WEST 24.09 FEET TO THE INTERSECTION OF THE NORTH LINE OF "PARCEL II" AS CONVEYED TO CT6, LLC BY DEED RECORDED UNDER AUDITOR'S FILE NUMBER 3682681, COWLITZ COUNTY RECORDS AND A POINT 30.00 FEET SOUTHWESTERLY OF, WHEN MEASURED PERPENDICULAR TO, THE CENTERLINE OF LARSEN LANE AND TO THE TRUE POINT OF BEGINNING;

THENCE SOUTH 53°23'25" WEST, ALONG SAID NORTH LINE 394.16 FEET;
THENCE SOUTH 89°35'00" WEST, ALONG SAID NORTH LINE 145.25 FEET TO THAT BOUNDARY AGREEMENT LINE AS DESCRIBED IN EXHIBIT A OF THAT BOUNDARY LINE AGREEMENT DOCUMENT RECORDED UNDER AUDITOR'S FILE NUMBER 3597924, COWLITZ COUNTY RECORDS:

THENCE ALONG SAID BOUNDARY AGREEMENT LINE AND THE ORDINARY HIGH WATER LINE ON THE LEFT BANK OF THE COWLITZ RIVER LINE APPROXIMATED BY THE FOLLOWING FOUR (4) COURSES:

THENCE SOUTH 16°25'08" EAST 239.13 FEET;
THENCE SOUTH 20°06'11" EAST 262.43 FEET;
THENCE SOUTH 25°28'57" EAST 218.98 FEET;
THENCE SOUTH 20°33'29" EAST 229.50 FEET;

THENCE LEAVING SAID ORDINARY HIGH WATER LINE AND CONTINUING ALONG SAID BOUNDARY AGREEMENT LINE THE FOLLOWING FOUR (4) COURSES;

THENCE NORTH 74°55'34" EAST 13.28 FEET

THENCE SOUTH 50°34'51" EAST 735.65 FEET TO A 1000.00 FOOT RADIUS CURVE TO THE LEFT;

THENCE ALONG SAID 1000.00 FOOT RADIUS CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 23°12'02 AN ARC DISTANCE OF 404.92 FEET:

THENCE SOUTH 73°46'53" EAST 380.03 FEET TO A POINT WHICH BEARS NORTH 88°25'11" WEST 732.00 FEET FROM A POINT ON THE EAST LINE OF THE NORTHEAST QUARTER OF SAID SECTION 23 THAT IS SOUTH 01°34'49" WEST, 1869.34 FEET FROM THE NORTHEAST CORNER OF SAID NORTHEAST QUARTER ;

THENCE NORTH 27°09'34" WEST LEAVING SAID BOUNDARY AGREEMENT LINE 473.65 FEET TO A NON-TANGENT 68.00 FOOT RADIUS CURVE TO THE RIGHT, FROM WHICH THE RADIUS POINT BEARS NORTH 44°16'29" WEST;

Docusign Envelope ID: 6F434786-CA70-45C3-80C1-8ECF165BF652

City of Castle Rock
Department Of Building and Planning
City Hall, PO Box 370 / 141 'A' St SW, Castle Rock, WA 98611
Phone: 360.274.8181 / Email: finance@ci.castle-rock.wa.us

CR _____

PLEASE PRINT IN INK OR TYPE

MASTER APPLICATION

PROPERTY INFORMATION

Project Address: See property sheet attached City: Castle Rock Parcel #: See property sheet

Short Plat/Subdivision: N/A Block: _____ Lot: _____

OWNER/APPLICANT INFORMATION

Applicant/Authorized Agent: Shane Tapani, CT6, LLC Phone: (360) 687-1148

Mailing Address: PO Box 1419 City: Battle Ground State: WA Zip: 98604

Property Owner: See property sheet attached Phone: _____

Mailing Address: _____ City: _____ State: _____ Zip: _____

Contractor: Tapani, Inc. Lic #: TAPANI*883OE Phone: (360) 687-1148

Mailing Address: PO Box 1900 City: Battle Ground State: WA Zip: 98604

Lender Name: _____ Phone: _____

Lender's Address: _____

PROJECT INFORMATION

Building/Construction
- ☐ Building Permit
- ☒ Excavation & Grading Permit
- ☐ Manufactured/Structure Placement
- ☐ Mechanical Permit
- ☐ Plumbing Permit
- ☐ Roofing Permit
- ☐ Signage Permit
- ☒ Other Engineering Plan Review

Planning
- ☐ Critical Areas
- ☐ Flood Plain
- ☐ Master Plan
- ☐ Mobile Home Park
- ☐ Plat (Preliminary)
- ☐ Plat (Final)
- ☐ Short Plat
- ☐ Site Plan (Preliminary)
- ☐ Site Plan (Final)

Environmental
- ☐ Critical Areas
- ☐ Flood Plain Permits
- ☐ SEPA
- ☐ Surface Mining
- ☐ Other _____

NOTE: WE'VE SUBMITTED THREE COPIES OF THE PERMIT, SIGNED BY EACH PROPERTY OWNER INVOLVED

PROJECT DESCRIPTION

Occupancy Group: N/A **Type of Construction:** N/A **Sq. Ft.** N/A **No. of Stories:** N/A **No. of Bedrooms:** N/A

Is there any grading, filling, or excavation associated with this project? Yes Quantity (cubic yards): 1,100 cubic yards

(Including grading for road construction, site preparation, and landscaping.) ***NO SITE WORK MAY BE DONE PRIOR TO CRITICAL AREAS DETERMINATION.***

Water Supply: N/A **Sewage Disposal:** N/A **Type of Heat:** N/A **Fair Market Value:** N/A

Does project involve Asbestos? ☐ YES ☒ NO

PLEASE PROVIDE A BASIC DESCRIPTION OF THE PROPOSED PROJECT:

Constructing a stormwater outfall to the Cowlitz River

I hereby certify that I am the owner or duly authorized agent of the owner for the purposes of this application. Further, I grant permission from the owner to any and all employees and representatives of the City of Castle Rock and other governmental agencies to enter upon and inspect said property as reasonably necessary to process this application. I further certify that I have read and examined this application and know the same to be true and correct. If any of the information provided on this application is incorrect, the permit or approval may be revoked.

APPLICANT'S SIGNATURE: DocuSigned by: Shane Tapani 8ADCF0136D1B439... DATE: 11/13/2024 | 4:04 PM PST

APPLICATION ACCEPTED BY: _____ DATE: _____

APPLICATION APPROVED BY: _____ DATE: _____

PERMIT NUMBER
CR _____

Docusign Envelope ID: 19F6CC3A-5806-49B4-963D-CAF49BB143D6

City of Castle Rock
Department Of Building and Planning
City Hall, PO Box 370 / 141 'A' St SW, Castle Rock, WA 98611
Phone: 360.274.8181 / Email: finance@ci.castle-rock.wa.us

CR _____

PLEASE PRINT IN INK OR TYPE

MASTER APPLICATION

PROPERTY INFORMATION

Project Address: See property sheet attached City: Castle Rock Parcel #: See property sheet

Short Plat/Subdivision: N/A Block: _____ Lot: _____

OWNER/APPLICANT INFORMATION

Applicant/Authorized Agent: Shane Tapani, CT6, LLC Phone: (360) 687-1148

Mailing Address: PO Box 1419 City: Battle Ground State: WA Zip: 98604

Property Owner: See property sheet attached Phone: _____

Mailing Address: _____ City: _____ State: _____ Zip: _____

Contractor: Tapani, Inc. Lic #: TAPANI*883OE Phone: (360) 687-1148

Mailing Address: PO Box 1900 City: Battle Ground State: WA Zip: 98604

Lender Name: _____ Phone: _____

Lender's Address: _____

PROJECT INFORMATION

Building/Construction
- ☐ Building Permit
- ☒ Excavation & Grading Permit
- ☐ Manufactured/Structure Placement
- ☐ Mechanical Permit
- ☐ Plumbing Permit
- ☐ Roofing Permit
- ☐ Signage Permit
- ☒ Other Engineering Plan Review

Planning
- ☐ Critical Areas
- ☐ Flood Plain
- ☐ Master Plan
- ☐ Mobile Home Park
- ☐ Plat (Preliminary)
- ☐ Plat (Final)
- ☐ Short Plat
- ☐ Site Plan (Preliminary)
- ☐ Site Plan (Final)

Environmental
- ☐ Critical Areas
- ☐ Flood Plain Permits
- ☐ SEPA
- ☐ Surface Mining
- ☐ Other _____

PROJECT DESCRIPTION

Occupancy Group: N/A **Type of Construction:** N/A **Sq. Ft.** N/A **No. of Stories:** N/A **No. of Bedrooms:** N/A

Is there any grading, filling, or excavation associated with this project? Yes Quantity (cubic yards): 1,100 cubic yards

(Including grading for road construction, site preparation, and landscaping.) ***NO SITE WORK MAY BE DONE PRIOR TO CRITICAL AREAS DETERMINATION.***

Water Supply: N/A **Sewage Disposal:** N/A **Type of Heat:** N/A **Fair Market Value:** N/A

Does project involve Asbestos? ☐ YES ☒ NO

PLEASE PROVIDE A BASIC DESCRIPTION OF THE PROPOSED PROJECT:

Constructing a stormwater outfall to the Cowlitz River

I hereby certify that I am the owner or duly authorized agent of the owner for the purposes of this application. Further, I grant permission from the owner to any and all employees and representatives of the City of Castle Rock and other governmental agencies to enter upon and inspect said property as reasonably necessary to process this application. I further certify that I have read and examined this application and know the same to be true and correct. If any of the information provided on this application is incorrect, the permit or approval may be revoked.

APPLICANT'S SIGNATURE: DocuSigned by: Mike Canton 6F822DCD5F5C4AD... DATE: 11/13/2024 | 5:16 PM PST

APPLICATION ACCEPTED BY: _____ DATE: _____

APPLICATION APPROVED BY: _____ DATE: _____

PERMIT NUMBER CR _____

Docusign Envelope ID: 3E9E94DD-A65A-4292-8F86-033A0C7A23D6

City of Castle Rock
Department Of Building and Planning
City Hall, PO Box 370 / 141 'A' St SW, Castle Rock, WA 98611
Phone: 360.274.8181 / Email: finance@ci.castle-rock.wa.us

CR _____

PLEASE PRINT IN INK OR TYPE

MASTER APPLICATION

PROPERTY INFORMATION

Project Address: See property sheet attached City: Castle Rock Parcel #: See property sheet

Short Plat/Subdivision: N/A Block: _____ Lot: _____

OWNER/APPLICANT INFORMATION

Applicant/Authorized Agent: Shane Tapani, CT6, LLC Phone: (360) 687-1148

Mailing Address: PO Box 1419 City: Battle Ground State: WA Zip: 98604

Property Owner: See property sheet attached Phone: _____

Mailing Address: _____ City: _____ State: _____ Zip: _____

Contractor: Tapani, Inc. Lic #: TAPANI*883OE Phone: (360) 687-1148

Mailing Address: PO Box 1900 City: Battle Ground State: WA Zip: 98604

Lender Name: _____ Phone: _____

Lender's Address: _____

PROJECT INFORMATION

Building/Construction
- ☐ Building Permit
- ☒ Excavation & Grading Permit
- ☐ Manufactured/Structure Placement
- ☐ Mechanical Permit
- ☐ Plumbing Permit
- ☐ Roofing Permit
- ☐ Signage Permit
- ☒ Other Engineering Plan Review

Planning
- ☐ Critical Areas
- ☐ Flood Plain
- ☐ Master Plan
- ☐ Mobile Home Park
- ☐ Plat (Preliminary)
- ☐ Plat (Final)
- ☐ Short Plat
- ☐ Site Plan (Preliminary)
- ☐ Site Plan (Final)

Environmental
- ☐ Critical Areas
- ☐ Flood Plain Permits
- ☐ SEPA
- ☐ Surface Mining
- ☐ Other _____

PROJECT DESCRIPTION

Occupancy Group: N/A **Type of Construction:** N/A **Sq. Ft.** N/A **No. of Stories:** N/A **No. of Bedrooms:** N/A

Is there any grading, filling, or excavation associated with this project? Yes Quantity (cubic yards): 1,100 cubic yards

(Including grading for road construction, site preparation, and landscaping.) ***NO SITE WORK MAY BE DONE PRIOR TO CRITICAL AREAS DETERMINATION.***

Water Supply: N/A **Sewage Disposal:** N/A **Type of Heat:** N/A **Fair Market Value:** N/A

Does project involve Asbestos? ☐ YES ☒ NO

PLEASE PROVIDE A BASIC DESCRIPTION OF THE PROPOSED PROJECT:

Constructing a stormwater outfall to the Cowlitz River

I hereby certify that I am the owner or duly authorized agent of the owner for the purposes of this application. Further, I grant permission from the owner to any and all employees and representatives of the City of Castle Rock and other governmental agencies to enter upon and inspect said property as reasonably necessary to process this application. I further certify that I have read and examined this application and know the same to be true and correct. If any of the information provided on this application is incorrect, the permit or approval may be revoked.

APPLICANT'S SIGNATURE: _____ DATE: _____

APPLICATION ACCEPTED BY: _____ DATE: _____

APPLICATION APPROVED BY DocuSigned by: Raymond Pieren E571790A6B82430... DATE: 11/13/2024 | 5:31 PM PST

PERMIT NUMBER CR _____

MacKay Sposito

Vancouver Office

18405 SE Mill Plain Boulevard, Suite 100 Vancouver, WA 98683
360.695.3411 www.mackaysposito.com

Castle Rock Landing on the Cowlitz
Property Information

BLA Parcel Number	Proposed Adjusted TPN	Property Owner
1	308640100	CT6, LLC
2	30813	CT6, LLC
3	6143802	CT6, LLC
4	308100100	MLC Ventures LLC
5	30812	Pieren Raymond
6	308640200	Pieren Raymond
7	30864	Pieren Raymond

CITY OF CASTLE ROCK
SUBSTANTIAL SHORELINE DEVELOPMENT PERMIT APPLICATION

LANDING ON THE COWLITZ STORMWATER OUTFALL

PARCEL NO. 308120500
LANDING ON THE COWLITZ

APPLICANT:
CT6, LLC
P.O. Box 1419
Battle Ground, WA 98604-1419
Contact: Ingrid Friedberg, Special Projects Manager
Email: ingridf@tapani.com
Phone: 360.907.553.9144

ENVIRONMENTAL CONSULTANT:
Ecological Land Solutions
1157 3rd Avenue, Suite 220A
Longview, WA 98632
Contact: Elizabeth Vaughn, Biologist
Email: elizabeth@eco-land.com
Phone: 360.578.1371

CT6, LLC.

TABLE OF CONTENTS

I. DEVELOPMENT SUMMARY INFORMATION 1
II. PROJECT DESCRIPTION 2
CONSTRUCTION METHODS 2
IMPACT AVOIDANCE AND MINIMIZATION METHODS 3
PROJECT IMPACT SUMMARY 3
ONSITE MITIGATION 4
III. EXISTING SITE CONDITIONS 4
IV. CONFORMANCE WITH THE CITY OF CASTE ROCK SHORELINE MASTER PROGRAM 4
V. CONCLUSION 23

I. DEVELOPMENT SUMMARY INFORMATION

Property Owner &: Applicant:	CT6, LLC P.O. Box 1419 Battle Ground, WA 98604-1419 Contact: Ingrid Friedberg, Special Projects Manager Email: ingridf@tapani.com Phone: 360.553.9144
Request:	Shoreline Substantial Development Permit Application Approval
Anticipated Applications Required:	Binding Site Plan Application and Shoreline Permit Application
Location:	The existing property is adjacent to Parcel 6143801, 3081501 and 308140200 (privately owned property outside of the Landing on the Cowlitz (LOTC) Master Plan) and Larsen Lane SW, LOTC BLA Parcel 7 (Parcel 30684), State of Washington Department of Land and Natural Resources (DNR) property, and the Cowlitz River.
Parcel ID:	308120500 (ref. Boundary Line Adjustment (BLA) Survey Parcel No. 3, recorded on December 5, 2024, Auditor's File No. (AFN) 3762029)
Area:	Parcel Size: 15.37 Acres (669,622 Square Feet)
Approximate Grading Volumes:	It is anticipated that this proposal will require approximately 113 cubic yards (cy) of fill, 121 cy of cut, resulting in 8 cy of net cut within the shoreline jurisdiction.
Zoning Designation:	Industrial (I)
Landing on the Cowlitz Land Use Area Designation:	Recreation and Open Space
Shoreline Environmental Designation (SED):	High-Intensity

II. PROJECT DESCRIPTION

This project involves the construction of a stormwater outfall and associated infrastructure within the shoreline buffer, shoreline jurisdiction, and the regulatory floodway and the 100-year floodplain of the Cowlitz River to facilitate a centralized discharge location for the Landing on the Cowlitz (LOTC) Master Plan. The stormwater outfall and conveyance pipes have been sized sufficiently to accommodate for the full build out of the LOTC Master Plan and have been designed to include corrugated polypropylene pipe (CPP) which range in size from shall include one (1) thirty- (30) inch to 48-inch CPP. Runoff intercepted from roadway surfaces will undergo preliminary water quality treatment through bioretention planters positioned along the roadways outside of the shoreline area. For each individual phase of the LOTC Master Plan, final treatment methodologies will be specified at the development stage integrating bioretention systems and mechanical filtration via catch basins to achieve regulatory compliance. The treated stormwater will be directed into an onsite conveyance system, channeling flows towards the outfall and facilitating discharge into the shoreline buffer of the Cowlitz River for infiltration. Additionally, an integrated infiltration strategy will be implemented at each capture point, optimizing upland infiltration and minimizing runoff volumes entering the conveyance system.

CONSTRUCTION METHODS

Stormwater infrastructure will be installed primarily through trenching for accurate pipeline placement. All onsite runoff will receive treatment though roadside bioretention rain gardens before discharge. Outfall construction will be completed with landward-based excavation, beginning at the OHWM of the Cowlitz River and moving progressively away from the river. Biodegradable jute erosion matting will be placed within the proposed restoration and enhancement area to stabilize soils prior to habitat features such as rootwads and rootwad logs are installed reducing the need for further equipment access for final planting. Construction traffic will use the existing gravel road connection to Huntington Avenue S., avoiding access from Larson Lane SW.

To construct the proposed stormwater outfall conveyance system, equipment to be used may include, but is not limited to, excavators, bull dozers, dump trucks, concrete trucks, compacting equipment, and hand tools. All staging and stockpile areas will be located outside of critical areas and buffers, and all project construction is proposed to be completed in a single phase during the dry season. All plant installation will be conducted during the appropriate planting windows as specified in this report.

The following details the general construction sequence:

1. All work limits will be clearly demarcated with silt fencing or construction fencing.
2. All appropriate best management practices (BMPs) will be installed.
3. Topsoil will be cleared and grubbed.
4. Infiltration areas will be marked to avoid heavy equipment from compacting soils and affecting infiltration.
5. Stormwater outfall will be graded to designed elevations.
6. Install signage prohibiting access to mitigation area.
7. Install biodegradable erosion control jute matting.
8. Install habitat features in shoreline jurisdiction.
9. Install riparian habitat and shoreline vegetation enhancement and restoration plantings.

IMPACT AVOIDANCE AND MINIMIZATION METHODS

This proposal involves the construction of water-dependent critical infrastructure and as such avoidance is not possible. Impacts associated with the construction of the stormwater infrastructure are unavoidable even if they were to be sited elsewhere. Therefore, this proposal includes minimization measures to the greatest extent practicable the inclusion of mitigation for this proposal which is described in greater detail within the onsite mitigation section included below.

The following construction best management practices (BMPs) are recommended by the Habitat Management, Mitigation and Monitoring Plan:

1. Construction will occur mainly during the dry season (May-October) as feasible.
2. Native vegetation will be retained to the greatest extent possible within shoreline jurisdiction where improvements are not proposed.
3. Only three trees within the project area will be removed to accommodate the installation of the outfall system.
4. Clearly demarcate the job site and critical areas that must be avoided prior to ground disturbing activities.
5. Install silt fencing on the waterward side of land disturbing activities in shoreline jurisdiction.
6. No equipment will enter below the OHWM of the Cowlitz River.
7. Vehicle and equipment maintenance, repair, and/or service will be performed at designated repair facilities whenever possible.
8. All equipment will be maintained or fueled up, a minimum of 200 feet from the Cowlitz River.
9. All bare soils within shoreline jurisdiction will be mulched with certified weed-free straw after ground disturbing activities.
10. Signage will be installed along the boundary of Area 1 and Area 3 to notify the public of mitigation locations and access restrictions (Figure 7).
11. Install large woody material rootwads and horizontal logs to deter entrance from the public to the stormwater outfall.

PROJECT IMPACT SUMMARY

All impacts have been minimized to the greatest extent possible. All mitigation for impacts to the shoreline buffer and shoreline jurisdiction of the Cowlitz River is proposed onsite. Most project impacts come from the proposed grading and fill, and the installation of the proposed dual outfall piping system. Proposed impacts to critical areas onsite are included in the table below.

Shoreline Buffer Impacts		
Habitat Area	**Proposed Impact**	**Size of Impact**
Shoreline Buffer for Cowlitz River (RHA)	Permanent Shoreline Buffer Impact	0.002 acres/108 square feet
	Temporary Shoreline Buffer Impact	0.217 acres/9,444 square feet
Shoreline Impacts		
Habitat Area	**Proposed Impact**	**Size of Impact**
Shoreline Jurisdiction for the Cowlitz River (outside of RHAs)	Temporary Shoreline Jurisdiction Impact	0.014 acres/629 square feet

ONSITE MITIGATION

The applicant is proposing project impacts be compensated for through onsite, in-kind mitigation. The goal of onsite mitigation is to ensure no net loss of ecological functions and meet vegetation conservation standards established in the SMP. The generally accepted mitigation ratio for permanent impacts and temporary impacts to shoreline buffers and shoreline jurisdiction impacts, in ELS experience, has been generally accepted at 1:1 mitigation ratio. CT6, LLC proposes a comprehensive onsite mitigation plan to address project impacts within the shoreline buffer and shoreline jurisdiction of the Cowlitz River. The plan includes:

- Permanent Impacts**:** Mitigation at a 2:1 ratio for permanent impacts to the shoreline buffer resulting from the installation of a gabion wall.
- Temporary Impacts: Mitigation at a 1:1 ratio for temporary impacts to the shoreline buffer and shoreline jurisdiction caused by grading and the installation of an outfall pipe system.
- Tree Removal: Mitigation at a 4:1 stem count ratio for the removal of three black cottonwood trees within the shoreline buffer to accommodate the outfall system installation.

Mitigation includes a combination of restoration and enhancement with an upland native grass seed application and installing native trees and shrubs. In addition to these measures, CT6, LLC will install habitat features within the shoreline buffer of the Cowlitz River to ensure no net loss of ecological function. Performance standards, monitoring, maintenance, and contingency methods will be discussed in subsequent sections of this report to ensure the mitigation areas are successful.

III. EXISTING SITE CONDITIONS

The site consists of undeveloped area within the recreation land use designated for recreation use in the approved Landing on the Cowlitz (LOTC) Master Plan and subsequent minor modification (Ordinance No. 2021-10 and Resolution No. 2024-03) (Master Plan). The site is further identified as Parcel 308120500 (BLA Parcel No. 3, CR-BLA-24-01 - AFN3762029 and AFN 3763318).

The site primarily consists of mudflow derived from the 1980 eruption of Mount St. Helen's or by dredge from the Cowlitz River. The site features sporadic vegetation consisting of deciduous native trees, herbaceous grasses and weeds, and non-native invasive species including scotch broom (*Cytisus scoparius*) and Himalayan blackberry (*Rubus armeniacus*). The site itself requires the removal of three (3) black cottonwood (*Populus trichocarpa*) trees in order to facilitate the grading and installation of the stormwater outfall system. Existing site slopes are less than 2:1. For more information, see the Habitat Management, Mitigation and Monitoring Plan dated December 4, 2024, prepared by Ecological Land Services, Inc.

IV. CONFORMANCE WITH THE CITY OF CASTE ROCK SHORELINE MASTER PROGRAM (ORD. 2022-03, MAY 9, 2022)

The following narrative addresses the way in which the proposed stormwater outfall has been designed in compliance with the City of Castle Rock Shoreline Master Program (SMP). Only applicable Sections of the SMP are included below and text appearing in italics denotes information contained within the SMP. Response text follows each SMP section. Ellipses (*[…]*) that appear to denote a truncation of SMP code text which does not apply.

[…]

5. Shoreline Environment Designations and Shorelines of Statewide Significance

[…]

5.4 Shoreline Environment Designations

The City classification system consists of shoreline environment designations that are consistent with and implement the Act, the Program, and the City of Castle Rock Comprehensive Plan.

These designations have been assigned consistent with the corresponding criteria provided for each shoreline environment designation. In delineating shoreline environment designations, the City aims to ensure that existing shoreline ecological functions are protected with the proposed pattern and intensity of development. Such designations should be consistent with the policies for restoration of degraded shorelines. The shoreline environment designations are, High-Intensity, Residential, Aquatic, and Recreation.

5.4.1 High-Intensity Environment

[…]

Management Policies

A. Priority should be given to water-dependent, water-related, and water-enjoyment uses in that order of preference. Non-water-oriented uses within the High-Intensity shoreline environment designation are appropriate on sites where there is no direct access to the shoreline because of another property separating it from the shoreline or an intervening public right-of-way.

Response: This proposal involves a water-dependent use within the High-intensity shoreline buffer. The purpose of the stormwater project is to facilitate the inclusion of critical infrastructure and does not include the provision of direct vehicular or pedestrian access to the shoreline. This proposal has been designed to enhance the ecological functions of the site. Existing undeveloped site conditions deciduous native trees, herbaceous grasses and weeds, and non-native, invasive species including sporadic scotch broom (*Cytisus scoparius*) and Himalayan blackberry (*Rubus armeniacus*). Site conditions are not resultant from previous degradation.

B. Non-water-oriented uses on sites adjacent to the water should provide public benefit in the form of ecological enhancement and/or public access in compliance with the provisions of this Program.

Response: Not applicable. This proposal involves a water-dependent use and as such the criteria for non-water-oriented uses does not apply.

c. Where unavoidable impacts to ecological functions occur, appropriate mitigation should be provided in accordance with this Program to achieve no-net-loss. Where applicable, development should include environmental cleanup and restoration of the shoreline in accordance with relevant state and federal law.

Response: This proposal involves unavoidable impacts to a portion of the Cowlitz River shoreline buffer area and the regulatory floodplain and as such, is required to include mitigation measures to ensure no-net-loss is achievable for the area.

This proposal has been designed to include onsite compensatory mitigation in order to achieve no net loss of habitat function:

- 2:1 ratio for permanent impacts associated with the installation of the gabion wall for the stormwater outfall;
- 1:1 ratio for temporary impacts associated with the installation of a stormwater outfall gabion wall, and;
- 4:1 stem count ratio for permanent impacts associated with tree removal

The mitigation that has been designed for this proposal exceed the 1:1 ratio which is generally accepted for permanent and temporary impacts within critical areas.

C. Visual and/or physical public access should be provided, where feasible.

Response: Not applicable. This proposal involves the construction of stormwater infrastructure on a privately owned site devoid of public access roads.

D. Aesthetic objectives of this Program should be in character with high intensity development and include height limits, screening, and other standards consistent with the primary purpose of accommodating high-intensity uses.

Response: This proposal has been designed in conformance with the aesthetic objectives of this Program. While topography renders the proposed stormwater outfall imperceivable from the nearest development located adjacent to Larsen Lane SW, the mitigation plan includes plantings which shall obstruct visibility of the stormwater outfall. The proposed plantings will further shield the Cowlitz River from any upland development in the vicinity of the outfall.

E. Existing urban areas appropriate for intensive development should be fully utilized before expanding intensive development into other areas.

Response: Not applicable. The site is not located within an existing urban area nor does the installation of essential stormwater infrastructure constitute an expansion of an existing intensive development into other areas.

Designation Criteria

The High-Intensity environment designation is given to shoreline areas within the City of Castle Rock if they currently support or are planned for high-intensity uses related to commercial, industrial, or transportation.

Response: The site is planned for adjacent high intensity uses in the future.

6. General Shoreline Regulations

This Chapter describes general regulations which apply to all shorelines of the state that are located in the City of Castle Rock. The general regulations Section is used in conjunction with the use and modification regulations found in Chapter 7.

6.1 No Net Loss of Ecological Function

A. All shoreline use and development, including preferred uses and uses that are exempt from permit requirements, shall be located, designed, constructed, conducted, and maintained in a manner that maintains shoreline ecological functions, in accordance with the mitigation sequencing provisions of the Program.

Response: This proposal has been designed to avoid and minimize impacts to the buffer by limiting the area of impact to the shoreline buffer involving 108 square feet (0.002 acres) of permanent impact and 9,444 square feet (0.217 acres) of temporary impact, and 629 square feet (0.014 acres) outside of the shoreline buffer but within shoreline jurisdiction. In addition, this proposal includes compensatory mitigation of 2:1 for permanent impacts, exceeding the generally accepted ratio of 1:1. Furthermore, non-native invasive species shall be cleared from the project area which shall enhance environmental conditions and result in no net loss of ecological function onsite within the area of impact. The small project footprint, BMPs, and proposed mitigation measures will maintain ecological functions.

B. *Shoreline ecological functions that shall be protected include, but are not limited to, fish and wildlife habitat, food web support, and water quality maintenance.*

Response: This proposal involves the installation of a stormwater system landward of the ordinary high water mark (OHWM) which shall avoid direct impacts to aquatic life. The native plantings included as part of the proposed mitigation plan shall provide an enhanced environmental quality within an area which currently features non-native, invasive plant species. Furthermore, this proposal includes a stormwater system with water quality treatment outside of the regulatory shoreline wherein which only treated and controlled stormwater runoff shall be discharged within the shoreline buffer of the Cowlitz River. The installed vegetation will slow surface runoff, reduce the potential for erosion, and promote infiltration, which protects water quality functions of the shoreline buffer. Additionally, the proposed vegetation and habitat features will provide nesting, roosting, and foraging opportunities.

C. *Shoreline processes that shall be protected include, but are not limited to, water flow; erosion and accretion; infiltration; groundwater recharge and discharge; sediment delivery, transport, and storage; large woody debris recruitment; organic matter input; nutrient and pathogen removal; and stream channel formation/maintenance.*

Response: This proposal has been designed to minimize impacts to shoreline processes by including a stormwater outfall above the OHWM with a permanent impact area limited to 108 square feet (0.002 acres) within the Cowlitz River shoreline buffer. The limited area of impact along with the proposed shoreline stabilization associated with the onsite mitigation shall reduce interruption to the shoreline processes. Erosion control and stabilization measures for the onsite restoration and enhancement shall include the installation of biodegradable jutte matting prior to the installation of habitat features such as rootwads and rootwad logs. The area proposed for the outfall is not significantly downcut and does not appear to have frequent erosion. Sediment transport and accretion will be maintained. Groundwater recharge will be supported through stormwater discharge to the riparian buffer. Because the proposed outfall is located landward of the OHWM, large woody material recruitment will not be impacted.

D. *In-water work shall be scheduled to protect biological productivity (including but not limited to fish runs, spawning, and benthic productivity). In-water work shall not occur in areas used for commercial fishing during a fishing season unless specifically addressed and mitigated for in the permit.*

Response: Not applicable. This proposal does not include or require in-water work.

E. An application for any permit or approval shall demonstrate all reasonable efforts have been taken to provide sufficient mitigation such that the activity does not result in net loss of ecological functions. Mitigation shall occur in the following prioritized order:

1. Avoid the adverse impact altogether by not taking a certain action or parts of an action or by moving the action.

Response: The project has been designed to avoid impacts to the shoreline buffer and shoreline jurisdiction to the greatest extent practicable. Due to the landscape position of the Phase 1a boundary and the water-related/water orientated nature of the stormwater outfall, complete avoidance of impacts to shorelines was not possible.

2. Minimize adverse impacts by limiting the degree or magnitude of the action and its implementation by using appropriate technology and engineering, or by taking affirmative steps to avoid or reduce adverse impacts.

Response: Permanent impacts from the proposed gabion wall are limited to 0.002 acres (108 sq. ft.) and will be offset with a 2:1 onsite mitigation ratio. Additionally, permanent impacts from grading and installation of the outfall system within the shoreline buffer necessitates the proposed removal of three black cottonwood (*Populus trichocarpa*) trees. Neither of these permanent impacts could be avoided to accommodate project design. Alternative locations for the outfall would result in the same amount of vegetation removal or more.

3. Rectify the adverse impact by repairing, rehabilitating, or restoring the affected environment.

Response: The affected environmental shall be restored to pre-project conditions and further enhanced with the inclusion of erosion control measures including jutte matting and hydroseeding of all disturbed areas. Native trees and shrubs as well as habitat features will be installed to result in no net loss of ecological functions. A total of 0.268 acres of the shoreline will be restored and enhanced with native trees and shrubs. Furthermore, the habitat mitigation plan includes the removal of non-native invasive species. For more details about the proposed onsite restoration and enhancement, see Table 2 and 5 within the Habitat Management, Mitigation and Monitoring Plan by Ecological Land Services.

4. Reduce or eliminate the adverse impact over time by preservation and maintenance operations during the life of the action.

Response: This proposal has been designed to include a monitoring and maintenance plan for three (1) restoration areas over the course of five (5) years to ensure the mitigation goals, objective, and performance standards are being met. Native vegetation will be monitored for overall success including survival and percent cover. Maintenance to the mitigation areas will include invasive vegetation removal, competing vegetation removal, and irrigation. Over the long term, the stormwater outfall and associated facility will be maintained for the life of the project to ensure proper function and to avoid impacts to the shoreline buffer and water quality.

5. *Compensate for the adverse impact by replacing, enhancing, or providing similar substitute resources or environments. Preference shall be given to measures that replace the impacted functions on site or in the immediate vicinity of the impact. However, alternative compensatory mitigation within the watershed that addresses limiting factors or identified critical needs for shoreline resource conservation based on watershed or comprehensive resource management plans may be authorized.*

   Response: The compensatory mitigation included in the Habitat Management, Mitigation and Monitoring Plan serves to replace and enhance the impacted environment within the area of temporary and permanent impact associated with the installation of the stormwater outfall. Onsite mitigation will ensure the impacted functions are replaced onsite and will result in no net loss of ecological function.

6. *Monitor the adverse impact and take appropriate corrective measures.*

   Response: This proposal includes a five- (5) year monitoring plan and includes corrective measures, if they are needed. The outfall will be monitored regularly to ensure proper function.

F. *Applicants for permits have the burden of proving that the proposed development is consistent with the criteria set forth in this Program and the Act, including demonstrating all reasonable efforts have been taken to provide sufficient mitigation such that the activity does not result in net loss of ecological functions.*

   Response: This proposal includes a Habitat Management and Mitigation Plan (Plan) and Monitoring Plan which details the proposed mitigation for anticipated permanent impacts in exceedance of the generally accepted mitigation ratio of 1:1. The Plan also includes 1:1 restoration and enhancement for temporary impacts.

G. *Uses and development activities that comply with the provisions of the Castle Rock Comprehensive Plan and the Castle Rock Municipal Code may be permitted landward of levees, dikes, revetments, roads, railways, and rights-of-way, in accordance with the provisions of the Shoreline Management Act and this Program, including but not limited to the provisions requiring no net loss of ecological function and mitigation sequencing.*

   Response: This proposal includes the provision of critical infrastructure and includes no net loss of ecological function and mitigation sequencing in conformance with the different City- and State-level regulatory requirements of the Comprehensive Plan, Castle Rock Municipal Code, City's SMP and the State Shoreline Management Act. The mitigation plan developed in conjunction with the proposed stormwater outfall includes an overall lift in ecological function within the existing riparian and shoreline habitat through the proposed plantings and habitat features, removal of non-native and invasive plant species, and the proposed compensatory mitigation ratios meeting and exceeding the generally accepted mitigation ratio.

6.2 *Archaeological, Cultural, and Historic Resources*

A. *If historic, cultural, or archaeological sites or artifacts are discovered in the process of development, work shall be stopped immediately in accordance with the provisions of federal, state, and local laws, the site secured, and the find reported as soon as possible to the City. The property owner also shall notify the Washington State*

Department of Archaeology and Historic Preservation (DAHP) and affected tribes. The City may provide for a site investigation by a qualified professional and may provide for avoidance or conservation of the resources in coordination with appropriate agencies. All shoreline permits shall contain a special provision notifying permittees of this requirement. Failure to comply with this requirement shall be considered a violation of the shoreline permit and shall subject the permittee to legal action.

Response: The Applicant acknowledges that adherence to federal, state and local laws. Pursuant to the Developer's Agreement Exhibit C, Notice of Modifications to the Mitigated Determination of Non-Significance, Item 13, requires consultation between the City and Project Sponsor and the Cowlitz Tribe prior to the initiation of any ground disturbing activities. Consultation took place prior to the initiation of the approved Landing on the Cowlitz Master Plan mass grading.

This proposal is subject to the Inadvertent Discovery Plan (Report No. 4820) dated July 18, 2022, by the Archaeological Investigations Northwest, Inc. for the Landing on the Cowlitz Master Plan. Refer to the Inadvertent Discovery Plan for more details.

B. *Prior to approval of development in an area of known or probable cultural resources, the City shall require a site assessment by a qualified professional archaeologist in coordination with affected tribes. Conditions of approval may require preservation or conservation of cultural resources as provided by applicable federal, state, and local statutes. All permits issued for development in areas known to be archaeologically significant shall provide for monitoring of any development activity for previously unidentified cultural resources.*

Response: The Applicant has satisfied this site assessment requirement with the approved Master Plan and involved a scope inclusive of the overall site. Should any cultural resources or archaeological items of significance be discovered with any ground disturbing activities, all work shall be required to immediately cease and protocol included in the Inadvertent Discovery be adhered to.

6.3 Critical Areas Protection

Critical Areas Regulations are in Appendix B.

6.3.1 Applicable Critical Areas

For purposes of this Program, the following critical areas, as defined in Appendix B, will be protected under this Program: Wetlands; Critical Aquifer Recharge Areas; Frequently Flooded Areas; Geologically Hazardous Areas; and Fish and Wildlife Habitat Conservation Areas.

Response: The site is located within frequently flooded areas including the regulatory floodway and the 100-year floodplain of the Cowlitz River, and within fish and wildlife habitat conservation areas in the shoreline buffer. As such, the Critical Areas Regulations contained within the City of Castle Rock Municipal Code (CRMC) Chapter 15.24, Chapter 18.10.130, and Chapter 18.10.140 appliy to this proposal.

6.3.2 General Provisions

A. *Shoreline uses, activities, developments and their associated structures and equipment shall be located, designed and operated to protect the ecological processes and functions of critical areas. Provide a level of protection to critical areas located within shoreline jurisdiction that assures no*

net loss of shoreline ecological functions necessary to sustain shoreline natural resources.

Response: This proposal involves the inclusion of critical infrastructure and has met mitigation sequencing, including proposed mitigation measures which are designed to result in no net loss of shoreline ecological functions necessary to sustain shoreline natural resources.

B. *New and/or expanded development proposals shall integrate protection of wetlands, fish and wildlife habitat, and flood hazard reduction with other stream management provisions to ensure no net loss of ecological functions.*

Response: This proposal includes the construction of stormwater infrastructure and integrates enhancement and long-term protection measures to result in a no net loss of ecological functions.

C. *Critical areas within the shoreline jurisdiction shall be regulated for any use, development, or activity as provided in accordance with this Program and Appendix B.*

Response: The Applicant acknowledges that the proposed stormwater outfall is subject to shoreline and critical areas regulations.

D. *If provisions of Appendix B and other parts of this Program conflict, the provisions most protective of ecological resources shall apply, as determined by the City.*

Response: The Applicant acknowledges that should any provisions of the Appendix B and other parts of this Program conflict, the provisions of the most protective ecological resources shall apply, as determined by the City. Ecological resources have been protected and enhanced to the greatest extent practicable.

E. *Unless otherwise stated, critical area buffers associated with jurisdictional shoreline areas shall be regulated in accordance with this Program and Appendix B, including but not limited to, Section 2.5, Table 7, and Table 8.*

Response: The Applicant acknowledges that the critical areas associated with jurisdictional shoreline areas shall be regulated in accordance with this Program and Appendix B, including but not limited to, Section 2.5, Table 7, and Table 8. No wetlands are present within the project area. Shoreline buffers have been established according to Table 7, which refers to Table 8. The shoreline buffer for this reach code is 150 feet.

F. *These provisions do not extend the shoreline jurisdiction beyond the limits specified in this Program as defined in Section 3.1, Applicability.*

Response: The Applicant acknowledges that these provisions shall not extend the shoreline jurisdiction beyond the limits specified in this Program as defined in Section 3.1, Applicability.

G. *All critical areas and critical areas buffers located outside of the jurisdiction of the Shoreline Management Act shall be subject to the provisions of the Castle Rock Municipal Code and the Washington State Growth Management Act.*

Response: The Applicant acknowledges that all critical areas and critical areas buffers located outside of the jurisdiction of the Shoreline Management Act shall be subject to the provisions of the Castle Rock Municipal Code and the Washington State Growth Management Act. This proposal involves work within area designated as frequently flooded and as such must comply with all applicable regulations.

6.4 Flood Prevention and Flood Damage Minimization

This Program addresses flooding in two different ways. This Section includes flood hazard reduction measures, including flood control works, intended to avoid increasing hazards and minimize damage. Section 6.3 includes flood hazard protections through the Critical Areas Regulations.

A. Development or uses in floodplains shall avoid significantly or cumulatively increasing flood hazards, and shall be consistent with Chapter 15.24 of the CRMC.

Response: This proposal has been designed to reduce site flood hazards by facilitating appropriate drainage of the overall master plan site. In addition, the outfall has been designed to include an inline check valve outside of the outfall pipe which in the event of side flooding, shall facilitate the utilization of an existing on-site ditch on the western side of the property for emergency storage. This proposal has been designed to include a parallel thirty- (30) inch system which shall separately handle off-site flows captured.

B. New residential, commercial, or industrial development and uses, including subdivision of land, within shoreline jurisdiction are prohibited if it would be reasonably foreseeable that the development or use would require structural flood hazard reduction measures in the channel migration zone or floodway over the life of the development.

Response: Not applicable. This proposal includes a stormwater outfall and does not comprise new residential, commercial or industrial development and uses.

C. The following uses and activities may be authorized in floodways or channel migration zones when otherwise permitted by this Program:

1. *Actions and development with a primary purpose of protecting or restoring ecological functions and ecosystem-wide processes.*

   Response: Not applicable. This proposal does not include a use with a primary purpose of protecting or restoring ecological functions and ecosystem-wide processes.

2. *Forest practices in compliance with the Washington State Forest Practices Act and its implementing rules.*

   Response: Not applicable. The site is not located within a forested area and does not include forest practice uses.

3. *Existing and ongoing agricultural practices, provided that no new restrictions to channel movement occur.*

   Response: Not applicable. This proposal does not involve existing or ongoing agricultural practices.

4. *Bridges, utility lines, public stormwater and wastewater facilities and their outfalls, and other public utility and transportation structures where no other feasible alternative exists, or where the alternative would result in unreasonable and disproportionate costs. Where such structures are allowed, mitigation shall address impacted functions and processes in the affected shoreline.*

   Response: This proposal involves the construction of stormwater utility lines and a stormwater outfall which shall be dedicated to the City of Castle Rock. There is no other feasible alternative for locating this infrastructure elsewhere as no other location could accommodate stormwater from both on- and off-site flows for the master plan.

5. *Repair and maintenance of an existing legally established use, provided flood hazards to other uses are not increased and that the activity does not cause significant ecological impacts that cannot be mitigated.*

   Response: Not applicable. This proposal does not involve an existing use.

6. *Development in Castle Rock, where structures exist that prevent active channel movement and flooding.*

   Response: Not applicable. The site is devoid of development.

7. *Modifications or additions to an existing nonagricultural legal use, provided that channel migration is not further limited and that the new development includes appropriate protection of ecological functions.*

   Response: Not applicable. This proposal does not involve modifications or additions to an existing nonagricultural legal use.

8. *Measures to reduce shoreline erosion provided that it is demonstrated that the erosion rate exceeds that which would normally occur in a natural condition, that the measures do not interfere with fluvial hydrological and geomorphological processes normally acting in natural conditions, and that the measures include appropriate mitigation of impacts to ecological functions associated with the river or stream.*

   Response: The proposed outfall is located landward of the OHWM and will not interfere with fluvial hydrological and geomorphological processes. This section of the Cowlitz River is linear and there is extremely minimal aggradation or degradation occurring in the area of the outfall. The proposed enhancements will not interfere with natural processes. This proposal has been designed to further include erosion control measures involving the installation of:

   (1) A gabion wall wherein which stormwater shall be discharged;
   (2) Biodegradable jutte matting
   (3) Large woody material for habitat enhancement and riparian bank stabilization
   (4) Native shrubs, and spreading native seed mix

In addition, the Erosion Control Notes as included in the Phase 1 Access and Utilities Plan (Sheet C0.1) shall be adhered to:

1. The contractor shall ensure that all erosion control measures are intact and in working condition prior commencement of drainage facility construction.
2. A high-visibility fence shall be installed and composed of a high-density polyethylene material and shall be at least four feet in height. Posts for the fencing shall be steel or wood and placed every 6 feet on center (maximum) or as needed to ensure rigidity. The fencing shall be fastened to the post every six inches with a polyethylene tie. On long continuous lengths of fencing, a tension wire or rope shall be used as a top stinger to prevent sagging between posts. The fence color shall be high-visibility orange. The fence tensile strength shall be 360 lbs/ft using the ASTM D4595 testing method. If appropriate install fabric silt fence in accordance with BMP C233: Silt fence to act as high-visibility fence. Silt fence shall be at least 3 feet high and must be highly visible to meet the requirements of this BMP. Metal fences shall be designated and installed according to the manufacturer's specifications. Metal fences shall be at least 3 feet high and must be highly visible. Fences shall not be wired or stapled to trees. If

the fence has been damaged or visibly reduced, it shall be repaired or replaced immediately and visibly restored.

3. Approval of this Erosion/Sedimentation Control (ESC) Plan does not constitute an approval of permanent road or drainage design (e.g. size and location of roads, pipes, restrictors, channels, retention facilities, utilities).
4. The implementation of this ESC Plan and the construction, maintenance, replacement, and upgrading of these ESC BMPs is the responsibility of the Applicant until all construction is completed and approved and vegetation/landscaping is established.
5. Clearly flag the boundaries of the clearing limits shown on this plan in the field prior to construction. During the construction period, no disturbance beyond the flagged clearing limits shall be permitted. The flagging shall be maintained by the Applicant for the duration of construction.
6. Construct the ESC BMPs shown on this Plan in conjunction with all clearing and grading activities, and in such a manner as to ensure that sediment and sediment laden water do not enter the drainage system, roadways, or violate applicable water standards.
7. The ESC BMPs shown on this plan are the minimum requirement for anticipated site conditions. During the construction period, upgrade these ESCP BMPs as needed for unexpected storm events and to ensure that sediment and sediment-laden water do not leave the site.
8. The Applicant shall inspect the ESC BMPs daily and maintain them as necessary to ensure their continued functioning. Inspect and maintain the ESC BMPs on inactive sites a minimum of once a month or within the 48 hours following a major storm event (i.e. a 24-hour storm event with a 10-yr or greater recurrence interval).
9. At no time shall the sediment exceed 60-percent of the sump depth or have less than 6-inches of clearance from the sediment surface to the invert of the lowest pipe. All catch basins and conveyance lines shall be cleaned prior to pacing. The cleaning operation shall not flush sediment laden water into the downstream system.
10. Install stabilized construction entrances at the beginning of construction and maintain for the duration of the project. Additional measures may be required to ensure that all paved areas are kept clean for the duration of the project.

D. Removal of materials for flood management purposes shall be consistent with an adopted flood hazard reduction plan in accordance with the mitigation sequencing provisions of this Program and shall only be allowed if a biological and geomorphological study demonstrates a long-term benefit to flood hazard reduction.

Response: This proposal does not include the removal of materials for flood management purposes.

E. Channel Migration Zones:

[…]

Response: Not applicable. Pursuant to the State of Washington Department of Ecology mapping, the site is not located in the Channel Migration Zones.

F. Flood Control Works:

[…]

Response: This proposal does not involve the inclusion of structural flood hazard reduction measures.

6.5 Public Access
[…]
Response: Not applicable. This proposal does not include the provision of a public project, it is not a water-dependent proposal that increases demand for public access, and does not interfere with existing access or use of public waters subject to the Public Trust Doctrine. Furthermore, the site is physically separated by property that is current undeveloped.

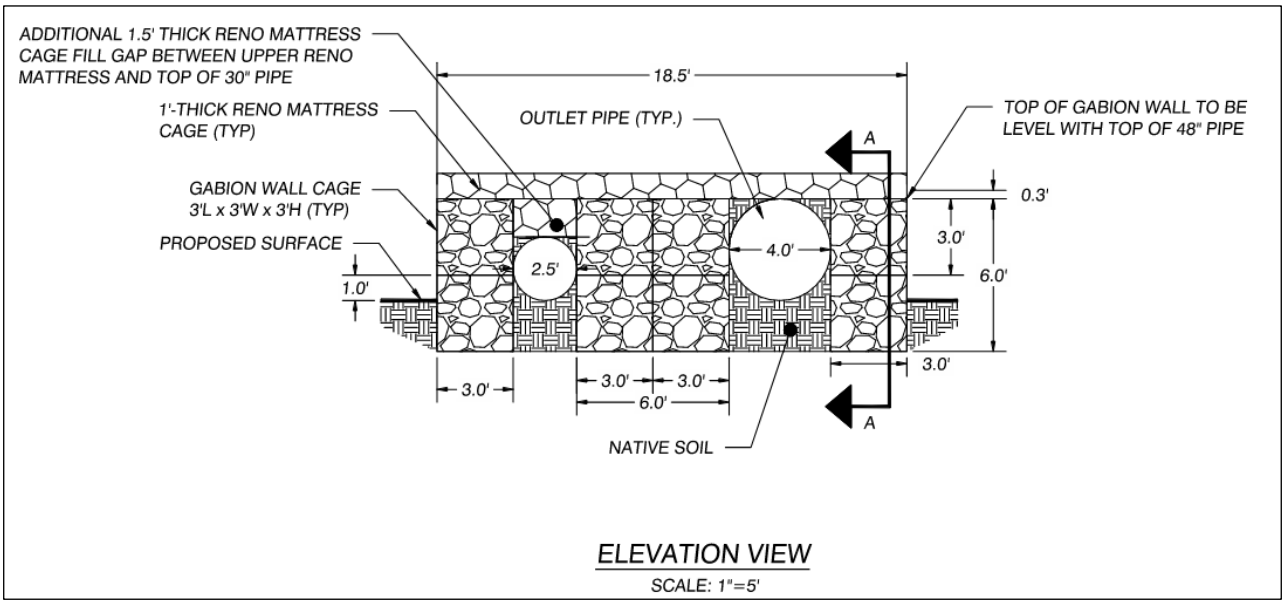
6.6 Vegetation Conservation

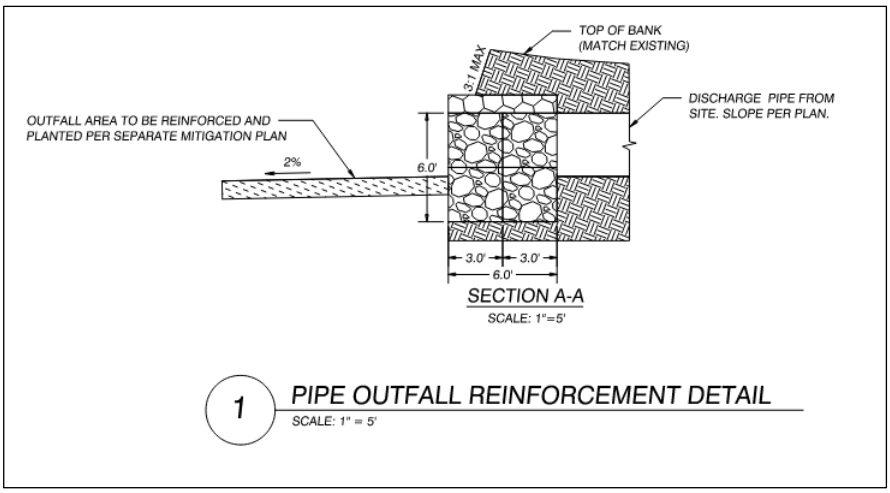
A. *All development shall minimize vegetation removal in areas of shoreline jurisdiction to the amount necessary to accommodate the permitted use.*

Response: This proposal has been designed to minimize the amount of vegetation removal within the shoreline by limiting the overall area of permanent impact to 0.002 acres (108 square feet). The installation of the outfall necessitates the removal of vegetation consisting of non-native invasive species including Scotch broom (Cytisus scoparius) and Himalayan blackberry (Rubus armeniacus). The three black cottonwood trees to be removed will be replaced onsite at a 4.:1 stem count ratio. Temporary shoreline vegetation impacts are limited to herbaceous and non-native vegetation.

B. *Unless otherwise specified, all shoreline uses and development shall comply with the setback and buffer provisions of this Program included in Table 7-1 and Appendix B, to protect and maintain shoreline vegetation.*

Response: This proposal includes a stormwater outfall and as such meets the criteria for the utilities shoreline use included in Table 7-1. Utilities may be permitted through a Shoreline Substantial Development Permit (SSDP). Shoreline vegetation has been protected and maintained through mitigation sequencing and onsite enhancement. For more information, see the discussion included below in response to Section 7 of the City of Castle Rock Shoreline Master Program.





[Source: Landing on the Cowlitz Stormwater Outfall Plan Set – Sheet C6.0, Outfall Enlargement]

C. *Vegetation conservation standards of this Program shall not apply retroactively in a way which requires lawfully existing uses and developments, including residential landscaping and gardens, to be removed, except as required as mitigation for new and expanded development. Routine maintenance of existing landscaping and gardens is allowed.*

Response: Not applicable. This proposal does not include the request to approve of vegetation conservation in response to retroactive removal of vegetation within the shoreline and associated buffer.

D. *Vegetation may be removed or altered landward of shoreline buffers described in this Program provided that there is no net loss of ecological function.*

Response: It is not anticipated that this proposal will require the removal or alteration of vegetation landward of shoreline buffers described in this Program. Temporary impacts to herbaceous vegetation will occur to install the underground pipers. This area will be restored through native seed installation.

E. *Shoreline landowners are encouraged to preserve and enhance sustainable woody vegetation and sustainable groundcovers to stabilize soils and provide habitat. When shoreline uses or modifications require a planting plan (i.e., uses or modifications that require a mitigation plan), maintaining sustainable plant communities, replacing noxious weeds and avoiding installation of ornamental plants are preferred. Non- native vegetation requiring use of fertilizers, herbicides/pesticides, or summer watering is discouraged.*

Response: This proposal includes a shoreline use which necessitates mitigation plantings. The mitigation included with this proposal includes the enhancement of the shoreline area with the installation of large woody material rootwads and horizontal logs to deter entrance from the public to the stormwater outfall. Proposed native trees and shrubs are woody vegetation that will provide additional bank stability.

F. *Mitigation plans shall be approved before initiation of other permitted activities, unless a phased schedule that ensures completion prior to occupancy has been approved.*

Response: The Applicant acknowledges that the mitigation plan must be approved by the City of Castle Rock prior to the initiation of activities within the jurisdictional shoreline and associated buffer.

G. *Aquatic weed control shall only occur to protect sustainable plant communities and associated habitats or where an existing water-dependent use is restricted by the presence of weeds. Aquatic weed control shall occur in compliance with all other applicable laws and standards and shall be done by a qualified professional.*

Response: Not applicable. This proposal does not include or require alteration of aquatic weeds.

H. *Limbing or crown thinning shall comply with the Tree Care Industry Association pruning standards, unless the tree is a hazard tree as defined by this SMP. No more than 25 percent of the limbs of any single tree may be removed and no more than 20 percent of the canopy cover in any single stand of trees may be removed for view preservation.*

Response: Not applicable. This proposal does not involve the limbing or crowning of trees and instead necessitates the removal of three cottonwood trees.

I. *The clearing of non-native vegetation is allowed as is routine landscape maintenance and family gardening, when conducted using hand-held equipment.*

Response: While this proposal shall require the clearing of non-native vegetation it shall not be undertaken as part of routine maintenance and family gardening. The site is devoid of an existing garden.

J. *Vegetation may be removed or altered landward of shoreline buffers described in this Program provided that there is no net loss of ecological function.*

Response: It is not currently anticipated that this proposal will necessitate permanent vegetation removal landward of the shoreline buffers for the installation of the stormwater outfall.

6.7 Water Quality and Quantity

A. *All shoreline development shall comply with the applicable requirements of the Castle Rock Comprehensive Plan, which identifies the 1992 Puget Sound Stormwater Management Manual, as approved by the City, as the guidance for the City's program, and best management practices to prevent impacts to water quality and stormwater quantity that would result in a net loss of shoreline ecological functions and/or a significant impact to aesthetic qualities or recreational opportunities.*

Response: This proposal has been designed in conformance with the applicable requirements of the Castle Rock Comprehensive Plan, the 1992 Puget Sound Stormwater Management Manual.

B. *Stormwater management structures including ponds, basins, and vaults shall be located outside of shoreline jurisdiction where possible, as far from the water's edge as feasible, and shall minimize disturbance of vegetation conservation buffers. Low impact development facilities (which do not substantially change the character of the shoreline) such as vegetation filter strips, grass-lined swales, and vegetated bioretention and infiltration facilities, are encouraged in association with development allowed in shoreline jurisdiction.*

Response: This proposal involves the installation of a stormwater outfall within the shoreline jurisdiction as no other location alternative is practicable which would avoid vegetation removal or impacts to the buffer associated with waterbodies. This proposal has been designed to minimize the disturbance of vegetation to the shoreline and associated buffer with anticipated total impacts of 0.22 acres (9,552 square feet) which is comprised of permanent impacts of 0.002 acres (108 square feet), 0.217 acres (9,444 square feet) of temporary impacts and the removal of three (3) black cottonwood trees. The proposed enhancements with native vegetation and habitat features will not substantially change the character of the shoreline, and will blend in with surrounding habitat.

C. *Sewage management. To avoid water quality degradation, sewer service is subject to the requirements outlined below.*
   1. *Any existing septic system or other on-site system that fails or malfunctions will be required to connect to an existing municipal sewer service system infeasible, or make system corrections approved by the Cowlitz County Environmental Health Unit.*
   2. *Any new development, business, single-family or multi-family unit will be required to connect to an existing municipal sewer service system if feasible, or install an on-site septic system approved by Cowlitz County Environmental Health Unit.*

   Response: Not applicable. This proposal does not involve sewage management facilities.

7. Specific Shoreline Use Regulations

The regulations in this Chapter apply to specific uses within shoreline jurisdiction. In many circumstances, more than one Section of use regulations will apply to a specific proposal. Guiding policies for uses and modifications are located in Chapter 4.

7.1 Shoreline Use, Modification, and Standards Tables

A. *Table 7-1 Shoreline Use, Modification, Setbacks, and Heights, shall be used to determine which uses may be permitted (P), approved with conditions through the issuance of a Shoreline Conditional Use Permit (SCUP), or prohibited (X) in each shoreline environment. Specific regulations for each corresponding Use and Modification can be found in Chapters 7 of the SMP.*

   Response: This proposal includes utilities and is permissible through an approved Shoreline Substantial Development Permit (SSDP).

B. *All uses and development activities proposed for jurisdictional shoreline areas must comply with all provisions of the Castle Rock Municipal Code, as determined by the City.*

   Response: This proposal has been designed in conformance with all applicable provisions of the City of Castle Rock Municipal Code. The Habitat Management, Mitigation and Monitoring Plan details the project compliance with critical areas regulations.

C. *Setbacks shall be measured on a horizontal plane landward from the required feature described in Table 7-1 below.*
   [NOTE: Excerpted portions of Table 7-1 is included herein:]

Table Key: P = May be permitted through SSDP or SLE	***Shoreline Environmental Designations***			
Shoreline Use	***High-Intensity***	***Residential***	***Recreation***	***Aquatic***
Utilities	*P*	*P*	*P*	*P*
Dimensional Standards				
Buffer [(23)]	*See Table 8, Appendix B [NOTE: High-Intensity Buffer for the Cowlitz River is 150 feet]*			
Building setback from Buffer in Table 8, Appendix B, or Landward Toe of Levee Where Present[(23)]	*10'*	*10'*	*10'*	*N/A*
Maximum Height [(21)]	*35'*	*35'*	*35'*	*35'*
Minimum River Frontage [(22)]	*N/A*	*60'*	*N/A*	*N/A*

Response: This proposal will result in impacts to the 150-foot shoreline buffer. As such, an evaluation of the proposed impacts along with mitigation to result in no net loss of ecological function is required.

This proposal has been designed in conformance with the thirty-five- (35) foot maximum height with the provision of a two- (2) foot high gabion wall and the top of bank shall be reestablished minimizing the protrusion of the installed gabion wall. In addition, there are no river frontage requirements applicable to a high-intensity use included in Table 7-1.

7.2 Shoreline Use

7.2.1 Commercial

[…]

Response: Not applicable.

7.2.2 Forest Practices

[…]

Response: Not applicable.

7.2.3 Industrial

[…]

Response: Not applicable.

7.2.4 In-stream Structures
[…]

Response: Not applicable. This proposal has been designed outside of the Cowlitz Stream and is located above the ordinary high water mark (OHWM).

7.2.5 Mining
[…]

Response: Not applicable. This proposal does not include mining related uses.

7.2.6 Recreational Development
[…]

Response: Not applicable. This proposal does not include recreational development.

7.2.7 Residential Development
[…]

Response: Not applicable.

7.2.8 Transportation Facilities
[…]

Response: Not applicable.

7.2.9 Utilities Uses
These provisions apply to services and facilities that produce, convey, store, or process power, water, sewage, stormwater, gas, communications, oil, waste, and similar services and functions. On-site utility features serving a primary use, such as a water, sewer, or gas line to a residence or other approved use, are accessory utilities and shall be considered a part of the primary use.

A. *New or expanded non-water dependent utilities or parts thereof may be located within shoreline jurisdiction only when the applicant demonstrates based on analysis of alternative locations and technologies that:*
   […]

   Response: Not applicable. This proposal involves the provision of a non-water-dependent use.

B. *Overhead electrical transmission lines should be located outside of shoreline jurisdictional areas, unless infeasible due to site constraints, including but not limited to topography or safety, as determined by the City.*

   Response: Not applicable. This proposal does not involve overhead electrical transmission lines.

C. *Transmission, distribution and conveyance facilities shall be located in existing rights of way and corridors or shall cross shoreline jurisdictional areas by the shortest, most direct route feasible, unless such route would cause significant environmental damage.*

   Response: This proposal includes the provision of a stormwater conveyance and discharge facility which crosses the shoreline jurisdiction area by the shortest, most direct route feasible. Additionally, the majority of the facility in shoreline jurisdiction is below ground, which further avoids environmental impacts.

D. Utility crossings of waterbodies shall be attached to bridges where feasible. Where attachment to a bridge is not feasible, underground construction methods that avoid surface disturbance are preferred.

Response: Not applicable. This proposal does not include utility crossings of water bodies.

E. All underwater pipelines transporting liquids intrinsically harmful to aquatic life or potentially harmful to water quality shall be equipped with automatic shut off valves.

Response: Not applicable. This proposal does not include the provision of underwater pipelines.

F. Structural utility buildings, such as pump stations, electrical substations, waste facilities, or other facilities shall be located outside of jurisdictional shoreline areas, unless no other feasible location exists, in which case they shall be visually compatible in scale with surrounding development and landscape to provide compatibility with natural features and adjacent uses.

Response: Not applicable. This proposal does not include the provision of a structural utility building.

G. Stormwater outfalls may be placed below the OHWM to reduce scouring. New outfalls and modifications to existing outfalls shall be designed and constructed to avoid impacts to existing native aquatic vegetation attached to or rooted in substrate.

Response: Not applicable. This proposal involves the provision of a stormwater outfall above the ordinary high water mark (OHWM).

H. The presence of existing utilities shall not justify more intense development. Rather, the development shall be consistent with the City Comprehensive Plan, Development Regulations, and this SMP, and shall be supported by adequate utilities.

1. *Existing facilities such as the City's Municipal Water System and Sewer System, that are located landward of a levee, may be improved in accordance with the mitigation sequencing provisions contained in this Program.*

   Response: Not applicable. The site is devoid of existing utilities.

7.3.1 Fill and Excavation

A. Fill may be placed in flood hazard areas only when otherwise allowed by the Frequently Flooded Areas Regulations in this Program (Appendix 8) and where it is demonstrated in a hydrogeological report prepared by a qualified professional that adverse impacts to hydrogeologic processes will be avoided.

Response: This proposal has been prepared by a licensed professional Engineer in the State of Washington. Included with this proposal is a stormwater report which evaluated the potential impacts of the proposed fill. No habitable structures exist or are proposed near the proposed outfall; therefore, the evaluation of a hydrogeological professional is not anticipated to be required. Furthermore, the proposed fill is limited to a small area and shall not cause a change in flood hazard conditions.

B. Fill placed below the OHWM for any other use besides ecological restoration requires a Shoreline Conditional Use Permit.

1. *Accomplish an aquatic habitat restoration plan.*
2. *Support a mitigation action, environmental restoration, beach nourishment or other enhancement project.*
3. *Correct the adverse results of past shoreline modification that have disrupted natural stream geomorphic conditions and adversely affected aquatic or terrestrial habitat.*
4. *Support a water-dependent use.*
5. *Serve as part of a public access proposal.*
6. *Support cleanup of contaminated sediments as part of an interagency environmental clean-up plan, or permitted under MTCA or CERCLA.*
7. *Expand or alter transportation facilities of statewide significance currently located on the shoreline only when demonstrated that alternatives to fill are not feasible.*

Response: Not applicable. This proposal does not include fill placed below the ordinary high water mark (OHWM).

C. Fill is restricted in wetlands or fish and wildlife habitat conservation areas in accordance with the critical areas standards in this Program, Section 6.3, and Appendix B.

Response: Not applicable. This proposal does not include or require fill n restricted wetlands or fish and wildlife habitat conservation areas.

D. Excavation of previously deposited dredge spoils above the OHWM may be permitted if the spoils site is part of a dredge materials management plan and the spoils were not originally placed as part of a beach nourishment or other shoreline restoration project.

Response: Not applicable. This proposal does not involve the excavation of previously deposited dredge spoils.

E. Excavation below the OHWM is considered dredging and is subject to provisions in Section 7.3.5, Dredging and Dredge Material Stockpiling.

Response: Not applicable. This proposal does not include excavation below the ordinary high water mark (OHWM).

7.3.2 Dredging and Dredge Material Stockpiling
[…]

Response: Not applicable. This proposal does not involve dredging or in-water disposal of material.

7.3.3 Shoreline Habitat and Ecological Enhancement Projects
[…]

Response: Not applicable.

V. CONCLUSION

This Shoreline Substantial Development Permit (SSDP) application narrative along with accompanying information has successfully met the burden of proof demonstrating compliance with the City of Castle Rock Shoreline Master Program (SMP). The Applicant respectfully requests the City's approval of the SSDP application.

Landing on the Cowlitz – Stormwater Outfall Submittal

SUMMARY NARRATIVE

11/13/2024

CT6, LLC, applicant

The applicant requests review of the proposed **Excavation & Grading Permit** and **Engineering Plan Review** for the Stormwater Outfall design of the Landing on the Cowlitz mixed-use master planned development.

Located at the southernmost end of the City of Castle Rock, the Landing on the Cowlitz property is accessed from I-5 at exit #48. The property is situated west of the BNSF line and Salmon Creek, and south of Huntington Ave. South of the property is DNR-owned property that contains a dredge spoils site. The property is currently accessed via a temporary access road from Huntington Avenue.

The Landing on the Cowlitz property is comprised of seven parcels, totaling approximately 118 acres. Those parcels are currently in the process of a Boundary Line Adjustment (CR-BLA-24-01), which includes a right of way dedication for the proposed roadway included in this design. The proposed stormwater outfall will serve as the primary stormwater outlet for the entire project. The Cowlitz River is a flow control exempt water body per the Washington State Department of Ecology, making this option an ideal choice for the development. The outfall design consists of two pipe systems to keep offsite flows and onsite runoff separate. This will ensure that the developed site does not have an adverse impact on the neighboring residential properties and visa versa.

In order to size the conveyance pipes in the two systems, an in-depth stormwater master plan was created. The logic, calculations, and intended use of the system are thoroughly described in the included Technical Information Report. The impacts of grading for the construction of the outfall system should have minimal impacts on the existing conditions of the site. While future development of the onsite parcels was factored into the calculations, no development outside of the outfall piping is being proposed with this application. The proposed Phase 1 Access & Utilities design shows the first connection to this stormwater outfall, but that project has been submitted for a separate review.

Wherever possible, this project will retain existing drainage patterns on. Drainage channels that have been created from previous onsite grading operations will continue to be used at this time and will lead to this new outfall. The construction of this stormwater outfall will have temporary and permanent impacts on buffer areas along the Cowlitz River. These impacts will require a Mitigation Plan and a Shoreline Permit, which are currently being prepared by Ecological Land Services and CT6, LLC. The engineering plans and stormwater analysis are being submitted in advance of these documents to begin the review of the engineering design, but they will be submitted to the City as soon as they are completed.

***

Docusign Envelope ID: 50973215-639F-4A40-AD55-4C1229A5BC6E

City of Castle Rock

P.O. Box 370
CASTLE ROCK, WA 98611
(360) 274-8181

SEPA ENVIRONMENTAL CHECKLIST

What is this for?

The City and other governmental agencies use this checklist to help determine whether the environmental impacts of your proposal are significant. This information will also help determine if it's possible to avoid, minimize, or compensate (mitigate) for the probable significant impacts; or whether an environmental impact statement needs to be prepared to further analyze the proposal.

***How to fill this out*:**

This environmental checklist asks you to describe some basic information about your proposal. Please answer each question accurately and carefully, to the best of your knowledge. You may need to consult with an agency specialist or private consultant for some questions. You may use "not applicable" or "does not apply" only when you can explain why it does not apply and not when the answer is unknown. You may also attach, excerpt, or refer to additional studies or reports. Complete and accurate answers to these questions often avoid delays with the SEPA process as well as later in the decisionmaking process.

The checklist questions apply to all parts of your proposal, even if you plan to do them over a period of time or on different parcels of land. Attach any additional information that will help describe your proposal or its environmental effects. The City or other agencies may ask you to explain your answers or provide additional information to determine if there may be a significant adverse impact.

If you're using this checklist for a nonproject proposal (such as an ordinance, regulations, plans, or programs), complete the applicable parts of Parts A and B plus the SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS (Part D). Please completely answer all questions that apply and note that the words "project," "applicant," and "property or site" should be read as "proposal," "proponent," and "affected geographic area," respectively. For nonproject actions, the lead agency may exclude questions in Part B that do not contribute meaningfully to the analysis of the proposal.

This form is set up as a Word table. Except for a few questions that ask for you to select options, each question is followed by a blank field in which you can type your answer. Type in the shaded box. Check boxes will fill in when you click them. Each field will expand to accommodate your text, and the overall form will expand to additional pages as you fill in answers.

A. BACKGROUND

1. Name of proposed project, if applicable:

   Landing on the Cowlitz Stormwater Outfall

2. Name of applicant:

   CT6, LLC

3. Address and phone number of applicant or contact person:

   PO Box 1419, Battle Ground, WA 98604 | Ingrid Friedberg, Special Projects Manager

4. Date checklist prepared:

   3/5/2025

5. Agency requesting checklist:

   City of Castle Rock

6. Proposed timing or schedule (including phasing, if applicable):

   It is anticipated that construction will commence upon the receipt of the necessary permits and approvals.

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? ☐ Yes ☒ No
   If yes, explain.

   Click or tap here to enter text.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.

   Specific to this stormwater outfall, the following items have been prepared:

   Preliminary Technical Information Report | MacKay Sposito | November 13, 2024 and subsequent updates
   Habitat Management and Mitigation and Monitoring Plan | Ecological Land Services, Inc. | December 4, 2024

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? ☐ Yes ☒ No
   If yes, explain.

   Click or tap here to enter text.

10. List any government approvals or permits that will be needed for your proposal, if known.

    Landing on the Cowlitz Phase 1 Access and Utilities and Stormwater Outfall Engineering Approval (CR-24-051)

    Prior to Construction:

    Shoreline Substantial Development Permit

    Critical Areas Permit

    General Construction Stormwater Permit

Docusign Envelope ID: 50973215-639F-4A40-AD55-4C1229A5BC6E

11. Give brief, complete description of your proposal, including the proposed uses and the size of the project and site. (There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers here.)

The Applicant, CT6, LLC, is requesting to construct the stormwater outfall in order to support the first phase of development within the approved Landing on the Cowlitz (LOTC) Master Plan and subsequent minor modification (Ordinance No. 2021-10 and Resolution No. 2024-03) (Master Plan).

The project includes installing a stormwater outfall within a portion of the Cowlitz River's shoreline buffer,shoreline jurisdiction, and the regulatory floodway. Stormwater will be conveyed to the outfall through two separate pipes; a 30-inch corrugated polypropylene pipe (CPP) for the offsite system and a 48-inch CPP for the onsite system. Runoff from the neighboring properties will flow through the study area via a portion of Ditch 4, before being conveyed to the outfall. The existing Ditch 4 will be separated by a berm to keep the onsite and offsite systems separated. All remaining onsite flows will be conveyed to the remainder of Ditch 4 and the outfall structure. Outfall profiles can be seen on Figures 5 and 6. The primary outfall is designated as the centralized discharge point for all stormwater within the project scope. Runoff intercepted from roadway surfaces will undergo preliminary water quality treatment through bioretention planters positioned along the roadways. For each individual phase of the LOTC Master Plan, final treatment methodologies will be specified at the development stage integrating bioretention systems and mechanical filtration via catch basins to achieve regulatory compliance. The treated stormwater will be directed into an onsite conveyance system, channeling flows towards the outfall and facilitating discharge into the shoreline buffer of the Cowlitz River. Additionally, an integrated infiltration strategy will be implemented at each capture point, optimizing upland infiltration and minimizing runoff volumes entering the conveyance system.

A single Residential Local Access roadway intersection is included in this proposal serving as the connection to the Standard Collector road included in Phase 1 of the Master Plan infrastructure.

Project impacts to critical areas are limited to the proposed outfall. The project will result in 0.002 acres of permanent shoreline buffer impacts, 0.217 acres of temporary shoreline buffer impacts, and 0.014 acres of temporary impacts to shoreline jurisdiction outside buffers. All mitigation is proposed onsite and consists of

0.268 acres of enhancement with native trees and shrubs to result in no net loss of ecological function.

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description and, if you haven't already done so with the permit application to which this checklist is related, a site plan, vicinity map, and topographic map, if reasonably available.

The site is included within the Recreation designated portion of the approved LOTC Master Plan and was recently adjusted as Boundary Line Adjustment (CR-BLA-24-01) Parcel 3 and is now designated by the County as 308110100.

B. ENVIRONMENTAL ELEMENTS

1. Earth

a. General description of the site:

☐ Flat ☐ Rolling ☐ Hilly ☒ Steep slopes ☐ Mountainous

☐ Other (specify): Insert text here.

b. What is the steepest slope on the site (approximate percent slope)?

The existing slope area is no steeper than 2:1. The proposed maximum slope area shall be limited to 3:1.

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any agricultural land of long-term commercial significance and whether the proposal results in removing any of these soils.

The existing soil type at the site includes Cowlitz extremely gravely sand, disturbed, 0 to 5 percent slopes.

d. Are there surface indications or history of unstable soils in the immediate vicinity? ☐ Yes ☒ No
If so, describe.

Insert text here.

e. Describe the purpose, type, total area, and approximate quantities and total affected area of any filling, excavation, and grading proposed. Indicate source of fill.

This proposal includes 121 cubic yards (cy) of cut and 113cy of fill, resulting in a net export of 8 cy in the regulatory floodway. The source of the fill shall be be from the onsite stockpiles consisting of dredged material from the Cowlitz River.

f. Could erosion occur as a result of clearing, construction, or use? ☒ Yes ☐ No
If so, generally describe.

As with any clearing or other types of earth-disturbing construction activity, there is potential for erosion to occur. Site-specific best management practices will be used

to mitigate erosion during the construction of the proposal. Site-specific erosion control measures will be implemented per the approved Grading Plan. Further, all sediment and erosion control design work will be completed in accordance with the requirements of the Construction Stormwater General Permit and City standards.

g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?

Approximately 0.002 acres (108 square feet) shall be covered by impervious surfaces after project construction and is associated with the stormwater outfall gabion wall. Of the total 15.37 acre-parcel, this consists of a nominal amount of additional impervious surface area.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any:

Proposed measures to reduce or control erosion, or other impacts to the earth include treating and detaining stormwater, installing silt fencing, and other standard erosion control best management practices. Stormwater and erosion control plans have been prepared by MacKay Sposito in compliance with the City's regulatory requirements and in conformance with the Washington State Department of Transportation (WSDOT) Standards.

2. Air

a. What types of emissions to the air would result from the proposal during construction, operation, and maintenance when the project is completed? If any, generally describe and give approximate quantities if known:

During Construction, Operation, and Maintenance:
Equipment and vehicles required for construction activities will generate dust and particulate emissions during the construction period.

After Project Completion:
Delivery trucks, mail delivery, solid waste, recycling vehicles and residence's automobiles will generate some particulate emissions in the long-term. Other emission sources include those typical to residential areas, e.g. small power tools including, heating, air conditioning, fireplaces, gas appliances, small gas-powered equipment used for site and landscape maintenance and emissions that are typical of a residential area are anticipated.

b. Are there any off-site sources of emissions or odor that may affect your proposal? ☐ Yes ☒ No
If so, generally describe.

Insert text here.

c. Proposed measures to reduce or control emissions or other impacts to air, if any:

If necessary, water will be utilized for dust control as needed during construction of on- and off-site improvements. Emissions control measures for vehicles and equipment are regulated under the Washington State Department of Ecology and U.S. Environmental Protection Agency. It is anticipated that all construction vehicles and equipment will be in compliance with these regulations.

3. Water

a. Surface Water

1) Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? ☒ Yes ☐ No
If yes, describe type and provide names. If applicable, state what stream or river it flows into.

The Cowlitz River, a Type S water, a shoreline of statewide significance, is located in the immediate vicnity of the site.

2) Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? ☒ Yes ☐ No
If yes, please describe, and attach available plans.

This proposal shall involve work adjacent to (within 200 feet) of the Cowlitz River.

3) Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material.

None.

4) Will the proposal require surface water withdrawals or diversions? ☐ Yes ☒ No
Give general description, purpose, and approximate quantities if known.

Insert text here.

5) Does the proposal lie within a 100-year floodplain? ☒ Yes ☐ No
If so, note location on the site plan.

6) Does the proposal involve any discharges of waste materials to surface waters? ☐ Yes ☒ No
If so, describe the type of waste and anticipated volume of discharge.

Insert text here.

b. Ground Water

1) Will groundwater be withdrawn from a well for drinking water or other purposes? ☐ Yes ☒ No
If so, give a general description of the well, proposed uses, and approximate quantities withdrawn from the well.

Insert text here.

Will water be discharged to groundwater? ☐ Yes ☒ No
Give general description, purpose, and approximate quantities if known.

Insert text here.

2) Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: domestic sewage; industrial, containing the following chemicals…; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.

Not applicable. This proposal shall not involve the discharge of wastewater into the ground.

c. Water runoff (including stormwater)

1) Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.

This proposal includes a stormwater outfall that will discharge treated stormwater from both on- and off-site areas into the riparian buffer of the Cowlitz River. The outfall and surrounding improvements have been designed to promote infiltration of treated stormwater in the buffer.

The sources of the off-site runoff shall be limited to capturing, conveing and treating runoff from Larsen Lane SW and the adjacent residential and Timberlake Church properties, which overall consist predominently of vegetated, pervious area.

The sources of the stormwater generated on-site are anticipated to be attributed to the Phase 1 roadway and the impervious surfaces associated with the future development of the residential, commercial, and industrial land use designated areas of the approved Landing on the Cowlitz Master Plan.

The Phase 1 roadway has been designed to include first line treatment consisting of bioretention treatment planters with subsequent infiltration into catchment locations or conveyance to the outfall. For the future development adjacent to the Phase 1 roadway, each site shall be required to include some form of City-approved treatment and infiltration prior to quantity controlled discharge to the outfall.

2) Could waste materials enter ground or surface waters? ☐ Yes ☒ No
If so, generally describe.

Insert text here.

3) Does the proposal alter or otherwise affect drainage patterns in the vicinity of the site?
☒ Yes ☐ No
If so, describe.

This proposal has been designed to enhance treatment and control discharge quantity of stormwater. The current drainage pattern entails drainage into a large drainage ditch that transects the site and eventually discharges to Salmon Creek and the Cowlitz River. This proposal has been designed to utilize the existing onsite ditch for

conveyance directly to the Cowlitz River buffer. A secondary option is contemplated to include retaining a portion of the existing conveyance for temporary or future overflow. Due to the hydraulic connectivity of the Salmon Creek and Cowlitz River, these proposed and potential modifications are not anticipated to result in significant or adverse impacts to the existing on-site drainage patterns.

d. Proposed measures to reduce or control surface, ground, and runoff water, and drainage pattern impacts, if any:

This proposal includes catchment points featuring infiltration to the maximum extent practiable on-site within the approved Landing on the Cowlitz Master Plan which shall result in quality and quanity control prior to discharge to the Cowlitz River.

4. Plants

a. Check the types of vegetation found on the site:

☐ alder ☐ maple ☐ aspen ☐ fir ☐ cedar ☐ pine ☒ other tree(s) (specify):

Black cottonwood, bigleaf maple

☐ shrubs ☒ grass ☐ pasture ☐ crop or grain ☐ orchards, vineyards or other permanent crops

☐ cattail ☐ buttercup ☐ bulrush ☐ skunk cabbage ☐ other wet soil plant(s) (specify): Insert text here.

☐ water lily ☐ eelgrass ☐ milfoil ☐ other water plant(s) (specify): Insert text here.

☐ other types of vegetation Insert text here.

b. What kind and amount of vegetation will be removed or altered?

All vegetation within the areas of the site proposed for development will be removed. The site is presently sparsley vegetated. Vegetation to be removed for the outfall includes mainly non-native and invasive Scot's broom. Three cottonwood trees will need to be removed to accommodate the outfall design. These trees will be mitigated onsite through the installation of native trees.

c. List threatened and endangered species known to be on or near the site.

No listed plants are known to be on or near the site.

d. List all noxious weeds and invasive species known to be on or near the site.

Class B

Scot's broom

Class C

Himalayan blackberry

Canada thistle

Reed canarygrass

5. Animals

a. Check any birds and other animals which have been observed on or near the site or are known to be on or near the site.

☒ hawk ☒ heron ☒ eagle ☒ songbirds, ☐ other bird(s) (specify): Insert text here.

☒ deer ☐ bear ☐ elk ☐ beaver ☒ other mammal(s) (specify): Small mammals

☐ bass ☒ salmon ☒ trout ☐ herring ☐ shellfish ☐ other fish (specify): Insert text here.

b. List any threatened and endangered species known to be on or near the site.

The proposed outfall is located adjacent to the Cowlitz River. The Cowlitz River provides habitat for the following federally listed species:

Columbia River Chum Salmon ESU - Threatened

Lower Columbia River Chinook ESU - Threatened

Lower Columbia River Coho Salmon ESU - Threatened

Lower Columbia River Steelhead DPS - Threatened

Eulachon (Columbia River Smelt) Southern DPS - Threatened

c. Washington as whole lies within the Pacific Flyway. Is the site part of any other migration route?
☐ Yes ☒ No
If so, explain.

No. The site is only part of the Pacific Flyway.

d. Proposed measures to preserve or enhance wildlife, if any:

Landscaping included in the final condition of the finished subdivision may provide some habitat for wildlife typical for urban environments. Enhancements to the riparian habitat onsite as mitigation for riparian habitat impacts and tree removal will provide nesting, roosting, and forage opportunities for wildlife.

e. List any invasive animal species known to be on or near the site.

None known.

6. Energy and Natural Resources

a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.

The completed project's energy needs shall be met by electric and natural gas.

b. Would your project affect the potential use of solar energy by adjacent properties?
☐ Yes ☒ No
If so, generally describe.

Insert text here.

c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:

This proposal does not include the construction of buildings. Future building applications shall be required to demonstrate compliance with the State of Washington Energy Code and the adopted version of the International Building Code.

7. Environmental Health

a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste, that could occur as a result of this proposal?
☐ Yes ☒ No
If so, describe.

Insert text here.

1) Describe any known or possible contamination at the site from present or past uses.

Unknown.

2) Describe existing hazardous chemicals/conditions that might affect project development and design. This includes underground hazardous liquid and gas transmission pipelines located within the project area and in the vicinity.

There are no known existing hazardous chemicals/conditions that might affect the project development and design. The Applicant shall be required to comply with all applicable local, state and federal regulations during the construction of this proposal.

3) Describe any toxic or hazardous chemicals that might be stored, used, or produced during the project's development or construction, or at any time during the operating life of the project.

Construction equipment will require the use of various petroleum products for fuel, hydraulics and lubrication. Spill kits will be located onsite for use in case of a spill.

4) Describe special emergency services that might be required.

Special emergency services are not anticipated for this proposal. However, State-compliant protocol shall be followed should any unforeseen complications arise with the spillage of hazardous or otherwise toxic chemicals. A spill prevention and/or response plan shall be on site at all times during construction.

5) Proposed measures to reduce or control environmental health hazards, if any:

Spill kits will be available onsite in case of any leaks from construction equipment. Other BMPs will be in place to protect critical areas in the project vicinity. Project construction will follow all conditions of permits upon receipt to help further avoid environmental health hazards.

b. Noise

1) What types of noise exist in the area which may affect your project (for example: traffic, equipment, operation, other)?

Some traffic noise from the Interstate 5 (I-5) Highway, may be heard currently at the site, but it not expectd to adversely affect the proposal as it involves the provision of critical infrastructure required to facilitate the first phase of development within the approved Landing on the Cowlitz (LOTC) Master Plan.

2) What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site.

Construction on the site will create short-term noise and shall not be allowed after 7 p.m. or before 7 a.m. Visitor, resident, mail and parcel deliveries, solid waste and recycling vehicles, and HVAC equipment will be associated on a long-term basis. Other long-term noise sources which may be created include small power tools associated with landscaping maintenance and upkeep typical to residential life.

3) Proposed measures to reduce or control noise impacts, if any:

Construction activities shall be limited between 7 a.m. and 7 p.m.

8. Land and Shoreline Use

a. What is the current use of the site and adjacent properties? Will the proposal affect current land uses on nearby or adjacent properties? ☐ Yes ☒ No
If so, describe.

The site is vacant and undeveloped. Surrounding areas include undeveloped Department of Natural Resources property, Timberlake Church, and established single-family residnetial areas.

b. Has the project site been used as working farmland or working forest land?
☐ Yes ☒ No
If so, describe.

Insert text here.

How much agricultural or forest land of long-term commercial significance will be converted to other uses as a result of the proposal, if any?

None. The site is not designated as agricultural or forest land of long-term commercial significance.

If resource lands have not been designated, how many acres in farmland or forest land tax status will be converted to nonfarm or nonforest use?

Not applicable. The site is not eligible for designation for resource lands.

1) Will the proposal affect or be affected by surrounding working farm or forest land normal business operations, such as oversize equipment access, the application of pesticides, tilling, and harvesting? ☐ Yes ☒ No

If so, how?

Insert text here.

c. Describe any structures on the site.

The site is devoid of exisitng structures.

d. Will any structures be demolished? ☐ Yes ☒ No
If so, what?

Not applicable. There are no existing structures at the site.

e. What is the current zoning classification of the site?

The site is located within the Light Industrial zoning classification. The site is also designated as part of the recreation land use designated area within the approved Landing on the Cowlitz (LOTC) Master Plan.

f. What is the current comprehensive plan designation of the site?

The current comprehensive plan designation of the site is Industrial.

g. If applicable, what is the current shoreline master program designation of the site?

Shoreline Environmental Designation (SED) is High-Intensity.

h. Has any part of the site been classified as a critical area by the city or county?
☒ Yes ☐ No
If so, specify.

A portion of the site is located within frequently flooded areas including the 100-year floodplain and the regulatory floodway of the Cowlitz River. Fish and wildlife habitat conservation areas onsite include the Cowlitz River and its associated shoreline buffer. The Cowlitz River is also a shoreline of statewide significance.

i. Approximately how many people would reside or work in the completed project?

None. This proposal involves the construction of critical infrastructure and does not include the provision of housing or workforce area.

j. Approximately how many people would the completed project displace?

None. This proposal involves the construction of a stormwater outfall within an undeveloped site devoid of residential structures.

k. Proposed measures to avoid or reduce displacement impacts, if any:

None. This proposal does not involve displacement of residential housing.

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:

This proposal is compatible with the projected land uses as it will help facilitate the first phase of the Landing on the Cowlitz Master Plan.

m. Proposed measures to reduce or control impacts to agricultural and forest lands of long-term commercial significance, if any:

None. The site is not on or near agricultural and forest lands of long-term commercial significance.

9. Housing

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.

None. This proposal does not involve the provision of residential housing.

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.

None. The site does not feature housing development.

c. Proposed measures to reduce or control housing impacts, if any:

None. This proposal will not impact housing.

10. Aesthetics

a. What is the tallest height of any proposed structure(s), not including antennas? What is the principal exterior building material(s) proposed?

This proposal involves the installation of a stormwater outfall which shall be located at or beneath grade.

b. What views in the immediate vicinity would be altered or obstructed?

No views will be altered as part of this proposal.

c. Proposed measures to reduce or control aesthetic impacts, if any:

None. This proposal shall not impact aesthetics.

11. Light and Glare

a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

None. This proposal does not include the provision of lighting fixtures.

b. Could light or glare from the finished project be a safety hazard or interfere with views?

Light or glare shall not result from the constructed stormwater outfall.

c. What existing off-site sources of light or glare may affect your proposal?

None. The nearest off-site sources of light or glare are not visible from the proposed stormwater outfall location.

d. Proposed measures to reduce or control light and glare impacts, if any:

None. This proposal does not include or require reduction or control for light or glare impacts.

12. Recreation

a. What designated and informal recreational opportunities are in the immediate vicinity?

While there are no designated or informal recreational opportunities in the near vicinity, the site itself is designated as a recreation land use area within the approved Landing on the Cowlitz (LOTC) Master Plan.

b. Would the proposed project displace any existing recreational uses? ☐ Yes ☒ No
If so, describe.

No. The site is not presently used for recreational purposes nor does it have access roadways.

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any:

None. This proposal does not include or require mitigation for recreational areas.

13. Historic and cultural preservation

a. Are there any buildings, structures, or sites, located on or near the site that are over 45 years old listed in or eligible for listing in national, state, or local preservation registers ? ☐ Yes ☒ No
If so, specifically describe.

Click or tap here to enter text.

b. Are there any landmarks, features, or other evidence of Indian or historic use or occupation? This may include human burials or old cemeteries. ☐ Yes ☒ No
Are there any material evidence, artifacts, or areas of cultural importance on or near the site?
☐ Yes ☒ No
Please list any professional studies conducted at the site to identify such resources.

Click or tap here to enter text.

c. Describe the methods used to assess the potential impacts to cultural and historic resources on or near the project site. Examples include consultation with local tribe(s) and the state Department of Archeology and Historic Preservation, archaeological surveys, historic maps, GIS data, etc.

This proposal is located within the approved Landing on the Cowlitz Master Plan and was evaluated by Archaeological Investigations Northwest, Inc. in an arcaheological survey report. Methods used to assess the potential impacts to cultural and historic resources on or near the project site included a review of historical records, recently completed surveys and a site reconaissance inspection.

d. Proposed measures to avoid, minimize, or compensate for loss, changes to, and disturbance to resources. Please include plans for the above and any permits that may be required.

This proposal does not include avoidance, minimization or compensatory measures as no cultural or historic resources were discovered at the site and none are anticipated. Archaeological Investigations Northwest, Inc. developed an inadvertent discovery plan which shall be adhered to in the unlikely event cultural or archaeological resources are

encountered during the site preparation, construction and site stabilization for the stormwater outfall.

14. Transportation

a. Identify public streets and highways serving the site or affected geographic area and describe proposed access to the existing street system. If any, show on site plan.

None. This proposal is not presently served by public street access. A temporary twenty- (20) foot-wide gravel access road shall provide access to the shoreline for construction of the outfall.

b. Is the site or affected geographic area currently served by public transit? ☐ Yes ☒ No
If so, generally describe. If not, what is the approximate distance to the nearest transit stop?

Insert text here.

c. How many additional parking spaces would the completed project or non-project proposal have? How many would the project or proposal eliminate?

None. This proposal involves the construction of a stormwater outfall and as such does not necessitate the provision of parking spaces.

d. Will the proposal require any new or improvements to existing roads, streets, pedestrian, bicycle or state transportation facilities, not including driveways? ☐ Yes ☒ No
If so, generally describe (indicate whether public or private).

Insert text here.

e. Will the project or proposal use (or occur in the immediate vicinity of) water, rail, or air transportation? ☐ Yes ☒ No
If so, generally describe.

Insert text here.

f. How many vehicle trips per day would be generated by the completed project or proposal? If known, indicate when peak volumes would occur and what percentage of the volume would be trucks (such as commercial and nonpassenger vehicles). What data or transportation models were used to make these estimates?

None. Following the completion of construction, it is anticipated that occasional maintenance will be required for the outfall. The vehicular trips associated with that shall be too infrequent to quantify and is not anticipated to adversely impact traffic in the vicinity of the site.

g. Will the proposal interfere with, affect or be affected by the movement of agricultural and forest products on roads or streets in the area? ☐ Yes ☒ No
If so, generally describe.

Insert text here.

h. Proposed measures to reduce or control transportation impacts, if any:

None. This proposal is not anticipated to result in transportation impacts.

15. Public Services

a. Would the project result in an increased need for public services (for example: fire protection, police protection, public transit, health care, schools, other)? ☐ Yes ☒ No

If so, generally describe.

Insert text here.

b. Proposed measures to reduce or control direct impacts on public services, if any.

None proposed, as the proposed outfall does not require public services and will not impact existing public services.

16. Utilities

a. Check utilities currently available at the site:

☐ electricity ☐ natural gas ☐ potable water ☐ irrigation water ☐ refuse service ☐ telephone ☐ sanitary sewer ☐ septic system ☐ other (specify):XNone available.

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity which might be needed.

None. This proposal includes the provision of stormwater utilities. The site is otherwise not served by utilities nor does this proposal necessitate the provision of additional utilities.

C. SIGNATURE

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

Signature:	Signed by: Ingrid Friedberg 8E83AE430A5A433... Manually sign above, print, & scan; or insert electronic signature here.
Name:	Ingrid Friedberg
Position:	Special Projects Manager
Agency/Organization:	CT6, LLC
Date Submitted:	March 5, 2025

Docusign Envelope ID: 50973215-639F-4A40-AD55-4C1229A5BC6E

D. SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS

(**Do NOT** use this sheet for project actions)

Because these questions are very general, it may be helpful to read them in conjunction with the list of the elements of the environment. When answering these questions, be aware of the extent the proposal, or the types of activities likely to result from the proposal, would affect the item at a greater intensity or at a faster rate than if the proposal were not implemented. Respond briefly and in general terms.

1. How would the proposal be likely to increase discharge to water; emissions to air; production, storage, or release of toxic or hazardous substances; or production of noise?

   Insert text here.

   Proposed measures to avoid or reduce such increases are:

   Insert text here.

2. How would the proposal be likely to affect plants, animals, fish, or marine life?

   Insert text here.

   Proposed measures to protect or conserve plants, animals, fish, or marine life are:

   Insert text here.

3. How would the proposal be likely to deplete energy or natural resources?

   Insert text here.

   Proposed measures to protect or conserve energy and natural resources are:

   Insert text here.

4. How would the proposal be likely to use or affect environmentally sensitive areas or areas designated (or eligible or under study) for governmental protection; such as parks, wilderness, wild and scenic rivers, threatened or endangered species' habitat, historic or cultural sites, wetlands, floodplains, or prime farmlands?

   Insert text here.

   Proposed measures to protect such resources or to avoid or reduce impacts are:

   Insert text heret.

5. How would the proposal be likely to affect land and shoreline use, including whether it would allow or encourage land or shoreline uses incompatible with existing plans?

   Insert text here.

   Proposed measures to avoid or reduce shoreline and land use impacts are:

   Insert text here.

6. How would the proposal be likely to increase demands on transportation or public services and utilities?

   Insert text here.

   Proposed measures to reduce or respond to such demand(s) are:

   Insert text here.

7. Identify, if possible, whether the proposal may conflict with local, state, or federal laws or requirements for the protection of the environment.

   Insert text here.

LANDING ON THE COWLITZ
STORMWATER OUTFALL

NW QTR, SECTION 14
TOWNSHIP T9N, RANGE R2W W.M.

VICINITY MAP
N.T.S.

PROJECT PARCEL # 6143802
 # CR-BLA-24-01, PARCEL 3

OWNER
CT6, LLC
SHANE TAPANI
PO BOX 1419
BATTLE GROUND ,WA 98604
PHONE: 360-687-1148

DEVELOPER
TAPANI, INC.
1705 SE 9TH AVE
BATTLE GROUND, WA 98604
JEROME SARKINEN
PHONE: 360-907-7615

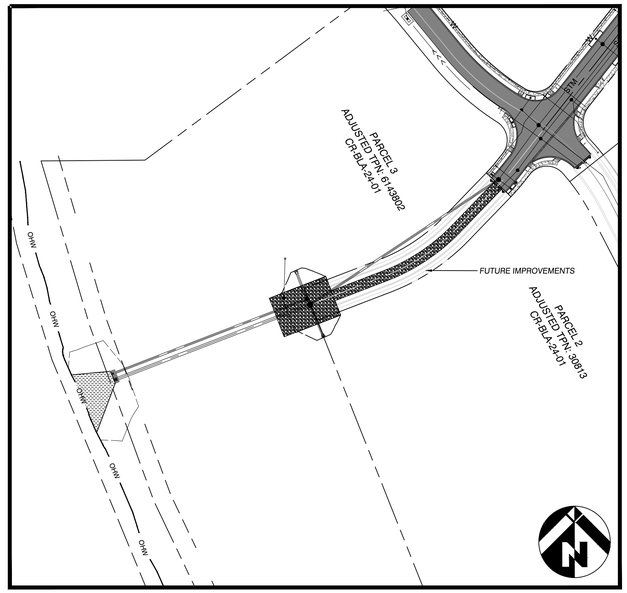
PROJECT ENGINEER
MacKay Sposito
18405 SE MILL PLAIN BLVD, SUITE 100
VANCOUVER, WA 98683
C (714)732-8563
O (360)823-1244
www.mackaysposito.com
ENGINEER: TAYLOR WILSON, PE
TWILSON@MACKAYSPOSITO.COM

VERTICAL DATUM

THE ELEVATIONS SHOWN ON THIS MAP ARE BASED ON AN OPUS SOLUTION AT CP 1 WITH A DERIVED NAVD88 ORTHOMETRIC ELEVATION OF 46.26 FEET.

HORIZONTAL DATUM

WASHINGTON STATE PLANE COORDINATE SYSTEM, SOUTH ZONE (4602), NAD83(2011)(EPOCH: 2010.0000), US SURVEY FOOT. DISTANCES SHOWN HEREON ARE GROUND DISTANCES. TO CONVERT TO GRID MULTIPLY BY THE COMBINED SCALE FACTOR OF 0.9999321353 ABOUT CP1



SITE MAP
1" = 100'

LEGEND

PERIMETER OF SITE	
RIGHT-OF-WAY LINE	
CENTERLINE OF ROAD	
FACE OF CURB	
LOT LINE	
EASEMENT LINE	
STM — STORM SEWER LINE	
STM — EXIST STORM SEWER	
SAN — SANITARY SEWER LINE	
SAN — EXIST SANITARY SEWER	
W — WATER SERVICE LINE	
W — EXIST WATER LINE	
123 — GRADED CONTOUR LINE	
123 — EXIST CONTOUR LINE	
MANHOLE	WATER SERVICE METER
WATER VALVE AND BOX	TELEPHONE RISER
FIRE HYDRANT ASSEMBLY	GAS RISER
CLEAN OUT	ELECTRIC RISER
CATCH BASIN	UTILITY POLE
THRUST BLOCK	UTILITY POLE W/ LIGHT
	SIGN POST

Sheet List Table

Sheet Title	Sheet Number
COVER SHEET	C1.0
NOTES	C1.1
EXISTING CONDITIONS	C2.0
EXISTING CONDITIONS	C2.1
GRADING AND EROSION CONTROL PLAN	C3.0
STORMWATER LAYOUT PLAN	C4.0
48-INCH STORMWATER OUTFALL PROFILE	C5.0
30-INCH STORMWATER OUTFALL PROFILE	C5.1
OUTFALL ENLARGEMENT	C6.0
DETAILS	C7.0
DETAILS	C7.1
DETAILS	C7.2

811 Know what's below. Call before you dig.

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

TAYLOR ANDREW WILSON
STATE OF WASHINGTON
22012357
REGISTERED PROFESSIONAL ENGINEER

2/12/2025

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

COVER SHEET
STORMWATER OUTFALL

REVISIONS:

JOB NO.:	18591
DATE:	2/12/2025
SCALE: H: N/A	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

FINAL

C1.0

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 - Outfall\C1.0 COVER.dwg PLOTSTYLE: Cover.stb

GENERAL NOTES:

1. ALL WORK SHALL FOLLOW THE CITY OF CASTLE ROCK DEVELOPMENT POLICIES AND PUBLIC WORKS STANDARDS, AND CONDUCTED USING CURRENT WISHA/OSHA REGULATIONS.
2. ALL WORK WITHIN THE CITY ROW SHALL COMPLY WITH CITY REQUIREMENTS AS OUTLINED IN THE CITY OF CASTLE ROCK ENGINEERING STANDARDS, DEVELOPMENT POLICIES AND PUBLIC WORKS STANDARDS.THE PUBLIC WORKS DIRECTORS OFFICE MUST BE CONTACTED 24 HOURS BEFORE BACKFILLING TRENCHES OR REPAIRING PAVEMENT AT 360-274-7478.
3. TRENCH BACKFILL AND PAVEMENT RESTORATION SHALL BE PER CHAPTER 4, SECTION 4.17 TABLE 4.3

GENERAL STORMWATER NOTES:

1. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH CITY STANDARDS AND THE MOST CURRENT COPY OF THE STATE OF WASHINGTON STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND MUNICIPAL CONSTRUCTION (WSDOT).
2. TEMPORARY EROSION/WATER POLLUTION MEASURES SHALL BE REQUIRED IN ACCORDANCE WITH SECTION 1-07.15 OF THE STANDARD SPECIFICATIONS. JULY 2020 STORM DRAINAGE STANDARDS 5-3
3. CONTRACTOR SHALL BE RESPONSIBLE FOR COMPLYING WITH ALL OTHER PERMITS AND OTHER REQUIREMENTS BY THE CITY OR OTHER GOVERNING AUTHORITY OR AGENCY AS MAY BE APPLICABLE.
4. A PRECONSTRUCTION MEETING SHALL BE HELD WITH THE CITY PRIOR TO THE START OF CONSTRUCTION.
5. ALL STORM MAINS AND RETENTION/DETENTION AREAS SHALL BE STAKED FOR GRADE AND ALIGNMENT BY AN ENGINEERING OR SURVEYING FIRM CAPABLE OF PERFORMING SUCH WORK, AND CURRENTLY LICENSED IN THE STATE OF WASHINGTON TO DO SO.
6. CONTRACTOR SHALL PROVIDE TRAFFIC CONTROL PLAN(S) AS REQUIRED IN ACCORDANCE WITH MUTCD.
7. CALL UNDERGROUND LOCATE LINE AT 811 A MINIMUM OF 72 HOURS PRIOR TO ANY EXCAVATIONS.
8. WHERE CONNECTIONS REQUIRE "FIELD VERIFICATIONS," CONNECTION POINTS WILL BE EXPOSED BY CONTRACTOR AND FITTINGS VERIFIED 48 HOURS PRIOR TO DISTRIBUTING SHUT-DOWN NOTICES.
9. PROPOSED CPP STORM DRAIN PIPE SHALL CONFORM WITH WSDOT STANDARDS FOR CORRUGATED POLYETHYLENE PIPE (PER CITY OF CASTLE ROCK ENGINEERING STANDARDS).

EROSION CONTROL NOTES:

1. THE CONTRACTOR SHALL ENSURE THAT ALL EROSION CONTROL MEASURES ARE INTACT AND IN WORKING CONDITION PRIOR TO COMMENCEMENT OF DRAINAGE FACILITY CONSTRUCTION.
2. A HIGH-VISIBILITY FENCE SHALL BE INSTALLED AND COMPOSED OF A HIGH-DENSITY POLYETHYLENE MATERIAL AND SHALL BE AT LEAST FOUR FEET IN HEIGHT. POSTS FOR THE FENCING SHALL BE STEEL OR WOOD AND PLACED EVERY 6 FEET ON CENTER (MAXIMUM) OR AS NEEDED TO ENSURE RIGIDITY. THE FENCING SHALL BE FASTENED TO THE POST EVERY SIX INCHES WITH A POLYETHYLENE TIE. ON LONG CONTINUOUS LENGTHS OF FENCING, A TENSION WIRE OR ROPE SHALL BE USED AS A TOP STRINGER TO PREVENT SAGGING BETWEEN POSTS. THE FENCE COLOR SHALL BE HIGH-VISIBILITY ORANGE. THE FENCE TENSILE STRENGTH SHALL BE 360 LBS/FT USING THE ASTM D4595 TESTING METHOD. IF APPROPRIATE INSTALL FABRIC SILT FENCE IN ACCORDANCE WITH BMP C233: SILT FENCE TO ACT AS HIGH-VISIBILITY FENCE. SILT FENCE SHALL BE AT LEAST 3 FEET HIGH AND MUST BE HIGHLY VISIBLE TO MEET THE REQUIREMENTS OF THIS BMP. METAL FENCES SHALL BE DESIGNED AND INSTALLED ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS. METAL FENCES SHALL BE AT LEAST 3 FEET HIGH AND MUST BE HIGHLY VISIBLE. FENCES SHALL NOT BE WIRED OR STAPLED TO TREES. IF THE FENCE HAS BEEN DAMAGED OR VISIBILITY REDUCED, IT SHALL BE REPAIRED OR REPLACED IMMEDIATELY AND VISIBILITY RESTORED.
3. APPROVAL OF THIS EROSION/SEDIMENTATION CONTROL (ESC) PLAN DOES NOT CONSTITUTE AN APPROVAL OF PERMANENT ROAD OR DRAINAGE DESIGN (E.G. SIZE AND LOCATION OF ROADS, PIPES, RESTRICTORS, CHANNELS, RETENTION FACILITIES, UTILITIES).
4. THE IMPLEMENTATION OF THIS ESC PLAN AND THE CONSTRUCTION, MAINTENANCE, REPLACEMENT, AND UPGRADING OF THESE ESC BMPS IS THE RESPONSIBILITY OF THE APPLICANT UNTIL ALL CONSTRUCTION IS COMPLETED AND APPROVED AND VEGETATION/LANDSCAPING IS ESTABLISHED.
5. CLEARLY FLAG THE BOUNDARIES OF THE CLEARING LIMITS SHOWN ON THIS PLAN IN THE FIELD PRIOR TO CONSTRUCTION. DURING THE CONSTRUCTION PERIOD, NO DISTURBANCE BEYOND THE FLAGGED CLEARING LIMITS SHALL BE PERMITTED. THE FLAGGING SHALL BE MAINTAINED BY THE APPLICANT FOR THE DURATION OF CONSTRUCTION.
6. CONSTRUCT THE ESC BMPS SHOWN ON THIS PLAN IN CONJUNCTION WITH ALL CLEARING AND GRADING ACTIVITIES, AND IN SUCH A MANNER AS TO ENSURE THAT SEDIMENT AND SEDIMENT LADEN WATER DO NOT ENTER THE DRAIN-AGE SYSTEM, ROADWAYS, OR VIOLATE APPLICABLE WATER STANDARDS.
7. THE ESC BMPS SHOWN ON THIS PLAN ARE THE MINIMUM REQUIREMENTS FOR ANTICIPATED SITE CONDITIONS. DURING THE CONSTRUCTION PERIOD, UPGRADE THESE ESC BMPS AS NEEDED FOR UNEXPECTED STORM EVENTS AND TO ENSURE THAT SEDIMENT AND SEDIMENT-LADEN WATER DO NOT LEAVE THE SITE.
8. THE APPLICANT SHALL INSPECT THE ESC BMPS DAILY AND MAINTAIN THEM AS NECESSARY TO ENSURE THEIR CONTINUED FUNCTIONING. INSPECT AND MAINTAIN THE ESC BMPS ON INACTIVE SITES A MINIMUM OF ONCE A MONTH OR WITHIN THE 48 HOURS FOLLOWING A MAJOR STORM EVENT (I.E. A 24-HOUR STORM EVENT WITH A 10-YR OR GREATER RECURRENCE INTERVAL).
9. AT NO TIME SHALL THE SEDIMENT EXCEED 60-PERCENT OF THE SUMP DEPTH OR HAVE LESS THAN 6-INCHES OF CLEARANCE FROM THE SEDIMENT SURFACE TO THE INVERT OF THE LOWEST PIPE. ALL CATCH BASINS AND CONVEYANCE LINES SHALL BE CLEANED PRIOR TO PAVING. THE CLEANING OPERATION SHALL NOT FLUSH SEDIMENT LADEN WATER INTO THE DOWNSTREAM SYSTEM.
10. INSTALL STABILIZED CONSTRUCTION ENTRANCES AT THE BEGINNING OF CONSTRUCTION AND MAINTAINED FOR THE DURATION OF THE PROJECT. ADDITIONAL MEASURES MAY BE REQUIRED TO ENSURE THAT ALL PAVED AREAS ARE KEPT CLEAN FOR THE DURATION OF THE PROJECT.

CHECKMATE ULTRAFLEX SLIP-IN INLINE CHECK VALVES
SPECIFICATION TT-CMUF-SL

PART 1: GENERAL

1.01 SUBMITTALS

A. SUBMIT PRODUCT LITERATURE THAT INCLUDES INFORMATION ON THE PERFORMANCE AND OPERATION OF THE VALVE, MATERIALS OF CONSTRUCTION, DIMENSIONS AND WEIGHTS, ELASTOMER CHARACTERISTICS, HEADLOSS, FLOW DATA AND PRESSURE RATINGS.

B. UPON REQUEST, PROVIDE SHOP DRAWINGS THAT CLEARLY IDENTIFY THE VALVE MATERIALS OF CONSTRUCTION AND DIMENSIONS.

1.02 QUALITY ASSURANCE

A. SUPPLIER SHALL HAVE AT LEAST TWELVE (12) YEARS EXPERIENCE IN THE DESIGN AND MANUFACTURE OF "CHECKMATE™" STYLE ELASTOMERIC CHECK VALVES.

B. MANUFACTURER SHALL HAVE DESIGNED, FABRICATED AND HAVE AT LEAST FIVE (5) CURRENT INSTALLATION OF A "CHECKMATE" STYLE ELASTOMERIC CHECK VALVES IN THE 72" (1800MM) SIZE. MANUFACTURER MUST PROVIDE DOCUMENTATION, INCLUDING PROJECT NAME, LOCATION, AND REFERENCES.

C. MANUFACTURER SHALL HAVE CONDUCTED INDEPENDENT HYDRAULIC TESTING TO DETERMINE HEADLOSS, JET VELOCITY AND VERTICAL OPENING HEIGHT CHARACTERISTICS ON A MINIMUM OF THREE (3) SIZES OF CHECKMATE VALVES RANGING FROM 6" (150MM) THROUGH 24" (600MM). THE TESTING MUST HAVE BEEN CONDUCTED FOR FREE DISCHARGE (PRESSURIZED AND OPEN CHANNEL FLOW DISCHARGING TO ATMOSPHERE) AND SUBMERGED CONDITIONS.

PART 2: PRODUCTS

2.01 CHECKMATE ULTRAFLEX ELASTOMERIC CHECK VALVES

A. CHECK VALVES ARE TO BE ALL RUBBER AND THE FLOW OPERATED CHECK TYPE WITH SLIP-IN CUFF CONNECTION. THE ENTIRE CHECKMATE ULTRAFLEX VALVE SHALL BE PLY REINFORCED THROUGHOUT THE BODY, SADDLE AND BILL, WHICH IS CURED AND VULCANIZED INTO A ONE-PIECE UNIBODY CONSTRUCTION. A SEPARATE VALVE BODY OR PIPE USED AS THE HOUSING IS NOT ACCEPTABLE. THE VALVE SHALL BE MANUFACTURED WITH NO METAL, MECHANICAL HINGES OR FASTENERS, WHICH WOULD BE USED TO SECURE ANY COMPONENT OF THE VALVE TO A VALVE HOUSING. THE PORT AREA OF THE SADDLE SHALL CONTOUR INTO A CIRCUMFERENTIAL SEALING AREA (THE "BILL") THAT IS CONCENTRIC WITH THE PIPE WHICH SHALL ALLOW PASSAGE OF FLOW IN ONE DIRECTION WHILE PREVENTING REVERSE FLOW. THE ENTIRE VALVE SHALL FIT WITHIN THE PIPE INSIDE DIAMETER. THE SADDLE AREA OF THE VALVE MUST BE FLAT, NOT CONICAL, AND INTEGRAL WITH THE RUBBER BODY ABOVE CENTERLINE IN ORDER TO NOT PRODUCE ANY AREAS OR VOIDS THAT CAN COLLECT OR TRAP DEBRIS. THE VALVE MUST BE EASILY INSTALLED IN PIPES WITH POOR END CONDITION WITHOUT THE NEED TO MODIFY OR UTILIZE THE HEADWALL OR STRUCTURE TO SEAL AND ANCHOR THE VALVE. ONCE INSTALLED, THE CHECKMATE ULTRAFLEX VALVE SHALL NOT PROTRUDE BEYOND THE FACE OF THE STRUCTURE OR END OF THE PIPE.

B. THE CHECKMATE ULTRAFLEX VALVE SHALL INCORPORATE MULTIPLE CONCAVE GROOVES MOLDED INTEGRALLY INTO THE FLAT SADDLE WALL THICKNESS EXTENDING LONGITUDINALLY A MINIMUM OF 80% OF THE LENGTH OF THE SADDLE TO REDUCE OPENING RESISTANCE AND REDUCE HEADLOSS.

C. THE CHECKMATE ULTRAFLEX VALVE SHALL INCORPORATE A CUSTOM SHAPED NOTCH IN THE END OF THE BILL TO REDUCE CRACKING PRESSURE. THE NOTCH SHALL BE AT THE INVERT/BOTTOM OF THE BILL AND SYMMETRICAL ABOUT THE VALVE CENTERLINE. THE LONGITUDINAL LENGTH OF THE NOTCH SHALL BE NO GREATER THAN HALF THE LENGTH OF THE BILL.

D. THE OUTSIDE DIAMETER OF THE UPSTREAM AND DOWNSTREAM SECTIONS OF THE VALVE MUST BE CIRCUMFERENTIALLY IN CONTACT WITH THE INSIDE DIAMETER OF THE PIPE.

E. SLIP-IN STYLE CHECKMATE ULTRAFLEX VALVES WILL BE FURNISHED WITH A SET OF STAINLESS STEEL EXPANSION CLAMPS. THE CLAMPS, WHICH WILL SECURE THE VALVE IN PLACE, SHALL BE INSTALLED IN THE UPSTREAM OR DOWNSTREAM CUFF OF THE VALVE, DEPENDING ON INSTALLATION ORIENTATION, AND SHALL EXPAND OUTWARDS BY MEANS OF A TURNBUCKLE. EACH BAND SHALL BE PRE-DRILLED ALLOWING FOR THE VALVE TO BE PINNED AND SECURED INTO POSITION IN ACCORDANCE WITH THE MANUFACTURER'S INSTALLATION INSTRUCTIONS.

F. MANUFACTURER MUST HAVE FLOW TEST DATA FROM AN ACCREDITED HYDRAULICS LABORATORY TO CONFIRM PRESSURE DROP AND HYDRAULIC DATA.

E. COMPANY NAME, PLANT LOCATION, VALVE SIZE PATENT NUMBER, AND SERIAL NUMBER SHALL BE BONDED TO THE CHECK VALVE.

2.02 FUNCTION

A. WHEN LINE PRESSURE EXCEEDS THE BACKPRESSURE, THE LINE PRESSURE FORCES THE BILL AND SADDLE OF THE VALVE OPEN, ALLOWING FLOW TO PASS. WHEN THE BACKPRESSURE EXCEEDS THE LINE PRESSURE, OR IN THE ABSENCE OF ANY UPSTREAM OR DOWNSTREAM PRESSURE, THE BILL AND SADDLE OF THE VALVE IS FORCED CLOSED, PREVENTING BACKFLOW.

2.03 MANUFACTURER

A. ALL VALVES SHALL BE SERIES CMUF-SL SLIP-IN CHECKMATE ULTRAFLEX VALVES AS MANUFACTURED BY TIDEFLEX TECHNOLOGIES, A DIVISION OF RED VALVE COMPANY, CARNEGIE, PA 15106. ALL VALVES SHALL BE MANUFACTURED IN THE U.S.A.

PART 3: EXECUTION

3.01 INSTALLATION

A. VALVE SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S WRITTEN INSTALLATION AND OPERATION MANUAL AND APPROVED SUBMITTALS.

3.02 MANUFACTURER'S CUSTOMER SERVICE

A. MANUFACTURER'S AUTHORIZED REPRESENTATIVE SHALL BE AVAILABLE FOR CUSTOMER SERVICE DURING INSTALLATION AND START-UP, AND TO TRAIN PERSONNEL IN THE OPERATION, MAINTENANCE AND TROUBLESHOOTING OF THE VALVE.

B. IF SPECIFIED, THE MANUFACTURER SHALL ALSO MAKE CUSTOMER SERVICE AVAILABLE DIRECTLY FROM THE FACTORY IN ADDITION TO AUTHORIZED REPRESENTATIVES FOR ASSISTANCE DURING INSTALLATION AND START-UP, AND TO TRAIN PERSONNEL IN THE PERATION, MAINTENANCE AND TROUBLESHOOTING OF THE VALVE.

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 - Outfall\C1.1 NOTES.dwg PLOTSTYLE: Detail Sheets.stb

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

2/12/2025

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

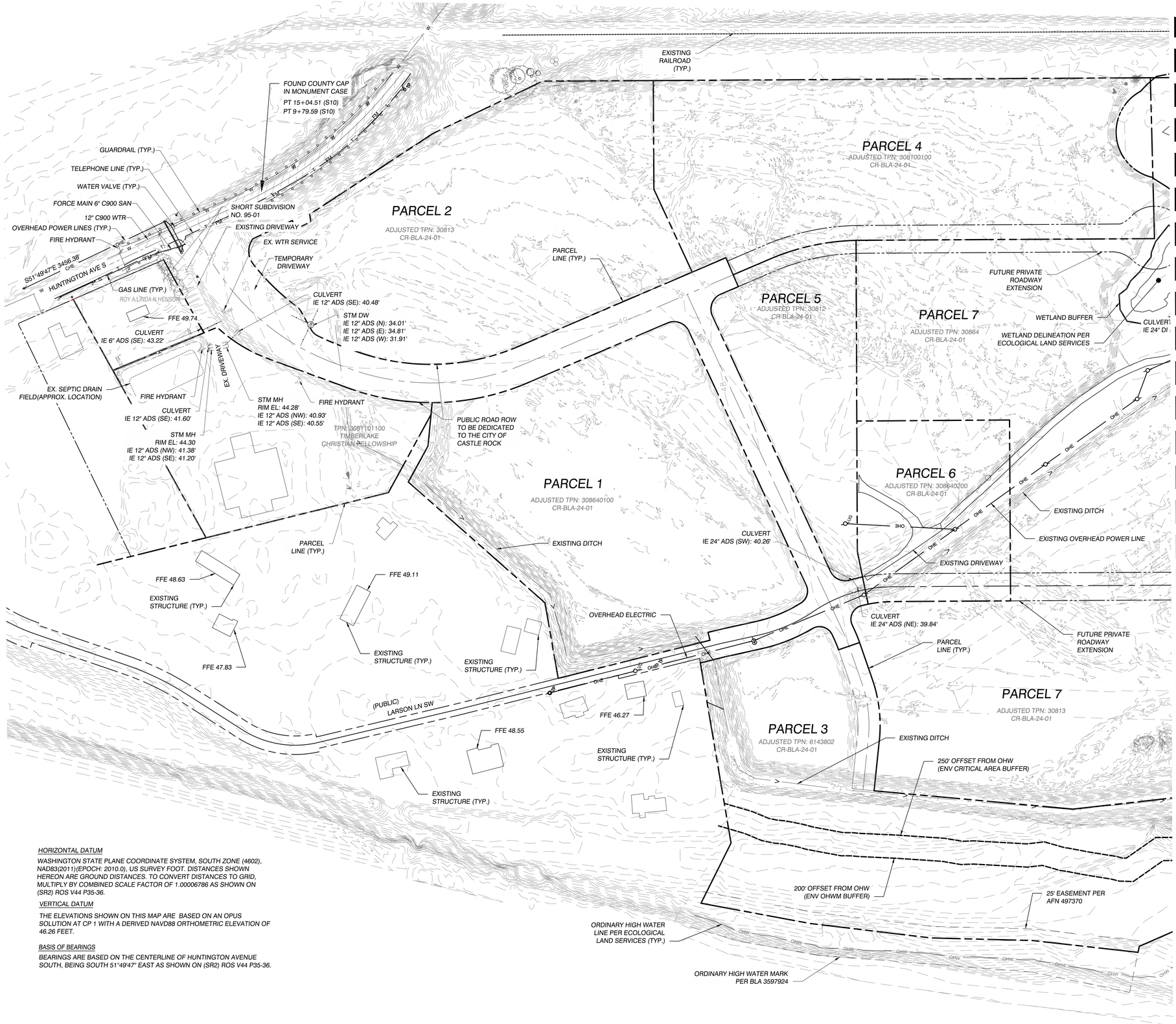
NOTES
STORMWATER OUTFALL

REVISIONS:

JOB NO.:	18591
DATE:	2/12/2025
SCALE: H: N/A	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

FINAL

C1.1



HORIZONTAL DATUM

WASHINGTON STATE PLANE COORDINATE SYSTEM, SOUTH ZONE (4602), NAD83(2011)(EPOCH: 2010.0), US SURVEY FOOT. DISTANCES SHOWN HEREON ARE GROUND DISTANCES. TO CONVERT DISTANCES TO GRID, MULTIPLY BY COMBINED SCALE FACTOR OF 1.00006786 AS SHOWN ON (SR2) ROS V44 P35-36.

VERTICAL DATUM

THE ELEVATIONS SHOWN ON THIS MAP ARE BASED ON AN OPUS SOLUTION AT CP 1 WITH A DERIVED NAVD88 ORTHOMETRIC ELEVATION OF 46.26 FEET.

BASIS OF BEARINGS

BEARINGS ARE BASED ON THE CENTERLINE OF HUNTINGTON AVENUE SOUTH, BEING SOUTH 51°49'47" EAST AS SHOWN ON (SR2) ROS V44 P35-36.

SURVEY NOTES:

1. THE BOUNDARY AND THE SUBSEQUENT MATHEMATICAL SOLUTIONS USED IN THE ADJUSTED LEGAL DESCRIPTIONS HEREON ARE BASED ON BOUNDARY LINE ADJUSTMENT SURVEY RECORDED UNDER AUDITOR'S FILE NUMBER 3597924 IN CONJUNCTION WITH RECORD OF SURVEY BY MACKAY SPOSITIO, RECORDED UNDER AUDITOR'S FILE NUMBER 3732400.
2. EXISTING CONTOURS SHOWN ARE BASED ON FINAL PROPOSED CONDITIONS OF REVISED MASS GRADING PLANS. MASS GRADING WORK SHALL BE COMPLETED PRIOR TO CONSTRUCTION KICKOFF OF ROADWAY.

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

2/12/2025

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

EXISTING CONDITIONS STORMWATER OUTFALL

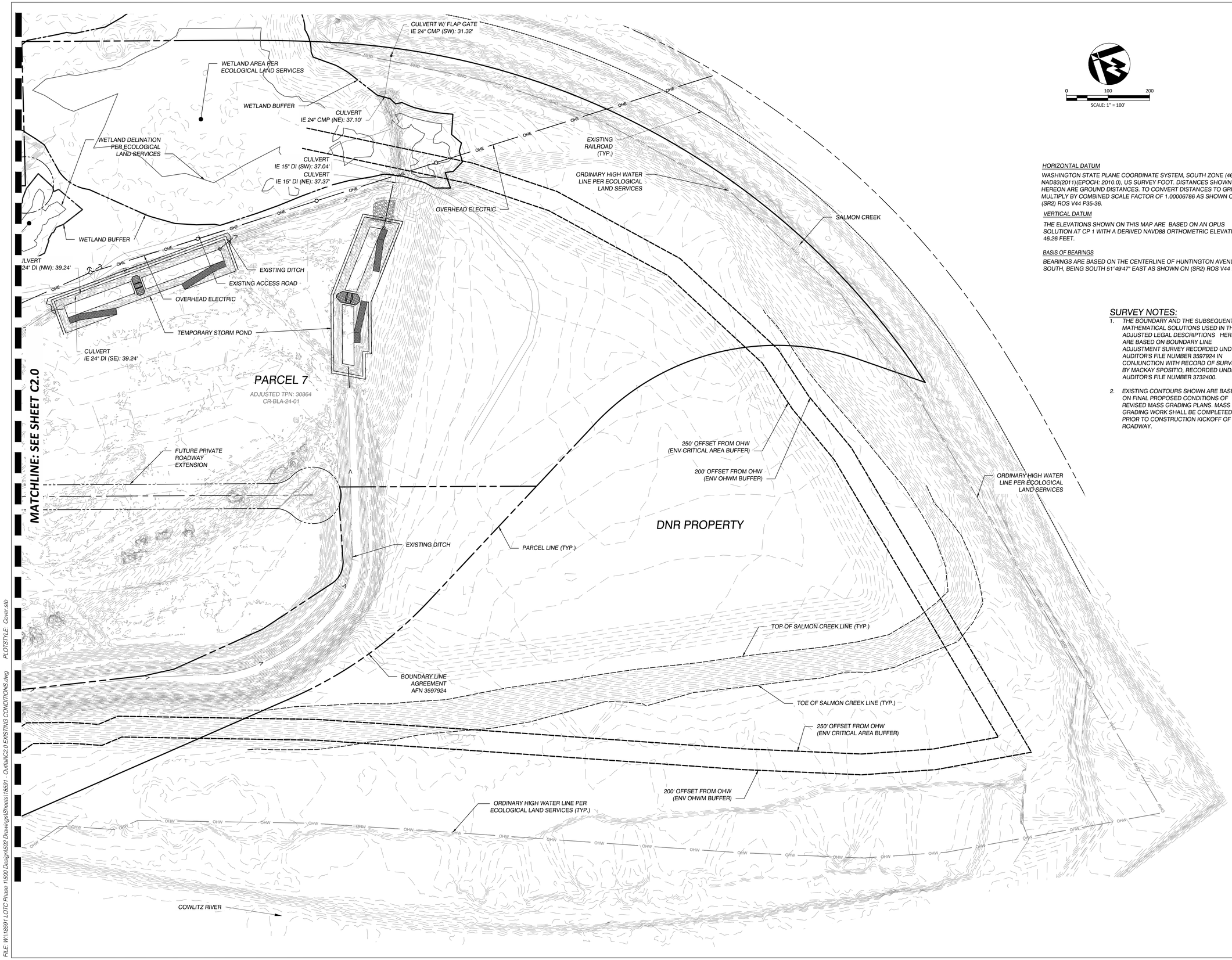
REVISIONS:

JOB NO.:	18591
DATE:	2/12/2025
SCALE: H: 1"= 100'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

FINAL

C2.0

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 - Outfall\C2.0 EXISTING CONDITIONS.dwg PLOTSTYLE: Cover.stb



0 100 200

SCALE: 1" = 100'

HORIZONTAL DATUM

WASHINGTON STATE PLANE COORDINATE SYSTEM, SOUTH ZONE (4602), NAD83(2011)(EPOCH: 2010.0), US SURVEY FOOT. DISTANCES SHOWN HEREON ARE GROUND DISTANCES. TO CONVERT DISTANCES TO GRID, MULTIPLY BY COMBINED SCALE FACTOR OF 1.00006786 AS SHOWN ON (SR2) ROS V44 P35-36.

VERTICAL DATUM

THE ELEVATIONS SHOWN ON THIS MAP ARE BASED ON AN OPUS SOLUTION AT CP 1 WITH A DERIVED NAVD88 ORTHOMETRIC ELEVATION OF 46.26 FEET.

BASIS OF BEARINGS

BEARINGS ARE BASED ON THE CENTERLINE OF HUNTINGTON AVENUE SOUTH, BEING SOUTH 51°49'47" EAST AS SHOWN ON (SR2) ROS V44 P35-36.

SURVEY NOTES:

1. *THE BOUNDARY AND THE SUBSEQUENT MATHEMATICAL SOLUTIONS USED IN THE ADJUSTED LEGAL DESCRIPTIONS HEREON ARE BASED ON BOUNDARY LINE ADJUSTMENT SURVEY RECORDED UNDER AUDITOR'S FILE NUMBER 3597924 IN CONJUNCTION WITH RECORD OF SURVEY BY MACKAY SPOSITO, RECORDED UNDER AUDITOR'S FILE NUMBER 3732400.*
2. *EXISTING CONTOURS SHOWN ARE BASED ON FINAL PROPOSED CONDITIONS OF REVISED MASS GRADING PLANS. MASS GRADING WORK SHALL BE COMPLETED PRIOR TO CONSTRUCTION KICKOFF OF ROADWAY.*

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

ANDREW T. WILLIAMS
STATE OF WASHINGTON
22012357
REGISTERED
PROFESSIONAL ENGINEER

2/12/2025

`LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

EXISTING CONDITIONS
STORMWATER OUTFALL

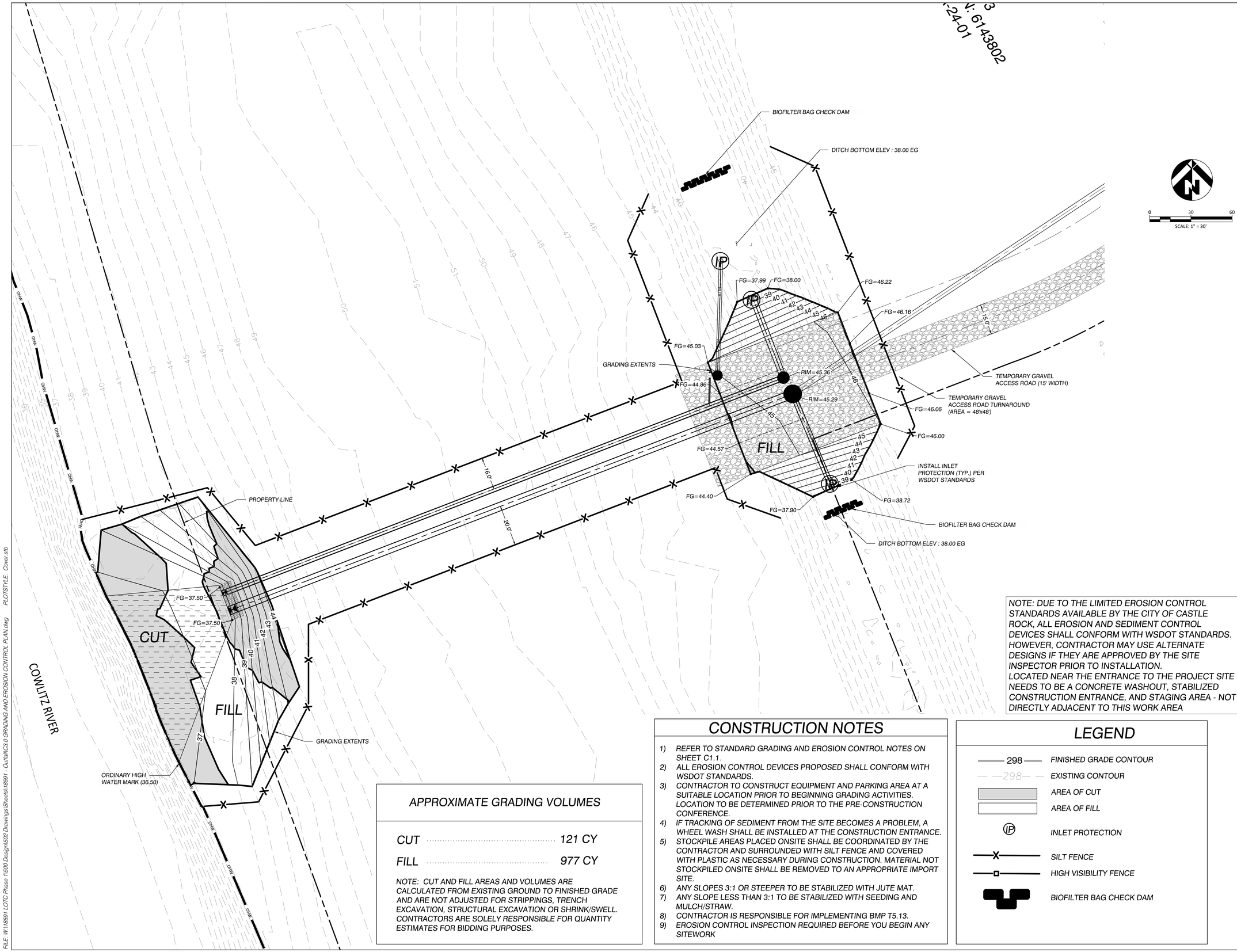
REVISIONS:

JOB NO.:	18591
DATE:	2/12/2025
SCALE: H: 1"= 100'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

FINAL

C2.1

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 - Outfall\C2.0 EXISTING CONDITIONS.dwg PLOTSTYLE: Cover.stb



NOTE: DUE TO THE LIMITED EROSION CONTROL STANDARDS AVAILABLE BY THE CITY OF CASTLE ROCK, ALL EROSION AND SEDIMENT CONTROL DEVICES SHALL CONFORM WITH WSDOT STANDARDS. HOWEVER, CONTRACTOR MAY USE ALTERNATE DESIGNS IF THEY ARE APPROVED BY THE SITE INSPECTOR PRIOR TO INSTALLATION.
LOCATED NEAR THE ENTRANCE TO THE PROJECT SITE NEEDS TO BE A CONCRETE WASHOUT, STABILIZED CONSTRUCTION ENTRANCE, AND STAGING AREA - NOT DIRECTLY ADJACENT TO THIS WORK AREA

APPROXIMATE GRADING VOLUMES

CUT	121 CY
FILL	977 CY

NOTE: CUT AND FILL AREAS AND VOLUMES ARE CALCULATED FROM EXISTING GROUND TO FINISHED GRADE AND ARE NOT ADJUSTED FOR STRIPPINGS, TRENCH EXCAVATION, STRUCTURAL EXCAVATION OR SHRINK/SWELL. CONTRACTORS ARE SOLELY RESPONSIBLE FOR QUANTITY ESTIMATES FOR BIDDING PURPOSES.

CONSTRUCTION NOTES

1) REFER TO STANDARD GRADING AND EROSION CONTROL NOTES ON SHEET C1.1.
2) ALL EROSION CONTROL DEVICES PROPOSED SHALL CONFORM WITH WSDOT STANDARDS.
3) CONTRACTOR TO CONSTRUCT EQUIPMENT AND PARKING AREA AT A SUITABLE LOCATION PRIOR TO BEGINNING GRADING ACTIVITIES. LOCATION TO BE DETERMINED PRIOR TO THE PRE-CONSTRUCTION CONFERENCE.
4) IF TRACKING OF SEDIMENT FROM THE SITE BECOMES A PROBLEM, A WHEEL WASH SHALL BE INSTALLED AT THE CONSTRUCTION ENTRANCE.
5) STOCKPILE AREAS PLACED ONSITE SHALL BE COORDINATED BY THE CONTRACTOR AND SURROUNDED WITH SILT FENCE AND COVERED WITH PLASTIC AS NECESSARY DURING CONSTRUCTION. MATERIAL NOT STOCKPILED ONSITE SHALL BE REMOVED TO AN APPROPRIATE IMPORT SITE.
6) ANY SLOPES 3:1 OR STEEPER TO BE STABILIZED WITH JUTE MAT.
7) ANY SLOPE LESS THAN 3:1 TO BE STABILIZED WITH SEEDING AND MULCH/STRAW.
8) CONTRACTOR IS RESPONSIBLE FOR IMPLEMENTING BMP T5.13.
9) EROSION CONTROL INSPECTION REQUIRED BEFORE YOU BEGIN ANY SITEWORK

LEGEND

- 298 — FINISHED GRADE CONTOUR
- 298 — EXISTING CONTOUR
- AREA OF CUT
- AREA OF FILL
- IP — INLET PROTECTION
- SILT FENCE
- HIGH VISIBILITY FENCE
- BIOFILTER BAG CHECK DAM

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

TYLER ANDREW WILLIAMS
STATE OF WASHINGTON
22012357
REGISTERED PROFESSIONAL ENGINEER

2/12/2025

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

GRADING AND EROSION CONTROL PLAN
STORMWATER OUTFALL

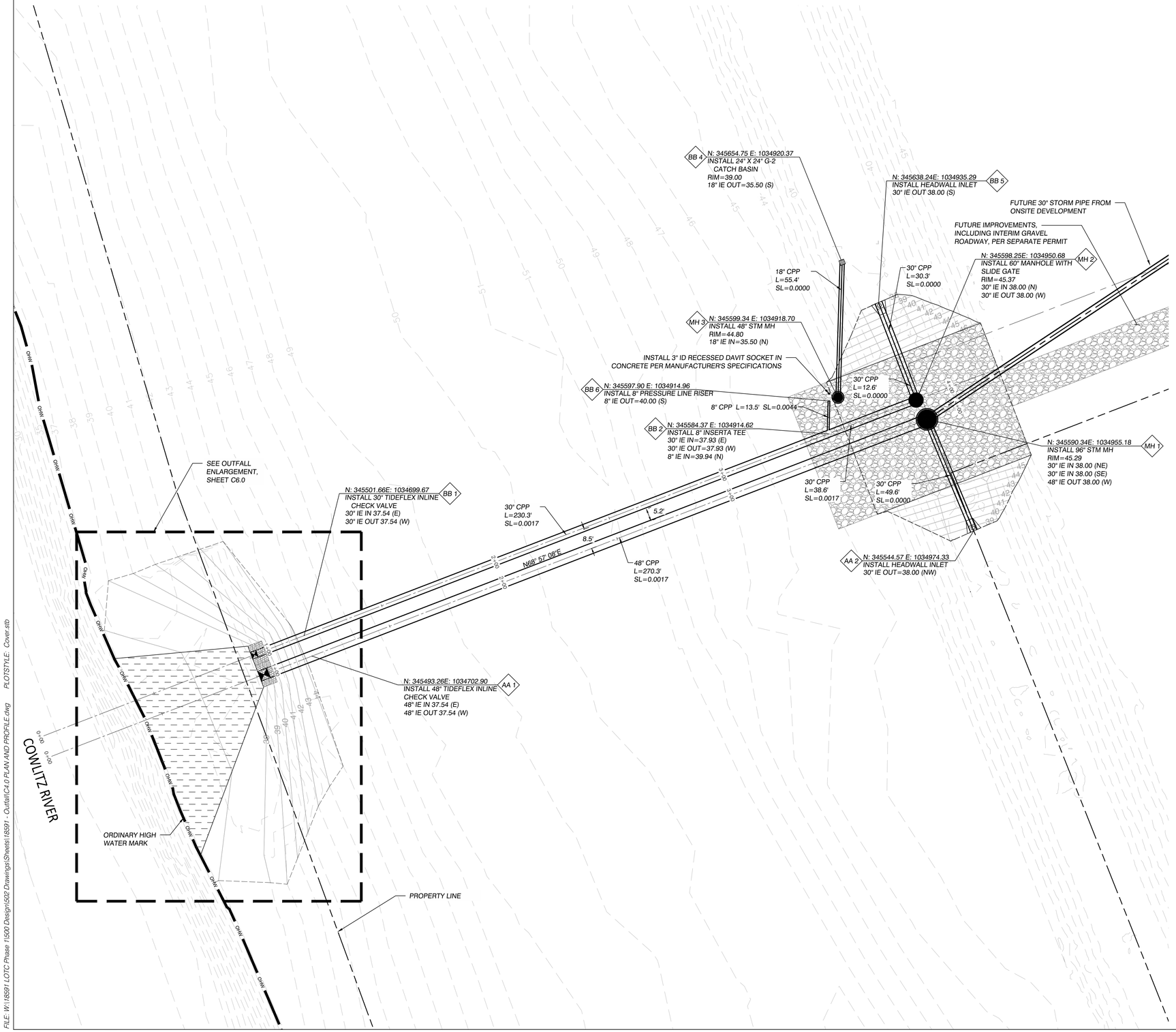
REVISIONS:

JOB NO.:	18591
DATE:	2/12/2025
SCALE: H: 1"= 30'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

FINAL

C3.0

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 - Outfall\C3.0 GRADING AND EROSION CONTROL PLAN.dwg PLOTSTYLE: Cover.stb



STORM DRAINAGE CONSTRUCTION NOTES:

1. *THE 30" OUTFALL PIPING SYSTEM IS DEDICATED TO OFFSITE FLOWS THAT ARE CURRENTLY CONTRIBUTING TO THE ONSITE DRAINAGE DITCH. FOR MORE INFORMATION ON THE OPERATING PROCEDURE DURING FLOOD CONDITIONS, SEE DETAIL 7 ON SHEET C7.0.*
2. *THE 48" OUTFALL PIPING SYSTEM IS DEDICATED TO ONSITE DEVELOPMENT FLOWS.*
3. *ALL PIPING TO BE INSTALLED PER DETAIL 2, SHEET C7.1*
4. *96" STORM MANHOLE TO BE CONSTRUCTED PER DETAILS 1 AND 2, SHEET C7.0.*
5. *48" STANDARD STORM MANHOLE TO BE CONSTRUCTED PER DETAILS 4, 5, AND 7, SHEET C7.0.*
6. *60" SUMP STORM MANHOLE TO BE CONSTRUCTED PER DETAILS 3 AND 5, SHEET C7.0.*
7. *HEADWALL STRUCTURES TO BE CONSTRUCTED PER DETAIL 1, SHEET C7.1.*
8. *TIDEFLEX INLINE CHECK VALVES (SIZE PER PLAN) TO BE CONSTRUCTED PER DETAIL 2, SHEET C7.2.*
9. *INSERTA TEE PIPE CONNECTION TO BE CONSTRUCTED PER DETAIL 6, SHEET C7.0.*
10. *SLUICE GATE IN MH 2 TO BE INSTALLED PER DETAIL 3 ON SHEET C7.0 AND DETAIL 1 ON SHEET C7.2*

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

TAW ANDREW WILSON
STATE OF WASHINGTON
22012357
REGISTERED PROFESSIONAL ENGINEER

2/12/2025

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

STORMWATER LAYOUT PLAN
STORMWATER OUTFALL

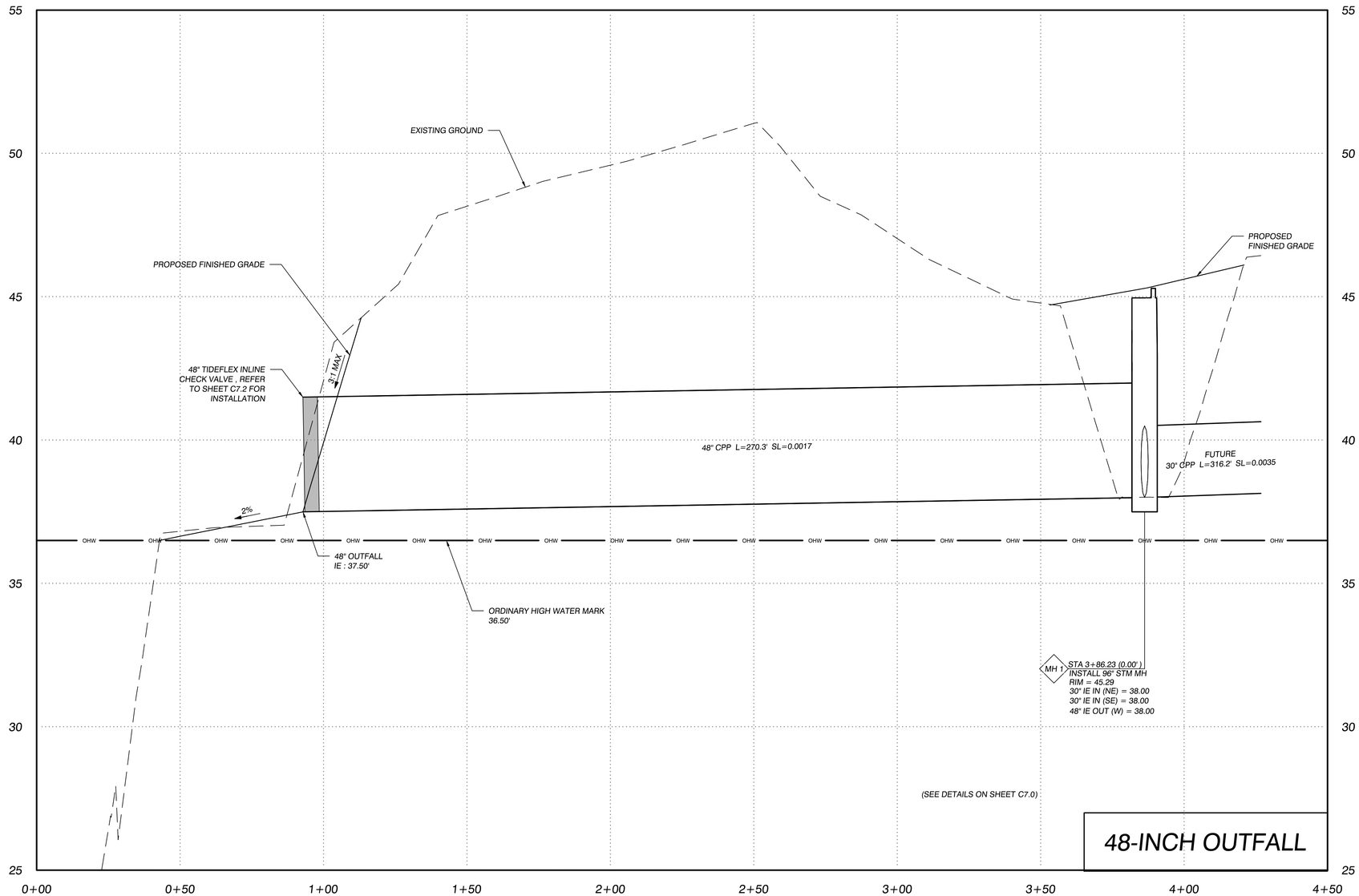
REVISIONS:

JOB NO.:	18591
DATE:	2/12/2025
SCALE: H: 1"= 20'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

FINAL

C4.0

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 - Outfall\C4.0 PLAN AND PROFILE.dwg PLOTSTYLE: Cover.stb



48-INCH STORMWATER OUTFALL PROFILE

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 - Outfall\C4.0 PLAN AND PROFILE.dwg PLOTSTYLE: Cover.stb

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

2/12/2025

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

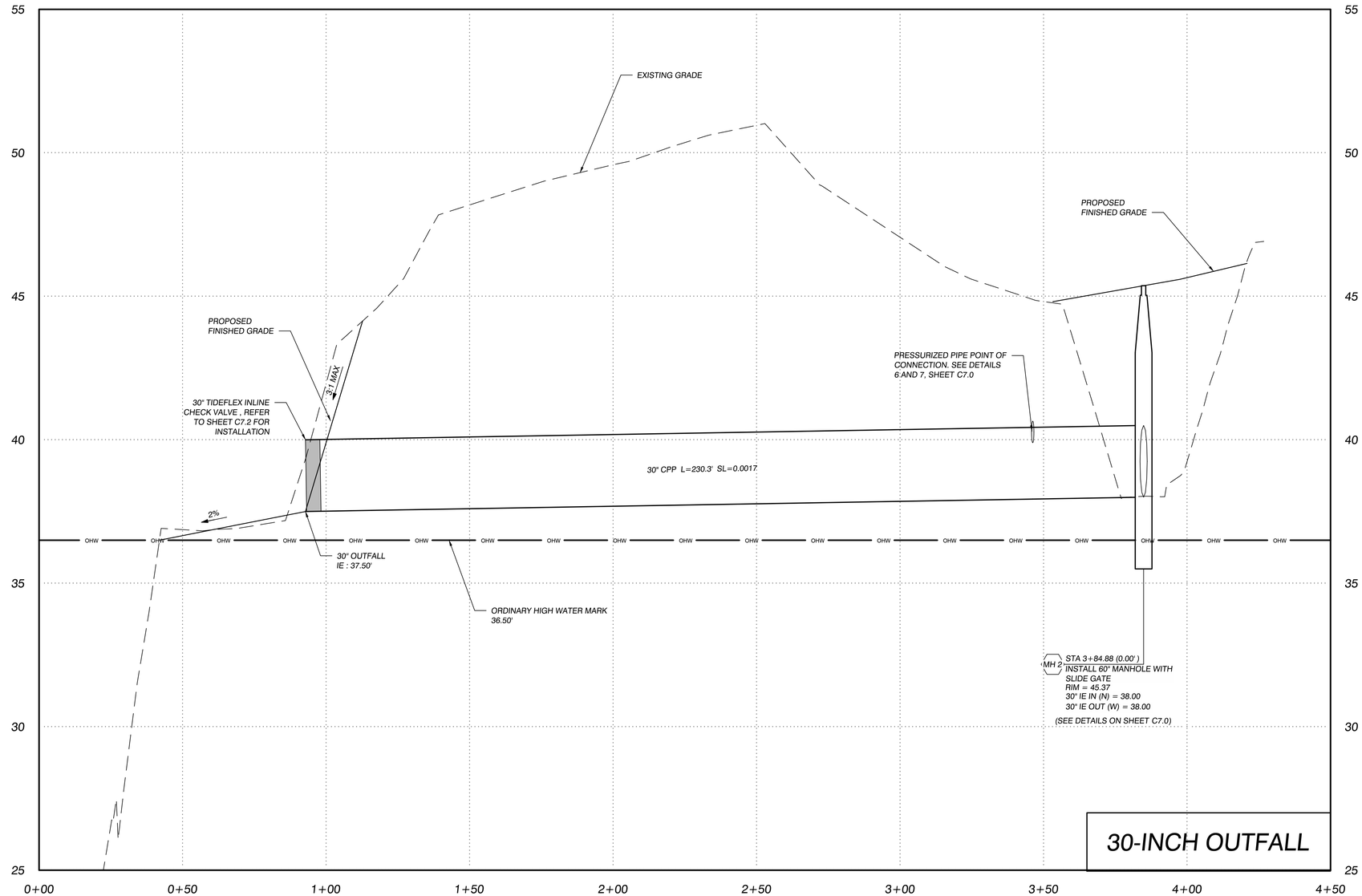
48-INCH STORMWATER OUTFALL PROFILE
STORMWATER OUTFALL

REVISIONS:

JOB NO.:	18591
DATE:	2/12/2025
SCALE: H: N/A	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

FINAL

C5.0



30-INCH STORMWATER OUTFALL PROFILE

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackysposito.com

ANDREW WEBB
STATE OF WASHINGTON
22012357
REGISTERED
PROFESSIONAL ENGINEER

2/12/2025

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

30-INCH STORMWATER OUTFALL PROFILE
STORMWATER OUTFALL

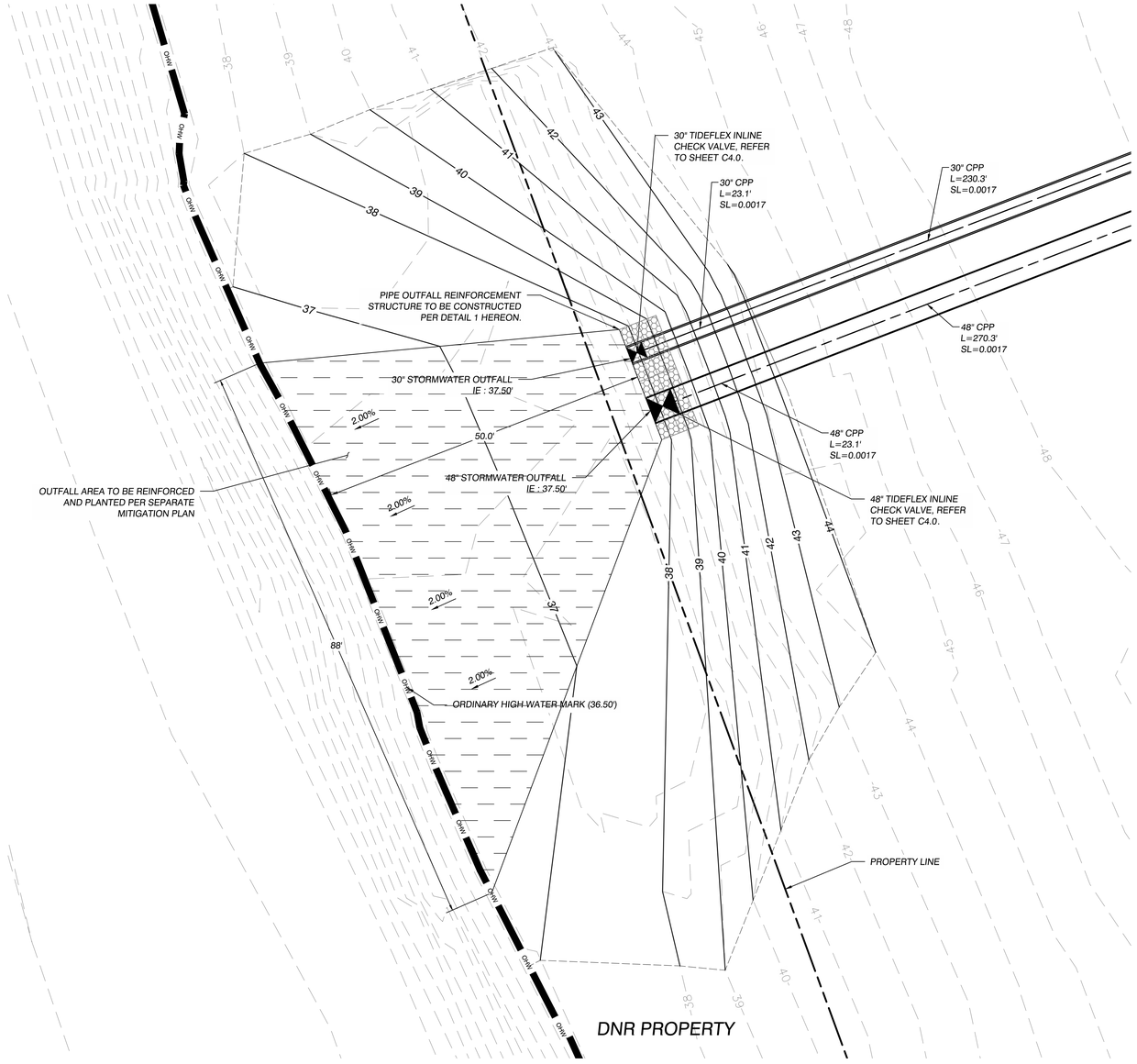
REVISIONS:

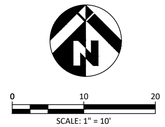
JOB NO.:	18591
DATE:	2/12/2025
SCALE: H: N/A	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

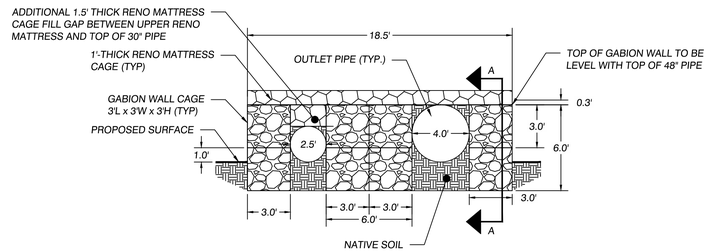
FINAL

C5.1

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 - Outfall\C4.0 PLAN AND PROFILE.dwg PLOTSTYLE: Cover.stb

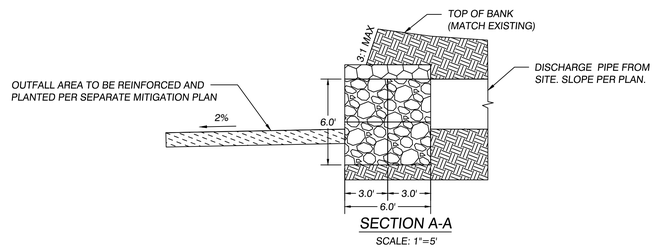






ELEVATION VIEW

SCALE: 1"=5'



SECTION A-A

SCALE: 1"=5'

1 PIPE OUTFALL REINFORCEMENT DETAIL

SCALE: 1" = 5'

MacKay Sposito

ENERGY PUBLIC WORKS LAND DEVELOPMENT

www.mackaysposito.com

2/12/2025

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

OUTFALL ENLARGEMENT
STORMWATER OUTFALL

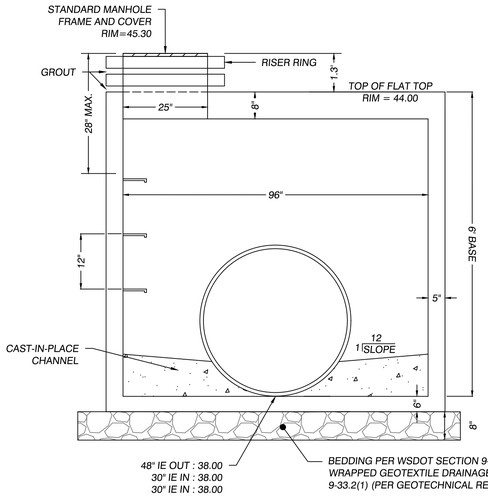
REVISIONS:

JOB NO.:	18591
DATE:	2/12/2025
SCALE: H: 1"= 5'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

FINAL

C6.0

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 - Outfall\C6.0 OUTFALL ENLARGEMENTS.dwg PLOTSTYLE: Cover.stb

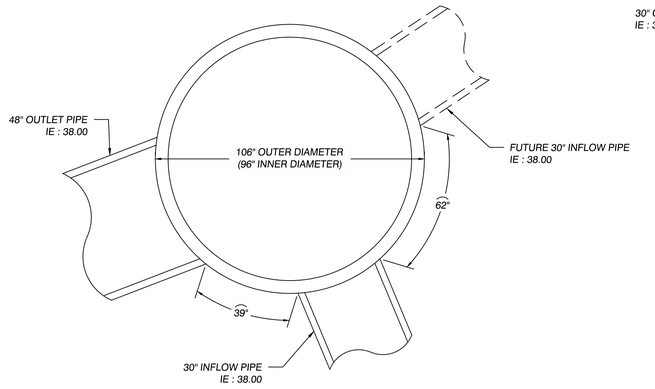


NOTES:

1. ALL PRECAST SECTIONS SHALL CONFORM TO ASTM C-478.
2. NON-SHRINK GROUT SHALL BE USED BETWEEN FRAME, RISER RINGS, AND MANHOLE.
3. BASE CONCRETE SHALL BE 3,000 PSI, 2"-4" SLUMP. FLOW LINES AND INSIDE SURFACES SHALL BE TROWELED SMOOTH AND UNIFORM AT TIME OF POUR.
4. JOINTS SHALL BE CONSTRUCTED SO AS TO BE WATERTIGHT. KENT-SEAL NO. 2 OR APPROVED EQUAL SHALL BE USED ON TONGUE AND GROOVE SECTIONS. PREMOLDED "O" RING MAY BE SUBSTITUTED ON BELL AND SPIGOT SECTIONS. ALL JOINTS SHALL BE GROUTED WITH PORTLAND CEMENT GROUT AND STRUCK EVEN WITH THE WALL.
5. MANHOLES UNDER 6 FEET IN DEPTH FROM RIM TO SHELF SHALL HAVE A FLAT TOP.
6. ALLOWABLE DISTANCE BETWEEN PIPE KNOCKOUTS IS 8 INCHES.
7. ALL PIPE OPENINGS SHALL BE SEALED WITH NON-SHRINK GROUT INSIDE AND OUTSIDE OF MANHOLE.
8. STANDARD MANHOLE FRAME AND COVER PER WSDOT STD. PLAN B-30.70-04.

1 96" STORM DRAINAGE MANHOLE (MH 1)

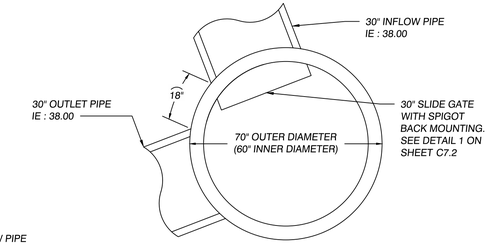
NO SCALE



NOTE: ARC MEASUREMENTS ARE FROM OUTSIDE DIAMETER OF PROPOSED PIPES AND STRUCTURES

2 STORM DRAINAGE MANHOLE (MH 1) CONFIGURATION

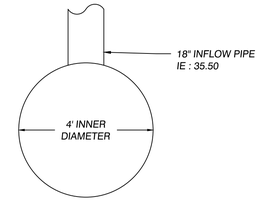
NO SCALE



NOTE: ARC MEASUREMENTS ARE FROM OUTSIDE DIAMETER OF PROPOSED PIPES AND STRUCTURES

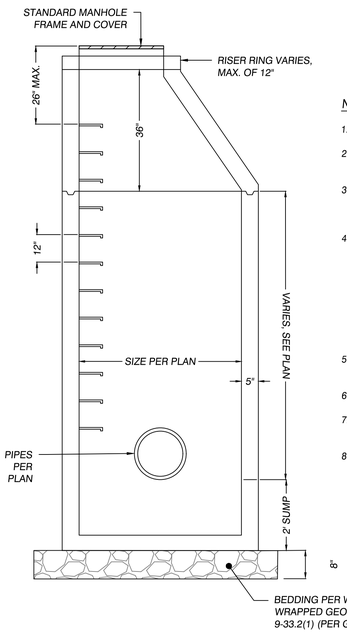
3 SUMP MANHOLE (MH 2) CONFIGURATION

NO SCALE



4 SUMP MANHOLE (MH 3) CONFIGURATION

NO SCALE

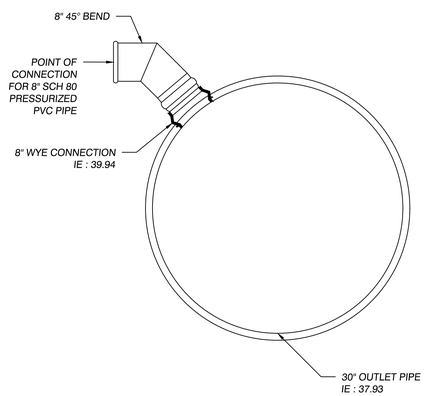


NOTES:

1. ALL PRECAST SECTIONS SHALL CONFORM TO ASTM C-478.
2. NON-SHRINK GROUT SHALL BE USED BETWEEN FRAME, RISER RINGS, AND MANHOLE.
3. BASE CONCRETE SHALL BE 3,000 PSI, 2"-4" SLUMP. FLOW LINES AND INSIDE SURFACES SHALL BE TROWELED SMOOTH AND UNIFORM AT TIME OF POUR.
4. JOINTS SHALL BE CONSTRUCTED SO AS TO BE WATERTIGHT. KENT-SEAL NO. 2 OR APPROVED EQUAL SHALL BE USED ON TONGUE AND GROOVE SECTIONS. PREMOLDED "O" RING MAY BE SUBSTITUTED ON BELL AND SPIGOT SECTIONS. ALL JOINTS SHALL BE GROUTED WITH PORTLAND CEMENT GROUT AND STRUCK EVEN WITH THE WALL.
5. MANHOLES UNDER 6 FEET IN DEPTH FROM RIM TO SHELF SHALL HAVE A FLAT TOP.
6. ALLOWABLE DISTANCE BETWEEN PIPE KNOCKOUTS IS 8 INCHES.
7. ALL PIPE OPENINGS SHALL BE SEALED WITH NON-SHRINK GROUT INSIDE AND OUTSIDE OF MANHOLE.
8. STANDARD MANHOLE FRAME AND COVER PER WSDOT STD. PLAN B-30.70-04.

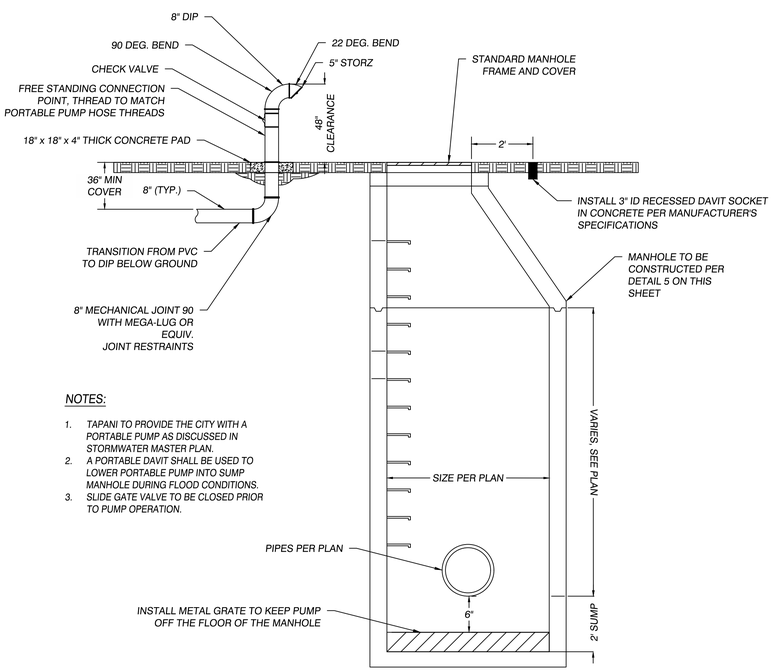
5 STANDARD STORM DRAINAGE MANHOLE

NO SCALE



6 PRESSURE PIPE CONNECTION

NO SCALE



NOTES:

1. TAPANI TO PROVIDE THE CITY WITH A PORTABLE PUMP AS DISCUSSED IN STORMWATER MASTER PLAN.
2. A PORTABLE DAVIT SHALL BE USED TO LOWER PORTABLE PUMP INTO SUMP MANHOLE DURING FLOOD CONDITIONS.
3. SLIDE GATE VALVE TO BE CLOSED PRIOR TO PUMP OPERATION.

7 SUMP MANHOLE (MH 3) PUMP CONFIGURATION

NO SCALE

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

2/12/2025

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

DETAILS
STORMWATER OUTFALL

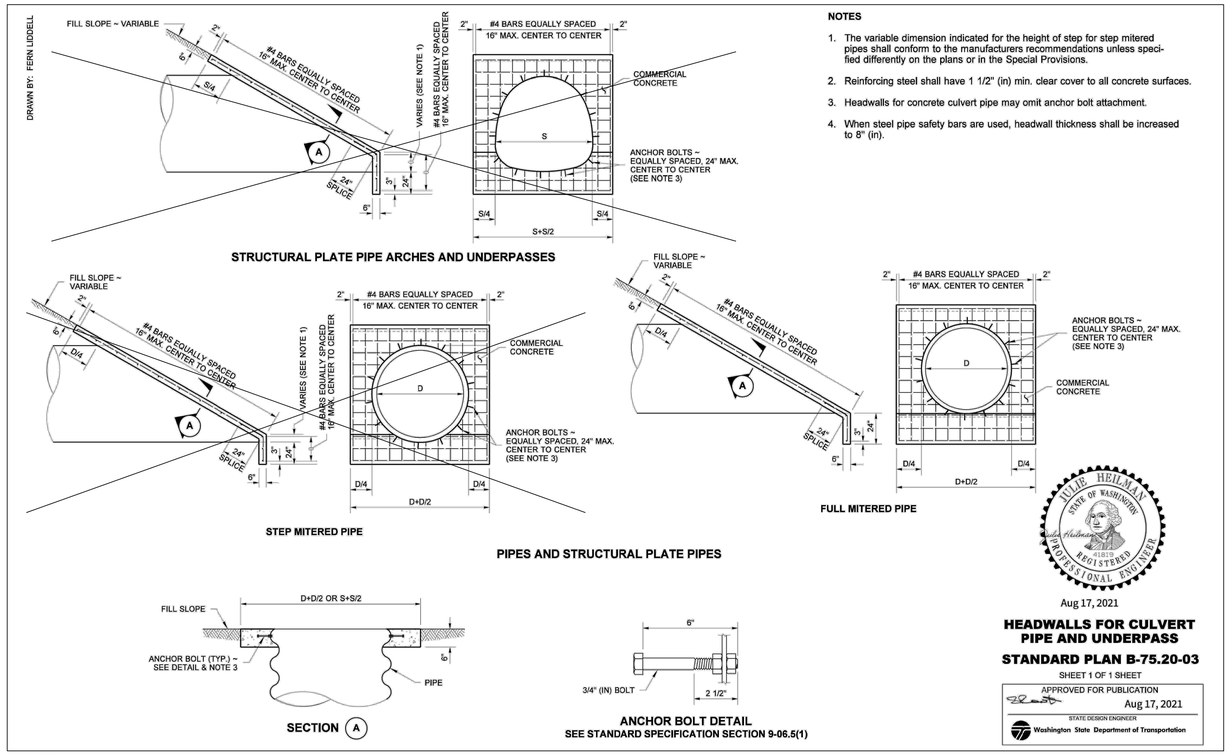
REVISIONS:

JOB NO.:	18591
DATE:	2/12/2025
SCALE: H: N/A	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

FINAL

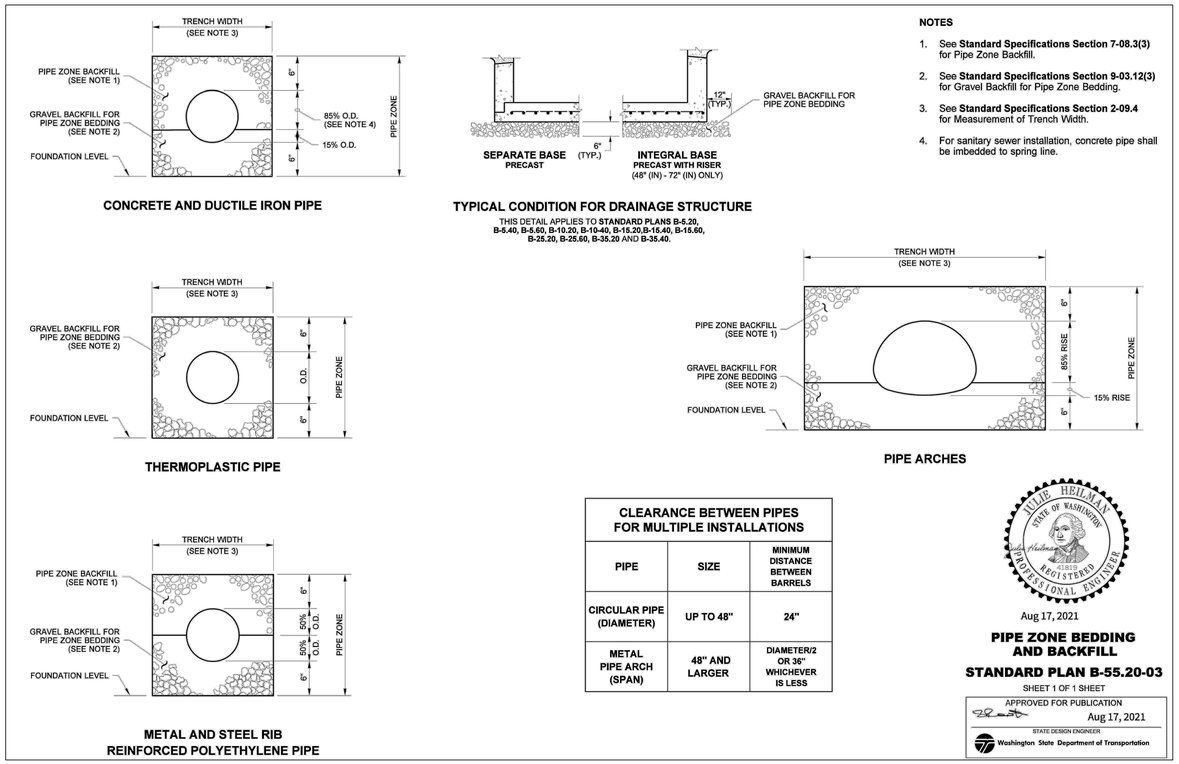
C7.0

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 - Outfall\C7.0 DETAILS.dwg PLOTSTYLE: Cover.stb



1 *STORMWATER HEADWALL INLET (TYP)*

NO SCALE *NOTE: SEE SHEET C4.0 FOR PROPOSED HEADWALL ELEVATIONS*



2 *STANDARD PIPE INSTALLATION*

NO SCALE

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

2/12/2025

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

DETAILS
STORMWATER OUTFALL

REVISIONS:

JOB NO.:	18591
DATE:	2/12/2025
SCALE: H: N/A	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

FINAL

C7.1

FILE: W:\18591 LOTC Phase 1\500 Design\500 Drawings\Sheets\18591 - Outfall\C7.0 DETAILS.dwg PLOTSTYLE: Cover.stb

FRESNO

SERIES 6600 MODEL 101C SLIDE GATE

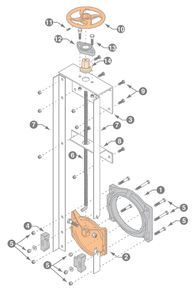
Series 6600 Slide Gate

Features

- One-piece adjustable wedges ensure uniform wedging action.
- Roll threaded rising stem provides ease of operation and extended stem life.
- Rugged Cast Iron seat and cover.
- Available for mounting to headwalls or corrugated pipe.
- Precision machined seating surfaces.

Material Specifications

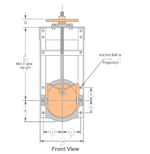
Item	Description	Material	Specification
1	Seat	Cast Iron	ASTM A126, Class B
2	Slide	Cast Iron	ASTM A126, Class B
3	Head Bar	Steel, Galvanized	ASTM A36
4	Wedge	Cast Iron	ASTM A126, Class B
5	Wedge Bolts/Nuts	Steel, Plated	ASTM A307, A164
6	Stem	Steel	ASTM A108, Grade 1045
7	Side Angles	Steel, Galvanized	ASTM A36
8	Stem Support	Steel, Galvanized	ASTM A36
9	Headbar Bolts/ Nuts	Steel, Plated	ASTM A307, A164
10	Handwheel	Cast Iron	ASTM A126, Class B
11	Handwheel Set Screw	Steel, Plated	ASTM A307, A164
12	Keeper	Cast Iron	ASTM A126, Class B
13	Keeper Bolts/Nuts	Steel, Plated	ASTM A307, A164
14	Lift Nut	Brass	ASTM B16
15	Stem Bolt/Nut	Plated	ASTM A307, A164



Applications

The Series 6600 Slide Gate is designed for use in canals and ditches, on corrugated pipe, flood control systems, oil refineries, fish hatcheries and various low head industrial water control applications where pressure is in seating direction only.

SPECIFICATIONS



Pressure Rating

Gate Size:

6"-24" ..... 23 ft.
30"-36" ..... 11 ft.
42"-48" ..... 9 ft.
54"-60" ..... 6 ft.

Installation

The Series 6600 Slide Gate is normally installed on corrugated steel pipe or bolted to a concrete head wall. When attaching to corrugated pipe, you may either bolt directly to the spigot back seat, or use a rod and harness assembly.

Options

- Frame angles available painted, galvanized or Stainless Steel.
- Cast Iron or Bronze seating faces.
- Stainless Steel stem and fasteners.
- Flat back for headwall or flange mounting.
- Spigot back for mounting to corrugated pipe.
- Square bottom slide in select sizes.
- Rising stem and non-projecting stem extensions.
- Tapered setting collars for concrete pipe installations.

Dimensional Information

Gate Size (Inches)	Dimensions (Inches)										Anchor Bolt Data			Lift Data		
	A	B	C	D	E	F	G	H	J	K	Qty.	Size	Qty.	Lift Type	H/Wheel Dia.	Stem Dia.
6	9.3	4.0	15.50	2.88	3.88	2.25	6.75	1.50	4.00	2.50	4.0	1/2 x 12	4.00	H1	10.0	7/8
8	11.3	5.0	18.00	2.88	3.88	2.25	8.75	1.50	5.00	4.00	4.0	1/2 x 12	4.00	H1	10.0	7/8
10	13.3	6.0	21.00	2.88	3.88	2.25	10.75	1.50	6.00	4.00	4.0	1/2 x 12	4.00	H1	10.0	7/8
12	15.3	7.3	24.00	2.88	3.88	2.25	13.25	1.50	7.00	4.00	4.0	1/2 x 12	4.00	H1	10.0	7/8
14	17.3	8.3	27.25	2.88	3.88	2.25	15.25	1.50	8.00	4.00	4.0	1/2 x 12	4.00	H1	10.0	7/8
15	18.3	8.8	28.50	2.88	3.88	2.25	16.25	1.50	8.50	4.00	4.0	1/2 x 12	4.00	H1	10.0	7/8
16	19.3	9.3	30.00	2.88	3.88	2.25	17.25	1.50	9.00	4.00	4.0	1/2 x 12	4.00	H1	10.0	7/8
18	23.0	10.6	33.25	2.88	4.88	2.88	19.25	1.50	10.50	7.00	4.0	5/8 x 12	4.50	H1	14.0	1-1/8
20	25.0	11.6	36.75	2.88	4.88	2.88	21.25	1.50	11.50	7.00	4.0	5/8 x 12	4.50	H1	14.0	1-1/8
21	26.0	12.1	37.25	2.88	4.88	2.88	22.25	1.50	12.00	7.00	4.0	5/8 x 12	4.50	H1	14.0	1-1/8
24	29.0	13.6	42.25	2.88	4.88	2.88	25.25	1.50	13.50	7.00	4.0	5/8 x 12	4.50	H1	14.0	1-1/8
30	35.9	17.1	51.50	2.88	5.88	3.75	31.25	2.00	16.88	12.00	4.0	3/4 x 12	5.25	H1	14.0	1-1/8
36	41.9	20.1	60.50	3.50	6.50	3.75	37.25	2.00	19.88	12.00	4.0	3/4 x 12	5.25	H2	24.0	1-1/2
42	47.9	23.1	69.50	3.50	6.88	4.12	43.38	2.00	22.88	16.00	6.0	3/4 x 12	5.50	H2	24.0	1-1/2
48	53.9	26.1	78.50	6.12	6.88	4.12	49.38	2.00	25.88	16.00	6.0	3/4 x 12	5.50	H2B	24.0	1-1/2
54	61.3	29.3	87.75	6.12	7.75	4.62	55.38	2.00	29.25	18.00	6.0	1 x 12	5.50	H2B	30.0	2.00
60	66.0	32.3	97.25	6.12	9.00	5.12	61.38	2.00	32.50	20.00	6.0	1 x 12	5.50	H2B	30.0	2.00

Fresno Valves & Castings, Inc.
7736 East Springfield Avenue
P.O. Box 40, Selma, CA 93662, U.S.A.
(800) 333-1658
www.fresnovalves.com

Specifications subject to change without notice. Fresno Valves & Castings, Inc. Printed in USA

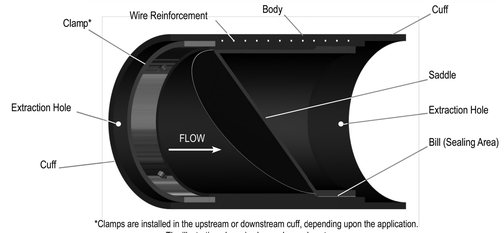
CheckMate® Installation Procedure

NEVER... Install the valve at an angle

NEVER... Use Sharp Tools on Rubber

NEVER... Exceed Design Back Pressure

NEVER... Install the Valve Backwards



*Clamps are installed in the upstream or downstream cuff, depending upon the application. The illustration above is shown clamped upstream.

CHECKMATE® INSTALLATION

1. Product Shipping

Valve sizes 3" - 18" are furnished with one clamp. Valves 20" - 60" ship with two clamps. 72" valves ship with three clamps.

NOTE: A clamp is installed on each end of the valve to keep the valve's shape during transit and storage. Once the installation orientation is determined the CheckMate® valve will be clamped from either the upstream or downstream side. **For valves with two or three clamps, they can be installed onto the same side of the valve and offset from each other, as illustrated in Figure 1.**

2. Unpacking & Lifting

Do not use sharp tools when unpacking this product as it may damage the valve.

For larger CheckMate® valves, the valve should be lifted with either a sling or with supports around the O.D. at each side of the valve to ease the installation procedure. Do not place an object through the valve in order to lift.

CAUTION: Do not try to bend, collapse or fold the valve in order to facilitate the installation as this will cause permanent damage and will not allow the valve to return to a fully round shape.

3. Inspection of Pipe I.D.

Check the inside diameter (I.D.) of the pipe section for rough or damaged areas. The inside surface should be uniform and relatively smooth. Long gouges or cracks in the pipe may allow water to pass and should be filled prior to installation. Do not attempt to install a CheckMate® in a smaller pipe I.D.

4. Pipe I.D. Measurements

The pipe I.D. is to be checked in the field. It should be a consistent diameter for the length of valve and should not be out of round. When there is a +/- tolerance on the pipe I.D., the CheckMate® Valve should be ordered to the smallest pipe I.D.. Then, rubber adhesive strip can be applied to both CheckMate® cuffs to build the cuff O.D. up to the actual pipe I.D. See procedure in #5.

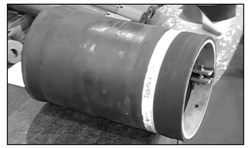
Figure 1 – Clamps shown installed on the same side of valve

CheckMate® Rubber Adhesive Strip Build Up Procedure

5. Rubber Adhesive Strip Build up

When valve O.D. is smaller than the pipe I.D., one-sided rubber adhesive strip is used to build up the O.D. of both CheckMate® cuffs to the actual pipe I.D.

NOTICE: Clean and dry the exterior of the valve prior to beginning rubber adhesive strip build up procedure.

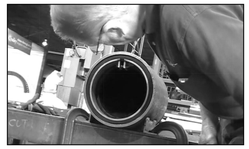


STEP A: Place the valve on a solid, flat surface with the clamped end hanging slightly over the edge of the surface.

STEP B: Slowly rotate the valve while firmly pressing the rubber adhesive strip onto itself in concentric layers until valve O.D. is equal to or a fraction smaller than pipe I.D.

STEP C: Repeat steps A and B on the opposite side of the valve to ensure uniformity of the CheckMate's® O.D. is consistent and matches the pipe I.D.

STEP D: Lubricate the valve and rubber adhesive strip surface. Slide valve into pipe. Ensure the area marked TOP is in the 12:00 position.



STEP E: Check O.D. of the valve to ensure it fits snugly into the I.D. of pipe. If loose, add another layer(s) of the rubber adhesive strip.

STEP F: Once in place, tighten the clamp to secure it against the pipe and compress the rubber adhesive strip.

1 SLIDE GATE (30") FOR MH 2

NO SCALE

NOTE: CONTRACTOR MAY USE APPROVED EQUAL IN LIEU OF THIS PRODUCT.

2 TIDEFLEX INLINE CHECK VALVE

NO SCALE

NOTE: SEE MANUFACTURER'S STANDARD SPECIFICAITONS ON SHEET C1.1.

CheckMate® Installation Procedure

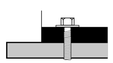
6. Preparation

The CheckMate® Valve uses expanding clamp(s) to exert pressure outwards on the walls of the valve to wedge it in place within the pipe. The walls of the pipe should be clean and free of debris prior to installation.

The valve should be inserted fully into the pipe so that no part of the cuff or bill extends outside the pipe. Ensure that the valve is not slanted at an angle with the bill pointing upwards or downwards. The valve centerline should be parallel to the pipe centerline.

Tideflex® Technologies recommends pinning the CheckMate® Valve on all installations. See below.

Four pre-drilled holes are provided in each expansion clamp. At least one clamp should be pinned. On exposed pipe, holes can be drilled through the valve and pipe, and a bolt run through secured with a nut. For buried pipe, silicon or similar sealant should be used to seal bolts.



7. Lubrication

The outside of the valve can be lubricated with a water-based lubricant prior to inserting the valve into the pipe. If the taping procedure has been used, the surface of the tape can be lubricate to aid insertion.

CAUTION: Do not use petroleum-based lubricants on this product or on the vulcanized rubber tape.

8. Plumb Lines and Arrows

The CheckMate® Valve arrives with a "top" arrow, "flow" arrow and plumb lines, marked in white, at the 12:00 and 6:00 position of the valve. Utilize this marking to orient the valve in the pipe, as well as to ensure the valve is oriented correctly in pipe section.

9. Valve Orientation

The CheckMate® Valve must be installed in a horizontal pipe. Valves 4" – 18" (nominal) are supplied with a single clamp. The clamp turnbuckle should be oriented at top dead center as delinated by the plumb line.

Valves 20" – 60" (nominal) are supplied with two clamps. The turnbuckles should be oriented 45° from the top center plumb line.

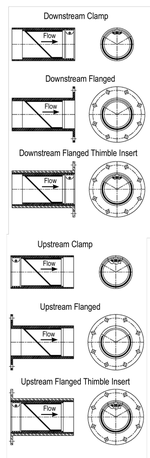
The 72" is supplied with three clamps. The turnbuckle for one clamp to be at top center. The other clamps to be 45° to each side of top center.

10. Insertion Into Pipe

Clamp to support the shape of the cuff should be hand tight and should be extended outward, but only tight enough to loosely keep the shape of the cuff during installation.

CAUTION: If you expand the clamp excessively at this step it will hinder or prevent the CheckMate® valve being fully inserted into the pipe.

CheckMate® Clamping Diagrams



11. Pallet Push for Larger CheckMate® Valves

Larger CheckMate® valves can be pushed into the pipe utilizing the shipping pallet. The pallet should be placed perpendicular to the valve being inserted into the pipe. Then, with assistance from an excavator, push with consistent even force against the shipping pallet to insert the CheckMate® valve into the pipe.

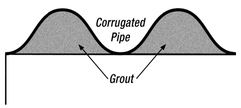
See the image to the right for the suggested positioning and usage of the excavator's shovel assistance for larger-sized CheckMate® valves. Clamps must be installed to prevent damage to cuff.

Pallet Push method for installing CheckMate® Valve

12. Corrugated Pipe and Smooth Wall (PVC, HDPE) Pipe Installation

For installation on corrugated pipe, it is recommended that the corrugations be filled with hydraulic cement (or similar material) that will provide a smooth I.D.

For smooth wall pipe, it is recommended that the valve be pinned.



CheckMate® can be made for any pipe I.D. Built to fit in sizes from 3-72" (75-1800mm).

Flange shape and bolt pattern can be customized. Flangeless thimble inserts are available.

Standard Pressure / Low Pressure	DIMENSIONS									
	NOMINAL PIPE SIZE I.D.		OVERALL LENGTH*		NUMBER OF CLAMPS	CUFF DEPTH		BACK PRESSURE RATING**		WEIGHT***
	Inches	Millimeters	Inches	Millimeters		Inches	Millimeters	Feet	Meters	lbs / Kg
Low	3	75	5.1	130	1	1.5	38	10	3.0	0.7 / 0.3
Low	4	100	7.9	201	1	1.5	38	10	3.0	1.5 / 0.7
Standard	4	100	7.9	201	1	1.5	38	85	26.0	3 / 1.5
Standard	5	125	9.5	241	1	1.5	38	83	25.3	4 / 2
Standard	6	150	11.0	279	1	2.0	51	83	25.3	9 / 4
Standard	7	175	12.8	325	1	2.0	51	79	24.1	11 / 5
Standard	8	200	15.2	386	1	2.0	51	79	24.1	13 / 6
Standard	9	225	15.4	391	1	2.0	51	75	22.9	17 / 8
Standard	10	250	16.1	409	1	2.0	51	71	21.6	20 / 10
Standard	12	300	19.8	503	1	2.0	51	68	20.1	37 / 17
Standard	14	350	25.8	655	1	4.0	102	64	20.0	110 / 50
Standard	15	381	25.8	655	1	4.0	102	62	18.9	120 / 55
Standard	16	400	28.6	726	1	4.0	102	60	18.3	133 / 52
Standard	18	450	31.0	787	1	4.0	102	56	17.1	143 / 65
Standard	20	500	42.1	1069	2	8.0	203	53	16.2	223 / 102
Standard	24	600	47.5	1207	2	8.0	203	45	13.7	304 / 137
Standard	26	650	50.0	1270	2	8.0	203	42	12.8	370 / 168
Standard	28	700	52.0	1321	2	8.0	203	40	12.2	434 / 197
Standard	30	750	54.9	1395	2	8.0	203	38	11.6	500 / 227
Standard	36	900	62.3	1582	2	8.0	203	30	9.1	828 / 376
Standard	42	1050	70.6	1793	2	8.0	203	28	8.5	1423 / 646
Standard	48	1200	79.0	2007	2	8.0	203	26	7.9	1801 / 817
Standard	54	1350	86.4	2195	2	8.0	203	20	6.1	2700 / 1225
Standard	60	1500	96.8	2459	2	9.0	229	18	5.5	3315 / 1504
Standard	72	1800	119.0	3023	3	12.0	305	15	4.6	6100 / 2767

*Shorter lengths available.

**Back pressure measured from pipe invert. Higher back pressure ratings available. Consult factory.

***Weights are approximate and do not include crating.

13. Flanged Valve Bolt Torques

The valve end with the rubber flange shall be installed using the backup rings provided. The sleeve split should be installed facing downstream, with the split in the vertical position.

The installation bolt torque on the end flange bolts are listed in the table below.

RECOMMENDED MINIMUM BOLT TORQUE

Valve Size	Bolt Size	Torque (ft*lb.)
1"	1/2" - 13NC	20
1-1/2"	1/2" - 13NC	20
2"	5/8" - 11NC	30
2-1/2"	5/8" - 11NC	40
3"	5/8" - 11NC	40
4"	5/8" - 11NC	30
5"	3/4" - 10NC	40
6"	3/4" - 10NC	30
8"	3/4" - 10NC	40
10"	7/8" - 9NC	40
12"	7/8" - 9NC	50
14"	1" - 8NC	50
16"	1" - 8NC	50
18"	1-1/8" - 7NC	30
20"	1-1/8" - 7NC	30
24"	1-1/4" - 7NC	40
30"	1-1/4" – 7NC	30
36"	1-1/2" – 6NC	40
42"	1-1/2" – 6NC	50
48"	1-1/2" – 6NC	55
54"	1-3/4"– 5NC	60
60"	1-3/4"– 5NC	80
72"	1-3/4"– 5NC	100

Torque values are suggested minimum values.

Torque all flange bolts in a star pattern, first to 50% of tabulated values, then retorque to 100% of tabulated values. If greater torque is required, continue retorquing in increments of 50% of tabulated values. Use of a high quality anti–seize compound on all bolt threads is recommended.

Always use a "star" pattern when bolting a check valve.

Variables such as the surface finish on bolt threads, type of anti–seize compound used, and surface finish of the mating flanges all have an effect on the minimum torque required to obtain a leak–tight flange seal.

During installation you may need to retorque the flange bolts several times for a proper seal. This will overcome any leaks due to the cold flow of the rubber sleeve flange.

CheckMate® Installation Notes

1. It is important that the CheckMate® is installed level within the pipe. The CheckMate® may "gap open" if installed improperly.

2. The sealing area of the CheckMate® must have room to expand outwards, while bottom of the sealing area rises. The area around the sealing area must be kept free of debris to allow the bill to close in order for the valve to seal properly.

3. The CheckMate® effectively reduces the inside diameter of the pipe in which it is installed, creating a restriction. It may also create a "ledge" inside the pipe, causing standing water.

4. Back pressure in excess of the back pressure rating may cause valve failure.

5. Should the conditions that the CheckMate® was designed for change, (line pressure, back pressure, chemical compatibility) the performance of the valve may suffer.

6. CheckMate® Valves must be installed in true round pipe which is concentric across the entire length. Out of round pipe may cause the sealing area of the valve to distort and gap, which will cause the valve to leak.

MAINTENANCE

Inspection

Valves should occasionally be inspected for damage, wear, and buildup of debris. The frequency of the inspections should be determined by the severity of the service and the environment in which it operates.

The clamps should be checked for proper tension, and be sure that the inside of the valve is free of debris. Soft marine growth is normal on valves in submerged applications. Because hard marine growth such as barnacles will not bond well to the CheckMate® they can be easily removed. Also insert pins to ensure they are tight.

STORAGE

If your CheckMate® is to be stored for a period of time prior to installation, the following storage guidelines will help to preserve the valve and assure a trouble-free installation:

1. Store in a clean, cool, dry location. Avoid exposure to light, electric motors, dirt, or chemicals.
2. Store valve vertically on floor or pallet.
3. Store valve to prevent other items from contacting check sleeve to prevent possible damage.
4. Store this manual with the valve, so that it is readily available at time of installation.

TROUBLESHOOTING GUIDE

Sleeve Inverted or Distorted

1. Excessive back pressure, water surge, or water hammer.

Leaking Around Perimeter of Valve

1. Tighten clamp.
2. Check for cracks and holes in surface of pipe.
3. If taped, check tape to ensure the pipe I.D. has been fully sealed

Backflow

1. Debris lodged inside bill.

Red Valve • 750 Holiday Drive, Suite 400, Pittsburgh, PA 15220 • 412-279-0044 • support@redvalve.com • RedValve.com

© 2024 Red Valve Company

2 TIDEFLEX INLINE CHECK VALVE (continued)

NO SCALE

NOTE: SEE MANUFACTURER'S STANDARD SPECIFICAITONS ON SHEET C1.1.

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

ALEXANDER M. MACKAY — STATE OF WASHINGTON — 22012357 — REGISTERED PROFESSIONAL ENGINEER

2/12/2025

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

DETAILS
STORMWATER OUTFALL

REVISIONS:

JOB NO.:	18591
DATE:	2/12/2025
SCALE: H: N/A	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

FINAL

C7.2

FILE: W:\18591 LOTC Phase 1\500 Design\500 Drawings\Sheets\18591 - Outfall\C7.0 DETAILS.dwg PLOTSTYLE: Cover.stb

Construction Stormwater General Permit (CSWGP)

Stormwater Pollution Prevention Plan (SWPPP)

for

Landing on the Cowlitz – Phase 1 Access and Utilities & Stormwater Outfall

Prepared for:
Department of Ecology
Southwest Regional Office

Permittee / Owner	Developer	Operator / Contractor
CT6, LLC	CT6, LLC	TBD

Parcels 308640100, 30813, 6143802, 308100100, 30812, 308640200, 30864

Certified Erosion and Sediment Control Lead (CESCL)

Name	Organization	Contact Phone Number
TBD	TBD	TBD

SWPPP Prepared By

Name	Organization	Contact Phone Number
Taylor Wilson, PE	MacKay Sposito, Inc.	(360) 823-1344

SWPPP Preparation Date
11/7/2024

Project Construction Dates

Activity / Phase	Start Date	End Date
Grading & Construction	01/01/2025	01/01/2030

GENERAL INSTRUCTIONS AND CAVEATS

This template presents the recommended structure and content for preparation of a Construction Stormwater General Permit (CSWGP) Stormwater Pollution Prevention Plan (SWPPP).

The Department of Ecology's (Ecology) CSWGP requirements inform the structure and content of this SWPPP template; however, **you must customize this template to reflect the conditions of your site.**

A Construction Stormwater Site Inspection Form can be found on Ecology's website. https://www.ecology.wa.gov/Regulations-Permits/Permits-certifications/Stormwater-general-permits/Construction-stormwater-permit

Using the SWPPP Template

Each section will include instructions and space for information specific to your project. Please read the instructions for each section and provide the necessary information when prompted. This Word template can be modified electronically. You may add/delete text, copy and paste, edit tables, etc. Some sections may be completed with brief answers while others may require several pages of explanation.

Follow this link to a copy of the Construction Stormwater General Permit: https://www.ecology.wa.gov/Regulations-Permits/Permits-certifications/Stormwater-general-permits/Construction-stormwater-permit

List of Acronyms and Abbreviations

Acronym / Abbreviation	Explanation
303(d)	Section of the Clean Water Act pertaining to Impaired Waterbodies
BFO	Bellingham Field Office of the Department of Ecology
BMP(s)	Best Management Practice(s)
CESCL	Certified Erosion and Sediment Control Lead
CO_2	Carbon Dioxide
CRO	Central Regional Office of the Department of Ecology
CSWGP	Construction Stormwater General Permit
CWA	Clean Water Act
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ERO	Eastern Regional Office of the Department of Ecology
ERTS	Environmental Report Tracking System
ESC	Erosion and Sediment Control
GULD	General Use Level Designation
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
NWRO	Northwest Regional Office of the Department of Ecology
pH	Power of Hydrogen
RCW	Revised Code of Washington
SPCC	Spill Prevention, Control, and Countermeasure
su	Standard Units
SWMMEW	Stormwater Management Manual for Eastern Washington
SWMMWW	Stormwater Management Manual for Western Washington
SWPPP	Stormwater Pollution Prevention Plan
TESC	Temporary Erosion and Sediment Control
SWRO	Southwest Regional Office of the Department of Ecology
TMDL	Total Maximum Daily Load
VFO	Vancouver Field Office of the Department of Ecology
WAC	Washington Administrative Code
WSDOT	Washington Department of Transportation
WWHM	Western Washington Hydrology Model

Project Information (1.0)

Project/Site Name: Landing on the Cowlitz – Phase 1 Access and Utilities & Stormwater Outfall
Parcel Numbers (1-7): 308640100, 30813, 6143802, 308100100, 30812, 308640200, 30864
City: Caste Rock State: WA Zip code: 98611
Subdivision: CR08080, Lot 2
Receiving waterbody: Salmon Creek/Cowlitz River

Existing Conditions (1.1)

Total acreage (including support activities such as off-site equipment staging yards, material storage areas, and borrow areas).

Total acreage: 118 acres

Disturbed acreage: 100 acres

Existing structures: There is one unoccupied single family home located on the site, as well as additional existing structures utilized for agricultural purposes.

Landscape topography: The site was mass graded for future development. The very southern portion of the site contains a plateau that is owned by the Department of Natural Resources (DNR). This plateau is a dredged material disposal area that contains sand dredge from the Cowlitz River after the 1980 Eruption of Mount Saint Helens.

Drainage patterns: Offsite and onsite drainage is captured by localized depressions and/or existing ditches that convey stormwater south, towards an existing outlet that discharges to Salmon Creek.

Existing Vegetation: The majority of the site is comprised of grass fields and dredge pile areas. There are some forested areas near the river and stream, and a line of trees at the toe of the slope between the farm field and dredge material pile.

Critical Areas (wetlands, streams, high erosion risk, steep or difficult to stabilize slopes): Three (3) existing wetlands have been identified onsite and are located near the southwest portion of the site. All 3 wetlands will be avoided with this phase of construction.

List of known impairments for 303(d) listed or Total Maximum Daily Load (TMDL) for the receiving waterbody: Cowlitz River has been on the 303(d) list for the following tested results with a current listing of Category 5:Temperature, Polychlorinated Biphenyls (PCBs), (2,3,7,8)-TCDD (Dioxin), Methyl mercury

Table 1 includes a list of suspected and/or known contaminants associated with the construction activity.

Table 1 – Summary of Site Pollutant Constituents

Constituent (Pollutant)	Location	Depth	Concentration
Refer to Element 9, Table 2	NA	NA	NA

Proposed Construction Activities (1.2)

Description of site development (example: subdivision):
The approved uses on the site include light industrial, flex/office space, commercial, single-family residential, and recreational. Approximately 53.5 acres have been identified for light industrial use, 12.5 acres for flex/office space, 9.9 acres for commercial uses, 10.3 acres for residential, and 13.9 acres for recreational use (which will include an RV park, recreational trails and other recreational amenities)

Description of construction activities (example: site preparation, demolition, excavation):
Land disturbing activities will include the demolition of existing hardscape and buildings, clearing, grading, and excavation. Upon grading completion, the construction will consist of infrastructure improvements, including: street, stormwater, sanitary sewer (both gravity and force main), water, and various other improvements.

Description of site drainage including flow from and onto adjacent properties. Must be consistent with Site Map in Appendix A: Runoff on the proposed Roadway will be directed to bioretention facilities for treatment before ultimately being conveyed through an onsite storm drain system. The parcels adjacent to the road corridor will be graded to flat pads in anticipation of future development. Stormwater runoff for these flat pads is expected to be negligible due to onsite soil types. Onsite ditches that were graded during the phase 1 mass grading (previous project) will be used to store and convey stormwater until the new system is in place.

Description of final stabilization (example: extent of revegetation, paving, landscaping):
The proposed project involves the construction of new roadways for the proposed Landing on the Cowlitz development, including associated sewer and water systems, stormwater treatment and conveyance systems, site signing and striping, and landscaping. This project includes a road connection to the existing Huntington Ave and a proposed storm outfall to the Cowlitz River for the entire Landing on the Cowlitz development.

Contaminated Site Information:

Proposed activities regarding contaminated soils or groundwater (example: on-site treatment system, authorized sanitary sewer discharge):
There are no known contaminants.

Construction Stormwater Best Management Practices (BMPs) (2.0)

The SWPPP is a living document reflecting current conditions and changes throughout the life of the project. These changes may be informal (i.e. hand-written notes and deletions). Update the SWPPP when the CESCL has noted a deficiency in BMPs or deviation from original design.

The 13 Elements (2.1)

Element 1: Preserve Vegetation / Mark Clearing Limits (2.1.1)

To protect adjacent properties and to reduce the area of soil exposed to construction, the limits of construction will be clearly marked before land-disturbing activities begin.

List and describe BMPs:

- BMP C103: High Visibility Plastic or Metal Fence
- BMP C233: Silt Fence

Installation Schedules:

- Prior to Site Clearing

Inspection and Maintenance plan:

- Silt fence and clearing limits shall be maintained until the final site development.

Responsible Staff: CESCL

Element 2: Establish Construction Access (2.1.2)

Construction vehicle access and exit shall be limited to the construction entrance being built off the existing driveway from Huntington Ave South. Access points shall be stabilized to minimize tracking of sediment onto public roads. A wheel wash and tire bath shall be located on site if the stabilized construction entrance is not effective in preventing sediment from being tracked onto public roads.

If sediment is being tracked offsite, roads shall be cleaned thoroughly at the end of each day, or more frequently during wet weather conditions. Sediment shall be removed from roads by shoveling or pick-up sweeping and shall be transported to a controlled sediment disposal area.

Street washing is allowed only after sediment is removed in accordance with the above-mentioned methods. Street wash wastewater shall be controlled by pumping back on site or otherwise be prevented from discharging onto systems tributary to waters of the state.

List and describe BMPs:

- BMP C105: Stabilized Construction Entrance/Exit
- BMP C107: Construction Road/Parking Area Stabilization. To be constructed if the stabilized construction entrance/exit does not effectively remove sediment from the construction vehicle tires.

To avoid potential erosion and sediment control issues, the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix C after the first sign that existing BMPs are ineffective or failing.

Installation Schedules:

- Prior to ground disturbing activities.

Inspection and Maintenance plan:

- Inspect construction access weekly, replace or clean once rock is full of sediment.

Responsible Staff: CESCL

Element 3: Control Flow Rates (2.1.3)

Stormwater runoff will be collected in grass-lined channels that slope towards 2 onsite temporary sediment ponds. The sediment ponds will have riser pipes to handle overflows during large storm events. Pond 2 will also have an emergency overflow spillway in the event both the dewatering orifice and riser become clogged. The surface area at the top of Pond 1 (riser elevation) was significantly increased due to shallow slope and low elevations surrounding the ditches that convey flows to sediment Pond 1. This was needed in order to contain flows below an elevation of 42 in the event of a 100 year storm event, and not allow flows to bypass the sediment pond. Due to those and other various constraints of the existing site, pond 1 will only be able to accommodate a riser pipe for emergency overflows. However the riser for Pond 1 has been sized to pass the 100 year flood event. Any overflows from Ponds 1 or 2 will be contained and channelized through the grass lined ditches, and drain to Salmon Creek via the outlet pipe.

The proposed final storm system will capture and infiltrate the majority of the runoff onsite. The remaining runoff will drain offsite, mimicking the existing conditions.

Will you construct stormwater retention and/or detention facilities?
☒ Yes ☐ No

Ditch 8 (labeled on the proposed basin map) will be constructed with a 10’ wide flat bottom for storing any excess stormwater in the drainage basin that overflows towards the site.

Will you use permanent infiltration ponds or other low impact development (example: rain gardens, bio-retention, porous pavement) to control flow during construction?
☒ Yes ☐ No

List and describe BMPs:

- BMP C241: Temporary Sediment Pond
- BMP C231: Brush Barrier (Outfall – Biofilter bag check dam)

Installation Schedules:

- Beginning of grading operations.

Inspection and Maintenance plan:

- Inspect weekly, clean or remove debris as necessary

Responsible Staff: CESCL

Element 4: Install Sediment Controls (2.1.4)

Stormwater runoff from disturbed areas shall pass through the appropriate sediment removal BMP prior to infiltration. Additional BMPs listed below shall be installed for runoff that will drain offsite.

Sediment control BMPs shall be constructed as one of the first steps in grading. These BMPs should be functional before other land disturbing activities take place. To avoid potential erosion and sediment control issues, the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix C after the first sign that existing BMPs are ineffective or failing

List and describe BMPs:

- BMP C220, Storm Drain Inlet Protection
- BMP C233: Silt Fence
- BMP C231: Brush Barrier

Installation Schedules:

- To be constructed as one of the first steps in grading

Inspection and Maintenance plan:

- Weekly and after rain events.

Responsible Staff: CESCL

Element 5: Stabilize Soils (2.1.5)

All disturbed soil on the site shall be stabilized upon completion of the grading activities. No soils should remain exposed or unworked for longer than the periods outlined in the table below to prevent erosion.

West of the Cascade Mountains Crest

Season	Dates	Number of Days Soils Can be Left Exposed
During the Dry Season	May 1 – September 30	7 days
During the Wet Season	October 1 – April 30	2 days

Soils must be stabilized at the end of the shift before a holiday or weekend if needed based on the weather forecast.

Anticipated project dates: Start date: 01/01/2025 End date: 01/01/2030

Will you construct during the wet season?
☒Yes ☐No

List and describe BMPs:

- BMP C120: Temporary and Permanent Seeding- Temporary EC seed mixes from table II-3.54 of the 2019 SWMMWW are recommended to be used for all onsite areas. Proposed ditches, sediment ponds and others disturbed areas onsite that contain or convey stormwater shall use a wet area seed mix from the table.
- BMP C122: Nets and Blankets (as needed)
- BMP C123: Plastic Covering (as needed)
- BMP C130: Surfacing Roughening (as needed)
- BMP C140: Dust Control

Installation Schedules:

- Soil stabilization BMPs shall be used as needed by the contractor. Soil stabilization shall be in conformance with the table above. During the dry season, dust control shall be implemented as needed to control wind-blown dust. If plastic covering is not placed on stockpiles, then the surface of the stockpiles shall be roughened, and a cutoff ditch shall be constructed at the base of the stockpile.

Inspection and Maintenance plan:

- Cover soils per the table above.

Responsible Staff: CESCL

Element 6: Protect Slopes (2.1.6)

All slopes onsite will be roughened and seeded within the required timeline depending on the time of year. Slopes toward the property lines will have silt fence installed around the perimeter. Other slopes onsite drain towards the grass-lined ditches and to the sediment pond onsite.

Will steep slopes be present at the site during construction?
☒Yes ☐No

List and describe BMPs:

- BMP C120: Temporary and Permanent Seeding
- BMP C130: Surface Roughening

Installation Schedules:

- During dry season, slopes will be roughened or seeded within 7 days of final cut. During wet season, slopes will be roughened or seeded within 2 days of final cut.

Inspection and Maintenance plan:

- Inspect weekly and after rain events.

Responsible Staff: CESCL

Element 7: Protect Drain Inlets (2.1.7)

Inlet protection devices shall be cleaned or removed and replaced when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).

List and describe BMPs:

- BMP C220: Storm Drain Inlet Protection

Installation Schedules:

- Prior to ground disturbing activities per the Grading, Drainage, and Erosion Control Plans.

Inspection and Maintenance plan:

- Inlets will be inspected weekly at a minimum and daily during storm events. Inlet protection devices will be cleaned (or removed and replaced), when sediment has filled the device by 1/3 or as specified by the manufacturer.

Responsible Staff: CESCL

Element 8: Stabilize Channels and Outlets (2.1.8)

The channels and ponds on the site will be seeded to limit any sediment travel onsite.

Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches, will be installed at the outlets of all conveyance systems.

List and describe BMPs:

- BMP C201: Grass-Lined Channels
- BMP C241: Sediment Pond (Temporary)

Installation Schedules:

- The channels and ponds will be constructed in the first phases of grading.

Inspection and Maintenance plan:

- Inspect weekly and after rain events.

Responsible Staff: CESCL

Element 9: Control Pollutants (2.1.9)

The following pollutants are anticipated to be present on-site:

Table 2 – Pollutants

Pollutant (and source, if applicable)
Construction Debris
Waste Materials

Waste materials will be stored onsite in a large dumpster and the dumpster will be hauled off before it reaches full capacity and replaced with an empty dumpster. Chemicals shall not be stored directly on the ground. Secondary containment shall be implemented. A spill kit shall be always retained onsite. All pollutants, including waste materials and demolition debris, that occur onsite shall be handled and disposed of in a manner that does not cause contamination of

stormwater. Good housekeeping and preventative measures will be taken to ensure that the site will be kept clean, well-organized, and free of debris. If required, BMPs to be implemented to control specific sources of pollutants are discussed below.

Vehicles, construction equipment, and/or petroleum product storage/dispensing:

- All vehicles, equipment, and petroleum product storage/dispensing areas will be inspected regularly to detect any leaks or spills, and to identify maintenance needs to prevent leaks or spills.
- On-site fueling tanks and petroleum product storage containers shall include secondary containment.
- Spill prevention measures, such as drip pans, will be used when conducting maintenance and repair of vehicles or equipment.
- In order to perform emergency repairs on site, temporary plastic will be placed beneath and, if raining, over the vehicle.
- Contaminated surfaces shall be cleaned immediately following any discharge or spill incident.

Excavation and tunneling spoils dewatering waste:

- Dewatering BMPs and BMPs specific to the excavation and tunneling (including handling of contaminated soils) are discussed under Element 10.

Demolition:

- Dust released from demolished sidewalks, buildings, or structures will be controlled using Dust Control measures (BMP C140).
- Storm drain inlets vulnerable to stormwater discharge carrying dust, soil, or debris will be protected using Storm Drain Inlet Protection (BMP C220 as described above for Element 7).

Process water and slurry resulting from sawcutting and surfacing operations will be prevented from entering the waters of the State by implementing Sawcutting and Surfacing Pollution Prevention measures (BMP C152).

Concrete and grout:

- Process water and slurry resulting from concrete work will be prevented from entering the waters of the State by implementing Concrete Handling measures (BMP C151).

Sanitary wastewater:

- Portable sanitation facilities will be firmly secured, regularly maintained, and emptied when necessary.

Wheel wash or tire bath wastewater shall be discharged to a separate on-site treatment system or to the sanitary sewer as part of Wheel Wash implementation (BMP C106).

This project does not require a Spill Prevention, Control, and Countermeasure (SPCC) Plan under the Federal regulations of the Clean Water Act (CWA).

No storage of potential pollutants is expected. Vehicle maintenance will be performed using equipment maintenance vehicles utilizing required BMPs to control pollutants.

List and describe BMPs:

- BMP C153: Material Delivery, Storage, & Containment

Installation Schedules:

- Installed prior to any grading activity.

Inspection and Maintenance plan:

- Inspect weekly and after rain events.

Responsible Staff: CESCL

Will maintenance, fueling, and/or repair of heavy equipment and vehicles occur on-site?
☒Yes ☐No

List and describe BMPs:

- BMP C153: Material Delivery, Storage, & Containment – The recommendations of BMP C153 shall be followed. Chemicals shall not be stored directly on the ground. Secondary containment shall be implemented. A spill kit shall be retained onsite.

Installation Schedules:

- Prior to performing refueling onsite.

Inspection and Maintenance plan:

- After any use of the spill kit, the kit shall be restocked.
- Inspect with each fueling/maintenance entry to the site

Responsible Staff: CESCL

Will wheel wash or tire bath system BMPs be used during construction?
☐Yes ☒No

List and describe BMPs: N/A

Installation Schedules: N/A

Inspection and Maintenance plan: N/A

Responsible Staff: N/A

Will pH-modifying sources be present on-site?
☒Yes ☐No

Table 3 – pH-Modifying Sources

	None
X	Bulk cement
X	Cement kiln dust
X	Fly ash
	Other cementitious materials
	New concrete washing or curing waters
	Waste streams generated from concrete grinding and sawing
	Exposed aggregate processes
	Dewatering concrete vaults
	Concrete pumping and mixer washout waters
	Recycled concrete
	Other (i.e. calcium lignosulfate) [please describe]

List and describe BMPs:

- The recommendations of BMP C151 shall be followed. Concrete trucks shall not be washed out on the ground. Hand tools shall be washed off into formed areas only. A concrete washout shall be used if needed to control concrete wash water.
- The recommendations of BMP C153 shall be followed. Chemicals shall not be stored directly on the ground. Secondary containment shall be implemented. A spill kit shall be retained onsite.
- The recommendations of BMP C154 shall be followed. If it is not possible to dispose of concrete wastewater and truck washout water off-site, then a concrete washout shall be constructed.

Installation Schedules:

- Concrete handline protocols and recommendations shall be implemented as soon as concrete is delivered to the site. A concrete washout shall be constructed prior to concrete deliveries if concrete trucks are to be washout out on-site. A spill kit shall be prepared and stored on-site prior to any chemicals or fuel being delivered or transferred on-site.

Inspection and Maintenance plan:

- Inspect concrete washouts after rain events and after use. Inspect secondary containment weekly.

Responsible Staff: CESCL

Concrete trucks must not be washed out onto the ground, or into storm drains, open ditches, streets, or streams. Excess concrete must not be dumped on-site, except in designated concrete washout areas with appropriate BMPs installed.

Element 10: Control Dewatering (2.1.10)

Dewatering may be required for excavations at the site taking place during the wet season. If seepage or groundwater is encountered, a sump pump may be used to dewater the area. Any water pumped from these areas will be pumped into a sediment trap.

Table 4 – Dewatering BMPs

X	Infiltration
	Transport off-site in a vehicle (vacuum truck for legal disposal)
	Ecology-approved on-site chemical treatment or other suitable treatment technologies
	Sanitary or combined sewer discharge with local sewer district approval (last resort)
X	Use of sedimentation bag with discharge to ditch or swale (small volumes of localized dewatering)

List and describe BMPs:

BMP C240: Sediment Trap

Installation Schedules: Construct prior to grading activities.

Inspection and Maintenance plan: Inspect weekly and after any rain event. Sediment shall be removed from the trap when it reaches 1’ in depth.

Responsible Staff: CESCL

Element 11: Maintain BMPs (2.1.11)

All temporary and permanent Erosion and Sediment Control (ESC) BMPs shall be maintained and repaired as needed to ensure continued performance of their intended function.

Maintenance and repair shall be conducted in accordance with each particular BMP specification (see *Volume II of the SWMMWW or Chapter 7 of the SWMMEW*).

Visual monitoring of all BMPs installed at the site will be conducted at least once every calendar week and within 24 hours of any stormwater or non-stormwater discharge from the site. If the site becomes inactive and is temporarily stabilized, the inspection frequency may be reduced to once every calendar month.

All temporary ESC BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed.

Trapped sediment shall be stabilized on-site or removed. Disturbed soil resulting from removal of either BMPs or vegetation shall be permanently stabilized.

Additionally, protection must be provided for all BMPs installed for the permanent control of stormwater from sediment and compaction. BMPs that are to remain in place following completion of construction shall be examined and restored to full operating condition. If sediment enters these BMPs during construction, the sediment shall be removed and the facility shall be returned to conditions specified in the construction documents.

Element 12: Manage the Project (2.1.12)

The project will be managed based on the following principles:

- Projects will be phased to the maximum extent practicable and seasonal work limitations will be taken into account.
- Inspection and monitoring:
    - Inspection, maintenance and repair of all BMPs will occur as needed to ensure performance of their intended function.
    - Site inspections and monitoring will be conducted in accordance with Special Condition S4 of the CSWGP. Sampling locations are indicated on the Site Map. Sampling station(s) are located in accordance with applicable requirements of the CSWGP.
- Maintain an updated SWPPP.
    - The SWPPP will be updated, maintained, and implemented in accordance with Special Conditions S3, S4, and S9 of the CSWGP.

As site work progresses the SWPPP will be modified routinely to reflect changing site conditions. The SWPPP will be reviewed monthly to ensure the content is current.

Check all the management BMPs that apply at your site:

Table 5 – Management

X	Design the project to fit the existing topography, soils, and drainage patterns
X	Emphasize erosion control rather than sediment control
X	Minimize the extent and duration of the area exposed
X	Keep runoff velocities low
X	Retain sediment on-site
X	Thoroughly monitor site and maintain all ESC measures
	Schedule major earthwork during the dry season
	Other (please describe)

Table 6 – BMP Implementation Schedule

Phase of Construction Project	Stormwater BMPs	Date	Wet/Dry Season
[Insert construction activity]	[Insert BMP]	[MM/DD/YYYY]	[Insert Season]

Phase of Construction Project	Stormwater BMPs	Date	Wet/Dry Season
[Insert construction activity]	[Insert BMP]	[MM/DD/YYYY]	[Insert Season]

Element 13: Protect Low Impact Development (LID) BMPs (2.1.13)

No impervious areas are proposed for this phase of the project, therefore no LID facilities will be constructed.

Pollution Prevention Team (3.0)

Table 7 – Team Information

Title	Name(s)	Phone Number
Certified Erosion and Sediment Control Lead (CESCL)	TBD	TBD
Resident Engineer	Taylor Wilson, PE MacKay Sposito, Inc.	(360) 823-1334
Emergency Ecology Contact	TBD	TBD
Emergency Permittee/ Owner Contact	Shane Tapani	360-687-1148
Non-Emergency Owner Contact	Jerome Sarkinen	360-907-7615
Monitoring Personnel	TBD	TBD
Ecology Regional Office	Southwest Region	(360) 407-6300

Monitoring and Sampling Requirements (4.0)

Monitoring includes visual inspection, sampling for water quality parameters of concern, and documentation of the inspection and sampling findings in a site log book. A site log book will be maintained for all on-site construction activities and will include:

- A record of the implementation of the SWPPP and other permit requirements
- Site inspections
- Stormwater sampling data

Create your own Site Inspection Form or use the Construction Stormwater Site Inspection Form found on Ecology's website. https://www.ecology.wa.gov/Regulations-Permits/Permits-certifications/Stormwater-general-permits/Construction-stormwater-permit

File a blank form under Appendix D.

The site log book must be maintained on-site within reasonable access to the site and be made available upon request to Ecology or the local jurisdiction.

Numeric effluent limits may be required for certain discharges to 303(d) listed waterbodies. See CSWGP Special Condition S8 and Section 5 of this template.

Complete the following paragraph for sites that discharge to impaired waterbodies for fine sediment, turbidity, phosphorus, or pH:

The receiving waterbody, Salmon Creek, is impaired for: no impairments. All stormwater and dewatering discharges from the site are subject to an **effluent limit** of 8.5 su for pH and/or 25 NTU for turbidity.

Site Inspection (4.1)

Site inspections will be conducted at least once every calendar week and within 24 hours following any discharge from the site. For sites that are temporarily stabilized and inactive, the required frequency is reduced to once per calendar month.

The discharge point(s) are indicated on the Site Map (see Appendix A) and in accordance with the applicable requirements of the CSWGP.

Stormwater Quality Sampling (4.2)

Turbidity Sampling (4.2.1)

Requirements include calibrated turbidity meter or transparency tube to sample site discharges for compliance with the CSWGP. Sampling will be conducted at all discharge points at least once per calendar week.

Method for sampling turbidity:

Table 8 – Turbidity Sampling Method

x	Turbidity Meter/Turbidimeter (required for disturbances 5 acres or greater in size)
	Transparency Tube (option for disturbances less than 1 acre and up to 5 acres in size)

The benchmark for turbidity value is 25 nephelometric turbidity units (NTU) and a transparency less than 33 centimeters.

If the discharge's turbidity is 26 to 249 NTU **or** the transparency is less than 33 cm but equal to or greater than 6 cm, the following steps will be conducted:

1. Review the SWPPP for compliance with Special Condition S9. Make appropriate revisions within 7 days of the date the discharge exceeded the benchmark.
2. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible. Address the problems within 10 days of the date the discharge exceeded the benchmark. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period.
3. Document BMP implementation and maintenance in the site log book.

If the turbidity exceeds 250 NTU **or** the transparency is 6 cm or less at any time, the following steps will be conducted:

1. Telephone or submit an electronic report to the applicable Ecology Region's Environmental Report Tracking System (ERTS) within 24 hours. https://www.ecology.wa.gov/About-us/Get-involved/Report-an-environmental-issue
    - Central Region (Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima): (509) 575-2490
    - Eastern Region (Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman): (509) 329-3400
    - Northwest Region (King, Kitsap, Island, San Juan, Skagit, Snohomish, Whatcom): (425) 649-7000
    - Southwest Region (Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Lewis, Mason, Pacific, Pierce, Skamania, Thurston, Wahkiakum,): (360) 407-6300
2. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible. Address the problems within 10 days of the date the discharge exceeded the benchmark. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period
3. Document BMP implementation and maintenance in the site log book.
4. Continue to sample discharges daily until one of the following is true:
    - Turbidity is 25 NTU (or lower).
    - Transparency is 33 cm (or greater).

- Compliance with the water quality limit for turbidity is achieved.
    - 1 - 5 NTU over background turbidity, if background is less than 50 NTU
    - 1% - 10% over background turbidity, if background is 50 NTU or greater
- The discharge stops or is eliminated.

pH Sampling (4.2.2)

pH monitoring is required for “Significant concrete work” (i.e. greater than 1000 cubic yards poured concrete or recycled concrete over the life of the project).The use of engineered soils (soil amendments including but not limited to Portland cement-treated base [CTB], cement kiln dust [CKD] or fly ash) also requires pH monitoring.

For significant concrete work, pH sampling will start the first day concrete is poured and continue until it is cured, typically three (3) weeks after the last pour.

For engineered soils and recycled concrete, pH sampling begins when engineered soils or recycled concrete are first exposed to precipitation and continues until the area is fully stabilized.

If the measured pH is 8.5 or greater, the following measures will be taken:

1. Prevent high pH water from entering storm sewer systems or surface water.
2. Adjust or neutralize the high pH water to the range of 6.5 to 8.5 su using appropriate technology such as carbon dioxide (CO_2) sparging (liquid or dry ice).
3. Written approval will be obtained from Ecology prior to the use of chemical treatment other than CO_2 sparging or dry ice.

Method for sampling pH:

Table 8 – pH Sampling Method

	pH meter
X	pH test kit
	Wide range pH indicator paper

Discharges to 303(d) or Total Maximum Daily Load (TMDL) Waterbodies (5.0)

303(d) Listed Waterbodies (5.1)

The 303(d) status is listed on the Water Quality Atlas: https://ecology.wa.gov/Water-Shorelines/Water-quality/Water-improvement/Assessment-of-state-waters-303d

Circle the applicable answer, if necessary:

Is the receiving water 303(d) (Category 5) listed for turbidity, fine sediment, phosphorus, or pH?

☐Yes ☒No

List the impairment(s):

N/A

The receiving waterbody, Cowlitz River, is impaired for: no impairments. All stormwater and dewatering discharges from the site are subject to an **effluent limit** of 8.5 su for pH and/or 25 NTU for turbidity.

If yes, discharges must comply with applicable effluent limitations in S8.C and S8.D of the CSWGP.

Describe the method(s) for 303(d) compliance:

List and describe BMPs:

N/A

TMDL Waterbodies (5.2)

Waste Load Allocation for CWSGP discharges:

N/A

Describe the method(s) for TMDL compliance:

List and describe BMPs:

N/A

Discharges to TMDL receiving waterbodies will meet in-stream water quality criteria at the point of discharge.

The Construction Stormwater General Permit Proposed New Discharge to an Impaired Water Body form is included in Appendix F.

Reporting and Record Keeping (6.0)

Record Keeping (6.1)

Site Log Book (6.1.1)

A site log book will be maintained for all on-site construction activities and will include:

- A record of the implementation of the SWPPP and other permit requirements
- Site inspections
- Sample logs

Records Retention (6.1.2)

Records will be retained during the life of the project and for a minimum of three (3) years following the termination of permit coverage in accordance with Special Condition S5.C of the CSWGP.

Permit documentation to be retained on-site:

- CSWGP
- Permit Coverage Letter
- SWPPP
- Site Log Book

Permit documentation will be provided within 14 days of receipt of a written request from Ecology. A copy of the SWPPP or access to the SWPPP will be provided to the public when requested in writing in accordance with Special Condition S5.G.2.b of the CSWGP.

Updating the SWPPP (6.1.3)

The SWPPP will be modified if:

- Found ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site.
- There is a change in design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the State.

The SWPPP will be modified within seven (7) days if inspection(s) or investigation(s) determine additional or modified BMPs are necessary for compliance. An updated timeline for BMP implementation will be prepared.

Reporting (6.2)

Discharge Monitoring Reports (6.2.1)

Cumulative soil disturbance is one (1) acre or larger; therefore, Discharge Monitoring Reports (DMRs) will be submitted to Ecology monthly. If there was no discharge during a given monitoring period the DMR will be submitted as required, reporting "No Discharge". The DMR due date is fifteen (15) days following the end of each calendar month.

DMRs will be reported online through Ecology's WQWebDMR System.

To sign up for WQWebDMR go to:
https://www.ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Water-quality-permits-guidance/WQWebPortal-guidance

Notification of Noncompliance (6.2.2)

If any of the terms and conditions of the permit is not met, and the resulting noncompliance may cause a threat to human health or the environment, the following actions will be taken:

1. Ecology will be notified within 24-hours of the failure to comply by calling the applicable Regional office ERTS phone number (Regional office numbers listed below).
2. Immediate action will be taken to prevent the discharge/pollution or otherwise stop or correct the noncompliance. If applicable, sampling and analysis of any noncompliance will be repeated immediately and the results submitted to Ecology within five (5) days of becoming aware of the violation.
3. A detailed written report describing the noncompliance will be submitted to Ecology within five (5) days, unless requested earlier by Ecology.

Specific information to be included in the noncompliance report is found in Special Condition S5.F.3 of the CSWGP.

Anytime turbidity sampling indicates turbidity is 250 NTUs or greater, or water transparency is 6 cm or less, the Ecology Regional office will be notified by phone within 24 hours of analysis as required by Special Condition S5.A of the CSWGP.

- Central Region at (509) 575-2490 for Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, or Yakima County
- Eastern Region at (509) 329-3400 for Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, or Whitman County
- Northwest Region at (425) 649-7000 for Island, King, Kitsap, San Juan, Skagit, Snohomish, or Whatcom County

- Southwest Region at (360) 407-6300 for Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Lewis, Mason, Pacific, Pierce, Skamania, Thurston, or Wahkiakum

Include the following information:

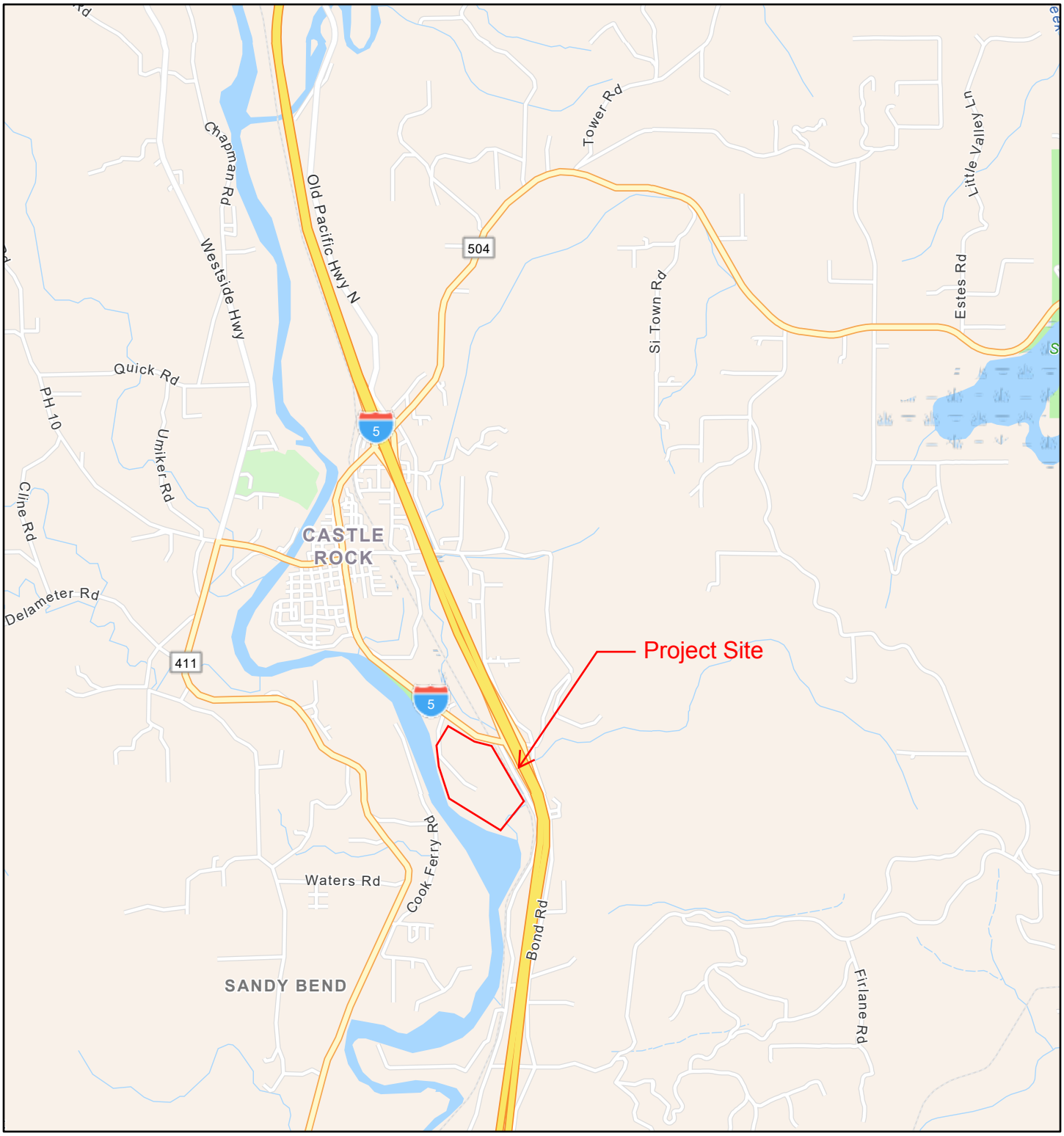
1. Your name and / Phone number
2. Permit number
3. City / County of project
4. Sample results
5. Date / Time of call
6. Date / Time of sample
7. Project name

In accordance with Special Condition S4.D.5.b of the CSWGP, the Ecology Regional office will be notified if chemical treatment other than CO_2 sparging is planned for adjustment of high pH water.

Appendix/Glossary

A. Vicinity Map

Vicinity Map



11/1/2024, 10:40:00 AM

County Boundary

1:72,224

0 0.42 0.85 1.7 mi

0 0.5 1 2 km

Oregon State Parks, State of Oregon GEO, WA State Parks GIS, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA, USFWS

Web AppBuilder for ArcGIS

Authenticated | Source: Esri, USDA FSA | Washington Geological Survey | USGS The National Map: 3D Elevation Program. Data Refreshed September, 2024. | Washington Department of Natural

B. BMP Details

permitting authority. These should not be disturbed and must protected with sediment control BMPs to prevent impacts. The local permitting authority may expand the buffer widths temporarily to allow the use of the expanded area for removal of sediment.

- Vegetative Buffer Zones - areas that may be identified in undisturbed vegetation areas or managed vegetation areas that are outside any Designated Critical Area Buffer. They may be utilized to provide an additional sediment control area and/or reduce runoff velocities. If being used for preservation of natural vegetation, they should be arranged in clumps or strips. They can be used to protect natural swales and incorporated into the natural landscaping area.

Design and Installation Specifications

- Preserving natural vegetation or plantings in clumps, blocks, or strips is generally the easiest and most successful method.
- Leave all unstable steep slopes in natural vegetation.
- Mark clearing limits and keep all equipment and construction debris out of the natural areas and buffer zones. Steel construction fencing is the most effective method to protect sensitive areas and buffers. Alternatively, wire-backed silt fence on steel posts is marginally effective. Flagging alone is typically not effective.
- Keep all excavations outside the dripline of trees and shrubs.
- Do not push debris or extra soil into the buffer zone area because it will cause damage by burying and smothering vegetation.
- Vegetative buffer zones for streams, lakes or other waterways shall be established by the local permitting authority or other state or federal permits or approvals.

Maintenance Standards

Inspect the area frequently to make sure flagging remains in place and the area remains undisturbed. Replace all damaged flagging immediately. Remove all materials located in the buffer area that may impede the ability of the vegetation to act as a filter.

BMP C103: High-Visibility Fence

Purpose

High-visibility fencing is intended to:

- Restrict clearing to approved limits.
- Prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed.
- Limit construction traffic to designated construction entrances, exits, or internal roads.
- Protect areas where marking with survey tape may not provide adequate protection.

Conditions of Use

To establish clearing limits, plastic, fabric, or metal fence may be used:

- At the boundary of sensitive areas, their buffers, and other areas required to be left uncleared.
- As necessary to control vehicle access to and on the site.

Design and Installation Specifications

High-visibility plastic fence shall be composed of a high-density polyethylene (HDPE) material and shall be at least four feet in height. Posts for the fencing shall be steel or wood and placed every 6 feet on center (maximum) or as needed to ensure rigidity. The fencing shall be fastened to the post every six inches with a polyethylene tie. On long continuous lengths of fencing, a tension wire or rope shall be used as a top stringer to prevent sagging between posts. The fence color shall be high-visibility orange. The fence tensile strength shall be 360 lbs/ft using the ASTM D4595 testing method.

If appropriate, install fabric silt fence in accordance with BMP C233: Silt Fence to act as high-visibility fence. Silt fence shall be at least 3 feet high and must be highly visible to meet the requirements of this BMP.

Metal fences shall be designed and installed according to the manufacturer's specifications.

Metal fences shall be at least 3 feet high and must be highly visible.

Fences shall not be wired or stapled to trees.

Maintenance Standards

If the fence has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.

BMP C105: Stabilized Construction Access

Purpose

Stabilized construction accesses are established to reduce the amount of sediment transported onto paved roads outside the project site by vehicles or equipment. This is done by constructing a stabilized pad of quarry spalls at entrances and exits for project sites.

Conditions of Use

Construction accesses shall be stabilized wherever traffic will be entering or leaving a construction site if paved roads or other paved areas are within 1,000 feet of the site.

For residential subdivision construction sites, provide a stabilized construction access for each residence, rather than only at the main subdivision entrance. Stabilized surfaces shall be of sufficient length/width to provide vehicle access/parking, based on lot size and configuration.

On large commercial, highway, and road projects, the designer should include enough extra materials in the contract to allow for additional stabilized accesses not shown in the initial Construction SWPPP. It is difficult to determine exactly where access to these projects will take place; additional materials will enable the contractor to install them where needed.

Design and Installation Specifications

- See Figure II-4.1: Stabilized Construction Access for details. Note: the 100' minimum length of the access shall be reduced to the maximum practicable size when the size or configuration of the site does not allow the full length (100').
- Construct stabilized construction accesses with a 12-inch thick pad of 4-inch to 8-inch quarry spalls, a 4-inch course of asphalt treated base (ATB), or use existing pavement. Do not use crushed concrete, cement, or calcium chloride for construction access stabilization because these products raise pH levels in stormwater and concrete discharge to waters of the State is prohibited.
- A separation geotextile shall be placed under the spalls to prevent fine sediment from pumping up into the rock pad. The geotextile shall meet the standards listed in Table II-4.2: Stabilized Construction Access Geotextile Standards.

Table II-4.2: Stabilized Construction Access Geotextile Standards

Geotextile Property	Required Value
Grab Tensile Strength (ASTM D4751)	200 psi min.
Grab Tensile Elongation (ASTM D4632)	30% max.
Mullen Burst Strength (ASTM D3786-80a)	400 psi min.
AOS (ASTM D4751)	No. 20 to No. 45 (U.S. standard sieve size)

- Consider early installation of the first lift of asphalt in areas that will be paved; this can be used as a stabilized access. Also consider the installation of excess concrete as a stabilized access. During large concrete pours, excess concrete is often available for this purpose.
- Fencing (see BMP C103: High-Visibility Fence) shall be installed as necessary to restrict traffic to the construction access.
- Whenever possible, the access shall be constructed on a firm, compacted subgrade. This can substantially increase the effectiveness of the pad and reduce the need for maintenance.
- Construction accesses should avoid crossing existing sidewalks and back of walk drains if at all possible. If a construction access must cross a sidewalk or back of walk drain, the full length of the sidewalk and back of walk drain must be covered and protected from sediment leaving the site.

Alternative Material Specification

WSDOT has raised safety concerns about the quarry spall rock specified above. WSDOT observes that the 4-inch to 8-inch rock sizes can become trapped between dually truck tires, and then released off-site at highway speeds. WSDOT has chosen to use a modified specification for the rock while continuously verifying that the stabilized construction access remains effective. To remain effective, the BMP must prevent sediment from migrating off site. To date, there has been no performance testing to verify operation of this new specification. Local jurisdictions may use the alternative specification, but must perform increased off-site inspection if they use, or allow others to use, it.

Stabilized construction accesses may use material that meets the requirements of WSDOT's *Standard Specifications for Road, Bridge, and Municipal Construction* Section 9-03.9(1) (WSDOT, 2016) for ballast except for the following special requirements.

The grading and quality requirements are listed in Table II-4.3: Stabilized Construction Access Alternative Material Requirements.

Table II-4.3: Stabilized Construction Access Alternative Material Requirements

Sieve Size	Percent Passing
2½″	99 to 100
2″	65 to 100
¾″	40 to 80
No. 4	5 max.
No. 100	0 to 2
% Fracture	75 min.

Notes:

1. All percentages are by weight.
2. The sand equivalent value and dust ratio requirements do not apply.
3. The fracture requirement shall be at least one fractured face and will apply the combined aggregate retained on the No. 4 sieve in accordance with FOP for AASHTO T 335.

Maintenance Standards

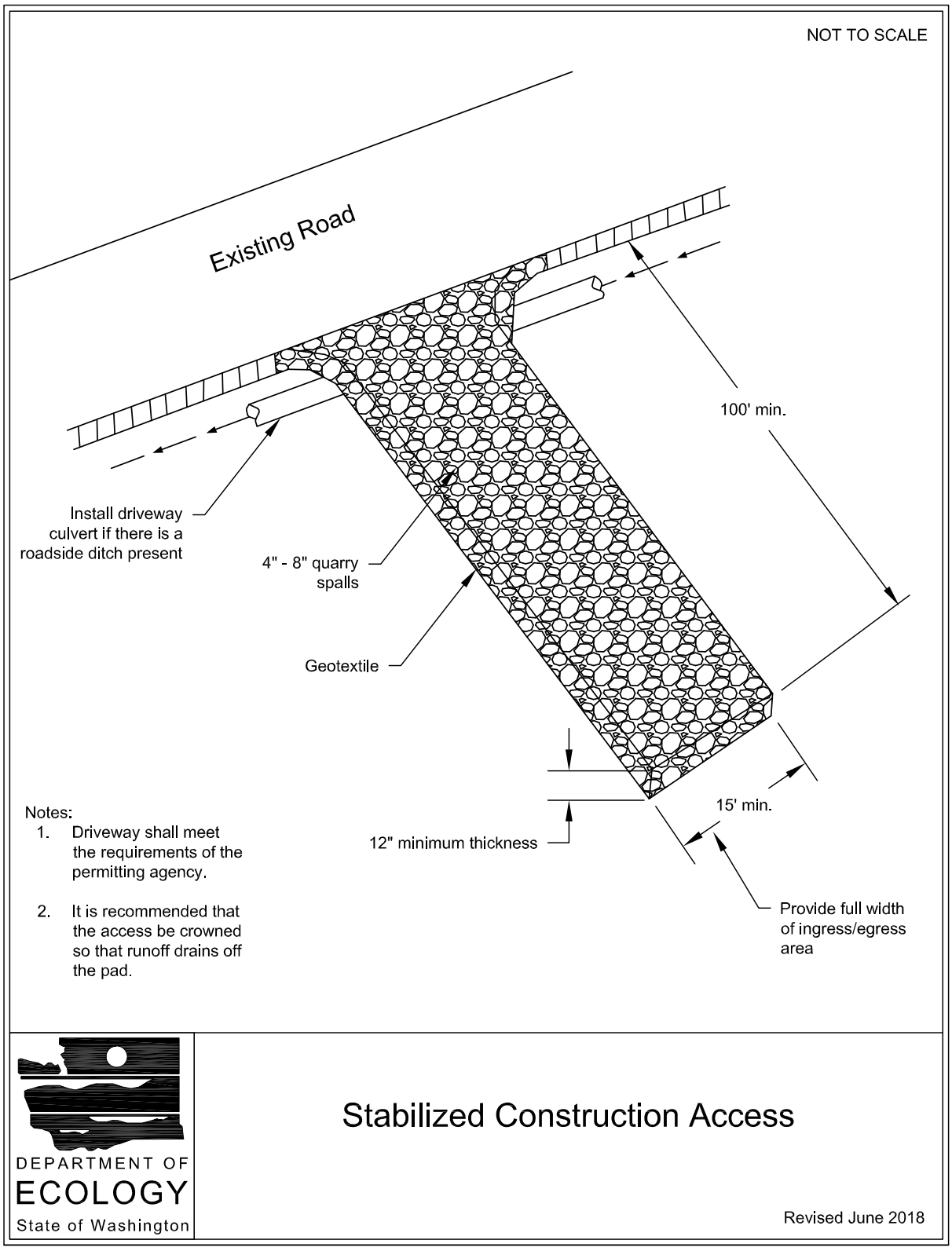
Quarry spalls shall be added if the pad is no longer in accordance with the specifications.

- If the access is not preventing sediment from being tracked onto pavement, then alternative measures to keep the streets free of sediment shall be used. This may include replacement/cleaning of the existing quarry spalls, street sweeping, an increase in the dimensions

of the access, or the installation of BMP C106: Wheel Wash.

- Any sediment that is tracked onto pavement shall be removed by shoveling or street sweeping. The sediment collected by sweeping shall be removed or stabilized on site. The pavement shall not be cleaned by washing down the street, except when sweeping is ineffective and there is a threat to public safety. If it is necessary to wash the streets, the construction of a small sump to contain the wash water shall be considered. The sediment would then be washed into the sump where it can be controlled.
- Perform street sweeping by hand or with a high efficiency sweeper. Do not use a non-high efficiency mechanical sweeper because this creates dust and throws soils into storm systems or conveyance ditches.
- Any quarry spalls that are loosened from the pad, which end up on the roadway shall be removed immediately.
- If vehicles are entering or exiting the site at points other than the construction access(es), BMP C103: High-Visibility Fence shall be installed to control traffic.
- Upon project completion and site stabilization, all construction accesses intended as permanent access for maintenance shall be permanently stabilized.

Figure II-4.1: Stabilized Construction Access



Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

BMP C106: Wheel Wash

Purpose

Wheel washes reduce the amount of sediment transported onto paved roads by washing dirt from the wheels of motor vehicles prior to the motor vehicles leaving the construction site.

Conditions of Use

- Use a wheel wash when BMP C105: Stabilized Construction Access is not preventing sediment from being tracked off site.
- Wheel washing is generally an effective BMP when installed with careful attention to topography. For example, a wheel wash can be detrimental if installed at the top of a slope abutting a right-of-way where the water from the dripping truck can run unimpeded into the street.
- Pressure washing combined with an adequately sized and surfaced pad with direct drainage to a large 10-foot x 10-foot sump can be very effective.
- Wheel wash wastewater is not stormwater. It is commonly called process water, and must be discharged to a separate on-site treatment system that prevents discharge to waters of the State, or to the sanitary sewer with local sewer district approval.
- Wheel washes may use closed-loop recirculation systems to conserve water use.
- Wheel wash wastewater shall not include wastewater from concrete washout areas.
- When practical, the wheel wash should be placed in sequence with BMP C105: Stabilized Construction Access. Locate the wheel wash such that vehicles exiting the wheel wash will enter directly onto BMP C105: Stabilized Construction Access. In order to achieve this, BMP C105: Stabilized Construction Access may need to be extended beyond the standard installation to meet the exit of the wheel wash.

Design and Installation Specifications

Suggested details are shown in Figure II-4.2: Wheel Wash. The local permitting authority may allow other designs. A minimum of 6 inches of asphalt treated base (ATB) over crushed base

material or 8 inches over a good subgrade is recommended to pave the wheel wash.

Use a low clearance truck to test the wheel wash before paving. Either a belly dump or lowboy will work well to test clearance.

Keep the water level from 12 to 14 inches deep to avoid damage to truck hubs and filling the truck tongues with water.

Midpoint spray nozzles are only needed in extremely muddy conditions.

Wheel wash systems should be designed with a small grade change, 6- to 12-inches for a 10-foot-wide pond, to allow sediment to flow to the low side of pond to help prevent re-suspension of sediment. A drainpipe with a 2- to 3-foot riser should be installed on the low side of the pond to allow for easy cleaning and refilling. Polymers may be used to promote coagulation and flocculation in a closed-loop system. Polyacrylamide (PAM) added to the wheel wash water at a rate of 0.25 to 0.5 pounds per 1,000 gallons of water increases effectiveness and reduces cleanup time. If PAM is already being used for dust or erosion control and is being applied by a water truck, the same truck can be used to change the wash water. PAM use shall be reviewed and approved by the local permitting authority. Discharge of PAM may be a basis for penalties per RCW 90.48.080.

Maintenance Standards

The wheel wash should start out each day with fresh water.

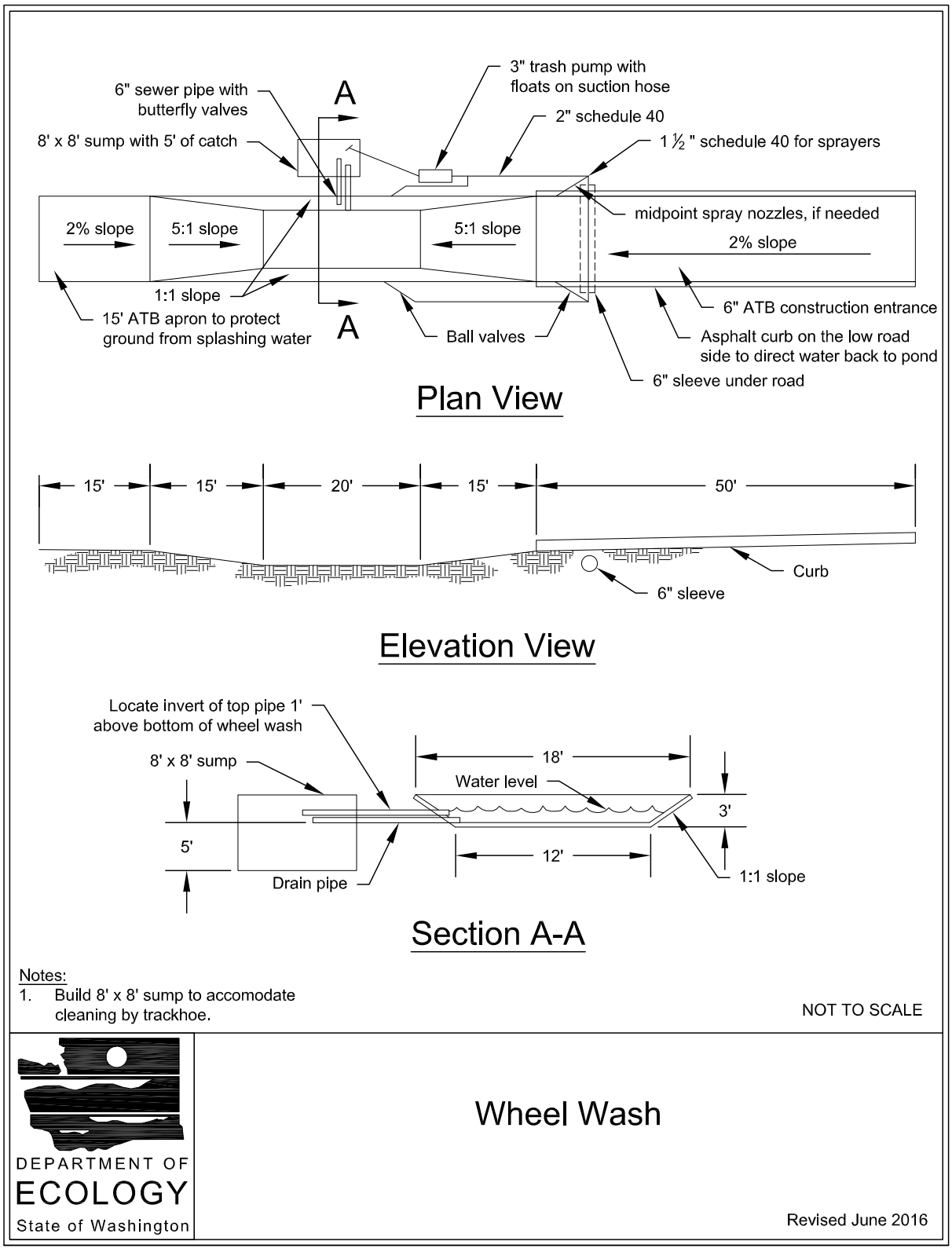
The wheel wash water should be changed a minimum of once per day. On large earthwork jobs where more than 10 to 20 trucks per hour are expected, the wheel wash water will need to be changed more often.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

Figure II-4.2: Wheel Wash



BMP C107: Construction Road / Parking Area Stabilization

Purpose

Stabilizing roads, parking areas, and other on-site vehicle transportation routes immediately after grading reduces erosion caused by construction traffic or stormwater runoff.

Conditions of Use

Roads and parking areas shall be stabilized wherever they are constructed, whether permanent or temporary, for use by construction traffic.

BMP C103: High-Visibility Fence shall be installed, if necessary, to limit the access of vehicles to only those roads and parking areas that are stabilized.

Design and Installation Specifications

- On areas that will receive asphalt as part of the project, install the first lift as soon as possible.
- A 6-inch depth of 2- to 4-inch crushed rock, gravel base, or crushed surfacing base course shall be applied immediately after grading or utility installation. A 4-inch course of asphalt treated base (ATB) may also be used, or the road/parking area may be paved. It may also be possible to use cement or calcium chloride for soil stabilization. If cement or cement kiln dust is used for road base stabilization, pH monitoring and BMP C252: Treating and Disposing of High pH Water is necessary to evaluate and minimize the effects on stormwater. If the area will not be used for permanent roads, parking areas, or structures, a 6-inch depth of hog fuel may also be used, but this is likely to require more maintenance. Whenever possible, construction roads and parking areas shall be placed on a firm, compacted subgrade.
- Temporary road gradients shall not exceed 15 percent. Roadways shall be carefully graded to drain. Drainage ditches shall be provided on each side of the roadway in the case of a crowned section, or on one side in the case of a super-elevated section. Drainage ditches shall be directed to a sediment control BMP.
- Rather than relying on ditches, it may also be possible to grade the road so that runoff sheet flows into a heavily vegetated area with a well-developed topsoil. Landscaped areas are not adequate. If this area has at least 50 feet of vegetation that water can flow through, then it is generally preferable to use the vegetation to treat runoff, rather than a sediment pond or trap. The 50 feet shall not include wetlands or their buffers. If runoff is allowed to sheet flow through adjacent vegetated areas, it is vital to design the roadways and parking areas so that no concentrated runoff is created.
- Storm drain inlets shall be protected to prevent sediment-laden water entering the drainage system (see BMP C220: Inlet Protection).

Maintenance Standards

Inspect stabilized areas regularly, especially after large storm events.

Crushed rock, gravel base, etc., shall be added as required to maintain a stable driving surface and to stabilize any areas that have eroded.

Following construction, these areas shall be restored to pre-construction condition or better to prevent future erosion.

Perform street cleaning at the end of each day or more often if necessary.

BMP C120: Temporary and Permanent Seeding

Purpose

Seeding reduces erosion by stabilizing exposed soils. A well-established vegetative cover is one of the most effective methods of reducing erosion.

Conditions of Use

- Use seeding throughout the project on disturbed areas that have reached final grade or that will remain unworked for more than 30 days. See II-2.5 Element 5: Stabilize Soils for specific timelines for stabilizing exposed soils.
- See Table II-4.4: Seeding Windows in Western Washington (continued) for appropriate seeding windows.
- Review all disturbed areas in late August to early September and complete all seeding by the end of September. Otherwise, vegetation will not establish itself enough to provide more than average protection.
- Mulch is required at all times for seeding because it protects seeds from heat, moisture loss, and transport due to runoff. Mulch can be applied on top of the seed or simultaneously by hydroseeding. See BMP C121: Mulching for specifications.
- Seed and mulch all disturbed areas not otherwise vegetated at final site stabilization. Final stabilization means the completion of all soil disturbing activities at the site and the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, riprap, gabions, or geotextiles) which will prevent erosion. See BMP T5.13: Post-Construction Soil Quality and Depth.

Table II-4.4: Seeding Windows in Western Washington

Month	Seeding Recommendations
January	Seeding requires a cover of mulch or an erosion control blanket until 75% grass cover is established
February	
March	

Table II-4.4: Seeding Windows in Western Washington (continued)

Month	Seeding Recommendations
April	Optimum seeding window
May	
June	
July	Seeding requires irrigation until 75% grass cover is established
August	
September	Optimum seeding window
October	Seeding requires a cover of mulch or an erosion control blanket until 75 percent grass cover is established
November	
December	

Design and Installation Specifications

General

- Install channels intended for vegetation before starting major earthwork and hydroseed with a Bonded Fiber Matrix (BFM). For vegetated channels that will have high flows, install erosion control blankets over the top of hydroseed. Before allowing water to flow in vegetated channels, establish a 75% vegetation cover. If vegetated channels cannot be established by seed before water flow, install sod or prevegetated mats in the channel bottom over top of hydromulch and erosion control blankets.
- Confirm the installation of all required stormwater control measures to prevent seed from washing away.
- Hydroseed applications shall include a minimum of 1,500 pounds per acre (lb/acre) of mulch with 3% tackifier. See BMP C121: Mulching for specifications.
- Areas that will have seeding only, and not landscaping, may need compost or meal-based mulch included in the hydroseed in order to establish vegetation. Re-install native topsoil on the disturbed soil surface before application. See BMP T5.13: Post-Construction Soil Quality and Depth.
- When installing seed via hydroseeding operations, only about 1/3 of the seed actually ends up in contact with the soil surface. This reduces the ability to establish a good stand of grass quickly. To overcome this, consider increasing seed quantities by up to 50 percent.
- Vegetation establishment can be enhanced by one of the following two approaches:
    - Approach 1: Enhance vegetation establishment by dividing the hydromulch operation into two phases:

        - Phase 1 – Install all seed and fertilizer with 25% to 30% mulch and tackifier onto the soil in the first lift.
        - Phase 2 – Install the remaining mulch and tackifier over the first lift.
    - Approach 2: Vegetation can also be enhanced by:
        - Installing the mulch, seed, fertilizer, and tackifier in one lift;
        - Spreading or blowing straw over the top of the hydromulch at a rate of about 800 to 1,000 lb/acre; or
        - Holding straw in place with a standard tackifier.

    Both of these approaches (Approach 1 and Approach 2) will increase cost moderately but will greatly improve and enhance vegetative establishment. The increased cost may be offset by the reduced need for:

    - Irrigation,
    - Reapplication of mulch, and
    - Repair of failed slope surfaces.

    Either of these approaches can use standard hydromulch (1,500 lb/acre minimum) and BFM/mechanically bonded fiber matrix (MBFM) (3,000 lb/acre minimum).

- Seed may be installed by hand if it is:
    - Temporary and covered by straw, mulch, or topsoil; or
    - Permanent in small areas (usually less than 1 acre) and covered with mulch, topsoil, or erosion blankets.
- Consult the local suppliers and/or the local conservation district for their recommendations for appropriate seed mixes and application rates. The appropriate mix depends on a variety of factors, including location, exposure, soil type, slope, and expected foot traffic.
- In addition to meeting erosion control functions and not hindering maintenance operations, selection of long-lived, successional growth native vegetation that can compete against or exclude weeds and grow with minimal maintenance after plant establishment is preferred. Provide diversity to the greatest extent possible and plan for a succession of flowering times to improve pollinator habitat.
- The seed mixes listed in Table II-4.5: Temporary and Permanent Seed Mixes for Western Washington (continued) include recommended mixes for both temporary and permanent seeding. Alternative seed mixes approved by the local jurisdiction may also be used.
- Apply the mixes in Table II-4.5: Temporary and Permanent Seed Mixes for Western Washington (continued), with the exception of the wet area seed mix, at a rate of 120 pounds per acre. This rate can be reduced if soil amendments or slow-release fertilizers are used. Apply the wet area seed mix at a rate of 60 pounds per acre.

Table II-4.5: Temporary and Permanent Seed Mixes for Western Washington

Common Name	Latin Name	% Weight	% Purity	% Germination
Temporary Erosion Control Seed Mix A standard mix for areas requiring a temporary vegetative cover.				
Chewings or annual blue grass	*Festuca rubra var. commutata* or *Poa anna*	40	98	90
Perennial rye	*Lolium perenne*	50	98	90
Redtop or colonial bentgrass	*Agrostis alba* or *Agrostis tenuis*	5	92	85
White dutch clover	*Trifolium repens*	5	98	90
Landscaping Seed Mix A recommended mix for landscaping seed.				
Perennial rye blend	*Lolium perenne*	70	98	90
Chewings and red fescue blend	*Festuca rubra var. commutata* or *Festuca rubra*	30	98	90
Low-Growing Turf Seed Mix A turf seed mix for dry situations where there is no need for watering. This mix requires very little maintenance.				
Dwarf tall fescue (several varieties)	*Festuca arundinacea var.*	45	98	90
Dwarf perennial rye (Barclay)	*Lolium perenne var. barclay*	30	98	90
Red fescue	*Festuca rubra*	20	98	90
Colonial bentgrass	*Agrostis tenuis*	5	98	90
Bioswale Seed Mix A seed mix for bioswales and other intermittently wet areas.				
Tall or meadow fescue	*Festuca arundinacea* or *Festuca elatior*	75-80	98	90
Seaside/Creeping bentgrass	*Agrostis palustris*	10-15	92	85
Redtop bentgrass	*Agrostis alba* or *Agrostis gigantea*	5-10	90	80
Wet Area Seed Mix				

Table II-4.5: Temporary and Permanent Seed Mixes for Western Washington (continued)

Common Name	Latin Name	% Weight	% Purity	% Germination
A low-growing, relatively non-invasive seed mix appropriate for very wet areas that are not regulated wetlands. Consult Hydraulic Permit Authority (HPA) for seed mixes if applicable.				
Tall or meadow fescue	*Festuca arundinacea* or *Festuca elatior*	60-70	98	90
Seaside/Creeping bentgrass	*Agrostis palustris*	10-15	98	85
Meadow foxtail	*Alepocurus pratensis*	10-15	90	80
Alsike clover	*Trifolium hybridum*	1-6	98	90
Redtop bentgrass	*Agrostis alba*	1-6	92	85
Meadow Seed Mix A recommended meadow seed mix for infrequently maintained areas or non-maintained areas where colonization by native plants is desirable. Likely applications include rural road and utility right-of-way. Seeding should take place in September or very early October in order to obtain adequate establishment prior to the winter months. Consider the appropriateness of clover, a fairly invasive species, in the mix. Amending the soil can reduce the need for clover.				
Redtop or Oregon bentgrass	*Agrostis alba* or *Agrostis oregonensis*	20	92	85
Red fescue	*Festuca rubra*	70	98	90
White dutch clover	*Trifolium repens*	10	98	90

Roughening and Rototilling

- The seedbed should be firm and rough. Roughen all soil no matter what the slope. Track walk slopes before seeding if engineering purposes require compaction. Backblading or smoothing of slopes greater than 4H:1V is not allowed if they are to be seeded.
- Restoration-based landscape practices require deeper incorporation than that provided by a simple, single-pass rototilling treatment. Wherever practical, initially rip the subgrade to improve long-term permeability, infiltration, and water inflow qualities. At a minimum, permanent areas shall receive soil amendments to achieve organic matter and permeability performance defined in engineered soil/landscape systems. For systems that are deeper than 8 inches, complete the rototilling process in multiple lifts, or prepare the soil amendments per the specifications and place to achieve the specified depth.

Fertilizers

- Conducting soil tests to determine the exact type and quantity of fertilizer needed is recommended. This will prevent the overapplication of fertilizer.
- Organic matter is the most appropriate form of fertilizer because it provides nutrients (including nitrogen, phosphorus, and potassium) in the least water-soluble form.
- In general, use 10-4-6 N-P-K (nitrogen-phosphorus-potassium) fertilizer at a rate of 90 pounds per acre.
- Always use slow-release fertilizers because they are more efficient and have fewer environmental impacts. Do not add fertilizer to the hydromulch machine, or agitate, more than 20 minutes before use. Too much agitation destroys the slow-release coating.
- There are numerous products available to take the place of chemical fertilizers, including several with seaweed extracts that are beneficial to soil microbes and organisms. If 100% cottonseed meal is used as the mulch in hydroseed, chemical fertilizer may not be necessary. Cottonseed meal provides a good source of long-term, slow-release, available nitrogen.

Bonded Fiber Matrix and Mechanically Bonded Fiber Matrix

- On steep slopes, use Bonded Fiber Matrix (BFM) or Mechanically Bonded Fiber Matrix (MBFM) products. Apply BFM/MBFM products at a minimum rate of 3,000 pounds per acre with approximately 10% tackifier. Achieve a minimum of 95% soil coverage during application. Numerous products are available commercially. Most products require 24-36 hours to cure before rainfall, and cannot be installed on wet or saturated soils. Generally, products come in 40-50 pound bags and include all necessary ingredients except for seed and fertilizer.
- Install products per manufacturer's instructions.
- BFMs and MBFMs provide good alternatives to blankets in most areas requiring vegetation establishment. Advantages over blankets include the following:
    - BFM and MBFMs do not require surface preparation.
    - Helicopters can assist in installing BFM and MBFMs in remote areas.
    - On slopes steeper than 2.5H:1V, blanket installers may require ropes and harnesses for safety.
    - Installing BFM and MBFMs can save at least $1,000 per acre compared to blankets.

Maintenance Standards

- Reseed any seeded areas that fail to establish at least 75% cover (100% cover for areas that receive sheet or concentrated flows) of all seeded areas after 3 months of active growth following germination during the growing season. If reseeding is ineffective, use an alternate method, such as sodding, mulching, or nets/blankets. If winter weather prevents

adequate grass growth, this time limit may be relaxed at the discretion of the local authority when sensitive areas would otherwise be protected.

- Reseed and protect by mulch any areas that experience erosion after achieving adequate cover. If the erosion problem is drainage related, the problem shall be fixed and the eroded area reseeded and protected by mulch.
- Supply seeded areas with adequate moisture, but do not water to the extent that it causes runoff.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

BMP C121: Mulching

Purpose

Mulching soils provides immediate temporary protection from erosion. Mulch also enhances plant establishment by conserving moisture, holding fertilizer, seed, and topsoil in place, and moderating soil temperatures. There are a variety of mulches that can be used. This section discusses only the most common types of mulch.

Conditions of Use

As a temporary cover measure, mulch should be used:

- For less than 30 days on disturbed areas that require cover.
- At all times for seeded areas, especially during the wet season and during the hot summer months.
- During the wet season on slopes steeper than 3H:1V with more than 10 feet of vertical relief.

Mulch may be applied at any time of the year and must be refreshed periodically.

For seeded areas, mulch may be made up of 100 percent:

- Cottonseed meal;
- Fibers made of wood, recycled cellulose, hemp, or kenaf;

Any areas that experience erosion shall be remulched and/or protected with a net or blanket. If the erosion problem is drainage related, then the problem shall be fixed and the eroded area remulched.

BMP C122: Nets and Blankets

Purpose

Erosion control nets and blankets are intended to prevent erosion and hold seed and mulch in place on steep slopes and in channels so that vegetation can become well established. In addition, some nets and blankets can be used to permanently reinforce turf to protect drainage systems during high flows.

Nets (commonly called matting) are strands of material woven into an open, but high-tensile strength net (e.g. coconut fiber matting). Blankets are strands of material that are not tightly woven, but instead form a layer of interlocking fibers, typically held together by a biodegradable or photodegradable netting (for example, excelsior or straw blankets). They generally have lower tensile strength than nets, but cover the ground more completely. Coir (coconut fiber) fabric comes as both nets and blankets.

Conditions of Use

Erosion control netting and blankets shall be made of natural plant fibers unaltered by synthetic materials.

Erosion control nets and blankets should be used:

- To aid permanent vegetated stabilization of slopes 2H:1V or greater and with more than 10 feet of vertical relief.
- For drainage ditches and swales (highly recommended). The application of appropriate netting or blanket to drainage ditches and swales can protect bare soil from channelized runoff while vegetation is established. Nets and blankets also can capture a great deal of sediment due to their open, porous structure. Nets and blankets can be used to permanently stabilize channels and may provide a cost-effective, environmentally preferable alternative to riprap.

Disadvantages of nets and blankets include:

- Surface preparation is required.
- On slopes steeper than 2.5H:1V, net and blanket installers may need to be roped and harnessed for safety.
- They cost at least $4,000 - $6,000 per acre installed.

Advantages of nets and blankets include:

- Installation without mobilizing special equipment.
- Installation by anyone with minimal training

- Installation in stages or phases as the project progresses.
- Installers can hand place seed and fertilizer as they progress down the slope.
- Installation in any weather.
- There are numerous types of nets and blankets that can be designed with various parameters in mind. Those parameters include: fiber blend, mesh strength, longevity, biodegradability, cost, and availability.

An alternative to nets and blankets in some limited conditions is BMP C202: Riprap Channel Lining. Ensure that BMP C202: Riprap Channel Lining is appropriate before using it as a substitute for nets and blankets.

Design and Installation Specifications

- See Figure II-4.3: Channel Installation (Clackamas County et al., 2008) and Figure II-4.4: Slope Installation for typical orientation and installation of nets and blankets used in channels and as slope protection. Note: these are typical only; all nets and blankets must be installed per manufacturer's installation instructions.
- Installation is critical to the effectiveness of these products. If good ground contact is not achieved, runoff can concentrate under the product, resulting in significant erosion.
- Install nets and blankets on slopes per the following steps:
    1. Complete final grade and track walk up and down the slope. Soils should be raked and uniform prior to installing nets or blankets. To be effective, nets and blankets must have good adhesion to the soil.
    2. Install hydromulch with seed and fertilizer.
    3. Dig a small trench, approximately 12 inches wide by 6 inches deep along the top of the slope.
    4. Install the leading edge of the net/blanket into the small trench and staple approximately every 18 inches.

       NOTE: Staples are metal, "U"-shaped, and a minimum of 6 inches long. Longer staples are used in sandy soils. Biodegradable stakes are also available.
    5. Roll the net/blanket slowly down the slope as the installer walks backward.

       NOTE: The net/blanket rests against the installer's legs. Staples are installed as the net/blanket is unrolled. It is critical that the proper staple pattern is used for the net/blanket being installed. The net/blanket is not to be allowed to roll down the slope on its own as this stretches the net/blanket, making it impossible to maintain soil contact. In addition, no one is allowed to walk on the net/blanket after it is in place.
    6. If the net/blanket is not long enough to cover the entire slope length, the trailing edge of the upper net/blanket should overlap the leading edge of the lower net/blanket and be stapled. On steeper slopes, this overlap should be installed in a small trench, stapled, and covered with soil.

- With the variety of products available, it is impossible to cover all the details of appropriate use and installation. Therefore, it is critical that the designer consult the manufacturer's information and that a site visit takes place in order to ensure that the product specified is appropriate. Information is also available in WSDOT's *Standard Specifications for Road, Bridge, and Municipal Construction* Division 8-01 and Division 9-14 (WSDOT, 2016).
- Use jute matting in conjunction with mulch (BMP C121: Mulching). Excelsior, woven straw blankets and coir (coconut fiber) blankets may be installed without mulch. There are many other types of erosion control nets and blankets on the market that may be appropriate in certain circumstances.
- In general, most nets (e.g., jute matting) require mulch in order to prevent erosion because they have a fairly open structure. Blankets typically do not require mulch because they usually provide complete protection of the surface.
- Extremely steep, unstable, wet, or rocky slopes are often appropriate candidates for use of synthetic blankets, as are riverbanks, beaches and other high-energy environments. If synthetic blankets are used, the soil should be hydromulched first.
- 100 percent biodegradable blankets are available for use in sensitive areas. These organic blankets are usually held together with a paper or fiber mesh and stitching which may last up to a year.
- Most netting used with blankets is photodegradable, meaning it breaks down under sunlight (not UV stabilized). However, this process can take months or years even under bright sun. Once vegetation is established, sunlight does not reach the mesh. It is not uncommon to find non-degraded netting still in place several years after installation. This can be a problem if maintenance requires the use of mowers or ditch cleaning equipment. In addition, birds and small animals can become trapped in the netting.

Maintenance Standards

- Maintain good contact with the ground. Erosion must not occur beneath the net or blanket.
- Repair and staple any areas of the net or blanket that are damaged or not in close contact with the ground.
- Fix and protect eroded areas if erosion occurs due to poorly controlled drainage.

Figure II-4.3: Channel Installation

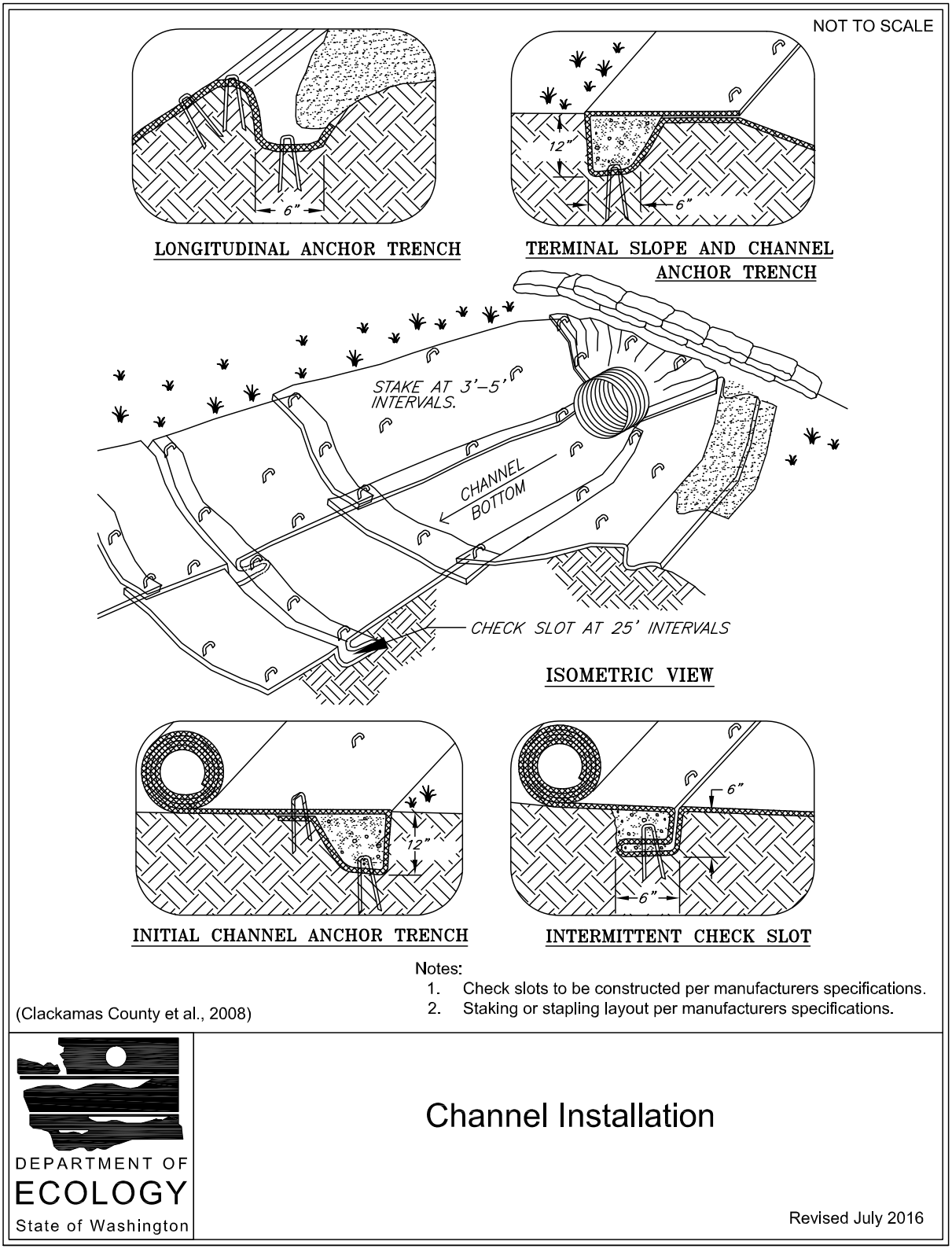
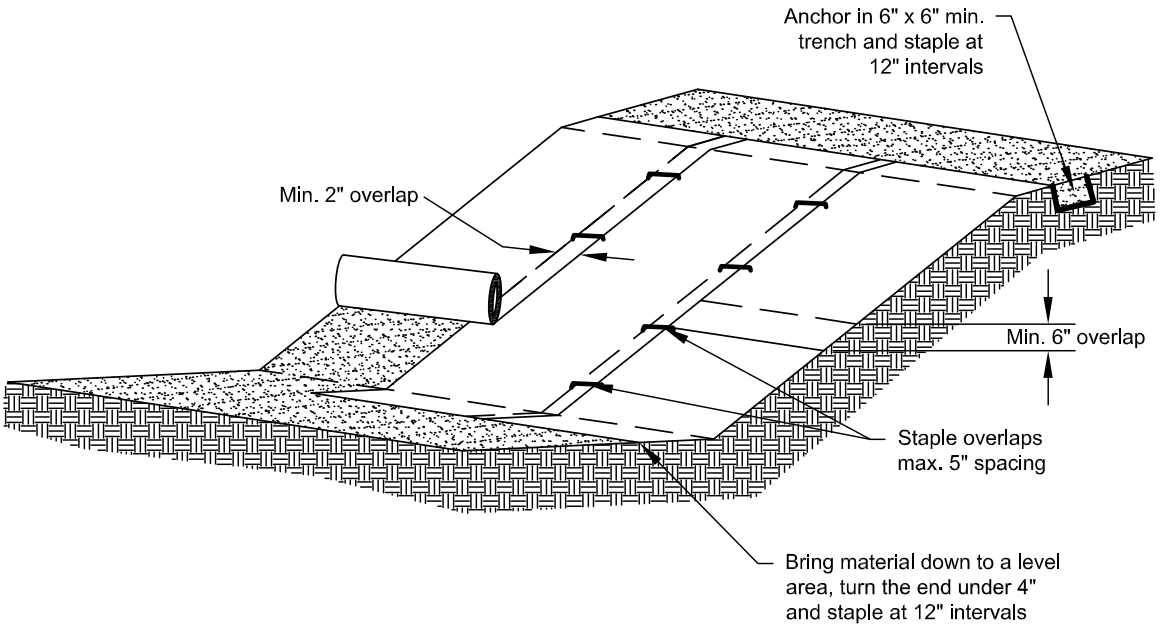


Figure II-4.4: Slope Installation



Notes:

1. Slope surface shall be smooth before placement for proper soil contact.
2. Stapling pattern as per manufacturer's recommendations.
3. Do not stretch blankets/mattings tight - allow the rolls to mold to any irregularities.
4. For slopes less than 3H:1V, rolls may be placed in horizontal strips.
5. If there is a berm at the top of the slope, anchor upslope of the berm.
6. Lime, fertilize, and seed before installation. Planting of shrubs, trees, etc. should occur after installation.

NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Slope Installation

Revised June 2016

BMP C123: Plastic Covering

Purpose

Plastic covering provides immediate, short-term erosion protection to slopes and disturbed areas.

Conditions of Use

Plastic covering may be used on disturbed areas that require cover measures for less than 30 days, except as stated below.

- Plastic is particularly useful for protecting cut and fill slopes and stockpiles. However, the relatively rapid breakdown of most polyethylene sheeting makes it unsuitable for applications greater than six months.
- Due to rapid runoff caused by plastic covering, do not use this method upslope of areas that might be adversely impacted by concentrated runoff. Such areas include steep and/or unstable slopes.
- Plastic sheeting may result in increased runoff volumes and velocities, requiring additional on-site measures to counteract the increases. Creating a trough with wattles or other material can convey clean water away from these areas.
- To prevent undercutting, trench and backfill rolled plastic covering products.
- Although the plastic material is inexpensive to purchase, the cost of installation, maintenance, removal, and disposal add to the total costs of this BMP.
- Whenever plastic is used to protect slopes, install water collection measures at the base of the slope. These measures include plastic-covered berms, channels, and pipes used to convey clean rainwater away from bare soil and disturbed areas. Do not mix clean runoff from a plastic covered slope with dirty runoff from a project.
- Other uses for plastic include:
    - Temporary ditch liner.
    - Pond liner in temporary sediment pond.
    - Liner for bermed temporary fuel storage area if plastic is not reactive to the type of fuel being stored.
    - Emergency slope protection during heavy rains.
    - Temporary drainpipe (“elephant trunk”) used to direct water.

Design and Installation Specifications

- Plastic slope cover must be installed as follows:
    1. Run plastic up and down the slope, not across the slope.
    2. Plastic may be installed perpendicular to a slope if the slope length is less than 10 feet.
    3. Provide a minimum of 8-inch overlap at the seams.
    4. On long or wide slopes, or slopes subject to wind, tape all seams.
    5. Place plastic into a small (12-inch wide by 6-inch deep) slot trench at the top of the slope and backfill with soil to keep water from flowing underneath.
    6. Place sand filled burlap or geotextile bags every 3 to 6 feet along seams and tie them together with twine to hold them in place.
    7. Inspect plastic for rips, tears, and open seams regularly and repair immediately. This prevents high velocity runoff from contacting bare soil, which causes extreme erosion.
    8. Sandbags may be lowered into place tied to ropes. However, all sandbags must be staked in place.
- Plastic sheeting shall have a minimum thickness of 6 mil.
- If erosion at the toe of a slope is likely, a gravel berm, riprap, or other suitable protection shall be installed at the toe of the slope in order to reduce the velocity of runoff.

Maintenance Standards

- Torn sheets must be replaced and open seams repaired.
- Completely remove and replace the plastic if it begins to deteriorate due to ultraviolet radiation.
- Completely remove plastic when no longer needed.
- Dispose of old tires used to weight down plastic sheeting appropriately.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

steep slopes, silty and clayey soils (USDA Classification Type "C" and "D" soils), long grades, and high precipitation areas. When PAM is applied first to bare soil and then covered with straw, a reapplication may not be necessary for several months.

- PAM may affect the treatment efficiency of chitosan flocculent systems.

BMP C130: Surface Roughening

Purpose

Surface roughening aids in the establishment of vegetative cover, reduces runoff velocity, increases infiltration, and provides for sediment trapping through the provision of a rough soil surface. Horizontal depressions are created by operating a tiller or other suitable equipment on the contour or by leaving slopes in a roughened condition by not fine grading them.

Use this BMP in conjunction with other BMPs such as BMP C120: Temporary and Permanent Seeding, BMP C121: Mulching, or BMP C124: Sodding.

Conditions for Use

- All slopes steeper than 3H:1V and greater than 5 vertical feet require surface roughening to a depth of 2 to 4 inches prior to seeding.
- Areas that will not be stabilized immediately may be roughened to reduce runoff velocity until seeding takes place.
- Slopes with a stable rock face do not require roughening.
- Slopes where mowing is planned should not be excessively roughened.

Design and Installation Specifications

There are different methods for achieving a roughened soil surface on a slope, and the selection of an appropriate method depends on the type of slope. Roughening methods include stair-step grading, grooving, contour furrows, and tracking. See Figure II-4.5: Surface Roughening by Tracking and Contour Furrows. Factors to be considered in choosing a roughening method are slope steepness, mowing requirements, and whether the slope is formed by cutting or filling.

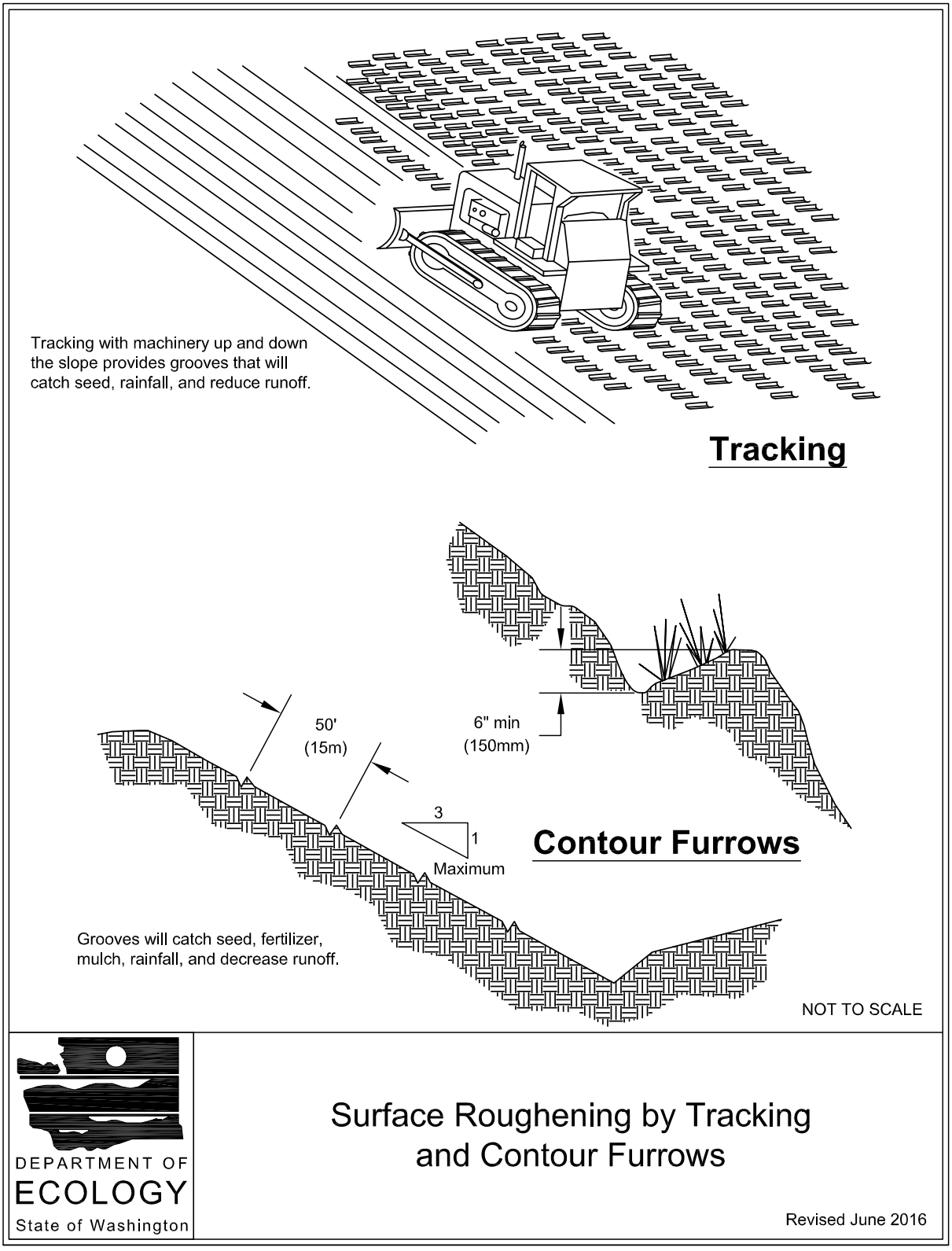
- Disturbed areas that will not require mowing may be stair-step graded, grooved, or left rough after filling.
- Stair-step grading is particularly appropriate in soils containing large amounts of soft rock. Each "step" catches material that sloughs from above, and provides a level site where vegetation can become established. Stairs should be wide enough to work with standard earth moving equipment. Stair steps must be on contour or gullies will form on the slope.
- Areas that will be mowed (these areas should have slopes less steep than 3H:1V) may have small furrows left by disking, harrowing, raking, or seed-planting machinery operated on the contour.

- Graded areas with slopes steeper than 3H:1V but less than 2H:1V should be roughened before seeding. This can be accomplished in a variety of ways, including "track walking", or driving a crawler tractor up and down the slope, leaving a pattern of cleat imprints parallel to slope contours.
- Tracking is done by operating equipment up and down the slope to leave horizontal depressions in the soil.

Maintenance Standards

- Areas that are surface roughened should be seeded as quickly as possible.
- Regular inspections should be made of the area. If rills appear, they should be re-roughened and re-seeded immediately.

Figure II-4.5: Surface Roughening by Tracking and Contour Furrows



BMP C140: Dust Control

Purpose

Dust control prevents wind transport of dust from disturbed soil surfaces onto roadways, into drainage systems, and into surface waters.

Conditions of Use

Use dust control in areas (including roadways) subject to surface and air movement of dust where on-site or off-site impacts to roadways, drainage systems, or surface waters are likely.

Design and Installation Specifications

- Vegetate or mulch areas that will not receive vehicle traffic. In areas where planting, mulching, or paving is impractical, apply gravel or landscaping rock.
- Limit dust generation by clearing only those areas where immediate activity will take place, leaving the remaining area(s) in the original condition. Maintain the original ground cover as long as practical.
- Construct natural or artificial windbreaks or windscreens. These may be designed as enclosures for small dust sources.
- Sprinkle the site with water until the surface is wet. Repeat as needed. To prevent carryout of mud onto the street, refer to BMP C105: Stabilized Construction Access and BMP C106: Wheel Wash.
- Irrigation water can be used for dust control. Irrigation systems should be installed as a first step on sites where dust control is a concern.
- Spray exposed soil areas with a dust palliative, following the manufacturer's instructions and cautions regarding handling and application. Used oil is prohibited from use as a dust suppressant. Local jurisdictions may approve other dust palliatives such as calcium chloride or PAM.
- PAM (BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection) added to water at a rate of 0.5 pounds per 1,000 gallons of water per acre and applied from a water truck is more effective than water alone. This is due to the increased infiltration of water into the soil and reduced evaporation. In addition, small soil particles are bonded together and are not as easily transported by wind. Adding PAM may reduce the quantity of water needed for dust control.

  Note that the application rate specified here applies to this BMP, and is not the same application rate that is specified in BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection, but the downstream protections still apply.

  Refer to BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection for conditions of use. PAM shall not be directly applied to water or allowed to enter a water body. PAM use shall

be reviewed and approved by the local permitting authority and discharge of PAM may be a basis for penalties per RCW 90.48.080.

- Contact your local Air Pollution Control Authority for guidance and training on other dust control measures. Compliance with the local Air Pollution Control Authority constitutes compliance with this BMP. See the following website for more information:

  https://ecology.wa.gov/About-us/Our-role-in-the-community/Partnerships-committees/Clean-air-agencies

- Use vacuum street sweepers.
- Remove mud and other dirt promptly so it does not dry and then turn into dust.
- Techniques that can be used for unpaved roads and lots include:
  - Lower speed limits. High vehicle speed increases the amount of dust stirred up from unpaved roads and lots.
  - Upgrade the road surface strength by improving particle size, shape, and mineral types that make up the surface and base materials.
  - Add surface gravel to reduce the source of dust emission. Limit the amount of fine particles (those smaller than .075 mm) to 10 to 20 percent.
  - Use geotextile fabrics to increase the strength of new roads or roads undergoing reconstruction.
  - Encourage the use of alternate, paved routes, if available.
  - Apply chemical dust suppressants using the admix method, blending the product with the top few inches of surface material. Suppressants may also be applied as surface treatments.
  - Limit dust-generating work on windy days.
  - Pave unpaved permanent roads and other trafficked areas.

Maintenance Standards

Respray area as necessary to keep dust to a minimum.

BMP C150: Materials on Hand

Purpose

Keep quantities of erosion prevention and sediment control materials on the project site at all times to be used for regular maintenance and emergency situations such as unexpected heavy rains. Having these materials on-site reduces the time needed to replace existing or implement new BMPs when inspections indicate that existing BMPs are not meeting the Construction SWPPP requirements. In addition, contractors can save money by buying some materials in bulk and storing them at their office or yard.

Conditions of Use

- Construction projects of any size or type can benefit from having materials on hand. A small commercial development project could have a roll of plastic and some gravel available for immediate protection of bare soil and temporary berm construction. A large earthwork project, such as highway construction, might have several tons of straw, several rolls of plastic, flexible pipe, sandbags, geotextile fabric and steel “T” posts.
- Materials should be stockpiled and readily available before any site clearing, grubbing, or earthwork begins. A large contractor or project proponent could keep a stockpile of materials that are available for use on several projects.
- If storage space at the project site is at a premium, the contractor could maintain the materials at their office or yard. The office or yard must be less than an hour from the project site.

Design and Installation Specifications

Depending on project type, size, complexity, and length, materials and quantities will vary. A good minimum list of items that will cover numerous situations includes:

- Clear plastic, 6 mil
- Drainpipe, 6 or 8 inch diameter
- Sandbags, filled
- Straw bales for mulching
- Quarry spalls
- Washed gravel
- Geotextile fabric
- Catch basin inserts
- Steel "T" posts
- Silt fence material
- Straw wattles

Maintenance Standards

- All materials with the exception of the quarry spalls, steel “T” posts, and gravel should be kept covered and out of both sun and rain.
- Re-stock materials as needed.

BMP C151: Concrete Handling

Purpose

Concrete work can generate process water and slurry that contain fine particles and high pH, both of which can violate water quality standards in the receiving water. Concrete spillage or concrete discharge to waters of the State is prohibited. Use this BMP to minimize and eliminate concrete, concrete process water, and concrete slurry from entering waters of the State.

Conditions of Use

Any time concrete is used, utilize these management practices. Concrete construction project components include, but are not limited to:

- Curbs
- Sidewalks
- Roads
- Bridges
- Foundations
- Floors
- Runways

Disposal options for concrete, in order of preference are:

1. Off-site disposal
2. Concrete wash-out areas (see BMP C154: Concrete Washout Area)
3. De minimus washout to formed areas awaiting concrete

Design and Installation Specifications

- Wash concrete truck drums at an approved off-site location or in designated concrete washout areas only. Do not wash out concrete trucks onto the ground (including formed areas awaiting concrete), or into storm drains, open ditches, streets, or streams. Refer to BMP C154: Concrete Washout Area for information on concrete washout areas.
    - Return unused concrete remaining in the truck and pump to the originating batch plant for recycling. Do not dump excess concrete on site, except in designated concrete washout areas as allowed in BMP C154: Concrete Washout Area.
- Wash small concrete handling equipment (e.g. hand tools, screeds, shovels, rakes, floats, trowels, and wheelbarrows) into designated concrete washout areas or into formed areas awaiting concrete pour.

- At no time shall concrete be washed off into the footprint of an area where an infiltration feature will be installed.
- Wash equipment difficult to move, such as concrete paving machines, in areas that do not directly drain to natural or constructed stormwater conveyance or potential infiltration areas.
- Do not allow washwater from areas, such as concrete aggregate driveways, to drain directly (without detention or treatment) to natural or constructed stormwater conveyances.
- Contain washwater and leftover product in a lined container when no designated concrete washout areas (or formed areas, allowed as described above) are available. Dispose of contained concrete and concrete washwater (process water) properly.
- Always use forms or solid barriers for concrete pours, such as pilings, within 15-feet of surface waters.
- Refer to BMP C252: Treating and Disposing of High pH Water for pH adjustment requirements.
- Refer to the Construction Stormwater General Permit (CSWGP) for pH monitoring requirements if the project involves one of the following activities:
    - Significant concrete work (as defined in the CSWGP).
    - The use of soils amended with (but not limited to) Portland cement-treated base, cement kiln dust or fly ash.
    - Discharging stormwater to segments of water bodies on the 303(d) list (Category 5) for high pH.

Maintenance Standards

Check containers for holes in the liner daily during concrete pours and repair the same day.

BMP C152: Sawcutting and Surfacing Pollution Prevention

Purpose

Sawcutting and surfacing operations generate slurry and process water that contain fine particles and have a high pH (concrete cutting), both of which can violate the water quality standards in the receiving water. Concrete spillage or concrete discharge to waters of the State is prohibited. Use this BMP to minimize and eliminate process water and slurry created by sawcutting or surfacing from entering waters of the State.

Conditions of Use

Utilize these management practices anytime sawcutting or surfacing operations take place. Sawcutting and surfacing operations include, but are not limited to:

- Sawing
- Coring
- Grinding
- Roughening
- Hydro-demolition
- Bridge and road surfacing

Design and Installation Specifications

- Vacuum slurry and cuttings during cutting and surfacing operations.
- Slurry and cuttings shall not remain on permanent concrete or asphalt pavement overnight.
- Slurry and cuttings shall not drain to any natural or constructed drainage conveyance including stormwater systems. This may require temporarily blocking catch basins.
- Dispose of collected slurry and cuttings in a manner that does not violate groundwater or surface water quality standards.
- Do not allow process water generated during hydro-demolition, surface roughening, or similar operations to drain to any natural or constructed drainage conveyance including stormwater systems. Dispose of process water in a manner that does not violate groundwater or surface water quality standards.
- Handle and dispose of cleaning waste material and demolition debris in a manner that does not cause contamination of water. Dispose of sweeping material from a pick-up sweeper at an appropriate disposal site.

Maintenance Standards

Continually monitor operations to determine whether slurry, cuttings, or process water could enter waters of the state. If inspections show that a violation of water quality standards could occur, stop operations and immediately implement preventive measures such as berms, barriers, secondary containment, and/or vacuum trucks.

BMP C153: Material Delivery, Storage, and Containment

Purpose

Prevent, reduce, or eliminate the discharge of pollutants to the stormwater system or watercourses from material delivery and storage. Minimize the storage of hazardous materials on-site, store materials in a designated area, and install secondary containment.

Conditions of Use

Use at construction sites with delivery and storage of the following materials:

- Petroleum products such as fuel, oil and grease
- Soil stabilizers and binders (e.g., polyacrylamide)
- Fertilizers, pesticides, and herbicides
- Detergents
- Asphalt and concrete compounds
- Hazardous chemicals such as acids, lime, adhesives, paints, solvents, and curing compounds
- Any other material that may be detrimental if released to the environment

Design and Installation Specifications

- The temporary storage area should be located away from vehicular traffic, near the construction entrance(s), and away from waterways or storm drains.
- Safety Data Sheets (SDS) should be supplied for all materials stored. Chemicals should be kept in their original labeled containers.
- Hazardous material storage on-site should be minimized.
- Hazardous materials should be handled as infrequently as possible.
- During the wet weather season (October 1 – April 30), consider storing materials in a covered area.
- Materials should be stored in secondary containments, such as an earthen dike, horse trough, or even a children's wading pool for non-reactive materials such as detergents, oil, grease, and paints. Small amounts of material may be secondarily contained in "bus boy" trays or concrete mixing trays.
- Do not store chemicals, drums, or bagged materials directly on the ground. Place these items on a pallet and, when possible, within secondary containment.
- If drums must be kept uncovered, store them at a slight angle to reduce ponding of rainwater on the lids to reduce corrosion. Domed plastic covers are inexpensive and snap to the top of drums, preventing water from collecting.
- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 shall be stored in approved containers and drums and shall not be overfilled. Containers and drums shall be stored in temporary secondary containment facilities.
- Temporary secondary containment facilities shall provide for a spill containment volume able to contain 10% of the total enclosed container volume of all containers, or 110% of the capacity of the largest container within its boundary, whichever is greater.

- Secondary containment facilities shall be impervious to the materials stored therein for a minimum contact time of 72 hours.
- Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.
- During the wet weather season (Oct 1 – April 30), each secondary containment facility shall be covered during non-working days.
- Secondary containment facilities shall be covered at all times, except when in active use.
- Keep material storage areas clean, organized, and equipped with an ample supply of appropriate spill clean-up material (spill kit).
- The spill kit should include, at a minimum:
    - 1 - Water resistant nylon bag
    - 3 - Oil absorbent socks 3”x 4’
    - 2 - Oil absorbent socks 3”x 10’
    - 12 - Oil absorbent pads 17”x19”
    - 1 - Pair splash resistant goggles
    - 3 - Pairs nitrile gloves
    - 10 - Disposable bags with ties
    - Instructions

Maintenance Standards

- Secondary containment facilities shall be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills shall be collected and placed into drums. These liquids shall be handled as hazardous waste unless testing determines them to be non-hazardous.
- Re-stock spill kit materials as needed.

BMP C154: Concrete Washout Area

Purpose

Prevent or reduce the discharge of pollutants from concrete waste to stormwater by conducting washout off-site, or performing on-site washout in a designated area.

Conditions of Use

Concrete washout areas are implemented on construction projects where:

- Concrete is used as a construction material
- It is not possible to dispose of all concrete wastewater and washout off-site (ready mix plant, etc.).
- Concrete truck drums are washed on-site.

  Note that auxiliary concrete truck components (e.g. chutes and hoses) and small concrete handling equipment (e.g. hand tools, screeds, shovels, rakes, floats, trowels, and wheel-barrows) may be washed into formed areas awaiting concrete pour.

At no time shall concrete be washed off into the footprint of an area where an infiltration feature will be installed.

Design and Installation Specifications

Implementation

- Perform washout of concrete truck drums at an approved off-site location or in designated concrete washout areas only.
- Do not wash out concrete onto non-formed areas, or into storm drains, open ditches, streets, or streams.
- Wash equipment difficult to move, such as concrete paving machines, in areas that do not directly drain to natural or constructed stormwater conveyance or potential infiltration areas.
- Do not allow excess concrete to be dumped on-site, except in designated concrete washout areas as allowed above.
- Concrete washout areas may be prefabricated concrete washout containers, or self-installed structures (above-grade or below-grade).
- Prefabricated containers are most resistant to damage and protect against spills and leaks. Companies may offer delivery service and provide regular maintenance and disposal of solid and liquid waste.
- If self-installed concrete washout areas are used, below-grade structures are preferred over above-grade structures because they are less prone to spills and leaks.
- Self-installed above-grade structures should only be used if excavation is not practical.
- Concrete washout areas shall be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.

Education

- Discuss the concrete management techniques described in this BMP with the ready-mix concrete supplier before any deliveries are made.
- Educate employees and subcontractors on the concrete waste management techniques described in this BMP.

- Arrange for the contractor's superintendent or Certified Erosion and Sediment Control Lead (CESCL) to oversee and enforce concrete waste management procedures.
- A sign should be installed adjacent to each concrete washout area to inform concrete equipment operators to utilize the proper facilities.

Contracts

Incorporate requirements for concrete waste management into concrete supplier and subcontractor agreements.

Location and Placement

- Locate concrete washout areas at least 50 feet from sensitive areas such as storm drains, open ditches, water bodies, or wetlands.
- Allow convenient access to the concrete washout area for concrete trucks, preferably near the area where the concrete is being poured.
- If trucks need to leave a paved area to access the concrete washout area, prevent track-out with a pad of rock or quarry spalls (see BMP C105: Stabilized Construction Access). These areas should be far enough away from other construction traffic to reduce the likelihood of accidental damage and spills.
- The number of concrete washout areas you install should depend on the expected demand for storage capacity.
- On large sites with extensive concrete work, concrete washout areas should be placed in multiple locations for ease of use by concrete truck drivers.

Concrete Truck Washout Procedures

- Washout of concrete truck drums shall be performed in designated concrete washout areas only.
- Concrete washout from concrete pumper bins can be washed into concrete pumper trucks and discharged into designated concrete washout areas or properly disposed of off-site.

Concrete Washout Area Installation

- Concrete washout areas should be constructed as shown in the figures below, with a recommended minimum length and minimum width of 10 ft, but with sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations.
- Plastic lining material should be a minimum of 10 mil polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.
- Lath and flagging should be commercial type.
- Liner seams shall be installed in accordance with manufacturers' recommendations.

- Soil base shall be prepared free of rocks or other debris that may cause tears or holes in the plastic lining material.

Maintenance Standards

Inspection and Maintenance

- Inspect and verify that concrete washout areas are in place prior to the commencement of concrete work.
- Once concrete wastes are washed into the designated washout area and allowed to harden, the concrete should be broken up, removed, and disposed of per applicable solid waste regulations. Dispose of hardened concrete on a regular basis.
- During periods of concrete work, inspect the concrete washout areas daily to verify continued performance.
    - Check overall condition and performance.
    - Check remaining capacity (% full).
    - If using self-installed concrete washout areas, verify plastic liners are intact and sidewalls are not damaged.
    - If using prefabricated containers, check for leaks.
- Maintain the concrete washout areas to provide adequate holding capacity with a minimum freeboard of 12 inches.
- Concrete washout areas must be cleaned, or new concrete washout areas must be constructed and ready for use once the concrete washout area is 75% full.
- If the concrete washout area is nearing capacity, vacuum and dispose of the waste material in an approved manner.
    - Do not discharge liquid or slurry to waterways, storm drains or directly onto ground.
    - Do not discharge to the sanitary sewer without local approval.
    - Place a secure, non-collapsing, non-water collecting cover over the concrete washout area prior to predicted wet weather to prevent accumulation and overflow of precipitation.
    - Remove and dispose of hardened concrete and return the structure to a functional condition. Concrete may be reused on-site or hauled away for disposal or recycling.
- When you remove materials from a self-installed concrete washout area, build a new structure; or, if the previous structure is still intact, inspect for signs of weakening or damage, and make any necessary repairs. Re-line the structure with new plastic after each cleaning.

Removal of Concrete Washout Areas

- When concrete washout areas are no longer required for the work, the hardened concrete, slurries and liquids shall be removed and properly disposed of.
- Materials used to construct concrete washout areas shall be removed from the site of the work and disposed of or recycled.
- Holes, depressions or other ground disturbance caused by the removal of the concrete washout areas shall be backfilled, repaired, and stabilized to prevent erosion.

Figure II-4.7: Concrete Washout Area with Wood Planks

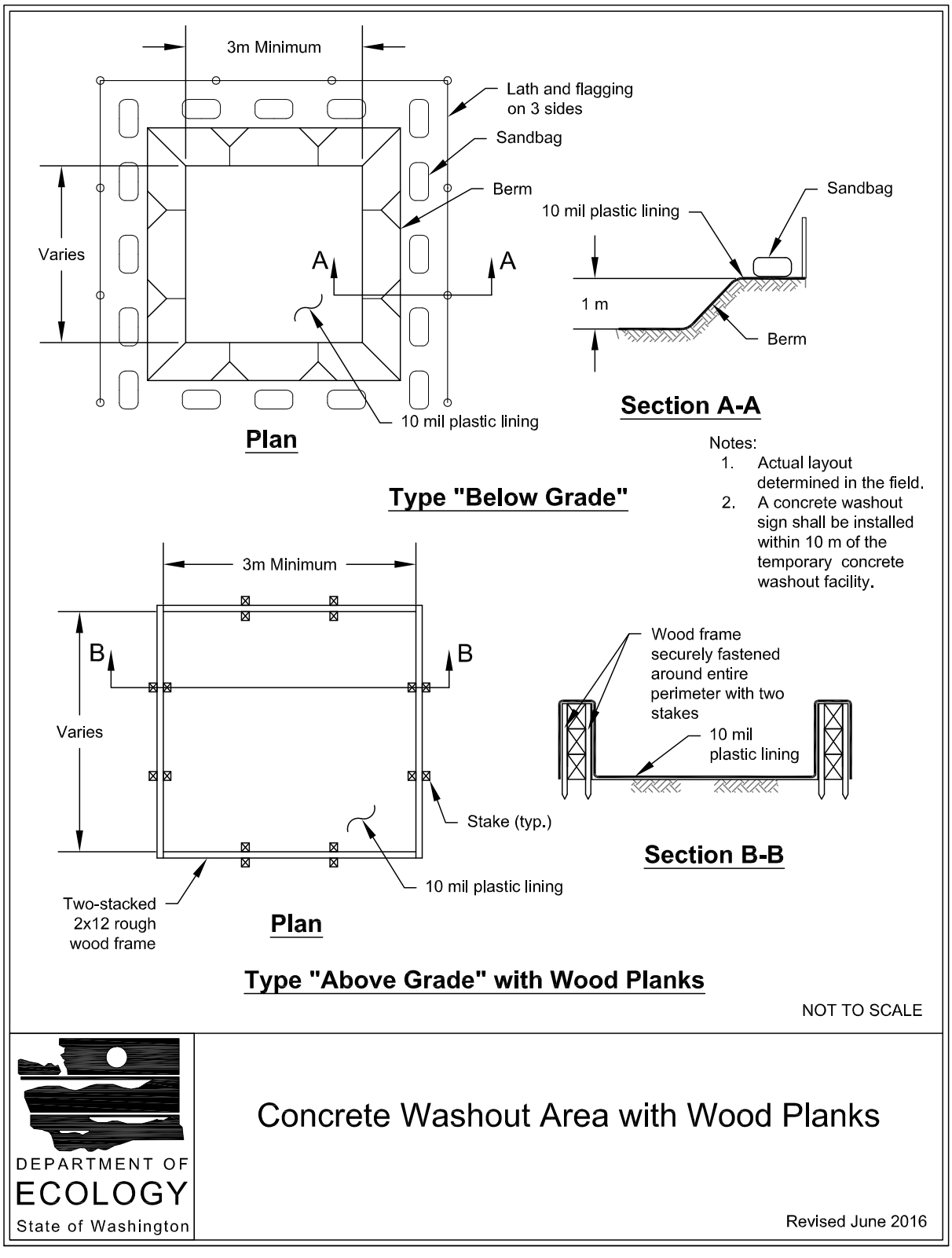
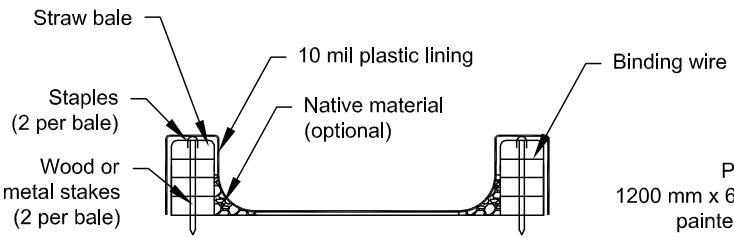
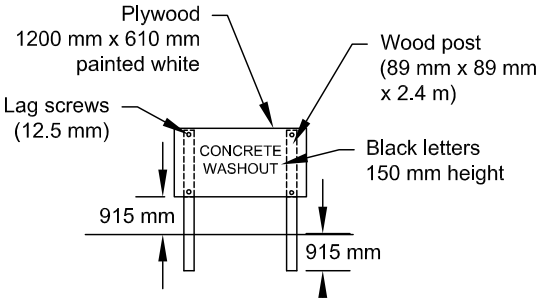


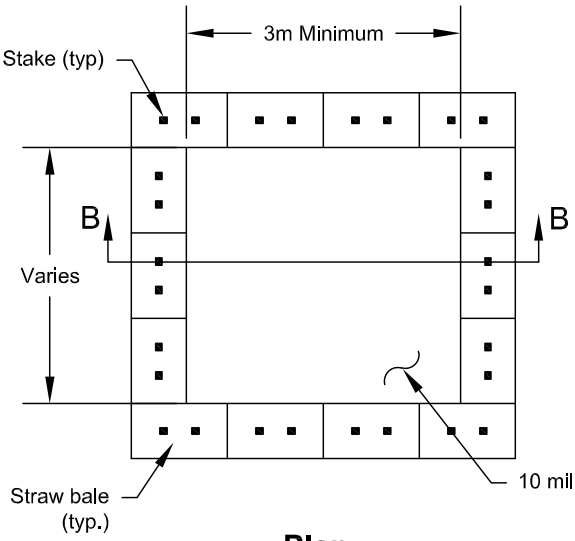
Figure II-4.8: Concrete Washout Area with Straw Bales



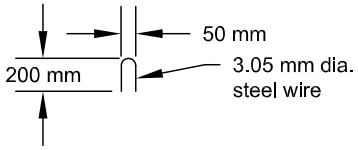
Section B-B



Concrete Washout Sign Detail (or equivalent)



Plan



Staple Detail

Notes:

1. Actual layout determined in the field.
2. The concrete washout sign shall be installed within 10 m of the temporary concrete washout facility.

Type "Above Grade" with Straw Bales

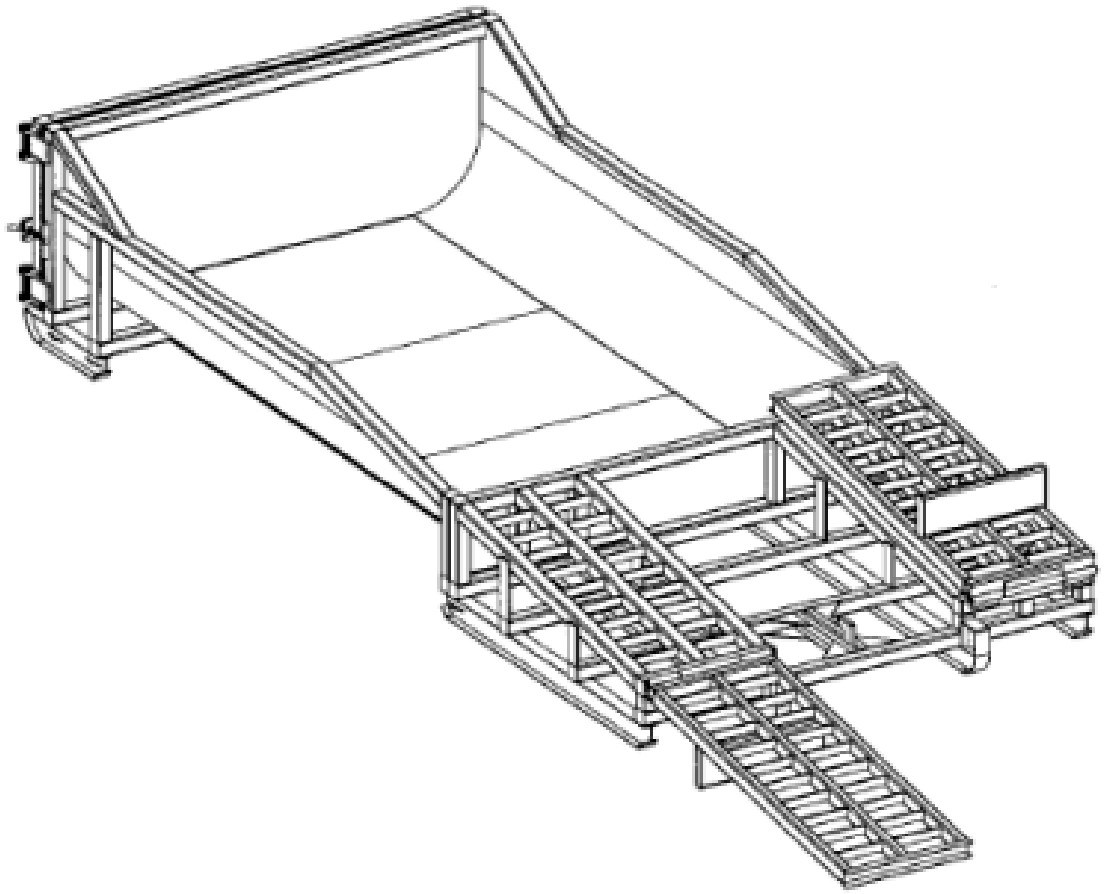
NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Concrete Washout Area with Straw Bales

Revised June 2016

Figure II-4.9: Prefabricated Concrete Washout Container with Ramp



NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Prefabricated Concrete Washout Container with Ramp

Revised June 2016

- See Table II-4.9: Horizontal Spacing of Interceptor Dikes Along Ground Slope for recommended horizontal spacing between dikes.

Table II-4.9: Horizontal Spacing of Interceptor Dikes Along Ground Slope

Average Slope	Slope Percent	Flowpath Length
20H:1V or less	3 - 5%	300 feet
(10 to 20)H:1V	5 - 10%	200 feet
(4 to 10)H:1V	10 - 25%	100 feet
(2 to 4)H:1V	25 - 50%	50 feet

Interceptor Swales

Interceptor swales shall meet the following criteria:

- Bottom Width: 2 feet minimum; the cross-section bottom shall be level.
- Depth: 1 foot minimum.
- Side Slope: 2H:1V or flatter.
- Grade: Maximum 5%, with positive drainage to a suitable outlet (such as BMP C241: Sediment Pond (Temporary)).
- Stabilization: Seed per BMP C120: Temporary and Permanent Seeding, or BMP C202: Riprap Channel Lining, 12 inches thick riprap pressed into the bank and extending at least 8 inches vertical from the bottom.

Maintenance Standards

- Inspect diversion dikes and interceptor swales once a week and after every rainfall. Immediately remove sediment from the flow area.
- Damage caused by construction traffic or other activity must be repaired before the end of each working day.
- Check outlets and make timely repairs as needed to avoid gully formation. When the area below the temporary diversion dike is permanently stabilized, remove the dike and fill and stabilize the channel to blend with the natural surface.

BMP C201: Grass-Lined Channels

Purpose

To provide a channel with a vegetative lining for conveyance of runoff. The purpose of the vegetative lining is to prevent transport of sediment and erosion.

Conditions of Use

This practice applies to construction sites where concentrated runoff needs to be directed to prevent erosion or flooding.

- Use this BMP when a vegetative lining can provide sufficient stability for the channel cross section and at lower velocities of water (normally dependent on grade). This means that the channel slopes are generally less than 5% and space is available for a relatively large cross section.
- Typical uses include roadside ditches, channels at property boundaries, outlets for diversions, and other channels and drainage ditches in low areas.
- Channels that will be vegetated should be installed before major earthwork and hydroseeded with a bonded fiber matrix (BFM). The vegetation should be well established (i.e. 75% cover) before water is allowed to flow in the ditch unless BMP C122: Nets and Blankets is used to protect the channel. With channels that will have high flows, erosion control blankets should be installed over the hydroseed. If vegetation cannot be established from seed before water is allowed in the ditch, sod should be installed in the bottom of the ditch in lieu of hydromulch and blankets.

Design and Installation Specifications

See Figure II-4.10: Typical Grass-Lined Channels

Locate channels where they can conform to the topography and other features such as roads. Use natural drainage systems to the greatest extent possible

- Avoid sharp changes in alignment or bends and changes in grade.
- Do not reshape the landscape to fit the drainage channel.
- The maximum design velocity shall be based on soil conditions, type of vegetation, and method of revegetation, but at no time shall velocity exceed 5 feet/second. The channel shall not be overtopped by the peak volumetric flow rate calculated by one of the following methods:
    - Single Event Hydrograph Method: The peak volumetric flow rate calculated using a 10-minute time step from a Type 1A, 10-year, 24-hour frequency storm for the worst-case land cover condition.

      OR

    - Continuous Simulation Method: The 10-year peak flow rate, as determined by an approved continuous runoff model with a 15-minute time step for the worst-case land cover condition.

  Worst-case land cover conditions (i.e. producing the most runoff) should be used for analysis (in most cases, this would be the land cover conditions just prior to final landscaping).
- Where the grass-lined channel will also function as a permanent stormwater conveyance facility, consult the drainage conveyance requirements of the local jurisdiction.

- An established grass or vegetated lining is required before the channel can be used to convey stormwater, unless stabilized with nets or blankets (see BMP C122: Nets and Blankets).
- If design velocity of a channel to be vegetated by seeding exceeds 2 ft/sec, a temporary channel liner is required. Geotextile or special mulch protection such as fiberglass roving or straw and netting provides stability until the vegetation is fully established. See Figure II-4.11: Temporary Channel Liners.
- Check dams shall be removed when the grass has matured sufficiently to protect the ditch or swale unless the slope of the swale is greater than 4%. The area beneath the check dams shall be seeded and mulched immediately after dam removal.
- If vegetation is established by sodding, the permissible velocity for established vegetation may be used and no temporary liner is needed.
- Do not subject the grass-lined channel to sedimentation from disturbed areas. Use sediment-trapping BMPs upstream of the channel.
- V-shaped grass channels generally apply where the quantity of water is small, such as in short reaches along roadsides. The V-shaped cross section is least desirable because it is difficult to stabilize the bottom where velocities may be high.
- Trapezoidal grass channels are used where runoff volumes are large and slope is low so that velocities are nonerosive to vegetated linings.

  Note: it is difficult to construct small parabolic shaped channels.
- Subsurface drainage or riprap channel bottoms may be necessary on sites that are subject to prolonged wet conditions due to long duration flows or a high water table.
- Provide outlet protection at culvert ends and at channel intersections.
- Grass channels, at a minimum, should carry peak runoff for temporary construction drainage facilities from the 10-year, 24-hour storm for the worst case land cover condition without eroding. Where flood hazard exists, increase the capacity according to the potential damage.
- Grassed channel side slopes generally are constructed 3H:1V or flatter to aid in the establishment of vegetation and for maintenance.
- Construct channels a minimum of 0.2 foot larger around the periphery to allow for soil bulking during seedbed preparations and sod buildup.

Maintenance Standards

During the establishment period, check grass-lined channels after every rainfall.

- After grass is established, periodically check the channel; check it after every heavy rainfall event. Immediately make repairs.
- Check the channel outlet and all road crossings for bank stability and evidence of piping or scour holes.

- Remove all significant sediment accumulations to maintain the designed carrying capacity. Keep the grass in a healthy, vigorous condition at all times, since it is the primary erosion protection for the channel.

Figure II-4.10: Typical Grass-Lined Channels

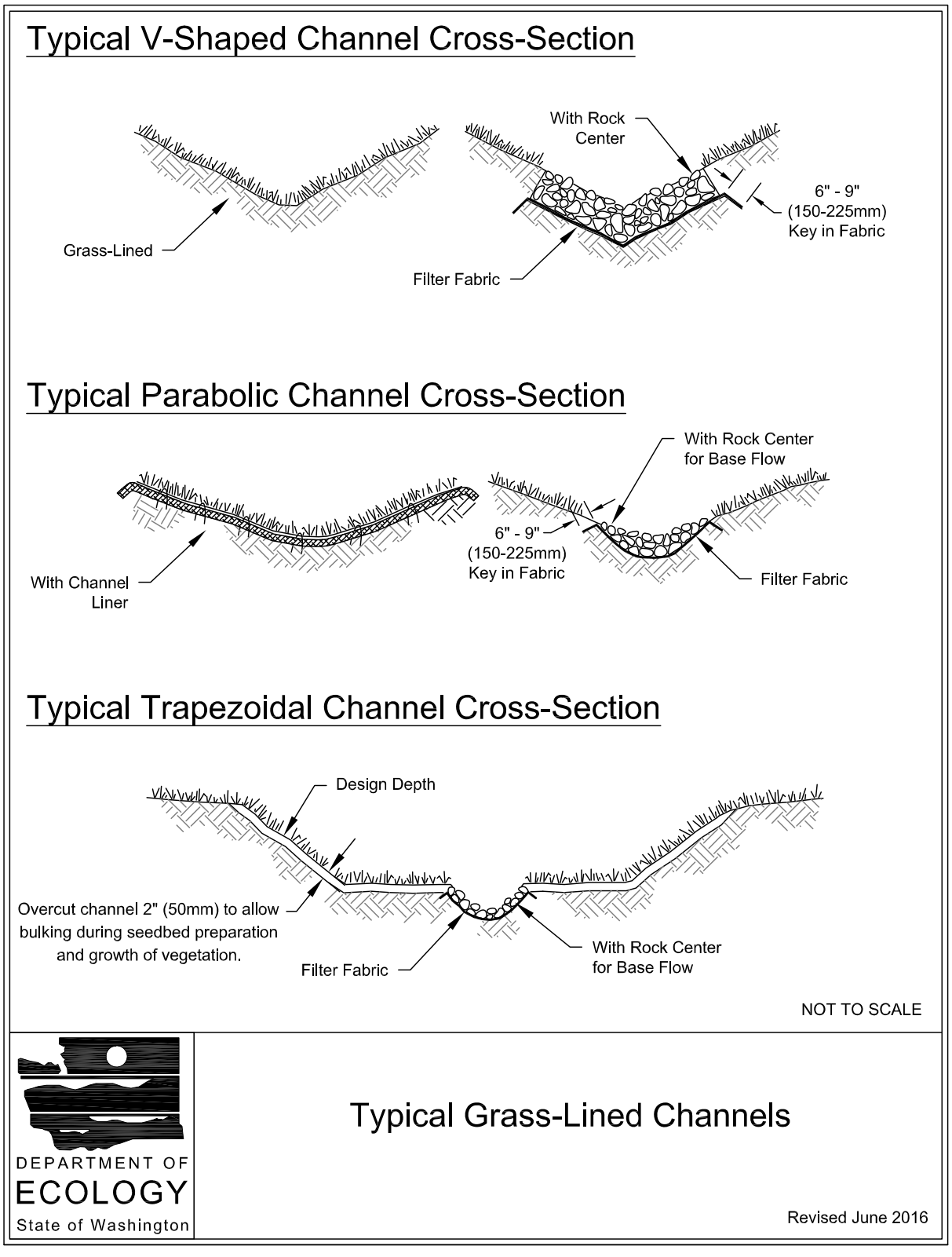
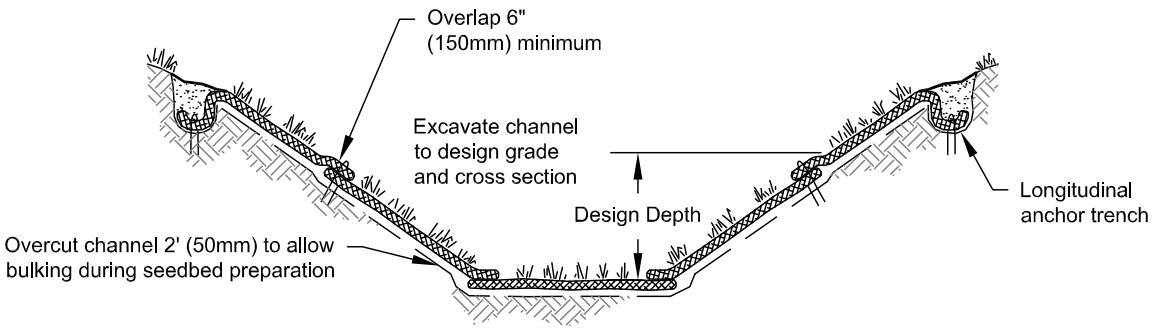
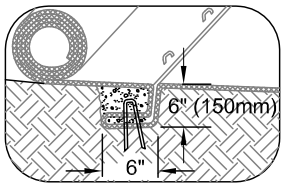


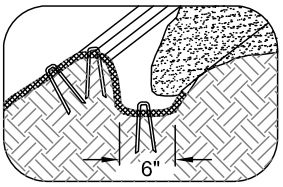
Figure II-4.11: Temporary Channel Liners



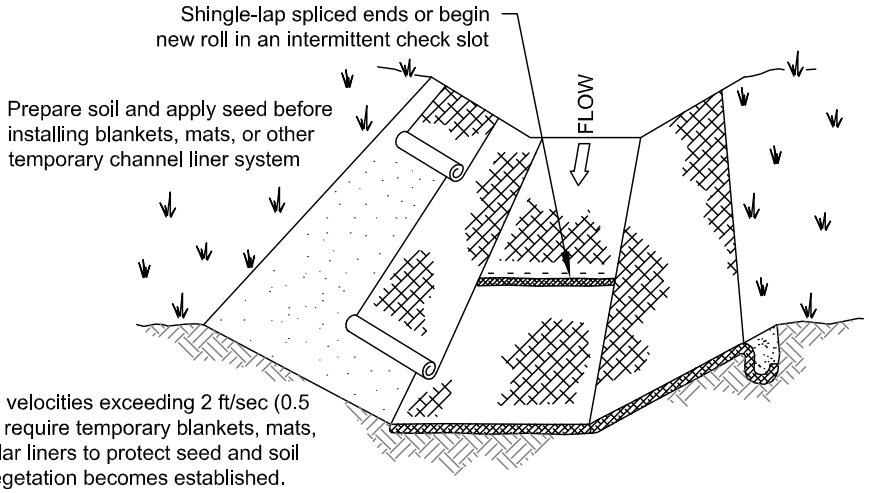


Intermittent Check Slot

Typical installation with
erosion control blankets
or turf reinforcement mats



Longitudinal Anchor Trench



Notes:

1. Design velocities exceeding 2 ft/sec (0.5 m/sec) require temporary blankets, mats, or similar liners to protect seed and soil until vegetation becomes established.
2. Grass-lined channels with design velocities exceeding 6 ft/sec (2 m/sec) should include turf reinforcement mats.

NOT TO SCALE

DEPARTMENT OF
ECOLOGY
State of Washington

Temporary Channel Liners

Revised July 2016

Maintenance Standards

- Monitor the spray field on a daily basis to ensure that over saturation of any portion of the field does not occur at any time. The presence of standing puddles of water or creation of concentrated flows visually signify that over saturation of the field has occurred.
- Monitor the vegetated spray field all the way down to the nearest surface water, or farthest spray area, to ensure that the water has not caused overland or concentrated flows, and has not created erosion around the spray nozzle(s).
- Do not exceed water quality standards for turbidity.
- Ecology recommends that a separate inspection log be developed, maintained, and kept with the existing site logbook to aid the operator conducting inspections. This separate "Field Filtration Logbook" can also aid in demonstrating compliance with permit conditions.
- Inspect the spray nozzles daily, at a minimum, for leaks and plugging from sediment particles.
- If erosion, concentrated flows, or over saturation of the field occurs, rotate the use of branches or spray heads or move the branches to a new field location.
- Check all branches and the manifold for unintended leaks.

BMP C240: Sediment Trap

Purpose

A sediment trap is a small temporary ponding area with a gravel outlet used to collect and store sediment from sites during construction. Sediment traps, along with other perimeter controls, shall be installed before any land disturbance takes place in the contributing drainage area.

Conditions of Use

- Sediment traps are intended for use on sites where the contributing drainage area is less than 3 acres, with no unusual drainage features, and a projected build-out time of 6 months or less. The sediment trap is a temporary measure (with a design life of approximately 6 months) and shall be maintained until the contributing drainage area is permanently protected against erosion by vegetation and/or structures.
- Sediment traps are only effective in removing sediment down to about the medium silt size fraction. Runoff with sediment of finer grades (fine silt and clay) will pass through untreated, emphasizing the need to control erosion to the maximum extent first.
- Projects that are constructing permanent Flow Control BMPs, or permanent Runoff Treatment BMPs that use ponding for treatment, may use the rough-graded or final-graded permanent BMP footprint for the temporary sediment trap. When permanent BMP footprints are used as temporary sediment traps, the surface area requirement of the sediment trap must be met. If the surface area requirement of the sediment trap is larger than the surface area of the permanent BMP, then the sediment trap shall be enlarged beyond the

permanent BMP footprint to comply with the surface area requirement.

- A floating pond skimmer may be used for the sediment trap outlet if approved by the Local Permitting Authority.
- Sediment traps may not be feasible on utility projects due to the limited work space or the short-term nature of the work. Portable tanks may be used in place of sediment traps for utility projects.

Design and Installation Specifications

- See Figure II-4.26: Cross Section of Sediment Trap and Figure II-4.27: Sediment Trap Outlet for details.
- To determine the sediment trap geometry, first calculate the design surface area (SA) of the trap, measured at the invert of the weir. Use the following equation:

$$SA = FS * (Q_2/V_s)$$

where:

SA = Design surface area of the trap (square feet)

FS = A safety factor of 2 to account for non-ideal settling.

Q_2 = The peak volumetric flow rate (cubic feet per second), calculated using one of the following options:

  - Option 1 - Single Event Hydrograph Method

    The peak volumetric flow rate calculated using a 10-minute time step from a Type 1A, 2-year, 24-hour frequency storm for the developed condition. The 10-year peak volumetric flow rate shall be used if the project size, expected timing and duration of construction, or downstream conditions warrant a higher level of protection.

  - Option 2 - The Rational Method

    For construction sites that are less than 1 acre, the peak volumetric flow rate calculated using the Rational Method.

V_s = The settling velocity of the soil particle of interest. The 0.02 mm (medium silt) particle with an assumed density of 2.65 g/cm3 has been selected as the particle of interest and has a settling velocity (V_s) of 0.00096 ft/sec.

Therefore, the equation for computing sediment trap surface area becomes:

$$SA = 2 \times Q_2/0.00096$$

or

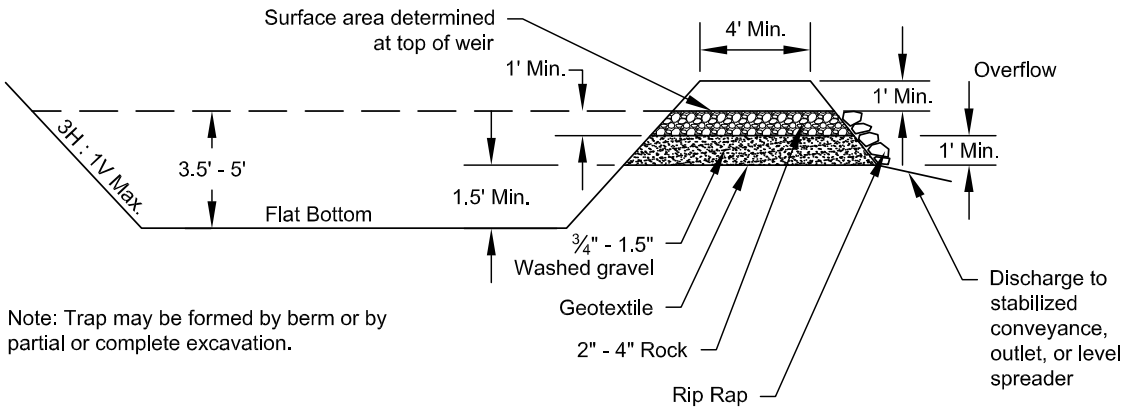
2080 square feet per cfs of inflow

- Sediment trap depth shall be 3.5 feet minimum from the bottom of the trap to the top of the overflow weir.
- To aid in determining sediment depth, all sediment traps shall have a staff gauge with a prominent mark 1 foot above the bottom of the trap.
- Design the discharge from the sediment trap by using the guidance for discharge from temporary sediment ponds in BMP C241: Sediment Pond (Temporary).

Maintenance Standards

- Sediment shall be removed from the trap when it reaches 1 foot in depth.
- Any damage to the trap embankments or slopes shall be repaired.

Figure II-4.26: Cross Section of Sediment Trap



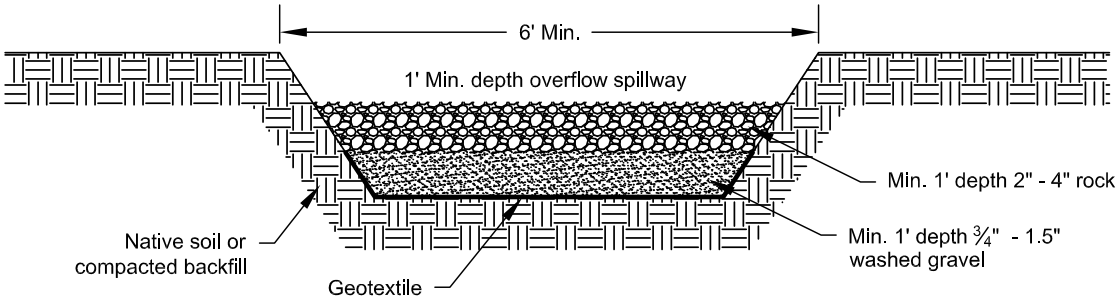
NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Cross Section of Sediment Trap

Revised June 2016

Figure II-4.27: Sediment Trap Outlet



NOT TO SCALE

DEPARTMENT OF
ECOLOGY
State of Washington

Sediment Trap Outlet

Revised June 2016

BMP C241: Sediment Pond (Temporary)

Purpose

Sediment ponds are temporary ponds used during construction to remove sediment from runoff originating from disturbed areas of the project site. Sediment ponds are typically designed to remove sediment no smaller than medium silt (0.02 mm). Consequently, they usually reduce turbidity only slightly.

Conditions of Use

- Use a sediment pond where the contributing drainage area to the pond is 3 acres or more. Ponds must be used in conjunction with other Construction Stormwater BMPs to reduce the amount of sediment flowing into the pond. For drainage areas smaller than 3 acres, use the guidance in BMP C240: Sediment Trap.
- Do not install sediment ponds on sites where failure of the BMP would result in loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities. Also, sediment ponds are attractive to children and can be dangerous. Compliance with local ordinances regarding health and safety must be addressed. If fencing of the pond is required, show the type of fence and its location on the drawings in the Construction SWPPP.
- Sediment ponds that can impound 10 acre-ft (435,600 cu-ft, or 3.26 million gallons) or more are subject to the Washington Dam Safety Regulations (Chapter 173-175 WAC). See BMP D.1: Detention Ponds for more information regarding dam safety considerations for detention ponds.
- Projects that are constructing permanent Flow Control BMPs or Runoff Treatment BMPs that use ponding for treatment may use the rough-graded or final-graded permanent BMP footprint for the temporary sediment pond. When permanent BMP footprints are used as temporary sediment ponds, the surface area requirement of the temporary sediment pond must be met. If the surface area requirement of the sediment pond is larger than the surface area of the permanent BMP, then the sediment pond shall be enlarged beyond the permanent BMP footprint to comply with the surface area requirement.

  The permanent control structure must be temporarily replaced with a control structure that only allows water to leave the temporary sediment pond from the surface or by pumping. Alternatively, the permanent control structure may be used if it is temporarily modified by plugging any outlet holes below the riser. The permanent control structure must be installed as part of the permanent BMP after the site is fully stabilized.

Design and Installation Specifications

General

- See Figure II-4.28: Sediment Pond Plan View, Figure II-4.29: Sediment Pond Cross Section, and Figure II-4.30: Sediment Pond Riser Detail for details.

- Use of permanent infiltration BMP footprints for temporary sediment ponds during construction tends to clog the soils and reduce their capacity to infiltrate. If permanent infiltration BMP footprints are used, the sides and bottom of the temporary sediment pond must only be rough excavated to a minimum of 2 feet above final grade of the permanent infiltration BMP. Final grading of the permanent infiltration BMP shall occur only when all contributing drainage areas are fully stabilized. Any proposed permanent pretreatment BMP prior to the infiltration BMP should be fully constructed and used with the temporary sediment pond to help prevent clogging of the soils.

  See II-2.13 Element 13: Protect Infiltration BMPs for more information about protecting permanent infiltration BMPs.

- The pond shall be divided into two roughly equal volume cells by a permeable divider that will reduce turbulence while allowing movement of water between the cells. The divider shall be at least one-half the height of the riser, and at least one foot below the top of the riser. Wire-backed, 2 to 3 foot high, high strength geotextile fabric supported by treated 4x4s can be used as a divider. Alternatively, staked straw bales wrapped with geotextile fabric may be used. If the pond is more than 6 feet deep, a different divider design must be proposed. A riprap embankment is one acceptable method of separation for deeper ponds. Other designs that satisfy the intent of this provision are allowed as long as the divider is permeable, structurally sound, and designed to prevent erosion under and around the divider.
- The most common structural failure of sediment ponds is caused by piping. Piping refers to two phenomena:

  1. Water seeping through fine-grained soil, eroding the soil grain by grain and forming pipes or tunnels; and,
  2. Water under pressure flowing upward through a granular soil with a head of sufficient magnitude to cause soil grains to lose contact and capability for support.

  The most critical construction practices to prevent piping are:

  - Tight connections between the riser and outlet pipe, and other pipe connections.
  - Adequate anchoring of the riser.
  - Proper soil compaction of the embankment and riser footing.
  - Proper construction of anti-seep devices.

Sediment Pond Geometry

To determine the sediment pond geometry, first calculate the design surface area (SA) of the pond, measured at the top of the riser pipe. Use the following equation:

$$SA = 2 \times Q_2/0.00096$$

or

2,080 square feet per cfs of inflow

where:

SA = design surface area of the pond (sf)

Q_2 = Peak volumetric flow rate (cfs)

See BMP C240: Sediment Trap for more information on the above equation.

The basic geometry of the pond can now be determined using the following design criteria:

- Required surface area SA (from the equation above) at the top of the riser.
- Minimum 3.5 foot depth from the top of the riser to the bottom of the pond.
- Maximum 3H:1V interior side slopes and maximum 2H:1V exterior slopes. The interior slopes can be increased to a maximum of 2H:1V if fencing is provided at or above the maximum water surface.
- One foot of freeboard between the top of the riser and the crest of the emergency spillway.
- Flat bottom.
- Minimum 1 foot deep spillway.
- Length-to-width ratio between 3:1 and 6:1.

Sediment Pond Discharge

The outlet for the pond consists of a combination of principal and emergency spillways. These outlets must pass the peak runoff expected from the contributing drainage area for a 100-year storm. If, due to site conditions and basin geometry, a separate emergency spillway is not feasible, the principal spillway must pass the entire peak runoff expected from the 100-year storm. However, an attempt to provide a separate emergency spillway should always be made. Base the runoff calculations on the site conditions during construction. The flow through the dewatering orifice cannot be utilized when calculating the 100-year storm elevation because of its potential to become clogged; therefore, available spillway storage must begin at the principal spillway riser crest.

The principal spillway designed by the procedures described below will result in some reduction in the peak rate of runoff. However, the design will not control the discharge flow rates to the extent required to comply with I-3.4.7 MR7: Flow Control. The size of the contributing basin, the expected life of the construction project, the anticipated downstream effects, and the anticipated weather conditions during construction should be considered to determine the need for additional discharge control.

Principal Spillway: Determine the required diameter for the principal spillway (riser pipe). The diameter shall be the minimum necessary to pass the peak volumetric flow rate using a 15-minute time step from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Use Figure II-4.31: Riser Inflow Curves to determine the riser diameter.

To aid in determining sediment depth, 1 foot intervals shall be prominently marked on the riser.

Emergency Overflow Spillway: Size the emergency overflow spillway for the peak volumetric flow rate using a 10-minute time step from a Type 1A, 100-year, 24-hour frequency storm for the

developed condition. See BMP D.1: Detention Ponds for additional guidance for Emergency Overflow Spillway design

Dewatering Orifice: Size the dewatering orifice(s) (minimum 1-inch diameter) using a modified version of the discharge equation for a vertical orifice and a basic equation for the area of a circular orifice. Determine the required area of the orifice with the following equation:

$$A_o = \frac{A_s * (2h)^{0.5}}{0.6 * 3600 * T * g^{0.5}}$$

where:

A_o = orifice area (square feet)

A_s = pond surface area (square feet)

h = head of water above orifice (height of riser in feet)

T = dewatering time (24 hours)

g = acceleration of gravity (32.2 feet/second^2)

Convert the orifice area (in square feet) to the orifice diameter D (in inches):

$$D = 24 \times \sqrt{\frac{A_o}{\pi}} = 13.54 \times \sqrt{A_o}$$

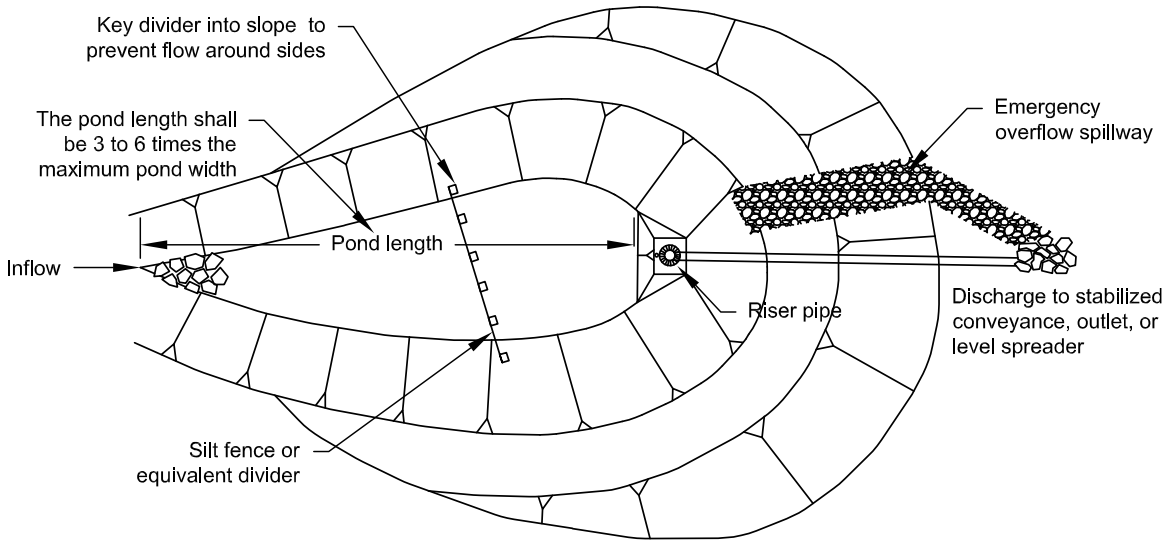
where:

D = orifice diameter (inches)

A_o = orifice area (sf)

The vertical, perforated tubing connected to the dewatering orifice must be at least 2 inches larger in diameter than the orifice to improve flow characteristics. The size and number of perforations in the tubing should be large enough so that the tubing does not restrict flow. The orifice should control the flow rate.

Figure II-4.28: Sediment Pond Plan View



Note: Pond may be formed by berm or by partial or complete excavation

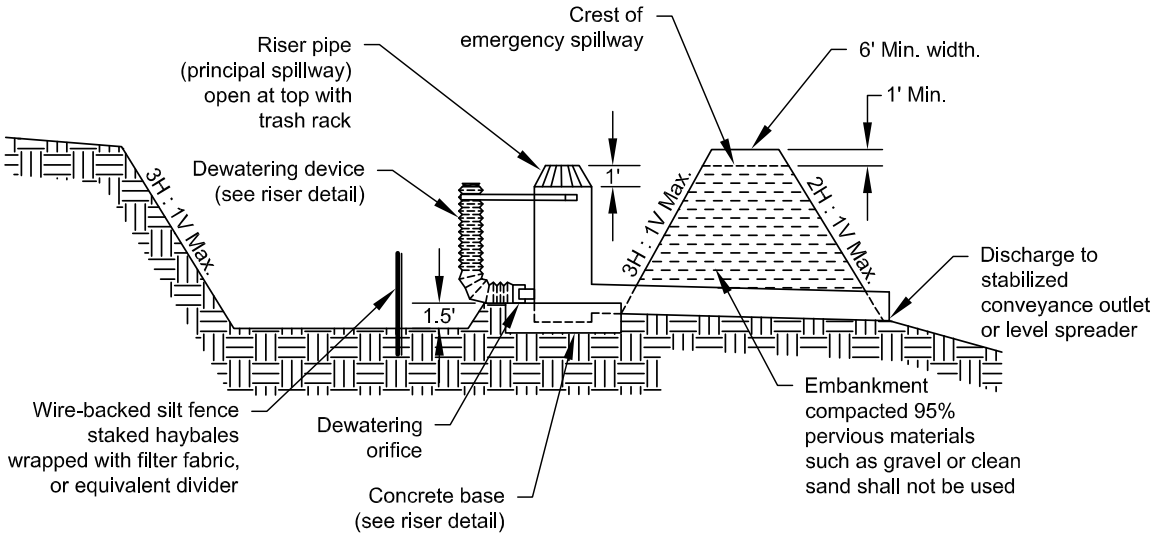
NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Sediment Pond Plan View

Revised June 2016

Figure II-4.29: Sediment Pond Cross Section



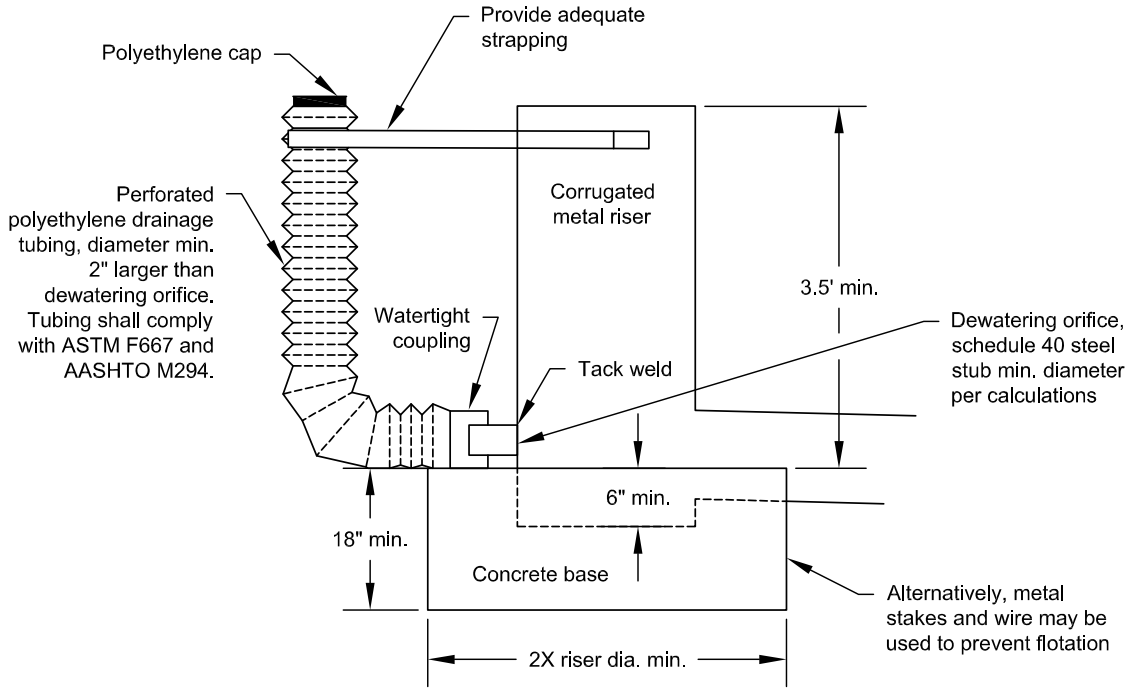
NOT TO SCALE

DEPARTMENT OF
ECOLOGY
State of Washington

Sediment Pond Cross Section

Revised June 2016

Figure II-4.30: Sediment Pond Riser Detail



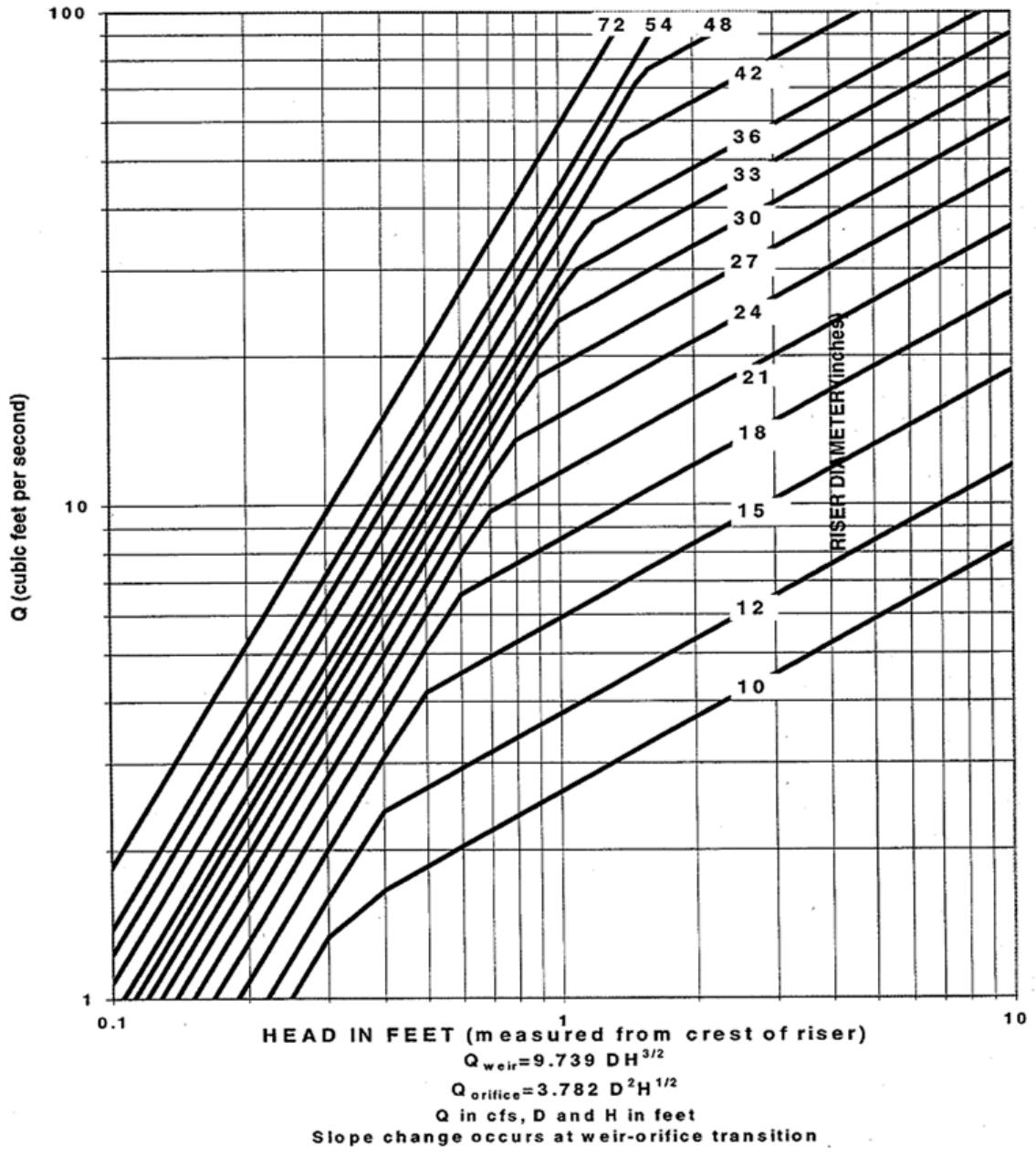
NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Sediment Pond Riser Detail

Revised June 2016

Figure II-4.31: Riser Inflow Curves



DEPARTMENT OF ECOLOGY
State of Washington

Riser Inflow Curves

Revised June 2016

C. Correspondence

N/A

D. Site Inspection Form

Construction Stormwater Site Inspection Form

Project Name _____ Permit # _____ Inspection Date _____ Time _____

Name of Certified Erosion Sediment Control Lead (CESCL) or qualified inspector if *less than one acre*
Print Name: _____

Approximate rainfall amount since the last inspection (in inches): _____

Approximate rainfall amount in the last 24 hours (in inches): _____

Current Weather Clear ☐ Cloudy ☐ Mist ☐ Rain ☐ Wind ☐ Fog ☐

A. Type of inspection: Weekly ☐ Post Storm Event ☐ Other ☐

B. Phase of Active Construction (*check all that apply*):

Pre Construction/installation of erosion/sediment controls	☐	Clearing/Demo/Grading	☐	Infrastructure/storm/roads	☐
Concrete pours	☐	Vertical Construction/buildings	☐	Utilities	☐
Offsite improvements	☐	Site temporary stabilized	☐	Final stabilization	☐

C. Questions:

1. Were all areas of construction and discharge points inspected? Yes ___ No ___
2. Did you observe the presence of suspended sediment, turbidity, discoloration, or oil sheen Yes ___ No ___
3. Was a water quality sample taken during inspection? (*refer to permit conditions S4 & S5*) Yes ___ No ___
4. Was there a turbid discharge 250 NTU or greater, or Transparency 6 cm or less?* Yes ___ No ___
5. If yes to #4 was it reported to Ecology? Yes ___ No ___
6. Is pH sampling required? pH range required is 6.5 to 8.5. Yes ___ No ___

If answering yes to a discharge, describe the event. Include when, where, and why it happened; what action was taken, and when.

_____

_____

_____

_____

*If answering yes to # 4 record NTU/Transparency with continual sampling daily until turbidity is 25 NTU or less/ transparency is 33 cm or greater.

Sampling Results: Date: _____

Parameter	Method (circle one)	Result			Other/Note
		NTU	cm	pH	
Turbidity	tube, meter, laboratory				
pH	Paper, kit, meter				

Construction Stormwater Site Inspection Form

D. Check the observed status of all items. Provide "Action Required "details and dates.

Element #	Inspection	BMPs Inspected			BMP needs maintenance	BMP failed	Action required (describe in section F)
		yes	no	n/a			
1 Clearing Limits	Before beginning land disturbing activities are all clearing limits, natural resource areas (streams, wetlands, buffers, trees) protected with barriers or similar BMPs? (high visibility recommended)						
2 Construction Access	Construction access is stabilized with quarry spalls or equivalent BMP to prevent sediment from being tracked onto roads?						
	Sediment tracked onto the road way was cleaned thoroughly at the end of the day or more frequent as necessary.						
3 Control Flow Rates	Are flow control measures installed to control stormwater volumes and velocity during construction and do they protect downstream properties and waterways from erosion?						
	If permanent infiltration ponds are used for flow control during construction, are they protected from siltation?						
4 Sediment Controls	All perimeter sediment controls (e.g. silt fence, wattles, compost socks, berms, etc.) installed, and maintained in accordance with the Stormwater Pollution Prevention Plan (SWPPP).						
	Sediment control BMPs (sediment ponds, traps, filters etc.) have been constructed and functional as the first step of grading.						
	Stormwater runoff from disturbed areas is directed to sediment removal BMP.						
5 Stabilize Soils	Have exposed un-worked soils been stabilized with effective BMP to prevent erosion and sediment deposition?						

Construction Stormwater Site Inspection Form

Element #	Inspection	BMPs Inspected			BMP needs maintenance	BMP failed	Action required (describe in section F)
		yes	no	n/a			
5 Stabilize Soils Cont.	Are stockpiles stabilized from erosion, protected with sediment trapping measures and located away from drain inlet, waterways, and drainage channels?						
	Have soils been stabilized at the end of the shift, before a holiday or weekend if needed based on the weather forecast?						
6 Protect Slopes	Has stormwater and ground water been diverted away from slopes and disturbed areas with interceptor dikes, pipes and or swales?						
	Is off-site storm water managed separately from stormwater generated on the site?						
	Is excavated material placed on uphill side of trenches consistent with safety and space considerations?						
	Have check dams been placed at regular intervals within constructed channels that are cut down a slope?						
7 Drain Inlets	Storm drain inlets made operable during construction are protected.						
	Are existing storm drains within the influence of the project protected?						
8 Stabilize Channel and Outlets	Have all on-site conveyance channels been designed, constructed and stabilized to prevent erosion from expected peak flows?						
	Is stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes and downstream conveyance systems?						
9 Control Pollutants	Are waste materials and demolition debris handled and disposed of to prevent contamination of stormwater?						
	Has cover been provided for all chemicals, liquid products, petroleum products, and other material?						
	Has secondary containment been provided capable of containing 110% of the volume?						
	Were contaminated surfaces cleaned immediately after a spill incident?						
	Were BMPs used to prevent contamination of stormwater by a pH modifying sources?						

Construction Stormwater Site Inspection Form

Element #	Inspection	BMPs Inspected			BMP needs maintenance	BMP failed	Action required (describe in section F)
		yes	no	n/a			
9 Cont.	Wheel wash wastewater is handled and disposed of properly.						
10 Control Dewatering	Concrete washout in designated areas. No washout or excess concrete on the ground.						
	Dewatering has been done to an approved source and in compliance with the SWPPP.						
	Were there any clean non turbid dewatering discharges?						
11 Maintain BMP	Are all temporary and permanent erosion and sediment control BMPs maintained to perform as intended?						
12 Manage the Project	Has the project been phased to the maximum degree practicable?						
	Has regular inspection, monitoring and maintenance been performed as required by the permit?						
	Has the SWPPP been updated, implemented and records maintained?						
13 Protect LID	Is all Bioretention and Rain Garden Facilities protected from sedimentation with appropriate BMPs?						
	Is the Bioretention and Rain Garden protected against over compaction of construction equipment and foot traffic to retain its infiltration capabilities?						
	Permeable pavements are clean and free of sediment and sediment laden-water runoff. Muddy construction equipment has not been on the base material or pavement.						
	Have soiled permeable pavements been cleaned of sediments and pass infiltration test as required by stormwater manual methodology?						
	Heavy equipment has been kept off existing soils under LID facilities to retain infiltration rate.						

E. Check all areas that have been inspected. ✔

All in place BMPs ☐ All disturbed soils ☐ All concrete wash out area ☐ All material storage areas ☐
All discharge locations ☐ All equipment storage areas ☐ All construction entrances/exits ☐

F. Elements checked "Action Required" (section D) describe corrective action to be taken. List the element number; be specific on location and work needed. Document, initial, and date when the corrective action has been completed and inspected.

Element #	Description and Location	Action Required	Completion Date	Initials

Attach additional page if needed

Sign the following certification:

"I certify that this report is true, accurate, and complete, to the best of my knowledge and belief"

Inspected by: (print) _____ (Signature) _____ Date: _____

Title/Qualification of Inspector: _____

E. Construction Stormwater General Permit (CSWGP)

Issuance Date: November 18, 2020
Effective Date: January 1, 2021
Expiration Date: December 31, 2025

CONSTRUCTION STORMWATER GENERAL PERMIT

National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge General Permit for Stormwater Discharges Associated with Construction Activity

State of Washington
Department of Ecology
Olympia, Washington 98504

In compliance with the provisions of
Chapter 90.48 Revised Code of Washington
(State of Washington Water Pollution Control Act)
and
Title 33 United States Code, Section 1251 et seq.
The Federal Water Pollution Control Act (The Clean Water Act)

Until this permit expires, is modified, or revoked, Permittees that have properly obtained coverage under this general permit are authorized to discharge in accordance with the special and general conditions that follow.

Vincent McGowan, P.E.
Water Quality Program Manager
Washington State Department of Ecology

TABLE OF CONTENTS

LIST OF TABLES ..... **ii**

SUMMARY OF PERMIT REPORT SUBMITTALS **1**

SPECIAL CONDITIONS **3**

S1. Permit Coverage 3

S2. Application Requirements 7

S3. Compliance with Standards 9

S4. Monitoring Requirements, Benchmarks, and Reporting Triggers 10

S5. Reporting and Recordkeeping Requirements 17

S6. Permit Fees 20

S7. Solid and Liquid Waste Disposal 20

S8. Discharges to 303(D) or TMDL Waterbodies 20

S9. Stormwater Pollution Prevention Plan 23

S10. Notice Of Termination 32

GENERAL CONDITIONS **34**

G1. Discharge Violations 34

G2. Signatory Requirements 34

G3. Right of Inspection and Entry 35

G4. General Permit Modification and Revocation 35

G5. Revocation of Coverage Under tPermit 35

G6. Reporting a Cause for Modification 36

G7. Compliance with Other Laws and Statutes 36

G8. Duty to Reapply 36

G9. Removed Substance 36

G10. Duty to Provide Information 36

G11. Other Requirements of 40 CFR 37

G12. Additional Monitoring 37

G13. Penalties for Violating Permit Conditions 37

G14. Upset 37

G15. Property Rights 37

G16. Duty to Comply 37

G17. Toxic Pollutants 38

G18. Penalties for Tampering 38

G19. Reporting Planned Changes 38

G20. Reporting Other Information 38

G21. Reporting Anticipated Non-Compliance 38

G22. Requests to Be Excluded From Coverage Under the Permit 39
G23. Appeals..... 39
G24. Severability..... 39
G25. Bypass Prohibited 39
APPENDIX A – DEFINITIONS.....42
APPENDIX B – ACRONYMS.....50

LIST OF TABLES

Table 1 Summary of Required Submittals..... 1
Table 2 Summary of Required On-site Documentation 2
Table 3 Summary of Primary Monitoring Requirements 12
Table 4 Monitoring and Reporting Requirements 14
Table 5 Turbidity, Fine Sediment & Phosphorus Sampling and Limits for 303(d)-Listed Waters 22
Table 6 pH Sampling and Limits for 303(d)-Listed Waters..... 22

SUMMARY OF PERMIT REPORT SUBMITTALS

Refer to the Special and General Conditions within this permit for additional submittal requirements. Appendix A provides a list of definitions. Appendix B provides a list of acronyms.

Table 1 Summary of Required Submittals

Permit Section	Submittal	Frequency	First Submittal Date
S5.A and S8	High Turbidity/Transparency Phone Reporting	As Necessary	Within 24 hours
S5.B	Discharge Monitoring Report	Monthly*	Within 15 days following the end of each month
S5.F and S8	Noncompliance Notification – Telephone Notification	As necessary	Within 24 hours
S5.F	Noncompliance Notification – Written Report	As necessary	Within 5 Days of non-compliance
S9.D	Request for Chemical Treatment Form	As necessary	Written approval from Ecology is required prior to using chemical treatment (with the exception of dry ice, CO_2 or food grade vinegar to adjust pH)
G2	Notice of Change in Authorization	As necessary	
G6	Permit Application for Substantive Changes to the Discharge	As necessary	
G8	Application for Permit Renewal	1/permit cycle	No later than 180 days before expiration
S2.A	Notice of Permit Transfer	As necessary	
G19	Notice of Planned Changes	As necessary	
G21	Reporting Anticipated Non-compliance	As necessary	

NOTE: *Permittees must submit electronic Discharge Monitoring Reports (DMRs) to the Washington State Department of Ecology monthly, regardless of site discharge, for the full duration of permit coverage. Refer to Section S5.B of this General Permit for more specific information regarding DMRs.

Table 2 Summary of Required On-site Documentation

Document Title	Permit Conditions
Permit Coverage Letter	See Conditions S2, S5
Construction Stormwater General Permit (CSWGP)	See Conditions S2, S5
Site Log Book	See Conditions S4, S5
Stormwater Pollution Prevention Plan (SWPPP)	See Conditions S5, S9
Site Map	See Conditions S5, S9

SPECIAL CONDITIONS

S1. PERMIT COVERAGE

A. Permit Area

This Construction Stormwater General Permit (CSWGP) covers all areas of Washington State, except for federal operators and Indian Country as specified in Special Condition S1.E.3 and 4.

B. Operators Required to Seek Coverage Under this General Permit

1. Operators of the following construction activities are required to seek coverage under this CSWGP:

    a. Clearing, grading and/or excavation that results in the disturbance of one or more acres (including off-site disturbance acreage related to construction-support activity as authorized in S1.C.2) and discharges stormwater to surface waters of the State; and clearing, grading and/or excavation on sites smaller than one acre that are part of a larger common plan of development or sale, if the common plan of development or sale will ultimately disturb one acre or more and discharge stormwater to surface waters of the State.

        i. This category includes forest practices (including, but not limited to, class IV conversions) that are part of a construction activity that will result in the disturbance of one or more acres, and discharge to surface waters of the State (that is, forest practices that prepare a site for construction activities); and

    b. Any size construction activity discharging stormwater to waters of the State that the Washington State Department of Ecology (Ecology):

        i. Determines to be a significant contributor of pollutants to waters of the State of Washington.

        ii. Reasonably expects to cause a violation of any water quality standard.

2. Operators of the following activities are not required to seek coverage under this CSWGP (unless specifically required under Special Condition S1.B.1.b, above):

    a. Construction activities that discharge all stormwater and non-stormwater to groundwater, sanitary sewer, or combined sewer, and have no point source discharge to either surface water or a storm sewer system that drains to surface waters of the State.

    b. Construction activities covered under an Erosivity Waiver (Special Condition S1.F).

    c. Routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of a facility.

C. Authorized Discharges

1. ***Stormwater Associated with Construction Activity.*** Subject to compliance with the terms and conditions of this permit, Permittees are authorized to discharge stormwater associated with construction activity to surface waters of the State or to a storm sewer system that drains to surface waters of the State. (Note that "surface waters of the

State" may exist on a construction site as well as off site; for example, a creek running through a site.)

2. ***Stormwater Associated with Construction Support Activity.*** This permit also authorizes stormwater discharge from support activities related to the permitted construction site (for example, an on-site portable rock crusher, off-site equipment staging yards, material storage areas, borrow areas, etc.) provided:

    a. The support activity relates directly to the permitted construction site that is required to have an NPDES permit; and

    b. The support activity is not a commercial operation serving multiple unrelated construction projects, and does not operate beyond the completion of the construction activity; and

    c. Appropriate controls and measures are identified in the Stormwater Pollution Prevention Plan (SWPPP) for the discharges from the support activity areas.

3. ***Non-Stormwater Discharges.*** The categories and sources of non-stormwater discharges identified below are authorized conditionally, provided the discharge is consistent with the terms and conditions of this permit:

    a. Discharges from fire-fighting activities.

    b. Fire hydrant system flushing.

    c. Potable water, including uncontaminated water line flushing.

    d. Hydrostatic test water.

    e. Uncontaminated air conditioning or compressor condensate.

    f. Uncontaminated groundwater or spring water.

    g. Uncontaminated excavation dewatering water (in accordance with S9.D.10).

    h. Uncontaminated discharges from foundation or footing drains.

    i. Uncontaminated or potable water used to control dust. Permittees must minimize the amount of dust control water used.

    j. Routine external building wash down that does not use detergents.

    k. Landscape irrigation water.

The SWPPP must adequately address all authorized non-stormwater discharges, except for discharges from fire-fighting activities, and must comply with Special Condition S3. At a minimum, discharges from potable water (including water line flushing), fire hydrant system flushing, and pipeline hydrostatic test water must undergo the following: dechlorination to a concentration of 0.1 parts per million (ppm) or less, and pH adjustment to within 6.5 – 8.5 standard units (su), if necessary.

D. Prohibited Discharges

The following discharges to waters of the State, including groundwater, are prohibited:

1. Concrete wastewater

2. Wastewater from washout and clean-up of stucco, paint, form release oils, curing compounds and other construction materials.

3. Process wastewater as defined by 40 Code of Federal Regulations (CFR) 122.2 (See Appendix A of this permit).

4. Slurry materials and waste from shaft drilling, including process wastewater from shaft drilling for construction of building, road, and bridge foundations unless managed according to Special Condition S9.D.9.j.

5. Fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance.

6. Soaps or solvents used in vehicle and equipment washing.

7. Wheel wash wastewater, unless managed according to Special Condition S9.D.9.

8. Discharges from dewatering activities, including discharges from dewatering of trenches and excavations, unless managed according to Special Condition S9.D.10.

E. Limits on Coverage

Ecology may require any discharger to apply for and obtain coverage under an individual permit or another more specific general permit. Such alternative coverage will be required when Ecology determines that this CSWGP does not provide adequate assurance that water quality will be protected, or there is a reasonable potential for the project to cause or contribute to a violation of water quality standards.

The following stormwater discharges are not covered by this permit:

1. Post-construction stormwater discharges that originate from the site after completion of construction activities and the site has undergone final stabilization.

2. Non-point source silvicultural activities such as nursery operations, site preparation, reforestation and subsequent cultural treatment, thinning, prescribed burning, pest and fire control, harvesting operations, surface drainage, or road construction and maintenance, from which there is natural runoff as excluded in 40 CFR Subpart 122.

3. Stormwater from any federal operator.

4. Stormwater from facilities located on ***Indian Country*** as defined in 18 U.S.C.§1151, except portions of the Puyallup Reservation as noted below.

   Indian Country includes:

   a. All land within any Indian Reservation notwithstanding the issuance of any patent, and, including rights-of-way running through the reservation. This includes all federal, tribal, and Indian and non-Indian privately owned land within the reservation.

   b. All off-reservation Indian allotments, the Indian titles to which have not been extinguished, including rights-of-way running through the same.

   c. All off-reservation federal trust lands held for Native American Tribes.

Puyallup Exception: Following the *Puyallup Tribes of Indians Land Settlement Act of 1989*, 25 U.S.C. §1773; the permit does apply to land within the Puyallup Reservation except for discharges to surface water on land held in trust by the federal government.

5. Stormwater from any site covered under an existing NPDES individual permit in which stormwater management and/or treatment requirements are included for all stormwater discharges associated with construction activity.

6. Stormwater from a site where an applicable Total Maximum Daily Load (TMDL) requirement specifically precludes or prohibits discharges from construction activity.

F. Erosivity Waiver

Construction site operators may qualify for an Erosivity Waiver from the CSWGP if the following conditions are met:

1. The site will result in the disturbance of fewer than five (5) acres and the site is not a portion of a common plan of development or sale that will disturb five (5) acres or greater.

2. Calculation of Erosivity "R" Factor and Regional Timeframe:

    a. The project's calculated rainfall erosivity factor ("R" Factor) must be less than five (5) during the period of construction activity, (See the CSWGP homepage http://www.ecy.wa.gov/programs/wq/stormwater/construction/index.html for a link to the EPA's calculator and step by step instructions on computing the "R" Factor in the *EPA Erosivity Waiver Fact Sheet*). The period of construction activity starts when the land is first disturbed and ends with final stabilization. In addition:

    b. The entire period of construction activity must fall within the following timeframes:

        i. For sites west of the Cascades Crest: June 15 – September 15.

        ii. For sites east of the Cascades Crest, excluding the Central Basin: June 15 – October 15.

        iii. For sites east of the Cascades Crest, within the Central Basin: no timeframe restrictions apply. The Central Basin is defined as the portions of Eastern Washington with mean annual precipitation of less than 12 inches. For a map of the Central Basin (Average Annual Precipitation Region 2), refer to: http://www.ecy.wa.gov/programs/wq/stormwater/construction/resourcesguidance.html.

3. Construction site operators must submit a complete Erosivity Waiver certification form at least one week before disturbing the land. Certification must include statements that the operator will:

    a. Comply with applicable local stormwater requirements; and

    b. Implement appropriate erosion and sediment control BMPs to prevent violations of water quality standards.

4. This waiver is not available for facilities declared significant contributors of pollutants as defined in Special Condition S1.B.1.b or for any size construction activity that could

reasonably expect to cause a violation of any water quality standard as defined in Special Condition S1.B.1.b.ii.

5. This waiver does not apply to construction activities which include non-stormwater discharges listed in Special Condition S1.C.3.

6. If construction activity extends beyond the certified waiver period for any reason, the operator must either:

   a. Recalculate the rainfall erosivity "R" factor using the original start date and a new projected ending date and, if the "R" factor is still under 5 *and* the entire project falls within the applicable regional timeframe in Special Condition S1.F.2.b, complete and submit an amended waiver certification form before the original waiver expires; *or*

   b. Submit a complete permit application to Ecology in accordance with Special Condition S2.A and B before the end of the certified waiver period.

S2. APPLICATION REQUIREMENTS

A. Permit Application Forms

1. *Notice of Intent Form*

a. Operators of new or previously unpermitted construction activities must submit a complete and accurate permit application (Notice of Intent, or NOI) to Ecology.

b. Operators must apply using the electronic application form (NOI) available on Ecology's website (http://ecy.wa.gov/programs/wq/stormwater/construction/index.html). Permittees unable to submit electronically (for example, those who do not have an internet connection) must contact Ecology to request a waiver and obtain instructions on how to obtain a paper NOI.

Department of Ecology
Water Quality Program - Construction Stormwater
PO Box 47696
Olympia, Washington 98504-7696

c. The operator must submit the NOI at least 60 days before discharging stormwater from construction activities and must submit it prior to the date of the first public notice (See Special Condition S2.B, below, for details). The 30-day public comment period begins on the publication date of the second public notice. Unless Ecology responds to the complete application in writing, coverage under the general permit will automatically commence on the 31st day following receipt by Ecology of a *completed* NOI, or the issuance date of this permit, whichever is later; unless Ecology specifies a later date in writing as required by WAC173-226-200(2). See S8.B for Limits on Coverage for New Discharges to TMDL or 303(d)-Listed Waters.

d. If an applicant intends to use a Best Management Practice (BMP) selected on the basis of Special Condition S9.C.4 ("demonstrably equivalent" BMPs), the applicant must notify Ecology of its selection as part of the NOI. In the event the applicant selects BMPs after submission of the NOI, the applicant must provide notice of the

selection of an equivalent BMP to Ecology at least 60 days before intended use of the equivalent BMP.

e. Applicants must notify Ecology if they are aware of contaminated soils and/or groundwater associated with the construction activity. Provide detailed information with the NOI (as known and readily available) on the nature and extent of the contamination (concentrations, locations, and depth), as well as pollution prevention and/or treatment BMPs proposed to control the discharge of soil and/or groundwater contaminants in stormwater. Examples of such detail may include, but are not limited to:

   i. List or table of all known contaminants with laboratory test results showing concentration and depth,

   ii. Map with sample locations,

   iii. Related portions of the Stormwater Pollution Prevention Plan (SWPPP) that address the management of contaminated and potentially contaminated construction stormwater and dewatering water,

   iv. Dewatering plan and/or dewatering contingency plan.

2. ***Transfer of Coverage Form***

   The Permittee can transfer current coverage under this permit to one or more new operators, including operators of sites within a Common Plan of Development, provided:

   i. The Permittee submits a complete Transfer of Coverage Form to Ecology, signed by the current and new discharger and containing a specific date for transfer of permit responsibility, coverage and liability (including any Administrative Orders associated with the permit); and

   ii. Ecology does not notify the current discharger and new discharger of intent to revoke coverage under the general permit. If this notice is not given, the transfer is effective on the date specified in the written agreement.

   When a current discharger (Permittee) transfers a portion of a permitted site, the current discharger must also indicate the remaining permitted acreage after the transfer. Transfers do not require public notice.

3. ***Modification of Coverage Form***

   Permittees must notify Ecology regarding any changes to the information provided on the NOI by submitting an Update/Modification of Permit Coverage form in accordance with General Conditions G6 and G19. Examples of such changes include, but are not limited to:

   i. Changes to the Permittee's mailing address,

   ii. Changes to the on-site contact person information, and

   iii. Changes to the area/acreage affected by construction activity.

B. Public Notice

For new or previously unpermitted construction activities, the applicant must publish a public notice at least one time each week for two consecutive weeks, at least 7 days apart, in a newspaper with general circulation in the county where the construction is to take place. The notice must be run after the NOI has been submitted and must contain:

1. A statement that "*The applicant is seeking coverage under the Washington State Department of Ecology's Construction Stormwater NPDES and State Waste Discharge General Permit*."
2. The name, address, and location of the construction site.
3. The name and address of the applicant.
4. The type of construction activity that will result in a discharge (for example, residential construction, commercial construction, etc.), and the total number of acres to be disturbed over the lifetime of the project.
5. The name of the receiving water(s) (that is, the surface water(s) to which the site will discharge), or, if the discharge is through a storm sewer system, the name of the operator of the system and the receiving water(s) the system discharges to.
6. The statement: *Any persons desiring to present their views to the Washington State Department of Ecology regarding this application, or interested in Ecology's action on this application, may notify Ecology in writing no later than 30 days of the last date of publication of this notice. Ecology reviews public comments and considers whether discharges from this project would cause a measurable change in receiving water quality, and, if so, whether the project is necessary and in the overriding public interest according to Tier II antidegradation requirements under WAC 173-201A-320. Comments can be submitted to: Department of Ecology, PO Box 47696, Olympia, Washington 98504-7696 Attn: Water Quality Program, Construction Stormwater*.

S3. COMPLIANCE WITH STANDARDS

A. Discharges must not cause or contribute to a violation of surface water quality standards (Chapter 173-201A WAC), groundwater quality standards (Chapter 173-200 WAC), sediment management standards (Chapter 173-204 WAC), and human health-based criteria in the Federal water quality criteria applicable to Washington. (40 CFR Part 131.45) Discharges that are not in compliance with these standards are prohibited.

B. Prior to the discharge of stormwater and non-stormwater to waters of the State, the Permittee must apply All Known, Available, and Reasonable methods of prevention, control, and Treatment (AKART). This includes the preparation and implementation of an adequate SWPPP, with all appropriate BMPs installed and maintained in accordance with the SWPPP and the terms and conditions of this permit.

C. Ecology presumes that a Permittee complies with water quality standards unless discharge monitoring data or other site-specific information demonstrates that a discharge causes or contributes to a violation of water quality standards, when the Permittee complies with the following conditions. The Permittee must fully:

1. Comply with all permit conditions, including; planning, sampling, monitoring, reporting, and recordkeeping conditions.

2. Implement stormwater BMPs contained in stormwater management manuals published or approved by Ecology, or BMPs that are demonstrably equivalent to BMPs contained in stormwater management manuals published or approved by Ecology, including the proper selection, implementation, and maintenance of all applicable and appropriate BMPs for on-site pollution control. (For purposes of this section, the stormwater manuals listed in Appendix 10 of the *Phase I Municipal Stormwater Permit* are approved by Ecology.)

D. Where construction sites also discharge to groundwater, the groundwater discharges must also meet the terms and conditions of this CSWGP. Permittees who discharge to groundwater through an injection well must also comply with any applicable requirements of the Underground Injection Control (UIC) regulations, Chapter 173-218 WAC.

S4. MONITORING REQUIREMENTS, BENCHMARKS, AND REPORTING TRIGGERS

A. Site Log Book

The Permittee must maintain a site log book that contains a record of the implementation of the SWPPP and other permit requirements, including the installation and maintenance of BMPs, site inspections, and stormwater monitoring.

B. Site Inspections

Construction sites one (1) acre or larger that discharge stormwater to surface waters of the State must have site inspections conducted by a Certified Erosion and Sediment Control Lead (CESCL). Sites less than one (1) acre may have a person without CESCL certification conduct inspections. (See Special Conditions S4.B.3 and B.4, below, for detailed requirements of the Permittee's CESCL.)

Site inspections must include all areas disturbed by construction activities, all BMPs, and all stormwater discharge points under the Permittee's operational control.

1. The Permittee must have staff knowledgeable in the principles and practices of erosion and sediment control. The CESCL (sites one acre or more) or inspector (sites less than one acre) must have the skills to assess the:

    a. Site conditions and construction activities that could impact the quality of stormwater; and

    b. Effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges. The SWPPP must identify the CESCL or inspector, who must be present on site or on-call at all times. The CESCL (sites one (1) acre or more) must obtain this certification through an approved erosion and sediment control training program that meets the minimum training standards established by Ecology. (See BMP C160 in the manual, referred to in Special Condition S9.C.1 and 2.)

2. The CESCL or inspector must examine stormwater visually for the presence of suspended sediment, turbidity, discoloration, and oil sheen. BMP effectiveness must be evaluated to

determine if it is necessary to install, maintain, or repair BMPs to improve the quality of stormwater discharges.

Based on the results of the inspection, the Permittee must correct the problems identified, by:

a. Reviewing the SWPPP for compliance with Special Condition S9 and making appropriate revisions within 7 days of the inspection.

b. Immediately beginning the process of fully implementing and maintaining appropriate source control and/or treatment BMPs, within 10 days of the inspection. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when an extension is requested by a Permittee within the initial 10-day response period.

c. Documenting BMP implementation and maintenance in the site log book.

3. The CESCL or inspector must inspect all areas disturbed by construction activities, all BMPs, and all stormwater discharge points at least once every calendar week and within 24 hours of any discharge from the site. (For purposes of this condition, individual discharge events that last more than one (1) day do not require daily inspections. For example, if a stormwater pond discharges continuously over the course of a week, only one (1) inspection is required that week.) Inspection frequency may be reduced to once every calendar month for inactive sites that are temporarily stabilized.

4. The Permittee must summarize the results of each inspection in an inspection report or checklist and enter the report/checklist into, or attach it to, the site log book. At a minimum, each inspection report or checklist must include:

a. Inspection date and time.

b. Weather information.

c. The general conditions during inspection.

d. The approximate amount of precipitation since the last inspection.

e. The approximate amount of precipitation within the last 24 hours.

f. A summary or list of all implemented BMPs, including observations of all erosion/sediment control structures or practices.

g. A description of:

i. BMPs inspected (including location).

ii. BMPs that need maintenance and why.

iii. BMPs that failed to operate as designed or intended, and

iv. Where additional or different BMPs are needed, and why.

h. A description of stormwater discharged from the site. The Permittee must note the presence of suspended sediment, turbidity, discoloration, and oil sheen, as applicable.

i. Any water quality monitoring performed during inspection.

j. General comments and notes, including a brief description of any BMP repairs, maintenance, or installations made following the inspection.

k. An implementation schedule for the remedial actions that the Permittee plans to take if the site inspection indicates that the site is out of compliance. The remedial actions taken must meet the requirements of the SWPPP and the permit.

l. A summary report of the inspection.

m. The name, title, and signature of the person conducting the site inspection, a phone number or other reliable method to reach this person, and the following statement: *I certify that this report is true, accurate, and complete to the best of my knowledge and belief.*

Table 3 Summary of Primary Monitoring Requirements

Size of Soil Disturbance[1]	Weekly Site Inspections	Weekly Sampling w/ Turbidity Meter	Weekly Sampling w/ Transparency Tube	Weekly pH Sampling[2]	CESCL Required for Inspections?
Sites that disturb less than 1 acre, but are part of a larger Common Plan of Development	Required	Not Required	Not Required	Not Required	No
Sites that disturb 1 acre or more, but fewer than 5 acres	Required	Sampling Required – either method[3]		Required	Yes
Sites that disturb 5 acres or more	Required	Required	Not Required[4]	Required	Yes

[1] Soil disturbance is calculated by adding together all areas that will be affected by construction activity. Construction activity means clearing, grading, excavation, and any other activity that disturbs the surface of the land, including ingress/egress from the site.

[2] If construction activity results in the disturbance of 1 acre or more, and involves significant concrete work (1,000 cubic yards of concrete or recycled concrete placed or poured over the life of a project) or the use of engineered soils (soil amendments including but not limited to Portland cement-treated base [CTB], cement kiln dust [CKD], or fly ash), and stormwater from the affected area drains to surface waters of the State or to a storm sewer stormwater collection system that drains to other surface waters of the State, the Permittee must conduct pH sampling in accordance with Special Condition S4.D.

[3] Sites with one or more acres, but fewer than 5 acres of soil disturbance, must conduct turbidity or transparency sampling in accordance with Special Condition S4.C.4.a or b.

[4] Sites equal to or greater than 5 acres of soil disturbance must conduct turbidity sampling using a turbidity meter in accordance with Special Condition S4.C.4.a.

C. Turbidity/Transparency Sampling Requirements

1. Sampling Methods

    a. If construction activity involves the disturbance of five (5) acres or more, the Permittee must conduct turbidity sampling per Special Condition S4.C.4.a, below.

    b. If construction activity involves one (1) acre or more but fewer than five (5) acres of soil disturbance, the Permittee must conduct either transparency sampling *or* turbidity sampling per Special Condition S4.C.4.a or b, below.

2. Sampling Frequency

    a. The Permittee must sample all discharge points at least once every calendar week when stormwater (or authorized non-stormwater) discharges from the site or enters any on-site surface waters of the state (for example, a creek running through a site); sampling is not required on sites that disturb less than an acre.

    b. Samples must be representative of the flow and characteristics of the discharge.

    c. Sampling is not required when there is no discharge during a calendar week.

    d. Sampling is not required outside of normal working hours or during unsafe conditions.

    e. If the Permittee is unable to sample during a monitoring period, the Permittee must include a brief explanation in the monthly Discharge Monitoring Report (DMR).

    f. Sampling is not required before construction activity begins.

    g. The Permittee may reduce the sampling frequency for temporarily stabilized, inactive sites to once every calendar month.

3. Sampling Locations

    a. Sampling is required at all points where stormwater associated with construction activity (or authorized non-stormwater) is discharged off site, including where it enters any on-site surface waters of the state (for example, a creek running through a site).

    b. The Permittee may discontinue sampling at discharge points that drain areas of the project that are fully stabilized to prevent erosion.

    c. The Permittee must identify all sampling point(s) in the SWPPP and on the site map and clearly mark these points in the field with a flag, tape, stake or other visible marker.

    d. Sampling is not required for discharge that is sent directly to sanitary or combined sewer systems.

    e. The Permittee may discontinue sampling at discharge points in areas of the project where the Permittee no longer has operational control of the construction activity.

4. Sampling and Analysis Methods

   a. The Permittee performs turbidity analysis with a calibrated turbidity meter (turbidimeter) either on site or at an accredited lab. The Permittee must record the results in the site log book in nephelometric turbidity units (NTUs).

   b. The Permittee performs transparency analysis on site with a 1¾ inch diameter, 60 centimeter (cm)-long transparency tube. The Permittee will record the results in the site log book in centimeters (cm).

Table 4 Monitoring and Reporting Requirements

Parameter	Unit	Analytical Method	Sampling Frequency	Benchmark Value
Turbidity	NTU	SM2130	Weekly, if discharging	25 NTUs
Transparency	Cm	Manufacturer instructions, or Ecology guidance	Weekly, if discharging	33 cm

5. Turbidity/Transparency Benchmark Values and Reporting Triggers

   The benchmark value for turbidity is 25 NTUs. The benchmark value for transparency is 33 centimeters (cm). Note: Benchmark values do not apply to discharges to segments of water bodies on Washington State's 303(d) list (Category 5) for turbidity, fine sediment, or phosphorus; these discharges are subject to a numeric effluent limit for turbidity. Refer to Special Condition S8 for more information and follow S5.F – Noncompliance Notification for reporting requirements applicable to discharges which exceed the numeric effluent limit for turbidity.

   a. Turbidity 26 – 249 NTUs, or Transparency 32 – 7 cm:

      If the discharge turbidity is 26 to 249 NTUs; or if discharge transparency is 32 to 7 cm, the Permittee must:

      i. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs, and no later than 10 days of the date the discharge exceeded the benchmark. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period.

      ii. Review the SWPPP for compliance with Special Condition S9 and make appropriate revisions within 7 days of the date the discharge exceeded the benchmark.

      iii. Document BMP implementation and maintenance in the site log book.

   b. Turbidity 250 NTUs or greater, or Transparency 6 cm or less:

      If a discharge point's turbidity is 250 NTUs or greater, or if discharge transparency is less than or equal to 6 cm, the Permittee must complete the reporting and adaptive

management process described below. For discharges which are subject to a numeric effluent limit for turbidity, see S5.F – Noncompliance Notification.

i. Within 24 hours, telephone or submit an electronic report to the applicable Ecology Region's Environmental Report Tracking System (ERTS) number (or through Ecology's Water Quality Permitting Portal [WQWebPortal] – Permit Submittals when the form is available), in accordance with Special Condition S5.A.

- **Central Region** (Okanogan, Chelan, Douglas, Kittitas, Yakima, Klickitat, Benton): (509) 575-2490
- **Eastern Region** (Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman): (509) 329-3400
- **Northwest Region** (Kitsap, Snohomish, Island, King, San Juan, Skagit, Whatcom): (425) 649-7000
- **Southwest Region** (Grays Harbor, Lewis, Mason, Thurston, Pierce, Clark, Cowlitz, Skamania, Wahkiakum, Clallam, Jefferson, Pacific): (360) 407-6300

These numbers and a link to the ERTS reporting page are also listed at the following website: http://www.ecy.wa.gov/programs/wq/stormwater/construction/index.html.

ii. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible, addressing the problems within 10 days of the date the discharge exceeded the benchmark. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period.

iii. Sample discharges daily until:

a) Turbidity is 25 NTUs (or lower); or

b) Transparency is 33 cm (or greater); or

c) The Permittee has demonstrated compliance with the water quality standard for turbidity:

1) No more than 5 NTUs over background turbidity, if background is less than 50 NTUs, or

2) No more than 10% over background turbidity, if background is 50 NTUs or greater; or

*Note: background turbidity in the receiving water must be measured immediately upstream (upgradient) or outside of the area of influence of the discharge.

d) The discharge stops or is eliminated.

iv. Review the SWPPP for compliance with Special Condition S9 and make appropriate revisions within seven (7) days of the date the discharge exceeded the benchmark.

v. Document BMP implementation and maintenance in the site log book.

Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with permit benchmarks.

D. pH Sampling Requirements – Significant Concrete Work or Engineered Soils

If construction activity results in the disturbance of 1 acre or more, *and* involves significant concrete work (significant concrete work means greater than 1000 cubic yards placed or poured concrete or recycled concrete used over the life of a project) or the use of engineered soils (soil amendments including but not limited to Portland cement-treated base [CTB], cement kiln dust [CKD], or fly ash), and stormwater from the affected area drains to surface waters of the State or to a storm sewer system that drains to surface waters of the State, the Permittee must conduct pH sampling as set forth below. Note: In addition, discharges to segments of water bodies on Washington State's 303(d) list (Category 5) for high pH are subject to a numeric effluent limit for pH; refer to Special Condition S8.

1. The Permittee must perform pH analysis on site with a calibrated pH meter, pH test kit, or wide range pH indicator paper. The Permittee must record pH sampling results in the site log book.

2. During the applicable pH monitoring period defined below, the Permittee must obtain a representative sample of stormwater and conduct pH analysis at least once per week.

    a. For sites with significant concrete work, the Permittee must begin the pH sampling period when the concrete is first placed or poured and exposed to precipitation, and continue weekly throughout and after the concrete placement, pour and curing period, until stormwater pH is in the range of 6.5 to 8.5 (su).

    b. For sites with recycled concrete where monitoring is required, the Permittee must begin the weekly pH sampling period when the recycled concrete is first exposed to precipitation and must continue until the recycled concrete is fully stabilized with the stormwater pH in the range of 6.5 to 8.5 (su).

    c. For sites with engineered soils, the Permittee must begin the pH sampling period when the soil amendments are first exposed to precipitation and must continue until the area of engineered soils is fully stabilized.

3. The Permittee must sample pH in the sediment trap/pond(s) or other locations that receive stormwater runoff from the area of significant concrete work or engineered soils before the stormwater discharges to surface waters.

4. The benchmark value for pH is 8.5 standard units. Anytime sampling indicates that pH is 8.5 or greater, the Permittee must either:

    a. Prevent the high pH water (8.5 or above) from entering storm sewer systems or surface waters of the state; *or*

    b. If necessary, adjust or neutralize the high pH water until it is in the range of pH 6.5 to 8.5 (su) using an appropriate treatment BMP such as carbon dioxide (CO_2) sparging, dry ice or food grade vinegar. The Permittee must obtain written approval from Ecology before using any form of chemical treatment other than CO_2 sparging, dry ice or food grade vinegar.

S5. REPORTING AND RECORDKEEPING REQUIREMENTS

A. High Turbidity Reporting

Anytime sampling performed in accordance with Special Condition S4.C indicates turbidity has reached the 250 NTUs or more (or transparency less than or equal to 6 cm), high turbidity reporting level, the Permittee must notify Ecology within 24 hours of analysis either by calling the applicable Ecology Region's Environmental Report Tracking System (ERTS) number by phone or by submitting an electronic ERTS report (through Ecology's Water Quality Permitting Portal (WQWebPortal) – Permit Submittals when the form is available). See the CSWGP website for links to ERTS and the WQWebPortal. (http://www.ecy.wa.gov/programs/wq/stormwater/construction/index.html) Also, see phone numbers in Special Condition S4.C.5.b.i.

B. Discharge Monitoring Reports (DMRs)

Permittees required to conduct water quality sampling in accordance with Special Conditions S4.C (Turbidity/Transparency), S4.D (pH), S8 (303[d]/TMDL sampling), and/or G12 (Additional Sampling) must submit the results to Ecology.

Permittees must submit monitoring data using Ecology's WQWebDMR web application accessed through Ecology's Water Quality Permitting Portal.

Permittees unable to submit electronically (for example, those who do not have an internet connection) must contact Ecology to request a waiver and obtain instructions on how to obtain a paper copy DMR at:

Department of Ecology
Water Quality Program - Construction Stormwater
PO Box 47696
Olympia, WA 98504-7696

Permittees who obtain a waiver not to use WQWebDMR must use the forms provided to them by Ecology; submittals must be mailed to the address above. Permittees must submit DMR forms to be received by Ecology within 15 days following the end of each month.

If there was no discharge during a given monitoring period, all Permittees must submit a DMR as required with "no discharge" entered in place of the monitoring results. DMRs are required for the full duration of permit coverage (from the first full month following the effective date of permit coverage up until Ecology has approved termination of the coverage). For more information, contact Ecology staff using information provided at the following website: www.ecy.wa.gov/programs/wq/permits/paris/contacts.html.

C. Records Retention

The Permittee must retain records of all monitoring information (site log book, sampling results, inspection reports/checklists, etc.), Stormwater Pollution Prevention Plan, copy of the permit coverage letter (including Transfer of Coverage documentation) and any other documentation of compliance with permit requirements for the entire life of the construction project and for a minimum of five (5) years following the termination of permit coverage. Such information must include all calibration and maintenance records, and records of all data used to complete the application for this permit. This period of retention must be extended during

the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by Ecology.

D. Recording Results

For each measurement or sample taken, the Permittee must record the following information:

1. Date, place, method, and time of sampling or measurement.
2. The first and last name of the individual who performed the sampling or measurement.
3. The date(s) the analyses were performed.
4. The first and last name of the individual who performed the analyses.
5. The analytical techniques or methods used.
6. The results of all analyses.

E. Additional Monitoring by the Permittee

If the Permittee samples or monitors any pollutant more frequently than required by this permit using test procedures specified by Special Condition S4 of this permit, the sampling results for this monitoring must be included in the calculation and reporting of the data submitted in the Permittee's DMR.

F. Noncompliance Notification

In the event the Permittee is unable to comply with any part of the terms and conditions of this permit, and the resulting noncompliance may cause a threat to human health or the environment (such as but not limited to spills or fuels or other materials, catastrophic pond or slope failure, and discharges that violate water quality standards), or exceed numeric effluent limitations (see S8 – Discharges to 303(d) or TMDL Waterbodies), the Permittee must, upon becoming aware of the circumstance:

1. Notify Ecology within 24 hours of the failure to comply by calling the applicable Regional office ERTS phone number (refer to Special Condition S4.C.5.b.i, or go to https://ecology.wa.gov/About-us/Get-involved/Report-an-environmental-issue to find contact information for the regional offices.)
2. Immediately take action to prevent the discharge/pollution, or otherwise stop or correct the noncompliance, and, if applicable, repeat sampling and analysis of any noncompliance immediately and submit the results to Ecology within five (5) days of becoming aware of the violation (See S5.F.3, below, for details on submitting results in a report).
3. Submit a detailed written report to Ecology within five (5) days of the time the Permittee becomes aware of the circumstances, unless requested earlier by Ecology. The report must be submitted using Ecology's Water Quality Permitting Portal (WQWebPortal) – Permit Submittals, unless a waiver from electronic reporting has been granted according to S5.B. The report must contain a description of the noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and the steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

The Permittee must report any unanticipated bypass and/or upset that exceeds any effluent limit in the permit in accordance with the 24-hour reporting requirement contained in 40 C.F.R. 122.41(l)(6).

Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with the terms and conditions of this permit or the resulting liability for failure to comply. Upon request of the Permittee, Ecology may waive the requirement for a written report on a case-by-case basis, if the immediate notification is received by Ecology within 24 hours.

G. Access to Plans and Records

1. The Permittee must retain the following permit documentation (plans and records) on site, or within reasonable access to the site, for use by the operator or for on-site review by Ecology or the local jurisdiction:

    a. General Permit

    b. Permit Coverage Letter

    c. Stormwater Pollution Prevention Plan (SWPPP)

    d. Site Log Book

    e. Erosivity Waiver (if applicable)

2. The Permittee must address written requests for plans and records listed above (Special Condition S5.G.1) as follows:

    a. The Permittee must provide a copy of plans and records to Ecology within 14 days of receipt of a written request from Ecology.

    b. The Permittee must provide a copy of plans and records to the public when requested in writing. Upon receiving a written request from the public for the Permittee's plans and records, the Permittee must either:

        i. Provide a copy of the plans and records to the requester within 14 days of a receipt of the written request; *or*

        ii. Notify the requester within 10 days of receipt of the written request of the location and times within normal business hours when the plans and records may be viewed; and provide access to the plans and records within 14 days of receipt of the written request; *or*

            Within 14 days of receipt of the written request, the Permittee may submit a copy of the plans and records to Ecology for viewing and/or copying by the requester at an Ecology office, or a mutually agreed location. If plans and records are viewed and/or copied at a location other than at an Ecology office, the Permittee will provide reasonable access to copying services for which a reasonable fee may be charged. The Permittee must notify the requester within 10 days of receipt of the request where the plans and records may be viewed and/or copied.

S6. PERMIT FEES

The Permittee must pay permit fees assessed by Ecology. Fees for stormwater discharges covered under this permit are established by Chapter 173-224 WAC. Ecology continues to assess permit fees until the permit is terminated in accordance with Special Condition S10 or revoked in accordance with General Condition G5.

S7. SOLID AND LIQUID WASTE DISPOSAL

The Permittee must handle and dispose of solid and liquid wastes generated by construction activity, such as demolition debris, construction materials, contaminated materials, and waste materials from maintenance activities, including liquids and solids from cleaning catch basins and other stormwater facilities, in accordance with:

A. Special Condition S3, Compliance with Standards.

B. WAC 173-216-110.

C. Other applicable regulations.

S8. DISCHARGES TO 303(d) OR TMDL WATERBODIES

A. Sampling and Numeric Effluent Limits For Certain Discharges to 303(d)-Listed Water Bodies

1. Permittees who discharge to segments of water bodies listed as impaired by the State of Washington under Section 303(d) of the Clean Water Act for turbidity, fine sediment, high pH, or phosphorus, must conduct water quality sampling according to the requirements of this section, and Special Conditions S4.C.2.b-f and S4.C.3.b-d, and must comply with the applicable numeric effluent limitations in S8.C and S8.D.

2. All references and requirements associated with Section 303(d) of the Clean Water Act mean the most current listing by Ecology of impaired waters (Category 5) that exists on January 1, 2021, or the date when the operator's complete permit application is received by Ecology, whichever is later.

B. Limits on Coverage for New Discharges to TMDL or 303(d)-Listed Waters

Construction sites that discharge to a TMDL or 303(d)-listed waterbody are not eligible for coverage under this permit *unless* the operator:

1. Prevents exposing stormwater to pollutants for which the waterbody is impaired, and retains documentation in the SWPPP that details procedures taken to prevent exposure on site; *or*

2. Documents that the pollutants for which the waterbody is impaired are not present at the site, and retains documentation of this finding within the SWPPP; *or*

3. Provides Ecology with data indicating the discharge is not expected to cause or contribute to an exceedance of a water quality standard, and retains such data on site with the SWPPP. The operator must provide data and other technical information to Ecology that sufficiently demonstrate:

    a. For discharges to waters without an EPA-approved or -established TMDL, that the discharge of the pollutant for which the water is impaired will meet in-stream water quality criteria at the point of discharge to the waterbody; *or*

    b. For discharges to waters with an EPA-approved or -established TMDL, that there is sufficient remaining wasteload allocation in the TMDL to allow construction stormwater discharge and that existing dischargers to the waterbody are subject to compliance schedules designed to bring the waterbody into attainment with water quality standards.

    Operators of construction sites are eligible for coverage under this permit only after Ecology makes an affirmative determination that the *discharge will not cause or contribute to the existing impairment or exceed the TMDL.*

C. Sampling and Numeric Effluent Limits for Discharges to Water Bodies on the 303(d) List for Turbidity, Fine Sediment, or Phosphorus

1. Permittees who discharge to segments of water bodies on the 303(d) list (Category 5) for turbidity, fine sediment, or phosphorus must conduct turbidity sampling in accordance with Special Condition S4.C.2 and comply with either of the numeric effluent limits noted in Table 5 below.

2. As an alternative to the 25 NTUs effluent limit noted in Table 5 below (applied at the point where stormwater [or authorized non-stormwater] is discharged off-site), Permittees may choose to comply with the surface water quality standard for turbidity. The standard is: no more than 5 NTUs over background turbidity when the background turbidity is 50 NTUs or less, or no more than a 10% increase in turbidity when the background turbidity is more than 50 NTUs. In order to use the water quality standard requirement, the sampling must take place at the following locations:

    a. Background turbidity in the 303(d)-listed receiving water immediately upstream (upgradient) or outside the area of influence of the discharge.

    b. Turbidity at the point of discharge into the 303(d)-listed receiving water, inside the area of influence of the discharge**.**

3. Discharges that exceed the numeric effluent limit for turbidity constitute a violation of this permit.

4. Permittees whose discharges exceed the numeric effluent limit must sample discharges daily until the violation is corrected and comply with the non-compliance notification requirements in Special Condition S5.F.

Table 5 Turbidity, Fine Sediment & Phosphorus Sampling and Limits for 303(d)-Listed Waters

Parameter identified in 303(d) listing	Parameter Sampled	Unit	Analytical Method	Sampling Frequency	Numeric Effluent Limit[1]
• Turbidity • Fine Sediment • Phosphorus	Turbidity	NTU	SM2130	Weekly, if discharging	25 NTUs, at the point where stormwater is discharged from the site; ***OR*** In compliance with the surface water quality standard for turbidity (S8.C.2.a)

[1] Permittees subject to a numeric effluent limit for turbidity may, at their discretion, choose either numeric effluent limitation based on site-specific considerations including, but not limited to, safety, access and convenience.

D. Discharges to Water Bodies on the 303(d) List for High pH

1. Permittees who discharge to segments of water bodies on the 303(d) list (Category 5) for high pH must conduct pH sampling in accordance with the table below, and comply with the numeric effluent limit of pH 6.5 to 8.5 su (Table 6).

Table 6 pH Sampling and Limits for 303(d)-Listed Waters

Parameter identified in 303(d) listing	Parameter Sampled/Units	Analytical Method	Sampling Frequency	Numeric Effluent Limit
High pH	pH /Standard Units	pH meter	Weekly, if discharging	In the range of 6.5 – 8.5 su

2. At the Permittee's discretion, compliance with the limit shall be assessed at one of the following locations:

   a. Directly in the 303(d)-listed waterbody segment, inside the immediate area of influence of the discharge; *or*

   b. Alternatively, the Permittee may measure pH at the point where the discharge leaves the construction site, rather than in the receiving water.

3. Discharges that exceed the numeric effluent limit for pH (outside the range of 6.5 – 8.5 su) constitute a violation of this permit.

4. Permittees whose discharges exceed the numeric effluent limit must sample discharges daily until the violation is corrected and comply with the non-compliance notification requirements in Special Condition S5.F.

E. Sampling and Limits for Sites Discharging to Waters Covered by a TMDL or another Pollution Control Plan

1. Discharges to a waterbody that is subject to a Total Maximum Daily Load (TMDL) for turbidity, fine sediment, high pH, or phosphorus must be consistent with the TMDL. Refer to http://www.ecy.wa.gov/programs/wq/tmdl/TMDLsbyWria/TMDLbyWria.html for more information on TMDLs.

    a. Where an applicable TMDL sets specific waste load allocations or requirements for discharges covered by this permit, discharges must be consistent with any specific waste load allocations or requirements established by the applicable TMDL.

        i. The Permittee must sample discharges weekly, unless otherwise specified by the TMDL, to evaluate compliance with the specific waste load allocations or requirements.

        ii. Analytical methods used to meet the monitoring requirements must conform to the latest revision of the *Guidelines Establishing Test Procedures for the Analysis of Pollutants* contained in 40 CFR Part 136.

        iii. Turbidity and pH methods need not be accredited or registered unless conducted at a laboratory which must otherwise be accredited or registered.

    b. Where an applicable TMDL has established a general waste load allocation for construction stormwater discharges, but has not identified specific requirements, compliance with Special Conditions S4 (Monitoring) and S9 (SWPPPs) will constitute compliance with the approved TMDL.

    c. Where an applicable TMDL has not specified a waste load allocation for construction stormwater discharges, but has not excluded these discharges, compliance with Special Conditions S4 (Monitoring) and S9 (SWPPPs) will constitute compliance with the approved TMDL.

    d. Where an applicable TMDL specifically precludes or prohibits discharges from construction activity, the operator is not eligible for coverage under this permit.

S9. STORMWATER POLLUTION PREVENTION PLAN

The Permittee must prepare and properly implement an adequate Stormwater Pollution Prevention Plan (SWPPP) for construction activity in accordance with the requirements of this permit beginning with initial soil disturbance and until final stabilization.

A. The Permittee's SWPPP must meet the following objectives:

1. To identify best management practices (BMPs) which prevent erosion and sedimentation, and to reduce, eliminate or prevent stormwater contamination and water pollution from construction activity.

2. To prevent violations of surface water quality, groundwater quality, or sediment management standards.

3. To control peak volumetric flow rates and velocities of stormwater discharges.

B. General Requirements

1. The SWPPP must include a narrative and drawings. All BMPs must be clearly referenced in the narrative and marked on the drawings. The SWPPP narrative must include documentation to explain and justify the pollution prevention decisions made for the project. Documentation must include:

    a. Information about existing site conditions (topography, drainage, soils, vegetation, etc.).

    b. Potential erosion problem areas.

    c. The 13 elements of a SWPPP in Special Condition S9.D.1-13, including BMPs used to address each element.

    d. Construction phasing/sequence and general BMP implementation schedule.

    e. The actions to be taken if BMP performance goals are not achieved—for example, a contingency plan for additional treatment and/or storage of stormwater that would violate the water quality standards if discharged.

    f. Engineering calculations for ponds, treatment systems, and any other designed structures. When a treatment system requires engineering calculations, these calculations must be included in the SWPPP. Engineering calculations do not need to be included in the SWPPP for treatment systems that do not require such calculations.

2. The Permittee must modify the SWPPP if, during inspections or investigations conducted by the owner/operator, or the applicable local or state regulatory authority, it is determined that the SWPPP is, or would be, ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The Permittee must then:

    a. Review the SWPPP for compliance with Special Condition S9 and make appropriate revisions within 7 days of the inspection or investigation.

    b. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible, addressing the problems no later than 10 days from the inspection or investigation. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when an extension is requested by a Permittee within the initial 10-day response period.

    c. Document BMP implementation and maintenance in the site log book.

    The Permittee must modify the SWPPP whenever there is a change in design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the State.

C. Stormwater Best Management Practices (BMPs)

BMPs must be consistent with:

1. *Stormwater Management Manual for Western Washington* (most current approved edition at the time this permit was issued), for sites west of the crest of the Cascade Mountains; *or*

2. *Stormwater Management Manual for Eastern Washington* (most current approved edition at the time this permit was issued), for sites east of the crest of the Cascade Mountains; *or*

3. Revisions to the manuals listed in Special Condition S9.C.1 & 2, or other stormwater management guidance documents or manuals which provide an equivalent level of pollution prevention, that are approved by Ecology and incorporated into this permit in accordance with the permit modification requirements of WAC 173-226-230; *or*

4. Documentation in the SWPPP that the BMPs selected provide an equivalent level of pollution prevention, compared to the applicable stormwater management manuals, including:

    a. The technical basis for the selection of all stormwater BMPs (scientific, technical studies, and/or modeling) that support the performance claims for the BMPs being selected.

    b. An assessment of how the selected BMP will satisfy AKART requirements and the applicable federal technology-based treatment requirements under 40 CFR part 125.3.

D. SWPPP – Narrative Contents and Requirements

The Permittee must include each of the 13 elements below in Special Condition S9.D.1-13 in the narrative of the SWPPP and implement them unless site conditions render the element unnecessary and the exemption from that element is clearly justified in the SWPPP.

1. Preserve Vegetation/Mark Clearing Limits

    a. Before beginning land-disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area.

    b. Retain the duff layer, native topsoil, and natural vegetation in an undisturbed state to the maximum degree practicable.

2. Establish Construction Access

    a. Limit construction vehicle access and exit to one route, if possible.

    b. Stabilize access points with a pad of quarry spalls, crushed rock, or other equivalent BMPs, to minimize tracking sediment onto roads.

    c. Locate wheel wash or tire baths on site, if the stabilized construction entrance is not effective in preventing tracking sediment onto roads.

    d. If sediment is tracked off site, clean the affected roadway thoroughly at the end of each day, or more frequently as necessary (for example, during wet weather). Remove sediment from roads by shoveling, sweeping, or pickup and transport of the sediment to a controlled sediment disposal area.

    e. Conduct street washing only after sediment removal in accordance with Special Condition S9.D.2.d.

    f. Control street wash wastewater by pumping back on site or otherwise preventing it from discharging into systems tributary to waters of the State.

3. Control Flow Rates

    a. Protect properties and waterways downstream of construction sites from erosion and the associated discharge of turbid waters due to increases in the velocity and peak volumetric flow rate of stormwater runoff from the project site, as required by local plan approval authority.

    b. Where necessary to comply with Special Condition S9.D.3.a, construct stormwater infiltration or detention BMPs as one of the first steps in grading. Assure that detention BMPs function properly before constructing site improvements (for example, impervious surfaces).

    c. If permanent infiltration ponds are used for flow control during construction, protect these facilities from sedimentation during the construction phase.

4. Install Sediment Controls

    The Permittee must design, install and maintain effective erosion controls and sediment controls to minimize the discharge of pollutants. At a minimum, the Permittee must:

    a. Construct sediment control BMPs (sediment ponds, traps, filters, infiltration facilities, etc.) as one of the first steps in grading. These BMPs must be functional before other land disturbing activities take place.

    b. Minimize sediment discharges from the site. The design, installation and maintenance of erosion and sediment controls must address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics, including the range of soil particle sizes expected to be present on the site.

    c. Direct stormwater runoff from disturbed areas through a sediment pond or other appropriate sediment removal BMP, before the runoff leaves a construction site or before discharge to an infiltration facility. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard of Special Condition S9.D.3.a.

    d. Locate BMPs intended to trap sediment on site in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages.

    e. Provide and maintain natural buffers around surface waters, direct stormwater to vegetated areas to increase sediment removal and maximize stormwater infiltration, unless infeasible.

    f. Where feasible, design outlet structures that withdraw impounded stormwater from the surface to avoid discharging sediment that is still suspended lower in the water column.

5. Stabilize Soils

    a. The Permittee must stabilize exposed and unworked soils by application of effective BMPs that prevent erosion. Applicable BMPs include, but are not limited to: temporary and permanent seeding, sodding, mulching, plastic covering, erosion

control fabrics and matting, soil application of polyacrylamide (PAM), the early application of gravel base on areas to be paved, and dust control.

b. The Permittee must control stormwater volume and velocity within the site to minimize soil erosion.

c. The Permittee must control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion.

d. Depending on the geographic location of the project, the Permittee must not allow soils to remain exposed and unworked for more than the time periods set forth below to prevent erosion.

West of the Cascade Mountains Crest
During the dry season (May 1 - September 30): 7 days
During the wet season (October 1 - April 30): 2 days

East of the Cascade Mountains Crest, except for Central Basin*
During the dry season (July 1 - September 30): 10 days
During the wet season (October 1 - June 30): 5 days

The Central Basin*, East of the Cascade Mountains Crest
During the dry Season (July 1 - September 30): 30 days
During the wet season (October 1 - June 30): 15 days

***Note: The Central Basin** is defined as the portions of Eastern Washington with mean annual precipitation of less than 12 inches.

e. The Permittee must stabilize soils at the end of the shift before a holiday or weekend if needed based on the weather forecast.

f. The Permittee must stabilize soil stockpiles from erosion, protected with sediment trapping measures, and where possible, be located away from storm drain inlets, waterways, and drainage channels.

g. The Permittee must minimize the amount of soil exposed during construction activity.

h. The Permittee must minimize the disturbance of steep slopes.

i. The Permittee must minimize soil compaction and, unless infeasible, preserve topsoil.

6. Protect Slopes

a. The Permittee must design and construct cut-and-fill slopes in a manner to minimize erosion. Applicable practices include, but are not limited to, reducing continuous length of slope with terracing and diversions, reducing slope steepness, and roughening slope surfaces (for example, track walking).

b. The Permittee must divert off-site stormwater (run-on) or groundwater away from slopes and disturbed areas with interceptor dikes, pipes, and/or swales. Off-site stormwater should be managed separately from stormwater generated on the site.

c. At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion.

i. West of the Cascade Mountains Crest: Temporary pipe slope drains must handle the peak 10-minute flow rate from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate predicted by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model (WWHM) to predict flows, bare soil areas should be modeled as "landscaped area."

ii. East of the Cascade Mountains Crest: Temporary pipe slope drains must handle the expected peak flow rate from a 6-month, 3-hour storm for the developed condition, referred to as the short duration storm.

d. Place excavated material on the uphill side of trenches, consistent with safety and space considerations.

e. Place check dams at regular intervals within constructed channels that are cut down a slope.

7. Protect Drain Inlets

a. Protect all storm drain inlets made operable during construction so that stormwater runoff does not enter the conveyance system without first being filtered or treated to remove sediment.

b. Clean or remove and replace inlet protection devices when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).

8. Stabilize Channels and Outlets

a. Design, construct and stabilize all on-site conveyance channels to prevent erosion from the following expected peak flows:

i. West of the Cascade Mountains Crest: Channels must handle the peak 10-minute flow rate from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate indicated by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the WWHM to predict flows, bare soil areas should be modeled as "landscaped area."

ii. East of the Cascade Mountains Crest: Channels must handle the expected peak flow rate from a 6-month, 3-hour storm for the developed condition, referred to as the short duration storm.

b. Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches at the outlets of all conveyance systems.

9. Control Pollutants

Design, install, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants. The Permittee must:

a. Handle and dispose of all pollutants, including waste materials and demolition debris that occur on site in a manner that does not cause contamination of stormwater.

b. Provide cover, containment, and protection from vandalism for all chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health or the environment. Minimize storage of hazardous materials on-site. Safety Data Sheets (SDS) should be supplied for all materials stored. Chemicals should be kept in their original labeled containers. On-site fueling tanks must include secondary containment. Secondary containment means placing tanks or containers within an impervious structure capable of containing 110% of the volume of the largest tank within the containment structure. Double-walled tanks do not require additional secondary containment.

c. Conduct maintenance, fueling, and repair of heavy equipment and vehicles using spill prevention and control measures. Clean contaminated surfaces immediately following any spill incident.

d. Discharge wheel wash or tire bath wastewater to a separate on-site treatment system that prevents discharge to surface water, such as closed-loop recirculation or upland land application, or to the sanitary sewer with local sewer district approval.

e. Apply fertilizers and pesticides in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Follow manufacturers' label requirements for application rates and procedures.

f. Use BMPs to prevent contamination of stormwater runoff by pH-modifying sources. The sources for this contamination include, but are not limited to: bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, recycled concrete stockpiles, waste streams generated from concrete grinding and sawing, exposed aggregate processes, dewatering concrete vaults, concrete pumping and mixer washout waters. (Also refer to the definition for "concrete wastewater" in Appendix A – Definitions.)

g. Adjust the pH of stormwater or authorized non-stormwater if necessary to prevent an exceedance of groundwater and/or surface water quality standards.

h. Assure that washout of concrete trucks is performed off-site or in designated concrete washout areas only. Do not wash out concrete truck drums onto the ground, or into storm drains, open ditches, streets, or streams. Washout of small concrete handling equipment may be disposed of in a formed area awaiting concrete where it will not contaminate surface or groundwater. Do not dump excess concrete on site, except in designated concrete washout areas. Concrete spillage or concrete discharge directly to groundwater or surface waters of the State is

prohibited. At no time shall concrete be washed off into the footprint of an area where an infiltration BMP will be installed.

i. Obtain written approval from Ecology before using any chemical treatment, with the exception of CO_2, dry ice or food grade vinegar, to adjust pH.

j. Uncontaminated water from water-only based shaft drilling for construction of building, road, and bridge foundations may be infiltrated provided the wastewater is managed in a way that prohibits discharge to surface waters. Prior to infiltration, water from water-only based shaft drilling that comes into contact with curing concrete must be neutralized until pH is in the range of 6.5 to 8.5 (su).

10. Control Dewatering

a. Permittees must discharge foundation, vault, and trench dewatering water, which have characteristics similar to stormwater runoff at the site, in conjunction with BMPs to reduce sedimentation before discharge to a sediment trap or sediment pond.

b. Permittees may discharge clean, non-turbid dewatering water, such as well-point groundwater, to systems tributary to, or directly into surface waters of the State, as specified in Special Condition S9.D.8, provided the dewatering flow does not cause erosion or flooding of receiving waters. Do not route clean dewatering water through stormwater sediment ponds. Note that "surface waters of the State" may exist on a construction site as well as off site; for example, a creek running through a site.

c. Other dewatering treatment or disposal options may include:

i. Infiltration

ii. Transport off site in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters.

iii. Ecology-approved on-site chemical treatment or other suitable treatment technologies (See S9.D.9.i, regarding chemical treatment written approval).

iv. Sanitary or combined sewer discharge with local sewer district approval, if there is no other option.

v. Use of a sedimentation bag with discharge to a ditch or swale for small volumes of localized dewatering.

d. Permittees must handle highly turbid or contaminated dewatering water separately from stormwater.

11. Maintain BMPs

a. Permittees must maintain and repair all temporary and permanent erosion and sediment control BMPs as needed to assure continued performance of their intended function in accordance with BMP specifications.

b. Permittees must remove all temporary erosion and sediment control BMPs within 30 days after achieving final site stabilization or after the temporary BMPs are no longer needed.

12. Manage the Project

    a. Phase development projects to the maximum degree practicable and take into account seasonal work limitations.

    b. Inspect, maintain and repair all BMPs as needed to assure continued performance of their intended function. Conduct site inspections and monitoring in accordance with Special Condition S4.

    c. Maintain, update, and implement the SWPPP in accordance with Special Conditions S3, S4, and S9.

13. Protect Low Impact Development (LID) BMPs

    The primary purpose of on-site LID Stormwater Management is to reduce the disruption of the natural site hydrology through infiltration. LID BMPs are permanent facilities.

    a. Permittees must protect all LID BMPs (including, but not limited to, Bioretention and Rain Garden facilities) from sedimentation through installation and maintenance of erosion and sediment control BMPs on portions of the site that drain into the Bioretention and/or Rain Garden facilities. Restore the BMPs to their fully functioning condition if they accumulate sediment during construction. Restoring the facility must include removal of sediment and any sediment-laden bioretention/ rain garden soils, and replacing the removed soils with soils meeting the design specification.

    b. Permittees must maintain the infiltration capabilities of LID BMPs by protecting against compaction by construction equipment and foot traffic. Protect completed lawn and landscaped areas from compaction due to construction equipment.

    c. Permittees must control erosion and avoid introducing sediment from surrounding land uses onto permeable pavements. Do not allow muddy construction equipment on the base material or pavement. Do not allow sediment-laden runoff onto permeable pavements or base materials.

    d. Permittees must clean permeable pavements fouled with sediments or no longer passing an initial infiltration test using local stormwater manual methodology or the manufacturer's procedures.

    e. Permittees must keep all heavy equipment off existing soils under LID BMPs that have been excavated to final grade to retain the infiltration rate of the soils.

E. SWPPP – Map Contents and Requirements

The Permittee's SWPPP must also include a vicinity map or general location map (for example, a USGS quadrangle map, a portion of a county or city map, or other appropriate map) with enough detail to identify the location of the construction site and receiving waters within one mile of the site.

The SWPPP must also include a legible site map (or maps) showing the entire construction site. The following features must be identified, unless not applicable due to site conditions.

1. The direction of north, property lines, and existing structures and roads.

2. Cut and fill slopes indicating the top and bottom of slope catch lines.

3. Approximate slopes, contours, and direction of stormwater flow before and after major grading activities.

4. Areas of soil disturbance and areas that will not be disturbed.

5. Locations of structural and nonstructural controls (BMPs) identified in the SWPPP.

6. Locations of off-site material, stockpiles, waste storage, borrow areas, and vehicle/equipment storage areas.

7. Locations of all surface water bodies, including wetlands.

8. Locations where stormwater or non-stormwater discharges off-site and/or to a surface waterbody, including wetlands.

9. Location of water quality sampling station(s), if sampling is required by state or local permitting authority.

10. Areas where final stabilization has been accomplished and no further construction-phase permit requirements apply.

11. Location or proposed location of LID facilities.

S10. NOTICE OF TERMINATION

Partial terminations of permit coverage are not authorized.

A. The site is eligible for termination of coverage when it has met any of the following conditions:

1. The site has undergone final stabilization, the Permittee has removed all temporary BMPs (except biodegradable BMPs clearly manufactured with the intention for the material to be left in place and not interfere with maintenance or land use), and all stormwater discharges associated with construction activity have been eliminated; *or*

2. All portions of the site that have not undergone final stabilization per Special Condition S10.A.1 have been sold and/or transferred (per Special Condition S2.A), and the Permittee no longer has operational control of the construction activity; *or*

3. For residential construction only, the Permittee has completed temporary stabilization and the homeowners have taken possession of the residences.

B. When the site is eligible for termination, the Permittee must submit a complete and accurate Notice of Termination (NOT) form, signed in accordance with General Condition G2, to:

Department of Ecology
Water Quality Program - Construction Stormwater
PO Box 47696
Olympia, WA 98504-7696

When an electronic termination form is available, the Permittee may choose to submit a complete and accurate Notice of Termination (NOT) form through the Water Quality Permitting Portal rather than mailing a hardcopy as noted above.

The termination is effective on the 31st calendar day following the date Ecology receives a complete NOT form, unless Ecology notifies the Permittee that termination request is denied because the Permittee has not met the eligibility requirements in Special Condition S10.A.

Permittees are required to comply with all conditions and effluent limitations in the permit until the permit has been terminated.

Permittees transferring the property to a new property owner or operator/Permittee are required to complete and submit the Notice of Transfer form to Ecology, but are not required to submit a Notice of Termination form for this type of transaction.

GENERAL CONDITIONS

G1. DISCHARGE VIOLATIONS

All discharges and activities authorized by this general permit must be consistent with the terms and conditions of this general permit. Any discharge of any pollutant more frequent than or at a level in excess of that identified and authorized by the general permit must constitute a violation of the terms and conditions of this permit.

G2. SIGNATORY REQUIREMENTS

A. All permit applications must bear a certification of correctness to be signed:

1. In the case of corporations, by a responsible corporate officer.
2. In the case of a partnership, by a general partner of a partnership.
3. In the case of sole proprietorship, by the proprietor.
4. In the case of a municipal, state, or other public facility, by either a principal executive officer or ranking elected official.

B. All reports required by this permit and other information requested by Ecology (including NOIs, NOTs, and Transfer of Coverage forms) must be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

1. The authorization is made in writing by a person described above and submitted to Ecology.
2. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters.

C. Changes to authorization. If an authorization under paragraph G2.B.2 above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph G2.B.2 above must be submitted to Ecology prior to or together with any reports, information, or applications to be signed by an authorized representative.

D. Certification. Any person signing a document under this section must make the following certification:

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

G3. RIGHT OF INSPECTION AND ENTRY

The Permittee must allow an authorized representative of Ecology, upon the presentation of credentials and such other documents as may be required by law:

A. To enter upon the premises where a discharge is located or where any records are kept under the terms and conditions of this permit.

B. To have access to and copy, at reasonable times and at reasonable cost, any records required to be kept under the terms and conditions of this permit.

C. To inspect, at reasonable times, any facilities, equipment (including monitoring and control equipment), practices, methods, or operations regulated or required under this permit.

D. To sample or monitor, at reasonable times, any substances or parameters at any location for purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act.

G4. GENERAL PERMIT MODIFICATION AND REVOCATION

This permit may be modified, revoked and reissued, or terminated in accordance with the provisions of Chapter 173-226 WAC. Grounds for modification, revocation and reissuance, or termination include, but are not limited to, the following:

A. When a change occurs in the technology or practices for control or abatement of pollutants applicable to the category of dischargers covered under this permit.

B. When effluent limitation guidelines or standards are promulgated pursuant to the CWA or Chapter 90.48 RCW, for the category of dischargers covered under this permit.

C. When a water quality management plan containing requirements applicable to the category of dischargers covered under this permit is approved, or

D. When information is obtained that indicates cumulative effects on the environment from dischargers covered under this permit are unacceptable.

G5. REVOCATION OF COVERAGE UNDER THE PERMIT

Pursuant to Chapter 43.21B RCW and Chapter 173-226 WAC, the Director may terminate coverage for any discharger under this permit for cause. Cases where coverage may be terminated include, but are not limited to, the following:

A. Violation of any term or condition of this permit.

B. Obtaining coverage under this permit by misrepresentation or failure to disclose fully all relevant facts.

C. A change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge.

D. Failure or refusal of the Permittee to allow entry as required in RCW 90.48.090.

E. A determination that the permitted activity endangers human health or the environment, or contributes to water quality standards violations.

F. Nonpayment of permit fees or penalties assessed pursuant to RCW 90.48.465 and Chapter 173-224 WAC.

G. Failure of the Permittee to satisfy the public notice requirements of WAC 173-226-130(5), when applicable.

The Director may require any discharger under this permit to apply for and obtain coverage under an individual permit or another more specific general permit. Permittees who have their coverage revoked for cause according to WAC 173-226-240 may request temporary coverage under this permit during the time an individual permit is being developed, provided the request is made within ninety (90) days from the time of revocation and is submitted along with a complete individual permit application form.

G6. REPORTING A CAUSE FOR MODIFICATION

The Permittee must submit a new application, or a supplement to the previous application, whenever a material change to the construction activity or in the quantity or type of discharge is anticipated which is not specifically authorized by this permit. This application must be submitted at least sixty (60) days prior to any proposed changes. Filing a request for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not relieve the Permittee of the duty to comply with the existing permit until it is modified or reissued.

G7. COMPLIANCE WITH OTHER LAWS AND STATUTES

Nothing in this permit will be construed as excusing the Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

G8. DUTY TO REAPPLY

The Permittee must apply for permit renewal at least 180 days prior to the specified expiration date of this permit. The Permittee must reapply using the electronic application form (NOI) available on Ecology's website. Permittees unable to submit electronically (for example, those who do not have an internet connection) must contact Ecology to request a waiver and obtain instructions on how to obtain a paper NOI.

Department of Ecology
Water Quality Program - Construction Stormwater
PO Box 47696
Olympia, WA 98504-7696

G9. REMOVED SUBSTANCE

The Permittee must not re-suspend or reintroduce collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of stormwater to the final effluent stream for discharge to state waters.

G10. DUTY TO PROVIDE INFORMATION

The Permittee must submit to Ecology, within a reasonable time, all information that Ecology may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee must also submit to Ecology, upon request, copies of records required to be kept by this permit [40 CFR 122.41(h)].

G11. OTHER REQUIREMENTS OF 40 CFR

All other requirements of 40 CFR 122.41 and 122.42 are incorporated in this permit by reference.

G12. ADDITIONAL MONITORING

Ecology may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

G13. PENALTIES FOR VIOLATING PERMIT CONDITIONS

Any person who is found guilty of willfully violating the terms and conditions of this permit shall be deemed guilty of a crime, and upon conviction thereof shall be punished by a fine of up to ten thousand dollars ($10,000) and costs of prosecution, or by imprisonment at the discretion of the court. Each day upon which a willful violation occurs may be deemed a separate and additional violation.

Any person who violates the terms and conditions of a waste discharge permit shall incur, in addition to any other penalty as provided by law, a civil penalty in the amount of up to ten thousand dollars ($10,000) for every such violation. Each and every such violation shall be a separate and distinct offense, and in case of a continuing violation, every day's continuance shall be deemed to be a separate and distinct violation.

G14. UPSET

Definition – "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of the following paragraph are met.

A Permittee who wishes to establish the affirmative defense of upset must demonstrate, through properly signed, contemporaneous operating logs or other relevant evidence that: 1) an upset occurred and that the Permittee can identify the cause(s) of the upset; 2) the permitted facility was being properly operated at the time of the upset; 3) the Permittee submitted notice of the upset as required in Special Condition S5.F, and; 4) the Permittee complied with any remedial measures required under this permit.

In any enforcement proceeding, the Permittee seeking to establish the occurrence of an upset has the burden of proof.

G15. PROPERTY RIGHTS

This permit does not convey any property rights of any sort, or any exclusive privilege.

G16. DUTY TO COMPLY

The Permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

G17. TOXIC POLLUTANTS

The Permittee must comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if this permit has not yet been modified to incorporate the requirement.

G18. PENALTIES FOR TAMPERING

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two years per violation, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this condition, punishment shall be a fine of not more than $20,000 per day of violation, or imprisonment of not more than four (4) years, or both.

G19. REPORTING PLANNED CHANGES

The Permittee must, as soon as possible, give notice to Ecology of planned physical alterations, modifications or additions to the permitted construction activity. The Permittee should be aware that, depending on the nature and size of the changes to the original permit, a new public notice and other permit process requirements may be required. Changes in activities that require reporting to Ecology include those that will result in:

A. The permitted facility being determined to be a new source pursuant to 40 CFR 122.29(b).

B. A significant change in the nature or an increase in quantity of pollutants discharged, including but not limited to: a 20% or greater increase in acreage disturbed by construction activity.

C. A change in or addition of surface water(s) receiving stormwater or non-stormwater from the construction activity.

D. A change in the construction plans and/or activity that affects the Permittee's monitoring requirements in Special Condition S4.

Following such notice, permit coverage may be modified, or revoked and reissued pursuant to 40 CFR 122.62(a) to specify and limit any pollutants not previously limited. Until such modification is effective, any new or increased discharge in excess of permit limits or not specifically authorized by this permit constitutes a violation.

G20. REPORTING OTHER INFORMATION

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to Ecology, it must promptly submit such facts or information.

G21. REPORTING ANTICIPATED NON-COMPLIANCE

The Permittee must give advance notice to Ecology by submission of a new application or supplement thereto at least forty-five (45) days prior to commencement of such discharges, of any facility expansions, production increases, or other planned changes, such as process modifications, in the permitted facility or activity which may result in noncompliance with permit limits or conditions. Any maintenance of facilities, which might necessitate unavoidable interruption of

operation and degradation of effluent quality, must be scheduled during non-critical water quality periods and carried out in a manner approved by Ecology.

G22. REQUESTS TO BE EXCLUDED FROM COVERAGE UNDER THE PERMIT

Any discharger authorized by this permit may request to be excluded from coverage under the general permit by applying for an individual permit. The discharger must submit to the Director an application as described in WAC 173-220-040 or WAC 173-216-070, whichever is applicable, with reasons supporting the request. These reasons will fully document how an individual permit will apply to the applicant in a way that the general permit cannot. Ecology may make specific requests for information to support the request. The Director will either issue an individual permit or deny the request with a statement explaining the reason for the denial. When an individual permit is issued to a discharger otherwise subject to the construction stormwater general permit, the applicability of the construction stormwater general permit to that Permittee is automatically terminated on the effective date of the individual permit.

G23. APPEALS

A. The terms and conditions of this general permit, as they apply to the appropriate class of dischargers, are subject to appeal by any person within 30 days of issuance of this general permit, in accordance with Chapter 43.21B RCW, and Chapter 173-226 WAC.

B. The terms and conditions of this general permit, as they apply to an individual discharger, are appealable in accordance with Chapter 43.21B RCW within 30 days of the effective date of coverage of that discharger. Consideration of an appeal of general permit coverage of an individual discharger is limited to the general permit's applicability or nonapplicability to that individual discharger.

C. The appeal of general permit coverage of an individual discharger does not affect any other dischargers covered under this general permit. If the terms and conditions of this general permit are found to be inapplicable to any individual discharger(s), the matter shall be remanded to Ecology for consideration of issuance of an individual permit or permits.

G24. SEVERABILITY

The provisions of this permit are severable, and if any provision of this permit, or application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

G25. BYPASS PROHIBITED

A. Bypass Procedures

Bypass, which is the intentional diversion of waste streams from any portion of a treatment facility, is prohibited for stormwater events below the design criteria for stormwater management. Ecology may take enforcement action against a Permittee for bypass unless one of the following circumstances (1, 2, 3 or 4) is applicable.

1. Bypass of stormwater is consistent with the design criteria and part of an approved management practice in the applicable stormwater management manual.

2. Bypass for essential maintenance without the potential to cause violation of permit limits or conditions.

Bypass is authorized if it is for essential maintenance and does not have the potential to cause violations of limitations or other conditions of this permit, or adversely impact public health.

3. Bypass of stormwater is unavoidable, unanticipated, and results in noncompliance of this permit.

   This bypass is permitted only if:

   a. Bypass is unavoidable to prevent loss of life, personal injury, or severe property damage. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass.

   b. There are no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, maintenance during normal periods of equipment downtime (but not if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance), or transport of untreated wastes to another treatment facility.

   c. Ecology is properly notified of the bypass as required in Special Condition S5.F of this permit.

4. A planned action that would cause bypass of stormwater and has the potential to result in noncompliance of this permit during a storm event.

   The Permittee must notify Ecology at least thirty (30) days before the planned date of bypass. The notice must contain:

   a. A description of the bypass and its cause

   b. An analysis of all known alternatives which would eliminate, reduce, or mitigate the need for bypassing.

   c. A cost-effectiveness analysis of alternatives including comparative resource damage assessment.

   d. The minimum and maximum duration of bypass under each alternative.

   e. A recommendation as to the preferred alternative for conducting the bypass.

   f. The projected date of bypass initiation.

   g. A statement of compliance with SEPA.

   h. A request for modification of water quality standards as provided for in WAC 173-201A-110, if an exceedance of any water quality standard is anticipated.

   i. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass.

5. For probable construction bypasses, the need to bypass is to be identified as early in the planning process as possible. The analysis required above must be considered during

preparation of the Stormwater Pollution Prevention Plan (SWPPP) and must be included to the extent practical. In cases where the probable need to bypass is determined early, continued analysis is necessary up to and including the construction period in an effort to minimize or eliminate the bypass.

Ecology will consider the following before issuing an administrative order for this type bypass:

a. If the bypass is necessary to perform construction or maintenance-related activities essential to meet the requirements of this permit.

b. If there are feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment down time, or transport of untreated wastes to another treatment facility.

c. If the bypass is planned and scheduled to minimize adverse effects on the public and the environment.

After consideration of the above and the adverse effects of the proposed bypass and any other relevant factors, Ecology will approve, conditionally approve, or deny the request. The public must be notified and given an opportunity to comment on bypass incidents of significant duration, to the extent feasible. Approval of a request to bypass will be by administrative order issued by Ecology under RCW 90.48.120.

B. Duty to Mitigate

The Permittee is required to take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment.

APPENDIX A – DEFINITIONS

AKART is an acronym for "**A**ll **K**nown, **A**vailable, and **R**easonable methods of prevention, control, and **T**reatment." AKART represents the most current methodology that can be reasonably required for preventing, controlling, or abating the pollutants and controlling pollution associated with a discharge.

Applicable TMDL means a TMDL for turbidity, fine sediment, high pH, or phosphorus, which was completed and approved by EPA before January 1, 2021, or before the date the operator's complete permit application is received by Ecology, whichever is later. TMDLs completed after a complete permit application is received by Ecology become applicable to the Permittee only if they are imposed through an administrative order by Ecology, or through a modification of permit coverage.

Applicant means an *operator* seeking coverage under this permit.

Benchmark means a pollutant concentration used as a permit threshold, below which a pollutant is considered unlikely to cause a water quality violation, and above which it may. When pollutant concentrations exceed benchmarks, corrective action requirements take effect. Benchmark values are not water quality standards and are not numeric effluent limitations; they are indicator values.

Best Management Practices (BMPs) means schedules of activities, prohibitions of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent or reduce the pollution of waters of the State. BMPs include treatment systems, operating procedures, and practices to control stormwater associated with construction activity, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Buffer means an area designated by a local jurisdiction that is contiguous to and intended to protect a sensitive area.

Bypass means the intentional diversion of waste streams from any portion of a treatment facility.

Calendar Day A period of 24 consecutive hours starting at 12:00 midnight and ending the following 12:00 midnight.

Calendar Week (same as **Week**) means a period of seven consecutive days starting at 12:01 a.m. (0:01 hours) on Sunday.

Certified Erosion and Sediment Control Lead (CESCL) means a person who has current certification through an approved erosion and sediment control training program that meets the minimum training standards established by Ecology (See BMP C160 in the SWMM).

Chemical Treatment means the addition of chemicals to stormwater and/or authorized non-stormwater prior to filtration and discharge to surface waters.

Clean Water Act (CWA) means the Federal Water Pollution Control Act enacted by Public Law 92-500, as amended by Public Laws 95-217, 95-576, 96-483, and 97-117; USC 1251 et seq.

Combined Sewer means a sewer which has been designed to serve as a sanitary sewer and a storm sewer, and into which inflow is allowed by local ordinance.

Common Plan of Development or Sale means a site where multiple separate and distinct construction activities may be taking place at different times on different schedules and/or by different contractors, but still under a single plan. Examples include: 1) phased projects and projects with multiple filings or lots, even if the separate phases or filings/lots will be constructed under separate contract or by separate owners (e.g., a development where lots are sold to separate builders); 2) a development plan that may be phased over multiple years, but is still under a consistent plan for long-term development; 3) projects in a contiguous area that may be unrelated but still under the same contract, such as construction of a building extension and a new parking lot at the same facility; and 4) linear projects such as roads, pipelines, or utilities. If the project is part of a common plan of development or sale, the disturbed area of the entire plan must be used in determining permit requirements.

Composite Sample means a mixture of grab samples collected at the same sampling point at different times, formed either by continuous sampling or by mixing discrete samples. May be "time-composite" (collected at constant time intervals) or "flow-proportional" (collected either as a constant sample volume at time intervals proportional to stream flow, or collected by increasing the volume of each aliquot as the flow increases while maintaining a constant time interval between the aliquots.

Concrete Wastewater means any water used in the production, pouring and/or clean-up of concrete or concrete products, and any water used to cut, grind, wash, or otherwise modify concrete or concrete products. Examples include water used for or resulting from concrete truck/mixer/pumper/tool/chute rinsing or washing, concrete saw cutting and surfacing (sawing, coring, grinding, roughening, hydro-demolition, bridge and road surfacing). When stormwater comingles with concrete wastewater, the resulting water is considered concrete wastewater and must be managed to prevent discharge to waters of the State, including groundwater.

Construction Activity means land disturbing operations including clearing, grading or excavation which disturbs the surface of the land (including off-site disturbance acreage related to construction-support activity). Such activities may include road construction, construction of residential houses, office buildings, or industrial buildings, site preparation, soil compaction, movement and stockpiling of topsoils, and demolition activity.

Construction Support Activity means off-site acreage that will be disturbed as a direct result of the construction project and will discharge stormwater. For example, off-site equipment staging yards, material storage areas, borrow areas, and parking areas.

Contaminant means any hazardous substance that does not occur naturally or occurs at greater than natural background levels. See definition of “hazardous substance” and WAC 173-340-200.

Contaminated soil means soil which contains contaminants, pollutants, or hazardous substances that do not occur naturally or occur at levels greater than natural background.

Contaminated groundwater means groundwater which contains contaminants, pollutants, or hazardous substances that do not occur naturally or occur at levels greater than natural background.

Demonstrably Equivalent means that the technical basis for the selection of all stormwater BMPs is documented within a SWPPP, including:

1. The method and reasons for choosing the stormwater BMPs selected.
2. The pollutant removal performance expected from the BMPs selected.

3. The technical basis supporting the performance claims for the BMPs selected, including any available data concerning field performance of the BMPs selected.
4. An assessment of how the selected BMPs will comply with state water quality standards.
5. An assessment of how the selected BMPs will satisfy both applicable federal technology-based treatment requirements and state requirements to use all known, available, and reasonable methods of prevention, control, and treatment (AKART).

Department means the Washington State Department of Ecology.

Detention means the temporary storage of stormwater to improve quality and/or to reduce the mass flow rate of discharge.

Dewatering means the act of pumping groundwater or stormwater away from an active construction site.

Director means the Director of the Washington State Department of Ecology or his/her authorized representative.

Discharger means an owner or operator of any facility or activity subject to regulation under Chapter 90.48 RCW or the Federal Clean Water Act.

Domestic Wastewater means water carrying human wastes, including kitchen, bath, and laundry wastes from residences, buildings, industrial establishments, or other places, together with such groundwater infiltration or surface waters as may be present.

Ecology means the Washington State Department of Ecology.

Engineered Soils means the use of soil amendments including, but not limited, to Portland cement treated base (CTB), cement kiln dust (CKD), or fly ash to achieve certain desirable soil characteristics.

Equivalent BMPs means operational, source control, treatment, or innovative BMPs which result in equal or better quality of stormwater discharge to surface water or to groundwater than BMPs selected from the SWMM.

Erosion means the wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep.

Erosion and Sediment Control BMPs means BMPs intended to prevent erosion and sedimentation, such as preserving natural vegetation, seeding, mulching and matting, plastic covering, filter fences, sediment traps, and ponds. Erosion and sediment control BMPs are synonymous with stabilization and structural BMPs.

Federal Operator is an entity that meets the definition of "Operator" in this permit and is either any department, agency or instrumentality of the executive, legislative, and judicial branches of the Federal government of the United States, or another entity, such as a private contractor, performing construction activity for any such department, agency, or instrumentality.

Final Stabilization (same as **fully stabilized** or **full stabilization**) means the completion of all soil disturbing activities at the site and the establishment of permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, riprap, gabions, or geotextiles) which will prevent erosion. See the applicable Stormwater Management Manual for more information on vegetative cover expectations and equivalent permanent stabilization measures.

Groundwater means water in a saturated zone or stratum beneath the land surface or a surface waterbody.

Hazardous Substance means any dangerous or extremely hazardous waste as defined in RCW 70.105.010 (5) and (6), or any dangerous or extremely dangerous waste as designated by rule under chapter 70.105 RCW; any hazardous sub-stance as defined in RCW 70.105.010(14) or any hazardous substance as defined by rule under chapter 70.105 RCW; any substance that, on the effective date of this section, is a hazardous substance under section 101(14) of the federal cleanup law, 42U.S.C., Sec. 9601(14); petroleum or petroleum products; and any substance or category of substances, including solid waste decomposition products, determined by the director by rule to present a threat to human health or the environment if released into the environment. The term hazardous substance does not include any of the following when contained in an underground storage tank from which there is not a release: crude oil or any fraction thereof or petroleum, if the tank is in compliance with all applicable federal, state, and local law.

Injection Well means a well that is used for the subsurface emplacement of fluids. (See **Well**.)

Jurisdiction means a political unit such as a city, town or county; incorporated for local self-government.

National Pollutant Discharge Elimination System (NPDES) means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Federal Clean Water Act, for the discharge of pollutants to surface waters of the State from point sources. These permits are referred to as NPDES permits and, in Washington State, are administered by the Washington State Department of Ecology.

Notice of Intent (NOI) means the application for, or a request for coverage under this general permit pursuant to WAC 173-226-200.

Notice of Termination (NOT) means a request for termination of coverage under this general permit as specified by Special Condition S10 of this permit.

Operator means any party associated with a construction project that meets either of the following two criteria:

- The party has operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications; or
- The party has day-to-day operational control of those activities at a project that are necessary to ensure compliance with a SWPPP for the site or other permit conditions (e.g., they are authorized to direct workers at a site to carry out activities required by the SWPPP or comply with other permit conditions).

Permittee means individual or entity that receives notice of coverage under this general permit.

pH means a liquid's measure of acidity or alkalinity. A pH of 7 is defined as neutral. Large variations above or below this value are considered harmful to most aquatic life.

pH Monitoring Period means the time period in which the pH of stormwater runoff from a site must be tested a minimum of once every seven days to determine if stormwater pH is between 6.5 and 8.5.

Point Source means any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, and container from which pollutants are or may be discharged to surface waters of the State. This term does not include return flows from irrigated agriculture. (See the Fact Sheet for further explanation)

Pollutant means dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, domestic sewage sludge (biosolids), munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste. This term does not include sewage from vessels within the meaning of section 312 of the CWA, nor does it include dredged or fill material discharged in accordance with a permit issued under section 404 of the CWA.

Pollution means contamination or other alteration of the physical, chemical, or biological properties of waters of the State; including change in temperature, taste, color, turbidity, or odor of the waters; or such discharge of any liquid, gaseous, solid, radioactive or other substance into any waters of the State as will or is likely to create a nuisance or render such waters harmful, detrimental or injurious to the public health, safety or welfare; or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses; or to livestock, wild animals, birds, fish or other aquatic life.

Process Wastewater means any non-stormwater which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct, or waste product. If stormwater commingles with process wastewater, the commingled water is considered process wastewater.

Receiving Water means the waterbody at the point of discharge. If the discharge is to a storm sewer system, either surface or subsurface, the receiving water is the waterbody to which the storm system discharges. Systems designed primarily for other purposes such as for groundwater drainage, redirecting stream natural flows, or for conveyance of irrigation water/return flows that coincidentally convey stormwater are considered the receiving water.

Representative means a stormwater or wastewater sample which represents the flow and characteristics of the discharge. Representative samples may be a grab sample, a time-proportionate *composite sample*, or a flow proportionate sample. Ecology's Construction Stormwater Monitoring Manual provides guidance on representative sampling.

Responsible Corporate Officer for the purpose of signatory authority means: (i) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or (ii) the manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures (40 CFR 122.22).

Sanitary Sewer means a sewer which is designed to convey domestic wastewater.

Sediment means the fragmented material that originates from the weathering and erosion of rocks or unconsolidated deposits, and is transported by, suspended in, or deposited by water.

Sedimentation means the depositing or formation of sediment.

Sensitive Area means a waterbody, wetland, stream, aquifer recharge area, or channel migration zone.

SEPA (State Environmental Policy Act) means the Washington State Law, RCW 43.21C.020, intended to prevent or eliminate damage to the environment.

Significant Amount means an amount of a pollutant in a discharge that is amenable to available and reasonable methods of prevention or treatment; or an amount of a pollutant that has a reasonable potential to cause a violation of surface or groundwater quality or sediment management standards.

Significant Concrete Work means greater than 1000 cubic yards placed or poured concrete or recycled concrete used over the life of a project.

Significant Contributor of Pollutants means a facility determined by Ecology to be a contributor of a significant amount(s) of a pollutant(s) to waters of the State of Washington.

Site means the land or water area where any "facility or activity" is physically located or conducted.

Source Control BMPs means physical, structural or mechanical devices or facilities that are intended to prevent pollutants from entering stormwater. A few examples of source control BMPs are erosion control practices, maintenance of stormwater facilities, constructing roofs over storage and working areas, and directing wash water and similar discharges to the sanitary sewer or a dead end sump.

Stabilization means the application of appropriate BMPs to prevent the erosion of soils, such as, temporary and permanent seeding, vegetative covers, mulching and matting, plastic covering and sodding. See also the definition of Erosion and Sediment Control BMPs.

Storm Drain means any drain which drains directly into a *storm sewer system*, usually found along roadways or in parking lots.

Storm Sewer System means a means a conveyance, or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains designed or used for collecting or conveying stormwater. This does not include systems which are part of *a combined sewer* or Publicly Owned Treatment Works (POTW), as defined at 40 CFR 122.2.

Stormwater means that portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes, and other features of a stormwater drainage system into a defined surface waterbody, or a constructed infiltration facility.

Stormwater Management Manual (SWMM) or **Manual** means the technical Manual published by Ecology for use by local governments that contain descriptions of and design criteria for BMPs to prevent, control, or treat pollutants in stormwater.

Stormwater Pollution Prevention Plan (SWPPP) means a documented plan to implement measures to identify, prevent, and control the contamination of point source discharges of stormwater.

Surface Waters of the State includes lakes, rivers, ponds, streams, inland waters, salt waters, and all other surface waters and water courses within the jurisdiction of the state of Washington.

Temporary Stabilization means the exposed ground surface has been covered with appropriate materials to provide temporary stabilization of the surface from water or wind erosion. Materials include, but are not limited to, mulch, riprap, erosion control mats or blankets and temporary cover crops. Seeding alone is not considered stabilization. Temporary stabilization is not a substitute for the more permanent “final stabilization.”

Total Maximum Daily Load (TMDL) means a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet state water quality standards. Percentages of the total maximum daily load are allocated to the various pollutant sources. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The TMDL calculations must include a "margin of safety" to ensure that the waterbody can be protected in case there are unforeseen events or unknown sources of the pollutant. The calculation must also account for seasonable variation in water quality.

Transfer of Coverage (TOC) means a request for transfer of coverage under this general permit as specified by Special Condition S2.A of this permit.

Treatment BMPs means BMPs that are intended to remove pollutants from stormwater. A few examples of treatment BMPs are detention ponds, oil/water separators, biofiltration, and constructed wetlands.

Transparency means a measurement of water clarity in centimeters (cm), using a 60 cm transparency tube. The transparency tube is used to estimate the relative clarity or transparency of water by noting the depth at which a black and white Secchi disc becomes visible when water is released from a value in the bottom of the tube. A transparency tube is sometimes referred to as a “turbidity tube.”

Turbidity means the clarity of water expressed as nephelometric turbidity units (NTUs) and measured with a calibrated turbidimeter.

Uncontaminated means free from any contaminant. See definition of “contaminant” and WAC 173-340-200.

Upset means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

Waste Load Allocation (WLA) means the portion of a receiving water’s loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality based effluent limitation (40 CFR 130.2[h]).

Water-Only Based Shaft Drilling is a shaft drilling process that uses water only and no additives are involved in the drilling of shafts for construction of building, road, or bridge foundations.

Water Quality means the chemical, physical, and biological characteristics of water, usually with respect to its suitability for a particular purpose.

Waters of the State includes those waters as defined as "waters of the United States" in 40 CFR Subpart 122.2 within the geographic boundaries of Washington State and "waters of the State" as defined in Chapter 90.48 RCW, which include lakes, rivers, ponds, streams, inland waters, underground waters, salt

waters, and all other surface waters and water courses within the jurisdiction of the state of Washington.

Well means a bored, drilled or driven shaft, or dug hole whose depth is greater than the largest surface dimension. (See **Injection Well**.)

Wheel Wash Wastewater means any water used in, or resulting from the operation of, a tire bath or wheel wash (BMP C106: Wheel Wash), or other structure or practice that uses water to physically remove mud and debris from vehicles leaving a construction site and prevent track-out onto roads. When stormwater comingles with wheel wash wastewater, the resulting water is considered wheel wash wastewater and must be managed according to Special Condition S9.D.9.

APPENDIX B – ACRONYMS

AKART	All Known, Available, and Reasonable Methods of Prevention, Control, and Treatment
BMP	Best Management Practice
CESCL	Certified Erosion and Sediment Control Lead
CFR	Code of Federal Regulations
CKD	Cement Kiln Dust
cm	Centimeters
CPD	Common Plan of Development
CTB	Cement-Treated Base
CWA	Clean Water Act
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency
ERTS	Environmental Report Tracking System
ESC	Erosion and Sediment Control
FR	Federal Register
LID	Low Impact Development
NOI	Notice of Intent
NOT	Notice of Termination
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit
RCW	Revised Code of Washington
SEPA	State Environmental Policy Act
SWMM	Stormwater Management Manual
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
UIC	Underground Injection Control
USC	United States Code
USEPA	United States Environmental Protection Agency
WAC	Washington Administrative Code
WQ	Water Quality
WWHM	Western Washington Hydrology Model

F. 303(d) List Waterbodies / TMDL Waterbodies Information

Search Results - 12 Matched Listings

Listing ID	AU ID	Medium	Parameter	Category	Waterbody Name	WRIA	WQ Improvement Project
6586	17080005000053_001_001	Water	Temperature	5	COWLITZ RIVER	26-Cowlitz	
17164	17080005000220_001_001	Tissue	Polychlorinated Biphenyls (PCBs)	5	COWLITZ RIVER	26-Cowlitz	
51552	17080005000220_001_001	Tissue	2,3,7,8-TCDD (Dioxin)	5	COWLITZ RIVER	26-Cowlitz	
86610	17080004000212_001_001	Tissue	Polychlorinated Biphenyls (PCBs)	5	COWLITZ RIVER	26-Cowlitz	
86614	17080005000069_001_001	Tissue	Polychlorinated Biphenyls (PCBs)	5	COWLITZ RIVER	26-Cowlitz	
86615	17080005000221_001_001	Tissue	Polychlorinated Biphenyls (PCBs)	5	COWLITZ RIVER	26-Cowlitz	
86616	17080005000222_001_001	Tissue	Polychlorinated Biphenyls (PCBs)	5	COWLITZ RIVER	26-Cowlitz	
88562	17080004000293_001_001	Tissue	Methyl mercury	5	COWLITZ RIVER	26-Cowlitz	
88565	17080005000069_001_001	Tissue	Methyl mercury	5	COWLITZ RIVER	26-Cowlitz	
88566	17080005000220_001_001	Tissue	Methyl mercury	5	COWLITZ RIVER	26-Cowlitz	
88567	17080005000221_001_001	Tissue	Methyl mercury	5	COWLITZ RIVER	26-Cowlitz	
88568	17080005000222_001_001	Tissue	Methyl mercury	5	COWLITZ RIVER	26-Cowlitz	

G. Contaminated Site Information

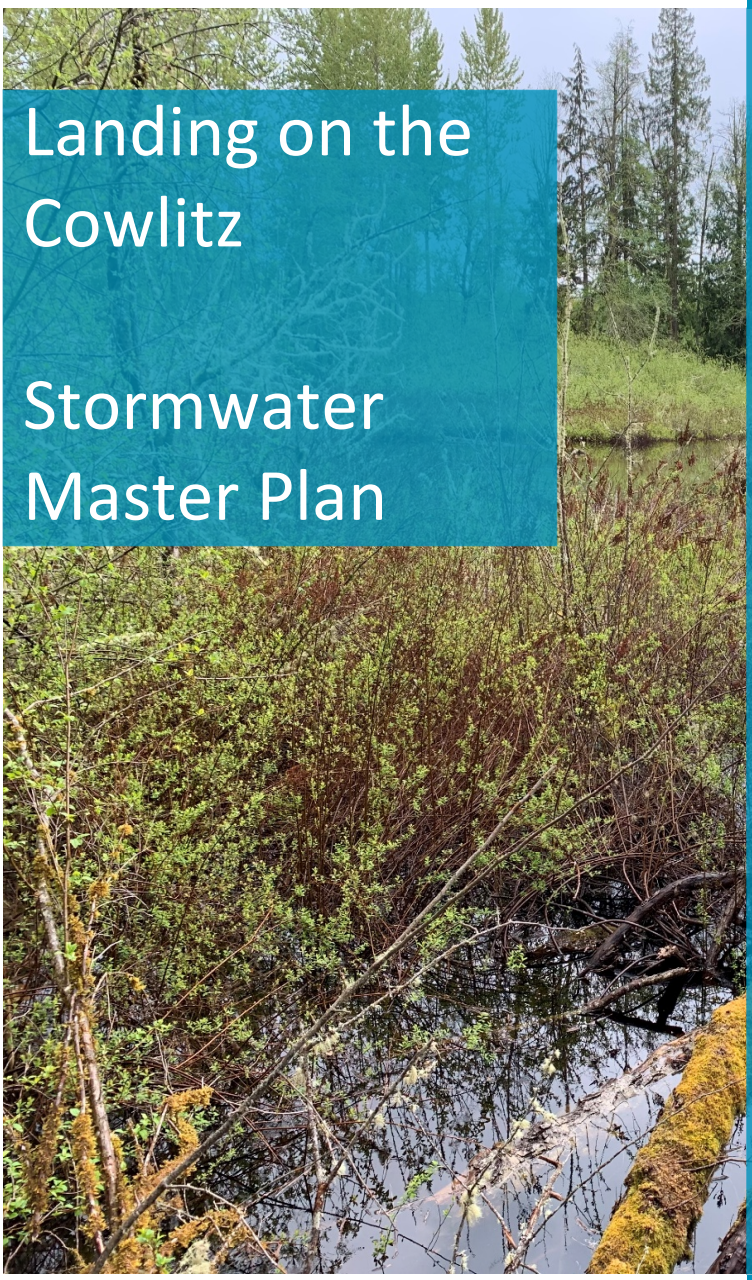
N/A

H. Engineering Calculations

N/A

Landing on the Cowlitz

Stormwater Master Plan



Technical Information Report

Landing on the Cowlitz – Stormwater Master Plan

March 10, 2025

PREPARED FOR :
City of Castle Rock
141 A St SW, Castle Rock, WA 98611

CLIENT :
CT6, LLC
Shane Tapani
360-687-1148
PO Box 1419
Battle Ground, WA 98604

Jurisdiction Project Number : XXXXX

MacKay Sposito
Prepared By : Taylor Wilson, PE
Project Number : 18591

03/10/2025

TAYLOR ANDREW WILSON
STATE OF WASHINGTON
22012357
REGISTERED
PROFESSIONAL ENGINEER

MacKay Sposito

Vancouver Office
18405 SE Mill Plain Blvd, Suite 100 • Vancouver, WA 98683
360.695.3411 • info@mackaysposito.com

March 10, 2025

Technical Information Report (TIR)
LOTC – Stormwater Master Plan

Engineer's Certification
March 10, 2025
City of Castle Rock
Development Engineer

"I hereby state this Technical Information Report (TIR) has been prepared under my supervision and meets the standards of care and expertise which is usual and customary in this community for professional engineers. The TIR includes the required information per City of Castle Rock's Storm Drainage Standards and complies with the 1992 Stormwater Management Manual for the Puget Sound Basin. The proposed stormwater design is feasible."

03/10/2025

Taylor Wilson, PE
Project Manager

Table of Contents

1. Project Overview 1
2. Minimum Requirements Overview 2
3. Streambank Erosion Control 4
4. Direct Discharge to the Cowlitz River 5
5. Conveyance System Analysis and Design 6
6. References 16

Tables

Table 1 – Proposed Onsite Basin Summary 2
Table 2 – Proposed Offsite Basin Summary 3
Table 3 - WWHM Flow Rates for the 2-, 10-, 25- and 100-year storm events 8
Table 4 – Cumulative WWHM Flow Rates at each node for the 25 and 100-year storm events 8
Table 5 - Water Elevation and Free-board at each node for the 25-Year Storm 10
Table 6 - Water Elevation and Free-board at each node for the 100-Year Storm 10
Table 7 - Water Elevation and Free-board at each node for the 25-Year Storm 11
Table 8 - Water Elevation and Free-board at each node for the 100-Year Storm 11
Table 9 - Water Elevation and Free-board at each node for the 25-Year Storm 11
Table 10 - Water Elevation and Free-board at each node for the 100-Year Storm 12
Table 11 - Water Elevation and Free-board at each node for the 25-Year Storm 12
Table 12 - Water Elevation and Free-board at each node for the 100-Year Storm 13
Table 13 - Water Elevation and Free-board at each node for the 100-Year Storm 14

Appendices

Appendix A: Maps & Figures

Appendix B: River and Rainfall Data

Appendix C: Stormwater Volume Calculations

Appendix D: Stormwater Conveyance Calculations

Appendix E: Geotechnical Report

1. Project Overview

The Landing on the Cowlitz is an approved mixed-use master plan development with a site area of approximately 118 acres.

The approved uses on the site include light industrial, flex/office space, commercial, single-family residential, and recreational. Approximately 53.5 acres have been identified for light industrial use, 12.5 acres for flex/office space, 9.9 acres for commercial uses, 10.3 acres for residential, and 13.9 acres for recreational use (which will include an RV park, recreational trails and other recreational amenities). The remaining acreage consists of public/private roadways and undevelopable shoreline along the Cowlitz River.

This report is being prepared to analyze the future stormwater demands of the site, as well as sizing the storm drain main lines for the site's stormwater outfall and Phase 1 access road (connecting the site to Huntington Ave).

Site Location and Topography

The project is located in the City of Castle Rock, Cowlitz County, WA. The site consists of seven parcels (currently being adjusted per CR-BLA-24-01): Parcel 1 (308640100), Parcel 2 (30813), Parcel 3 (6143802), Parcel 4 (308100200), Parcel 5 (30812), Parcel 6 (308640200), and Parcel 7 (30864). Also, there is an adjacent DNR-owned property to the south that is expected to contribute to the site's runoff in the future and has been included in the contributing area (bounded by the Cowlitz River and Salmon Creek). The project site is accessed from I-5 at exit #48 and is located south of Huntington Avenue S. The property is situated between the BNSF line and Salmon Creek to the east and south, and the Cowlitz River to the west. North of the property is the Timberlake Church and some residential uses along Larsen Lane.

The site is mostly flat, with several closed depressions. Along the western and southern ends of the site, there is a berm that separates the site from Salmon Creek and the Cowlitz River. Towards the southern end of the site there is an approximately 33% slope at the dredge pile that is partially located on the Landing site, with the other part of the pile being located on the DNR parcel.

Existing and Proposed Storm Systems for Early Grading

Prior to any onsite grading, the existing site contained two private ditches to convey stormwater. The main ditch generally runs north-south through the center of the site and utilizes 3 culverts (ranging in size from 15"-24" diam.) to cross existing access roads. The existing secondary ditch is located at the toe of the dredge pile slope located near the southern portion of the site. Both ditches convey stormwater drainage to an existing 24" diameter outfall culvert which discharges to Salmon Creek.

With the initial grading to fill the site above the 100-year flood elevation, the existing primary ditch was widened in its existing alignment. New ditches were installed along the west perimeter of the site to capture and convey onsite runoff and allow neighboring properties to drain in the event of a large storm or flood event. The perimeter ditches are conveyed to a large, flat ditch which acts as a detention pond for the Phase 1 mass grading prior to discharging to Salmon Creek. Temporary sediment and detention ponds were installed near the downstream end of the new ditches while keeping clear of the wetland buffers.

Drainage to and From Adjacent Properties

The overall project site is surrounded by residential lots and a church to the north, the Cowlitz River to the west, the BNSF railroad to the east, Huntington Avenue to the northeast, and Salmon Creek to the south.

Currently there are approximately 5.3 acres of offsite stormwater that flows onto the site from the BNSF railroad to the east and 2.1 acres that flow onto the site from Huntington Ave. In large storm events, it is anticipated that runoff can occur from the adjacent lots to the northwest that are primarily single-family homes on larger lots (along Larsen Lane) and also a Church directly adjacent to the site with paved parking (roughly 32 acres of mostly pervious area). However, this offsite area has many intermediate low points that would need to fill and overflow before making its way onsite.

Environmental Impacts

The FEMA flood map for the project site shows flooding for the 100-year storm event at an elevation of 48' (See appendix A for details). There is an existing wetland that has been mapped near the southeast portion of the property. There is a 200 ft Shoreline Buffer and a 250 ft Critical Habit Buffer that extends onto the site from the ordinary high water mark (OHWM) of both the Cowlitz River and Salmon Creek.

2. Minimum Requirements Overview

The stormwater management design for this project is required to comply with Section 5 of the City of Castle Rock Development Polices and Public Works Standards, and the 1992 Stormwater Management Manual for the Puget Sound Basin. Per section I-2.4.1 of the 1992 Stormwater Management Manual for the Puget Sound Basin and figure I-2.1 "Flowchart for determining Minimum Requirements" (see Appendix A), minimum requirements 1-11 will apply to the site development. The site results in over an acre of land disturbing area. See the Stormwater Master Plan Basin and Conveyance Exhibit, attached in Appendix A, for a more detailed summary of basin areas and conveyance assumptions. For a summary of the basin areas used in all stormwater models, reference the tables below.

Table 1 – Proposed Onsite Basin Summary

Basin	Pervious Area (AC)	Impervious Area (AC)	Total Area (AC)
Road 1	1.160	1.684	2.844
Basin 1	1.210	10.889	12.099
Road 2	0.091	0.250	0.341
Basin 2	4.645	4.276	8.921
Road 3	0.239	0.710	0.949
Basin 3	0.306	2.757	3.063
Basin 4	9.462	66.396	75.858
Total	**17.113**	**86.962**	**104.075**

Table 2 – Proposed Offsite Basin Summary

Basin	Pervious Area (AC)	Impervious Area (AC)	Total Area (AC)
Offsite	25.386	6.346	31.732
Road 4	0.107	0.156	0.263
Total	**25.493**	**6.502**	**31.995**

Below is the summary of the requirements and a brief description of how each applies.

I-2.5 Minimum Requirement #1: Erosion and Sediment Control

For each phase of the project, an Erosion Control Plan and Stormwater Pollution Prevention Plan (SWPPP) will be prepared in accordance with the city requirements.

I-2.6 Minimum Requirement #2: Preservation of Natural Drainage Systems

Natural drainage patterns will be maintained as feasible.

I-2.7 Minimum Requirement #3: Source Control of Pollution

Each phase of the development will implement applicable Source Control BMP's based on the proposed land use.

I-2.8 Minimum Requirement #4: Runoff Treatment BMPs

As each phase is developed, Treatment BMP's will be designed to meet quality control requirements for each land use.

I-2.9 Minimum Requirement #5: Streambank Erosion Control

See Section 3 below for further details.

I-2.10 Minimum Requirement #6: Wetlands

No hydrologic modifications to the existing conditions are proposed for the wetland areas on the site.

I-2.11 Minimum Requirement #7: Water Quality Sensitive Areas

There are no sensitive areas that will be impacted by the current development.

I-2.12 Minimum Requirement #8: Off-site Analysis and Mitigation

See Section 5 below for further discussion.

I-2.13 Minimum Requirement #9: Basin Planning

No watershed-based basin plans are intended to be used to modify any of the minimum requirements at this time.

I-2.14 Minimum Requirement #10: Operation and Maintenance

All onsite stormwater treatment systems will be privately maintained by an HOA. The City of Castle Rock will own, operate, and maintain the proposed offsite stormwater facilities and the two proposed stormwater outfalls to the Cowlitz River. Pages from the 1992 SWMMPSB are attached in Appendix E detailing maintenance requirements for applicable components onsite. The site will be inspected for defects and maintained as needed at least once every season, as well as after all major storm events (including and in excess of the 100-year storm event).

I-2.15 Minimum Requirement #11: Financial Liability

A performance bond or other appropriate financial instruments (as approved by the City) shall be provided to ensure compliance with these standards.

3. Streambank Erosion Control

Per Section 5 of the City of Castle Rock Development Polices and Public Works Standards and the 1992 Stormwater Management Manual for the Puget Sound Basin, the project is required to limit the peak rate of runoff from the developed site to:

- 50% of the existing 2-year, 24-hour design storm
- the 10 year, 24-hour design storm.
- the 25 year, 24-hour design storm.
- the 100 year, 24-hour design storm.

Since the different onsite soils are all classified as Hydrologic Soil Group A, management of runoff is generally through infiltration due to the limited runoff experienced from Group A soils.

Review of the onsite soils for infiltration potential was completed by Columbia West Engineering (CWE) in March 2023 with follow up exploration in March 2024. See Appendix C for the CWE Geotechnical Report and Exploration Map showing locations and tested infiltration rates. Tested infiltration rates ranged from a high of 200 in/hr. to negligible. The test pits identified hardpan layers and strata with very high silt content resulting in very variable rates across the site. Groundwater was also encountered between 9ft and 35ft with the likelihood of perched groundwater at even shallower depths being encountered. Due to the issues related to infiltration rates identified in CWE's original investigation, further investigation was completed in March 2024. The follow up investigations confirmed CWE's recommendations that infiltration should only be used to address Low Impact Development (LID) Best Management Practices (BMP's) rather than as the mechanism to remove all runoff from the site.

Discussions were had with CWE to reclassify the onsite soil from a Group A to a tighter soil type with higher historical runoff. However, due to the high rates tested, a reclassification was not possible. Due to the issues related to both detention and infiltration, direct discharge from the site was explored.

Per the 2024 Stormwater Management Manual for Western Washington Section 1-3.4.7: Flow Control, under TDA Exemption, it states: Flow Control is not required for TDAs that discharge directly to, or

indirectly through an MS4 to a water listed in Appendix 1-A: Flow Control Exempt Receiving Waters. Based on Appendix 1-A, the Cowlitz River is Flow Control Exempt Downstream of confluence of the Ohanapecosh River and the Clear Fork Cowlitz River. Since the confluence of the Ohanapecosh is approximately 85 miles upstream of the site, the project is well within the Flow Control Exempt reaches of the Cowlitz River.

Applying the latest Stormwater Manual for Western Washington (SWMMWW) and thus the Flow Control Exemption rather than the 1992 Puget Sound Manual was discussed with the city. Based on the above site issues, City staff supported using the SWMMWW due to the afore mentioned issues. By applying the flow control exemption, the project also takes on the responsibility to apply the Minimum Requirements (MR) from the manual. The only MR that really differs between the two manuals is the requirement in the SWMMWW to address LID standards. Therefore, future development on the site will meet the LID standards per the requirements.

4. Direct Discharge to the Cowlitz River

Since the site is predominantly located within a 100-year flood zone of the Cowlitz River, any design has to address the ability of a system to remove stormwater from the site in all situations without impacting any buildings or creating any safety issues to the public. There are two distinct areas associated with the project drainage:

- Onsite Areas that will be raised to or above the 100-year flood elevation
- Offsite Areas that will stay at the existing elevation between 42ft and 55ft

The development of the project site will be creating a significant amount of impervious surface that will create a large increase in both runoff flow and volume. To convey this flow from the different parts of the site creates a hydraulic grade line that exceeds the offsite elevation. To address this difference in flow elevation and flow rate/volume, two systems are being proposed for the project; an offsite system and an onsite system, both with their own direct discharge to the Cowlitz River. These systems will be kept hydraulically disconnected so the onsite flow elevation will not impact the elevation of the offsite storm.

Since the offsite area is well below the 100-year flood elevation of 48 ft, this project is proposing several measures to prevent the offsite area from being adversely impacted by not only this development, but also from flooding of the Cowlitz River. The paths that stormwater runoff take to get to the site will remain largely unchanged. The existing culverts from neighboring properties and the series of smaller ditches along the norther boundary that lead to the large drainage ditch onsite will remain in place, with minor modifications to their grades/depths. To keep the offsite and onsite stormwater runoff hydraulically disconnected, an earthen berm will be constructed that separates the existing drainage ditch into two separate detention ponds. The northern most portion of the ditch will be tied to the offsite system while the remaining portion will be used for the onsite system. A 30” storm pipe will be used to convey water from the offsite system to a new outfall along the Cowlitz River. To prevent backflow into the offsite system during flood events in the Cowlitz River, an internal check valve will be installed in the 30” pipe. As a secondary measure, a manhole with a manual slide gate valve will also be installed so that the City can manually isolate the offsite detention pond if the primary valve fails.

If either (or both) of the valves are closed, the offsite system will require a pumping system to ensure that offsite runoff doesn’t flood the basin. Since the need for pumping is anticipated to be infrequent

the development is not proposing a permanent pump station at this time. Instead, a dry sump manhole will be constructed in close proximity to the proposed slide gate manhole in which a portable pump can be utilized. Tapani/CT6 is currently in possession of a 2,290 GPM portable pump to maintain the existing drainage system and has agreed to donate that pump to the City upon completion of construction for use on this offsite system. Please see Section 5 for more information on pumping frequency and anticipated performance of the offsite system.

For the onsite area, the conveyance system is being sized to minimize localized flooding even when the Cowlitz River reaches flood stage. Roads and parking will be designed through site development to provide flow routes and ponding locations to ensure that no buildings are impacted if there was ever a 100-yeaar storm event. Onsite conveyance will consist of both underground piping and above ground drainage channels that lead to a second (and separate) outfall at the Cowlitz River. A manhole will be constructed within the earthen berm described above to combine the underground flows with the above ground flows in remaining portion of the onsite ditch. From that point, a 48" storm pipe will convey runoff to the discharge point at the Cowlitz River. This 48" line will also have an internal check valve to prevent backflow onto the site during flood conditions in the Cowlitz River. However, due to the higher hydraulic grade of the onsite system, we do not anticipate that the internal check valve on the onsite system will close as frequently as the valve on the offsite system. In the rare occasions that the internal check valve does close, the remaining portion of the onsite ditch will act as onsite detention until river levels subside. As a measure of extreme precaution, the Phase 1 roadway has been designed so that the surface elevations gradually cascade down towards the river. Runoff can surface flow down the roadway towards the existing ditch until it spills over the edge towards the river. Please see Section 5 for more information on the capabilities and expected operation of the onsite storm system.

5. Conveyance System Analysis and Design

Determination of Ordinary Highwater Mark

In the early stages of the stormwater master planning process, we walked the project frontage along the Cowlitz River with the client and their environmental consultant (Ecological Land Services) to better understand the flow patterns of the river before setting a location and elevation for a potential outfall. Based on observations in the field and the ordinary highwater mark (OHWM) shown on preliminary design documents, it became evident that the OHWM may not have been accurately represented on the preliminary plans. To more clearly define it, we studied the available data for the Cowlitz River at a nearby gauging station and compared it to survey information gathered at various locations along the project frontage on the river.

The nearest gauging station for the Cowlitz River is located at the bridge crossing the river just north of the project site in Castle Rock. On April 25, 2024, surveyors collected the water elevation under the bridge and then captured the water elevation at the location of the proposed outfall location. The water elevation at the bridge gauging station was 33.501 feet at 11:22 am. The water elevation at the north property line of the project was 27.205 feet at 11:51 am. This shows a drop of 6.3 feet from the bridge to the site.

Next, we compared this to the readings at the gauging station from the USGS Gauging Station Web Site. On April 25, 2024, the reading for the water elevation at the bridge was listed as 34.17 feet (at 11:15 am, 11:30 am, and 11:45 am). This shows a difference in datum of 0.7 feet.

Water elevations of the Cowlitz at the gauging station for the previous 4 winters were then downloaded (See Appendix B). Based on the graphs of these flows, a river elevation was estimated that would cover the extended higher flow river surfaces for all the four years. A line at this elevation has been added the graphs. The estimated elevation was 37.2 feet. Based on the difference in datum between the gauging station and the surveyed readings of 0.7 feet, the resulting ordinary high water elevation at the site is 36.5 feet.

Determination of Flood Stage Elevation

The USGS River Gaging Station website lists four classes of flood stages for the Cowlitz River at the Castle Rock Gaging Station: Action Stage (46 ft), Minor Flood Stage (48 ft), Moderate Flood Stage (54 ft), and Major Flood Stage (57 ft). Based on these classifications, a flood event at this site would be any event resulting in a water elevation of 48 feet or higher. Using the same methodology that we used to assume the OHWM at our site in relation to the reading at the gaging station, we were able to determine that any river water level above 41 feet in elevation at the project site should be considered a flood event. More specifically, the flood stages in relation to our site are as follows: Minor Flood Stage (41 ft), Moderate Flood Stage (47 ft), and Major Flood Stage (50 ft).

The USGS Gaging Station website has data for this location dating back to 2007. Since 2007, there have been a total of three events that have reached flood stages (2 minor and 1 moderate). See Appendix B for more information on these events.

Hydraulic Analysis

The stormwater master plan breaks the development into four (4) distinct drainage basins to be drained by either a piped system or ditch in addition to the one (1) offsite drainage basin (See Master Storm Conveyance Plan in Appendix A). In order to simplify the calculations, additional basins were created for the portions of the proposed Phase 1 roadway adjacent to those basins. In accordance with the SWMMWW, the onsite flows to be used in the analysis of the storm system were calculated using WSDOE's WWHM model.

Overall, the stormwater master plan conveyance model for the site is comprised of five (5) nodes. Four of those nodes are tied to the onsite system, while the last node represents the offsite system. A summary of the nodes is shown below:

- Node A – Captures Drainage from Basin 1 (commercial and flex properties) and the adjacent public roadway. Runoff leaves this node in a 24" pipe.
- Node B – Runoff from Basin 2 (residential) and the adjacent public roadway enters the storm main and continues downstream in a 24" pipe.
- Node C – Runoff from Basin 3 (flex) and the adjacent public roadway enters the storm main and the storm pipe is upsized to 30".
- Node D – Runoff from the rest of the onsite area is conveyed to the large onsite drainage ditch/detention pond through a combination of roadside swales, ditches, and culverts. This ditch is tied into a manhole (by 30" pipe) where it converges with the rest of the runoff from Nodes A-C. Runoff leaves this node in a 48" pipe where it continued towards the ultimate discharge point at the proposed Cowlitz River outfall.
- Node E – Any onsite runoff that makes its way to the northern limits of the project area will be collected via ditches along the property lines or culverts to the remaining portion of the existing

ditch that has been preserved for the offsite system. A short stretch of the roadway improvements on Larsen Lane will also be conveyed to this offsite system due to the transitioning grade from our raised site to the lower existing elevations.

To determine the flow from each of the basin areas, a separate WWHM model was developed for the basins leading to each node. Due to the requirements of this project including stormwater treatment and infiltration (to meet the LID Standard), preliminary bioretention planters and infiltration trenches were designed for each basin. These facilities do assist in reducing the amount of runoff being generated by the parcels and help reduce the pipe sizes in our conveyance system. While these designs are not final, preliminary sizing as completed for this report should be a close approximation. These models provide the necessary design flows for each storm event in each basin (See Appendix C for WWHM models). Based on the models, the flows associated with the 2-year, 10-year, 25-year and 100-year storm events for each basin are as follows:

Table 3 - WWHM Flow Rates for the 2-, 10-, 25- and 100-year storm events

	Flow (CFS)				
Storm	Node A	Node B	Node C	Node D	Node E (Offsite)
2 Yr	3.504	2.939	1.112	16.233	10.287
10 Yr	8.044	6.235	2.689	25.643	21.126
25 Yr	10.575	7.928	3.607	29.385	26.397
100 Yr	14.402	10.369	5.016	34.011	33.741

Since conveyance is generally sized to convey the 25-year storm, the table below shows the cumulative flow that can be expected at each node for both the 25-year and 100-year storm events.

Table 4 – Cumulative WWHM Flow Rates at each node for the 25 and 100-year storm events

Node	25-Year	100-Year
A	10.575 CFS	14.402 CFS
B	18.503 CFS	24.771 CFS
C	22.110 CFS	29.787 CFS
D	51.495 CFS	63.798 CFS
E (Offsite)*	26.397 CFS	33.741 CFS

*Offsite system is completely disconnected from the onsite system.

Due to the size of the site, limited vertical elevation available, and the impact from the Cowlitz River, head losses within the conveyance system become the key factor in sizing pipes within the storm system. To offset the project size and losses within the last pipe from the site to the Cowlitz River, a ponded area is being proposed. This ponded area will act as overflow of the open channel ditch that

provides conveyance for Basin 4. The detention provided in this area reduces the peak flow within the pipe thus reducing head losses.

Assumptions and Basis for Conveyance Modeling

HydroCAD was used to model the conveyance since it has the capacity to model detention, change tailwater elevations to determine hydraulic grades though the system, and add pump flows. For the standard 2-, 10-, 25-, and 100-year storm events, the lowest downstream nodes were set to open flow conditions. To hydraulically connect the nodes within HydroCAD, we utilized catch basin ponds instead of reaches. The furthest downstream nodes (D & E) were set with storage areas to match the volumes of the ditches/detention ponds that they're attached to. The offsite system pond storage was designed to match the volume of the remaining ditch, plus a 2' deep area adjacent on the offsite area where any overflow would collect (should that be necessary). This elevation would still be at least 2-3 feet below the finished floor elevations of the nearest structures on the property. The onsite pond was modeled to reflect a future relocation/realignment of the existing onsite drainage ditch. For these models, it was assumed that the end of the pond will end near the end of the future Phase 2 Road cul-de-sac. In the interim condition, the existing onsite ditch actually has more storage than we've accounted for in these calculations. We also included a large overflow extending from the top of the ditch, as described earlier in this report. Outlet pipes matching the outfall design and free discharge conditions were also modeled. The peak water elevation at a node was then applied to the next node upstream of it as tailwater, to represent the hydraulic grade line in the pipe at that node.

For the onsite system, the pipe diameter was reduced by one pipe size to represent the potential head loss within the outfall pipe to compensate for the backflow device. This approach was not applied to the offsite drainage system due to the smaller size and flatter hydraulic grade. While an effort was made to represent the head loss due to these valves, it should be noted that the Tideflex CheckMate UltraFlex Inline Check Valve is known for causing extremely low headloss. For more information, please reference the product brochure in Appendix D.

For the offsite system, it should be noted that no storm system exists on the neighboring properties. Therefore, the majority of runoff is sheet flow over vegetated areas with little to no concentration of the flow with the exception of the Church parking lot. It should also be noted that the ditches constructed along the west property line of the site do not currently see flow even in large storm events. The above flows associated with the offsite area assume the runoff reaches the outfall area. Based on visual observations, it is likely the offsite flows will be significantly less than what was calculated using the hydrologic modelling.

HydroCAD Reports for all the scenarios that were run for this site are provided in Appendix D.

To properly evaluate the performance of the proposed drainage systems, we modeled a variety of scenarios combining different storm events with various potential flood events of the Cowlitz River. Those scenarios include an analysis of the 25- and 100-year storm events (both on- and offsite) when the Cowlitz River is as at/or Below the OHWM, at the Minor Flood Stage, at the Moderate Flood Stage, at the FEMA 100-year flood plain elevation, and at Major Flood Stage.

Cowlitz River Elevation at/or below OHWM

The first scenario modeled reflects the ideal scenario for the site in which the Cowlitz elevation is at or below the OHWM. In this condition, we see the typical free discharge system with no initial tailwater applied to Node D or E (the furthest downstream nodes). The following results for the proposed system when the river levels were at the OHWM or below were calculated:

Table 5 - Water Elevation and Free-board at each node for the 25-Year Storm

Node	A	B	C	D	E (Offsite)
Water Elevation	50.24	48.56	44.32	42.27	40.30
Rim Elevation	50.41	49.52	48.83	45.29	42.00*
Free-Board	0.17	0.96	4.51	3.02	1.70

*Approximate elevation at which water could overflow ditch into offsite area.

Table 6 - Water Elevation and Free-board at each node for the 100-Year Storm

Node	A	B	C	D	E (Offsite)
Water Elevation	50.56	49.68	46.40	43.12	40.85
Rim Elevation	50.41	49.52	48.83	45.29	42.00*
Free-Board	-0.15	-0.16	2.43	2.17	1.15

*Approximate elevation at which water could overflow ditch into offsite area.

Only two nodes on the model are shown exceeding the rim elevation (by less than 3”) during the 100-year storm event. Both the onsite and offsite systems show adequate capacity to convey these storm events in this condition. The development should have no adverse impacts on the neighboring offsite areas when the Cowlitz River is at or below the OHWM. Additionally, no pumping assistance will be needed in these conditions.

Cowlitz River Elevation at Minor Flood Stage

With the onsite and offsite storm systems performing more than adequately while the Cowlitz River is at or below the OHWM, we then updated the models to test the condition in which the flood stages are reached. As previously explained in this report, minor flood events in the Cowlitz would be equal to an elevation of 41 feet at our site. The inline backflow valve will automatically close when the flood stage exceeds the outfall IE by a few inches and the upstream water elevation is at or lower than this elevation. By closing, any onsite stormwater storage is preserved for use by an onsite storm event. For the following onsite analysis, the most conservative approach has been taken by assuming the onsite storage is already full to the elevation of the flood stage in the Cowlitz River being studied. As the onsite ponded elevation exceeds that of the Cowlitz River, the check valve will open to allow flow into the river. For the onsite model, we’ve assigned a tailwater elevation of 41 feet as the basis for Node D. The results for the onsite system during a flood event on the Cowlitz are shown below.

Table 7 - Water Elevation and Free-board at each node for the 25-Year Storm

Node	A	B	C	D
Water Elevation	50.45	48.77	44.53	42.48
Rim Elevation	50.41	49.52	48.83	45.29
Free-Board	-0.04	0.75	4.30	2.81

Table 8 - Water Elevation and Free-board at each node for the 100-Year Storm

Node	A	B	C	D
Water Elevation	50.56	49.68	46.47	43.19
Rim Elevation	50.41	49.52	48.83	45.29
Free-Board	-0.15	-0.16	2.36	2.10

With the data shown above, our onsite system shows it can handle the 25-year storm while maintaining a hydraulic grade line just above the surface elevation at the high point of the storm main when the river is experiencing a minor flood stage. During the 100-year storm, only the two upper nodes on the are shown exceeding the rim elevation and by less than 3”.

For the offsite system, a flood stage of 41 will almost certainly close the internal check valve due to the lack of head behind the offsite flows. If for some reason the internal check valve doesn’t close, we would recommend that the City close the manual slide gate valve to ensure that the offsite area is protected from flooding. With the valves closed, the offsite system is essentially an isolated detention pond with no gravity outlet. In this condition, the temporary pump should be used to drain the pond and force water out towards the river. As mentioned above, the City would need to use the Tapani-provided pump (capable of pumping 5.0 CFS) to lower the water level in the detention pond. Whenever the pump is to be operated, the City should manually close the slide valve to ensure that none of the pump water makes its way back into the pond. This pump has been modeled in HydroCAD as a Skimmer outlet at elevation 40.

Table 9 - Water Elevation and Free-board at each node for the 25-Year Storm

Node	E
Water Elevation	42.45**
Rim Elevation	42.00*
Overflow Depth	0.45

*Approximate elevation at which water could overflow ditch into offsite area.
**Assumes use of pump, operating at 5.0 CFS outflow

Table 10 - Water Elevation and Free-board at each node for the 100-Year Storm

Node	A
Water Elevation	43.65**
Rim Elevation	42.00*
Overflow Depth	1.65

*Approximate elevation at which water could overflow ditch into offsite area.
**Assumes use of pump, operating at 5.0 CFS outflow

As shown above, minor overflowing of the stormwater detention pond is possible when flood elevations force the valves to close and a 25-year or greater storm event occurs. However, the proposed pump should minimize that to less than 2' of ponding within the existing localized depression adjacent to the detention pond. Topographic surveys of the area show that none of the existing structures adjacent to the property line are below a finished floor elevation of 46 feet, more than 2' above the peak elevation of the 100-year design storm. It's also important to note that the models that have been prepared show a simplified offsite system with a single point of confluence and do not factor in the numerous local depressions, conveyance systems, or infiltration facilities that exist on the adjacent properties. Actual surface conditions will likely result in much less surface runoff than the models show.

Cowlitz River Elevation at Moderate Flood Stage

When the Cowlitz River reaches major flood stages, the equivalent elevation at our site would be 47 feet. As described above in the Minor Flood section, the inline check valve for the onsite system will likely remain closed until the ponded elevation of water on the site exceeds the level of water in the river. In this model, we have made the same conservative assumption that the water elevation onsite will be matching the river elevation prior to the valve closing and therefore reducing the available storage in the detention pond. To test the capacity of the system at this elevation, we've assigned a tailwater elevation of 47 feet as the basis for Node D. In addition to the 48" outlet pipe, this scenario also includes a weir at elevation 48. With the tailwater elevation being so high, the weir was provided as an emergency overflow. The proposed weir would be approximately 30'-wide and the location is yet to be determined, but it would need to lead directly to the Cowlitz River or Salmon Creek. In the interim condition, additional flooding within Basin 4 should have no impact on the site as the existing ditch has an existing spillway to Salmon Creek. In the final condition, a relocated/realigned ditch would likely also provide an emergency overflow to Salmon Creek. The results for the onsite system during a flood event on the Cowlitz are shown below.

Table 11 - Water Elevation and Free-board at each node for the 25-Year Storm

Node	A	B	C	D
Water Elevation	50.51	49.73	48.92	47.56
Rim Elevation	50.41	49.52	48.83	48.00*
Free-Board	-0.10	-0.21	-0.09	0.44

*Elevation of the proposed weir.

Table 12 - Water Elevation and Free-board at each node for the 100-Year Storm

Node	A	B	C	D
Water Elevation	50.57	49.80	49.06	48.12
Rim Elevation	50.41	49.52	48.83	48.00*
Free-Board	-0.16	-0.28	-0.23	-0.12

*Elevation of the proposed weir.

With the Cowlitz River in moderate flood stages, we start seeing the impact of the flooding on the onsite system. The 25-year design storm event maintain an HGL just above the proposed roadway elevation without reaching an elevation where the emergency overflow weir is utilized. However, we start to see some water making its way over the spillway during the 100-year storm. In this condition, we also see runoff at a surface level at depths up to 3.5". Due to the design of the road profile for Phase 1, surface runoff that backs up into the roadway will eventually spill down to the existing pond and over the weir (if necessary). Please note that this scenario was modeled with the assumption that the elevation of ponder water in the onsite detention pond was already equivalent to the river flood elevation prior to the event beginning. In actuality, the available storage in the detention pond will likely be much greater and the resulting water elevations at each node would likely come down below the surface elevation of the roadway.

For the offsite system, a flood stage of 47 will certainly close the internal check valve and it is likely that the City would choose to manually close the slide gate valve if the river reached moderate flood stares. In this scenario, the offsite system will operate in exactly the same fashion as it does during the minor flood stage. The offsite storm system has shown adequate capacity up to the 100-year storm event when the system is totally isolated from the river outfall. As long as the river elevation stays below the highest point of the bank, the offsite storm pond can still handle the full 100-year storm event with the pump is running at full capacity.

Cowlitz River Elevation at FEMA 100-year Flood Plain Elevation of 48

As previously mentioned, the inline check valve will close once the river elevation exceeds the IE of the outflow pipe by a few inches and the upstream water elevation is at or less than the river elevation. As the river floods to an elevation of 48ft, it is highly likely that considerable onsite detention volume will still be available for an onsite storm event. However, to analyze the most conservative option, it is assumed that all onsite storage volume is already at an elevation of 48ft and flow through the outfall pipe is negligible. In this scenario, the volume available to store any onsite runoff is restricted to the area adjacent to the onsite ditch/detention pond. The plan is to have a low area of parking along the ditch to provide this volume. For this study, the volume in the model for node D is assumed as approximately 200ft wide parking at 2% slope to ditch for the length of the ditch. Total depth of this volume is 2ft. With the 30ft overflow to Salmon creek at the south end of the property. The maximum depth for this pond was found to be 0.61ft or 48.61ft. At this time, we anticipate the minimum building elevations onsite to be 50ft. Therefore, all buildings will be over 1ft above the highest 100yr onsite flood elevation under the most conservative assumptions. To simplify the calculations for this scenario, we started directly with the 100-year storm event. The results for the onsite system during a flood event on the Cowlitz are shown below.

Table 13 - Water Elevation and Free-board at each node for the 100-Year Storm

Node	A	B	C	D
Water Elevation	50.49	49.71	49.02	48.61
Rim Elevation	50.41	49.52	48.83	48.00*
Free-Board	-0.08	-0.19	-0.19	N/A

*Elevation of the proposed weir.

As shown above, the system is capable of passing the 100-year storm event even if the river elevation reaches the 100-year flood plain elevation of 48. In this scenario, water will fill the entire onsite conveyance system and then surface flow down the proposed Phase 1 road towards the ditch (less than 3" deep). At the weir, water could reach a peak elevation of 48.61 feet and spill into Salmon Creek or the Cowlitz directly, depending on the location chosen. It is important to note that even in this condition, we do not anticipate any surface runoff on the roadway to run towards the existing Larsen Lane. The elevations of Node C consistently stay below the high point on our proposed extension of Larsen Lane. This scenario was also tested for the actual isopluvial rainfall and the results were very similar to the data above. In that report, a peak elevation of 48.85 feet is shown at the weir which is still more than 1' lower than the minimum finish floor of 50ft.

Once again, the offsite system would be fully isolated in this condition and no additional analysis was required.

Cowlitz River at Major Flood Stage

If the Cowlitz River ever reaches Major Flood Stages (elevation 50 or higher per USGS), the river elevation would likely breach the banks along the project frontage and cause flooding in both the onsite and offsite systems. This level of flooding exceeds even the FEMA 100-year flood elevation and is beyond what is required for our analysis. But as river elevations subside below the bank elevation for the proposed systems, flooding should dissipate much faster than it would in current conditions.

Frequency of Large Storm Events, Flooding, and Need for Pumping

The impact to the site when the Cowlitz River is in flood stages depends on the local weather during the period in which the river levels are high. The Cowlitz River has two major dams upriver from the site. The impact of the dams is that the peaks in flow are modulated and peak flows are generally short in nature. Reviewing the gauging data from 2007 to present, there have only been three events that are considered within flood stage. Between the three events, the river was considered above flood stage for a total of 3 days. Since elevated water elevation in the Cowlitz River is based on extreme weather in its upper reaches rather than local weather, a severe local event occurring at the same time is very unlikely.

In addition to the river flood elevation available on the USGS website, we were also provided with actual rainfall data by the City of Castle Rock Public Works Department. After reviewing their records (which go back to January of 2007), we identified 11 storm events in that time period that would be considered a significant storm event. Nine of those events qualified as 2-year storm events, one as a 10-year storm,

and one as a 100-year storm. Of those nine events in the past 17 years, only two of them occurred on a day in which the river elevation was also at a flood stage elevation.

In the past 17 years, it appears that there were only two (2) occasions in which the offsite system would have required pumping (1/8/2009 and 12/9/2015). In both cases, the inline check valve would have closed, the City would have closed the manual slide gate valve, and pumping would have been needed for no more than 24 hours. While the data suggests that pumping was needed approximately once every ten years, it should be assumed that the pump should be prepared for use any time that the river gage shows flood conditions and a significant storm event is forecasted. Based on historic data, this may occur only every few years. Over time, City staff should become educated on the likely events and conditions that may require the use of the pump. The City could also opt to operate the pump more frequently to ease the concerns of the neighbors if they deem it necessary.

6. References

Castle Rock Public Works Department. 2020. *Development Policies and Public Works Standards.* Castle Rock, WA: City of Castle Rock.

Cowlitz County Public Works Department. 2017. *Cowlitz County Stormwater Drainage Manual.* Cowlitz County.

Hinman, Curtis. 2012. *Low Impact Development Technical Guidance Manual for Puget Sound.* PSP 2012-3. Puyallup, WA: Washington State University Extension.

Ridgefield Public Works Department. 2017. *Engineering Standards for Public Works Construction.* Ridgefield, WA: City of Ridgefield.

USDA Natural Resources Conservation Service. 2023. *National Soil Survey Handbook, Title 430.* United States Department of Agriculture.

USDA Soil Conservation Service. 1972. *Soil Survey of Clark County.* United States Department of Agriculture.

USDA Soil Science Division Staff. 2018. *Soil Survey Manual.* United States Department of Agriculture.

WADOE. 2006. *Guidance for UIC Wells that Manage Stormwater.* 05-10-067. Olympia, WA: Washington State Department of Ecology.

—. 1992. *Stormwater Management Manual for the Puget Sound Basin.*

—. 2019. *Stormwater Manual for Western Washington.* 19-10-021. Olympia, WA: Washington State Department of Ecology.

Appendix A: Maps & Figures

USDA Soil Map

Isopluvial Maps- Figures III-A.1 through A.3

1992 Stormwater Manual "Figure I-2.1 Flowchart for Determining Minimum Requirements"

FEMA Flood Map

Stormwater Master Plan Basin and Conveyance Exhibit

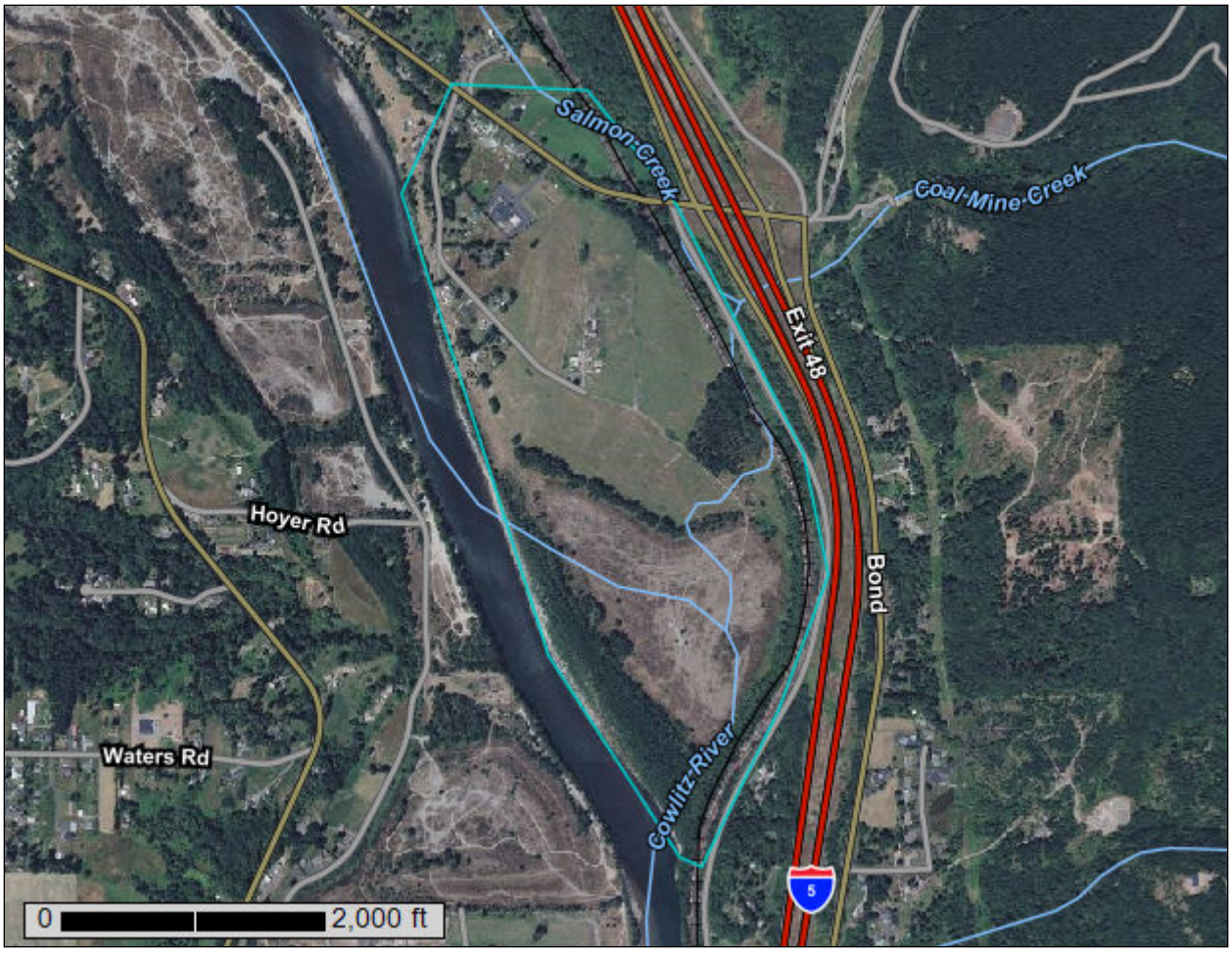
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Cowlitz County, Washington



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Preface.....2
How Soil Surveys Are Made.....5
Soil Map.....8
Soil Map (The Landing at Castle Rock).....9
Legend.....10
Map Unit Legend (The Landing at Castle Rock).....11
Map Unit Descriptions (The Landing at Castle Rock).....11
Cowlitz County, Washington.....14
19—Carrolls loamy sand, 0 to 2 percent slopes.....14
27—Cinebar silt loam, 20 to 30 percent slopes.....15
36—Cowlitz extremely gravelly sand, disturbed, 0 to 5 percent slopes.....16
37—Cowlitz extremely gravelly sand, disturbed, 5 to 15 percent slopes.....17
38—Cowlitz extremely gravelly sand, disturbed, 15 to 30 percent slopes.....18
65—Godfrey silt loam, 0 to 3 percent slopes.....19
100—Kelso silt loam, 0 to 8 percent slopes.....20
102—Kelso silt loam, 15 to 30 percent slopes.....21
103—Kelso silt loam, 30 to 50 percent slopes.....22
141—Newberg fine sandy loam, 0 to 3 percent slopes.....23
151—Panamaker gravelly sand, 0 to 3 percent slopes.....24
160—Pilchuck loamy fine sand, 0 to 8 percent slopes.....25
263—Water.....26
References.....27

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

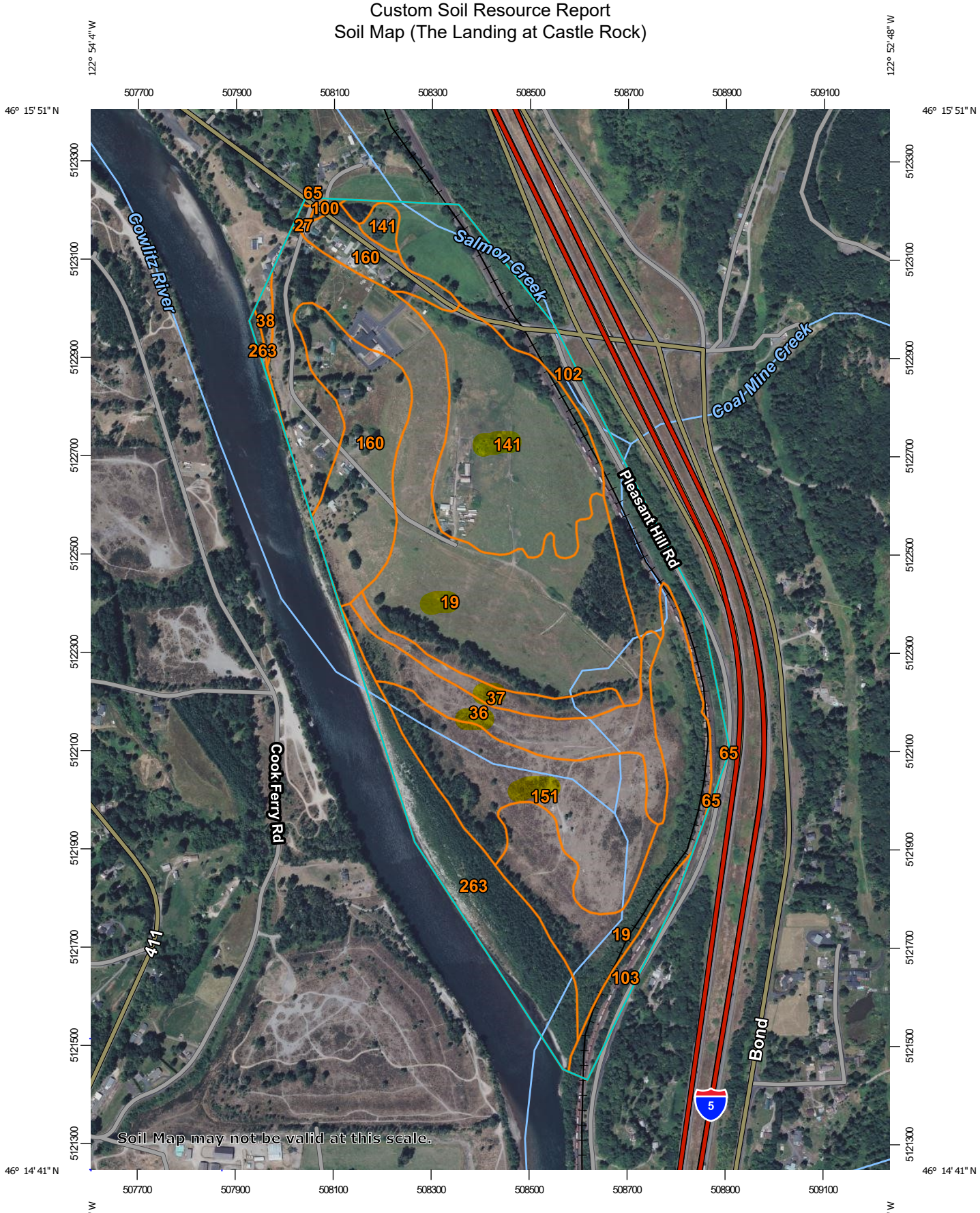
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.



Map Scale: 1:10,500 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Cowlitz County, Washington
Survey Area Data: Version 22, Aug 23, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 21, 2021—Nov 22, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend (The Landing at Castle Rock)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
19	Carrolls loamy sand, 0 to 2 percent slopes	87.9	35.9%
27	Cinebar silt loam, 20 to 30 percent slopes	0.3	0.1%
36	Cowlitz extremely gravelly sand, disturbed, 0 to 5 percent slopes	14.4	5.9%
37	Cowlitz extremely gravelly sand, disturbed, 5 to 15 percent slopes	5.2	2.1%
38	Cowlitz extremely gravelly sand, disturbed, 15 to 30 percent slopes	0.9	0.4%
65	Godfrey silt loam, 0 to 3 percent slopes	0.2	0.1%
100	Kelso silt loam, 0 to 8 percent slopes	0.4	0.2%
102	Kelso silt loam, 15 to 30 percent slopes	26.4	10.8%
103	Kelso silt loam, 30 to 50 percent slopes	5.2	2.1%
141	Newberg fine sandy loam, 0 to 3 percent slopes	32.5	13.3%
151	Panamaker gravelly sand, 0 to 3 percent slopes	25.9	10.6%
160	Pilchuck loamy fine sand, 0 to 8 percent slopes	25.0	10.2%
263	Water	20.2	8.3%
Totals for Area of Interest		**244.4**	**100.0%**

Map Unit Descriptions (The Landing at Castle Rock)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the

landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present

or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Cowlitz County, Washington

19—Carrolls loamy sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2f5r
Elevation: 10 to 100 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Carrolls and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Carrolls

Setting

Landform: Flood plains
Parent material: Sandy alluvium over mudflow deposits

Typical profile

H1 - 0 to 7 inches: loamy sand
H2 - 7 to 10 inches: very fine sandy loam
H3 - 10 to 60 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Ecological site: F002XB007WA - Portland Basin Wet Forest
Forage suitability group: Wet Soils (G002XV102WA)
Other vegetative classification: Wet Soils (G002XV102WA)
Hydric soil rating: Yes

Minor Components

Mountsolo

Percent of map unit: 10 percent
Landform: Terraces
Hydric soil rating: Yes

Unnamed, poorly drained

Percent of map unit: 5 percent
Hydric soil rating: No

27—Cinebar silt loam, 20 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2fbd
Elevation: 50 to 2,000 feet
Mean annual precipitation: 50 to 75 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 160 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Cinebar and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cinebar

Setting

Landform: Hillslopes
Parent material: Volcanic ash over glaciofluvial deposits

Typical profile

H1 - 0 to 10 inches: silt loam
H2 - 10 to 23 inches: silt loam
H3 - 23 to 60 inches: silt loam

Properties and qualities

Slope: 20 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very high (about 16.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: F002XB004WA - Portland Basin Forest
Forage suitability group: Sloping to Steep Soils (G002XV702WA)
Other vegetative classification: Sloping to Steep Soils (G002XV702WA)
Hydric soil rating: No

Minor Components

Zynbar
Percent of map unit: 10 percent
Hydric soil rating: No

Newaukum
Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed, moderately well drained
Percent of map unit: 5 percent
Hydric soil rating: No

36—Cowlitz extremely gravelly sand, disturbed, 0 to 5 percent slopes

Map Unit Setting
National map unit symbol: 2fd1
Elevation: 10 to 200 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition
Cowlitz and similar soils: 85 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cowlitz

Setting
Landform: Terraces, flood plains
Parent material: Alluvium over mudflow deposits

Typical profile
H1 - 0 to 11 inches: extremely gravelly sand
H2 - 11 to 60 inches: very gravelly sand

Properties and qualities
Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Droughty Soils (G002XV402WA)
Other vegetative classification: Droughty Soils (G002XV402WA)
Hydric soil rating: No

Minor Components

Panamaker

Percent of map unit: 5 percent
Hydric soil rating: No

37—Cowlitz extremely gravelly sand, disturbed, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2fd5
Elevation: 10 to 200 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Cowlitz and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cowlitz

Setting

Landform: Terraces, flood plains
Parent material: Alluvium over mudflow deposits

Typical profile

H1 - 0 to 11 inches: extremely gravelly sand
H2 - 11 to 60 inches: very gravelly sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Droughty Soils (G002XV402WA)
Other vegetative classification: Droughty Soils (G002XV402WA)
Hydric soil rating: No

Minor Components

Panamaker

Percent of map unit: 15 percent
Hydric soil rating: No

38—Cowlitz extremely gravelly sand, disturbed, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2fdb
Elevation: 10 to 200 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Cowlitz and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cowlitz

Setting

Landform: Terraces, flood plains
Parent material: Alluvium over mudflow deposits

Typical profile

H1 - 0 to 11 inches: extremely gravelly sand
H2 - 11 to 60 inches: very gravelly sand

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Droughty Soils (G003XF403WA)
Other vegetative classification: Droughty Soils (G003XF403WA)
Hydric soil rating: No

Minor Components

Panamaker

Percent of map unit: 15 percent
Hydric soil rating: No

65—Godfrey silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2flz
Elevation: 20 to 300 feet
Mean annual precipitation: 40 to 65 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Godfrey and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Godfrey

Setting

Landform: Flood plains
Parent material: Alluvium

Typical profile

H1 - 0 to 5 inches: silt loam
H2 - 5 to 27 inches: silty clay loam
H3 - 27 to 60 inches: sandy clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 59 inches to abrupt textural change
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None

Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Ecological site: F002XA008WA - Puget Lowlands Riparian Forest
Forage suitability group: Seasonally Wet Soils (G002XV202WA)
Other vegetative classification: Seasonally Wet Soils (G002XV202WA)
Hydric soil rating: Yes

Minor Components

Godfrey, drained

Percent of map unit: 10 percent
Hydric soil rating: Yes

Caples

Percent of map unit: 5 percent
Landform: Flood plains
Hydric soil rating: Yes

100—Kelso silt loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2f11
Elevation: 50 to 200 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 52 degrees F
Frost-free period: 165 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Kelso and similar soils: 80 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kelso

Setting

Landform: Terraces
Parent material: Alluvium

Typical profile

H1 - 0 to 11 inches: silt loam
H2 - 11 to 34 inches: silt loam
H3 - 34 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Seasonally Wet Soils (G002XV202WA)
Other vegetative classification: Seasonally Wet Soils (G002XV202WA)
Hydric soil rating: No

Minor Components

Hazeldell

Percent of map unit: 5 percent
Hydric soil rating: No

Olympic

Percent of map unit: 5 percent
Hydric soil rating: No

102—Kelso silt loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2f18
Elevation: 50 to 200 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 52 degrees F
Frost-free period: 165 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Kelso and similar soils: 80 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kelso

Setting

Landform: Escarpments, terraces
Parent material: Alluvium

Typical profile

H1 - 0 to 11 inches: silt loam
H2 - 11 to 34 inches: silt loam
H3 - 34 to 60 inches: silt loam

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Sloping to Steep Soils (G002XV702WA)
Other vegetative classification: Sloping to Steep Soils (G002XV702WA)
Hydric soil rating: No

Minor Components

Hazeldell

Percent of map unit: 5 percent
Hydric soil rating: No

Olympic

Percent of map unit: 5 percent
Hydric soil rating: No

103—Kelso silt loam, 30 to 50 percent slopes

Map Unit Setting

National map unit symbol: 2f19
Elevation: 50 to 200 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 52 degrees F
Frost-free period: 165 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Kelso and similar soils: 80 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kelso

Setting

Landform: Escarpments, terraces
Parent material: Alluvium

Typical profile

H1 - 0 to 11 inches: silt loam
H2 - 11 to 34 inches: silt loam
H3 - 34 to 60 inches: silt loam

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: F002XA004WA - Puget Lowlands Forest
Hydric soil rating: No

Minor Components

Olympic

Percent of map unit: 5 percent
Hydric soil rating: No

Hazeldell

Percent of map unit: 5 percent
Hydric soil rating: No

141—Newberg fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2f3d
Elevation: 10 to 1,500 feet
Mean annual precipitation: 18 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Newberg and similar soils: 85 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Newberg

Setting

Landform: Flood plains
Parent material: Alluvium

Typical profile

H1 - 0 to 10 inches: fine sandy loam
H2 - 10 to 28 inches: very fine sandy loam
H3 - 28 to 60 inches: fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A
Ecological site: F002XA008WA - Puget Lowlands Riparian Forest
Forage suitability group: Soils with Few Limitations (G002XV502WA)
Other vegetative classification: Soils with Few Limitations (G002XV502WA)
Hydric soil rating: No

Minor Components

Chehalis

Percent of map unit: 5 percent
Hydric soil rating: No

151—Panamaker gravelly sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2f3s
Elevation: 200 to 600 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Panamaker and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Panamaker

Setting

Landform: Flood plains, terraces
Parent material: Sandy drege material from mudflow deposits

Typical profile

H1 - 0 to 3 inches: gravelly sand
H2 - 3 to 60 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: NoneRare
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F002XA005WA - Puget Lowlands Moist Forest
Forage suitability group: Droughty Soils (G002XV402WA)
Other vegetative classification: Droughty Soils (G002XV402WA)
Hydric soil rating: No

160—Pilchuck loamy fine sand, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2f45
Elevation: 10 to 50 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 195 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Pilchuck and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pilchuck

Setting

Landform: Flood plains
Parent material: Alluvium

Typical profile

H1 - 0 to 12 inches: loamy fine sand

H2 - 12 to 36 inches: fine sand
H3 - 36 to 60 inches: gravelly sand

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: NoneRare
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: F002XA005WA - Puget Lowlands Moist Forest
Forage suitability group: Droughty Soils (G002XV402WA)
Other vegetative classification: Droughty Soils (G002XV402WA)
Hydric soil rating: No

263—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water

Setting

Landform: Alluvial cones

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

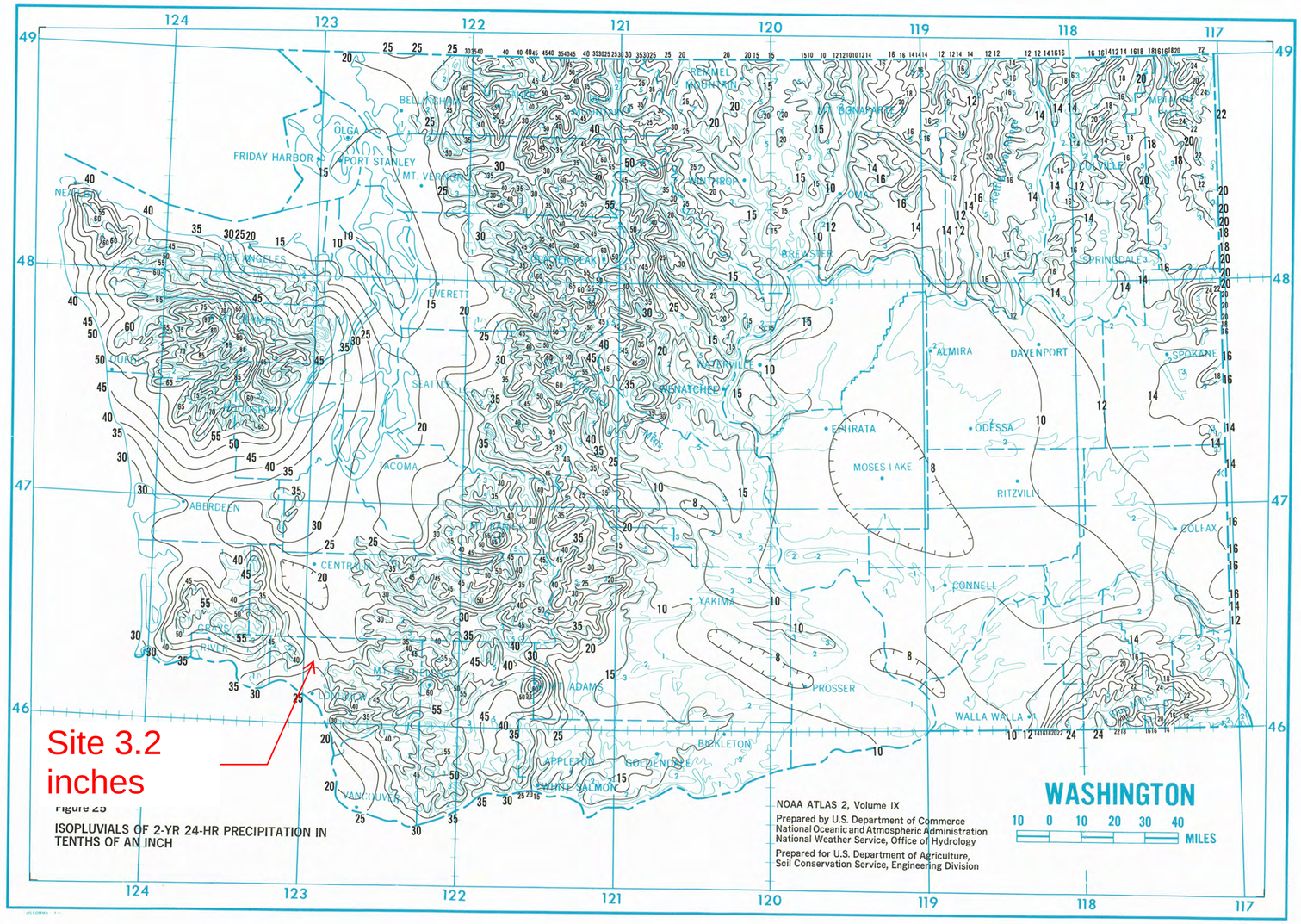


Figure 25

ISOPLUVIALS OF 2-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

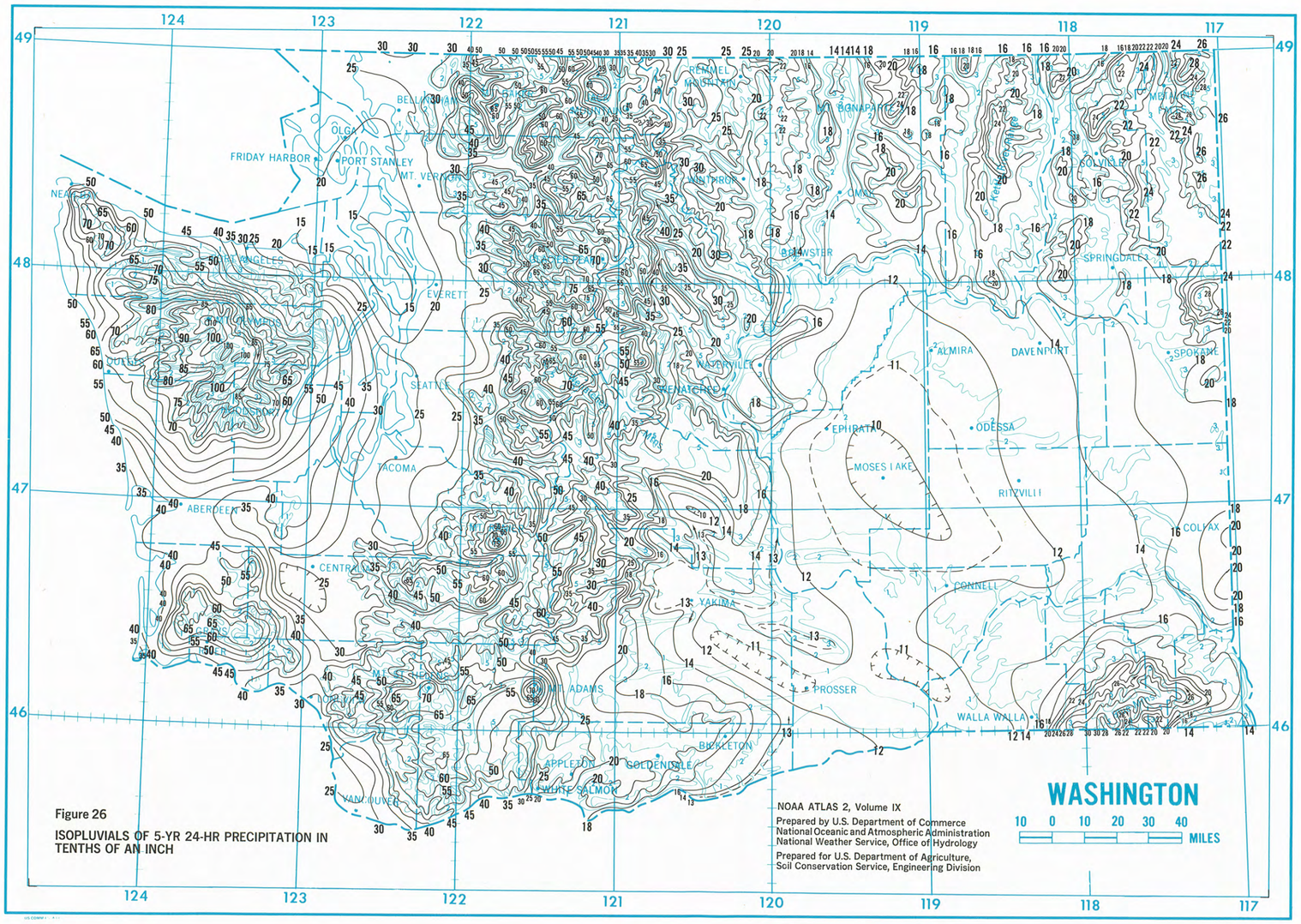


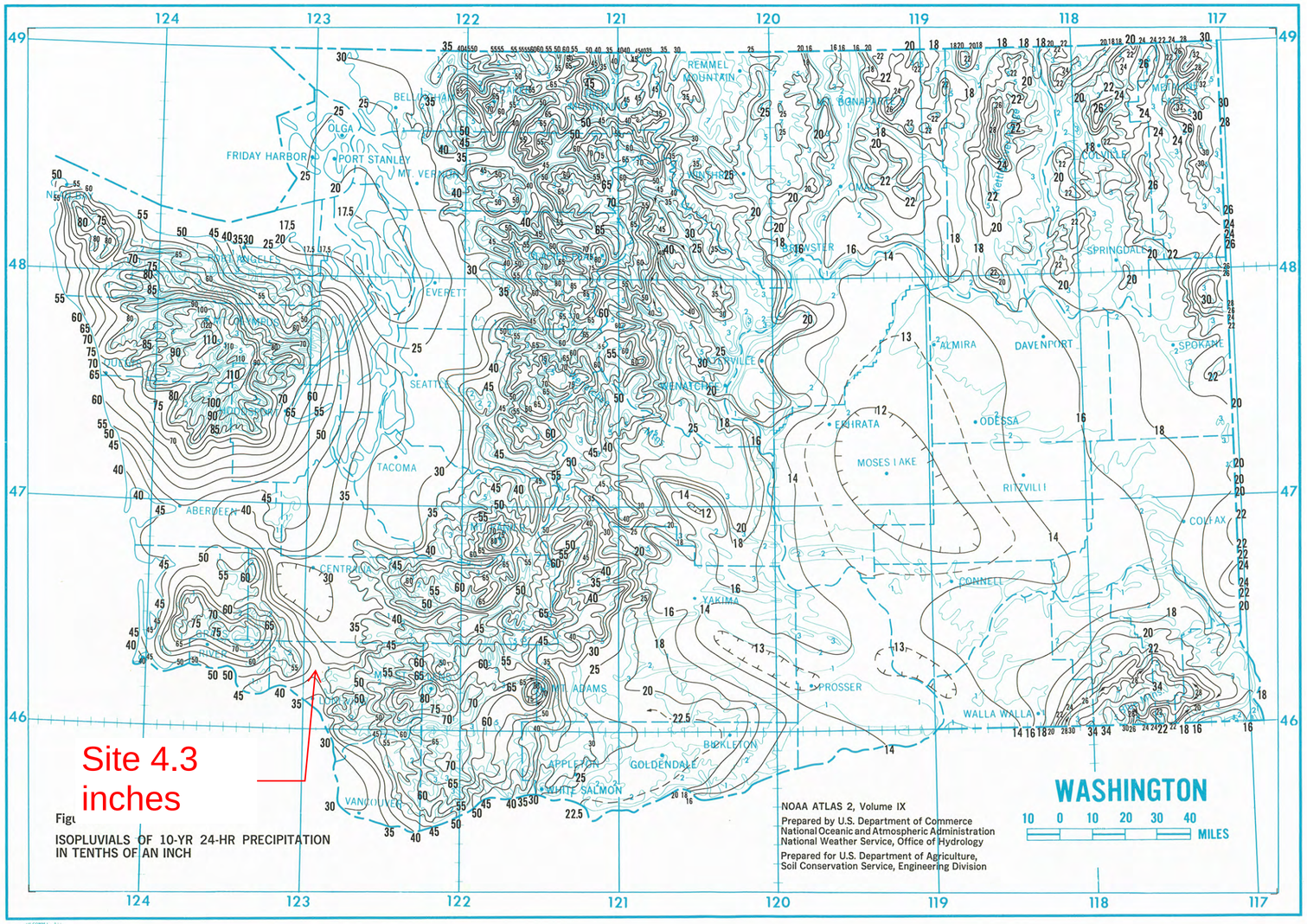
Figure 26

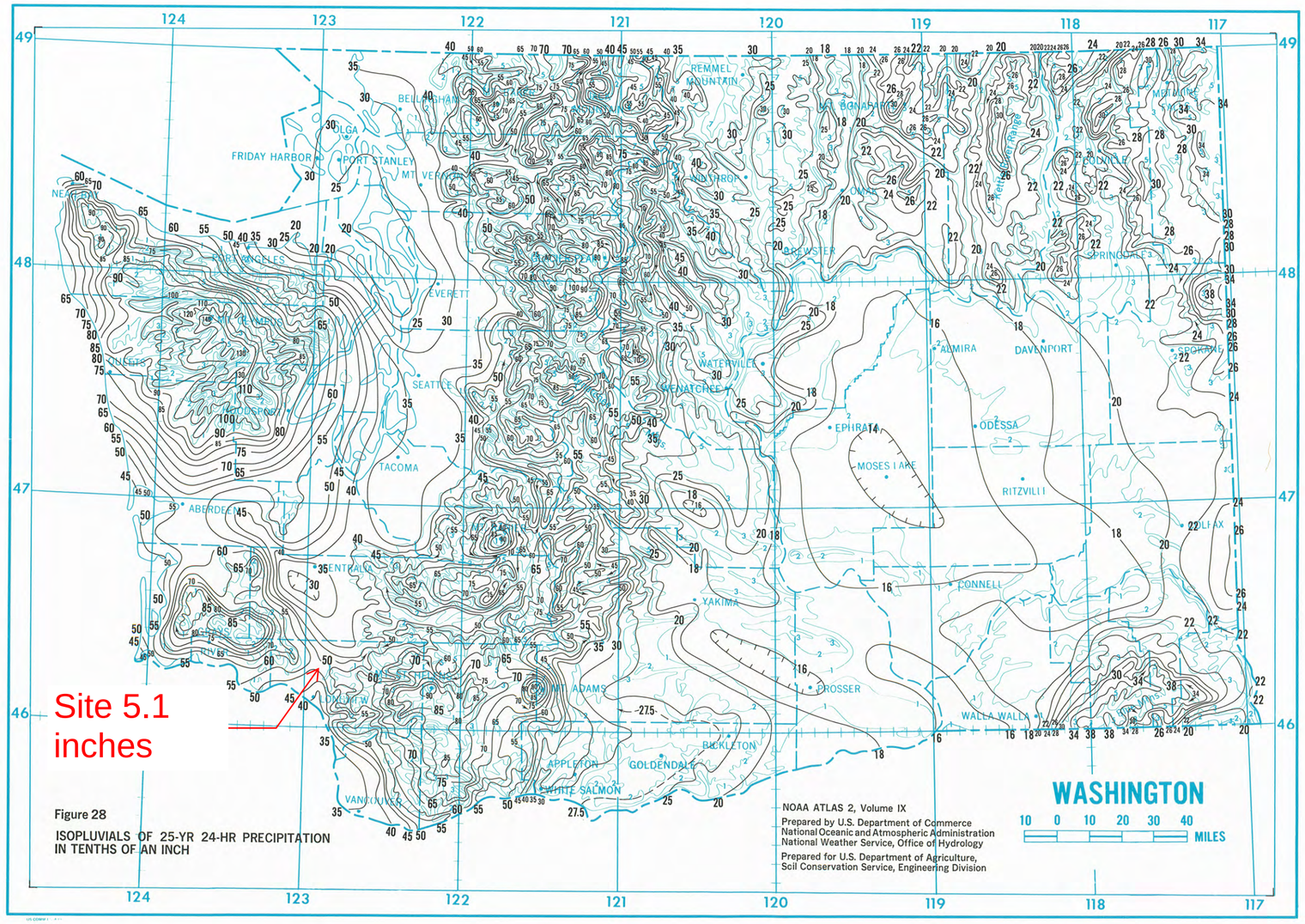
ISOPLUVIALS OF 5-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume IX

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division


124
123
122
121
120
119
118
117
49
48
47
46
FRIDAY HARBOR
PORT STANLEY
OLGA
BELLINGHAM
MT. VERNON
EVERETT
SEATTLE
TACOMA
ABERDEEN
CENTRALIA
OLYMPIA
VANCOUVER
REMMEL MOUNTAIN
WENATCHEE
OMAK
OKANOGAN
BREWSTER
CHELAN
COULEE
SPRINGDALE
ALMIRA
DAVENPORT
SPOKANE
EPHRATA
ODESSA
MOSES LAKE
RITZVILLE
COLFAX
CONNELL
YAKIMA
PROSSER
WALLA WALLA
MT. ADAMS
BICKLETON
APPLETON
GOLDENDALE
WHITE SALMON
Site 4.3 inches
Figu
ISOPLUVIALS OF 10-YR 24-HR PRECIPITATION
IN TENTHS OF AN INCH
NOAA ATLAS 2, Volume IX
Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division
WASHINGTON
10 0 10 20 30 40
MILES


Site 5.1 inches
WASHINGTON
NOAA ATLAS 2, Volume IX
Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division
10 0 10 20 30 40 MILES
FRIDAY HARBOR
PORT STANLEY
OLGA
BELLINGHAM
EVERETT
SEATTLE
TACOMA
ABERDEEN
OLYMPIA
CENTRALIA
CHEHALIS
YAKIMA
ELLENSBURG
WENATCHEE
WATERVILLE
OMAK
OKANOGAN
BREWSTER
CHELAN
REMMEL MOUNTAIN
MT. VERNON
NEWHALEM
PORT ANGELES
QUILLAYUTE
MOSES LAKE
EPHRATA
ODESSA
RITZVILLE
DAVENPORT
SPRINGDALE
COLVILLE
METALINE
SPOKANE
ALMIRA
COLFAX
CONNELL
PROSSER
WALLA WALLA
DIXON
ADAMS
APPLETON
GOLDENDALE
BICKLETON
WHITE SALMON
VANCOUVER
Figure 28
ISOPLUVIALS OF 25-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

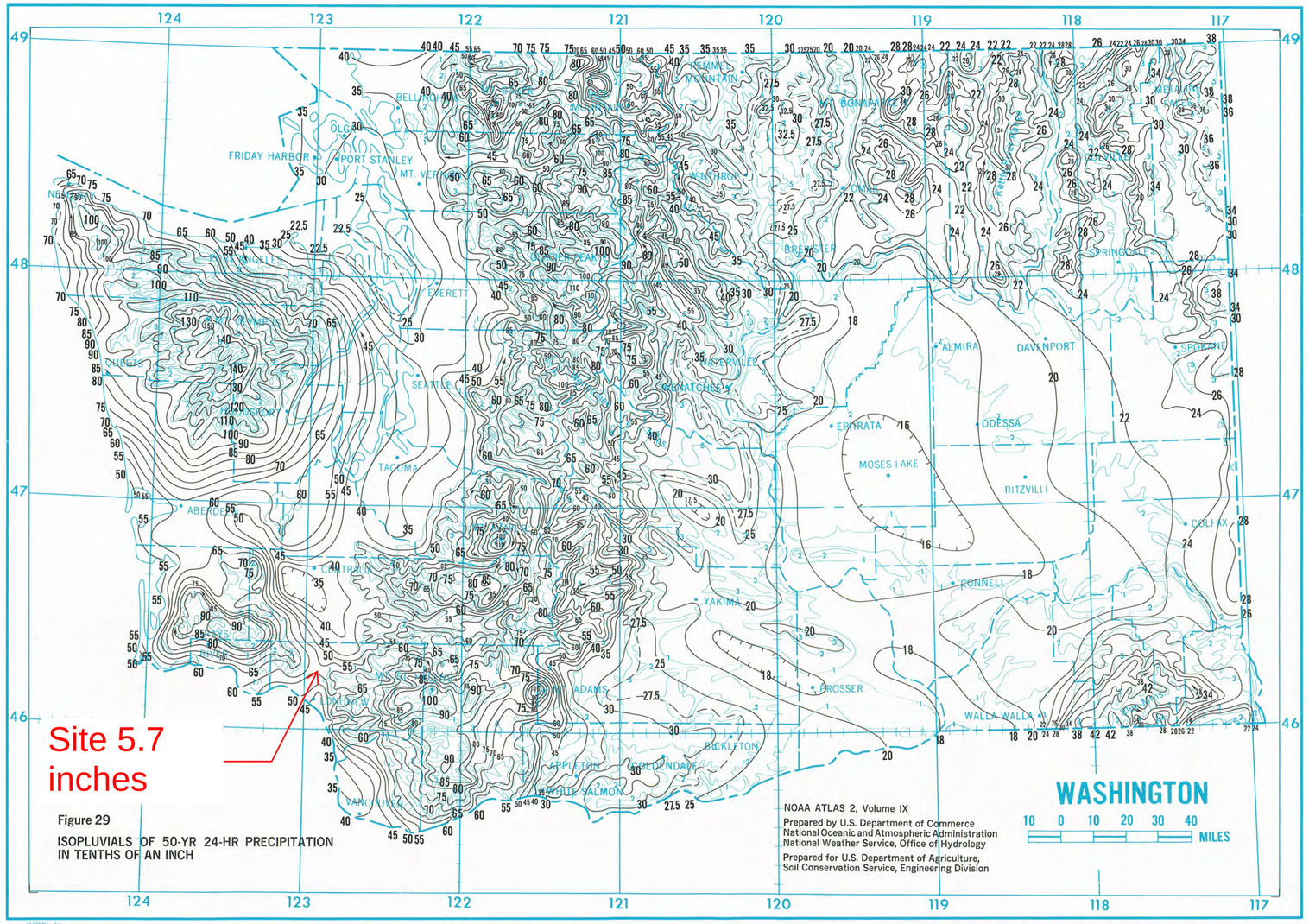


Figure 29

ISOPLUVIALS OF 50-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

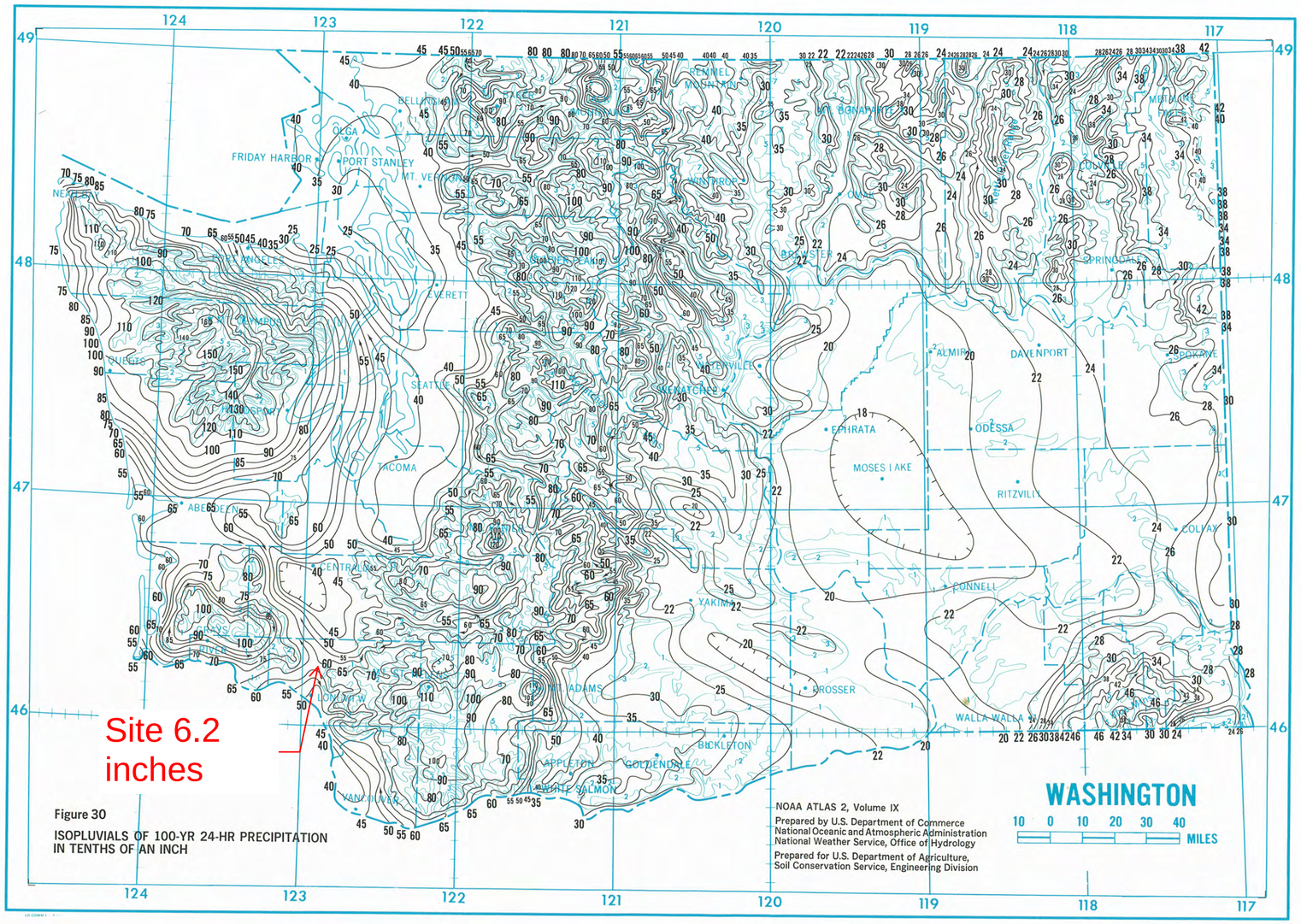
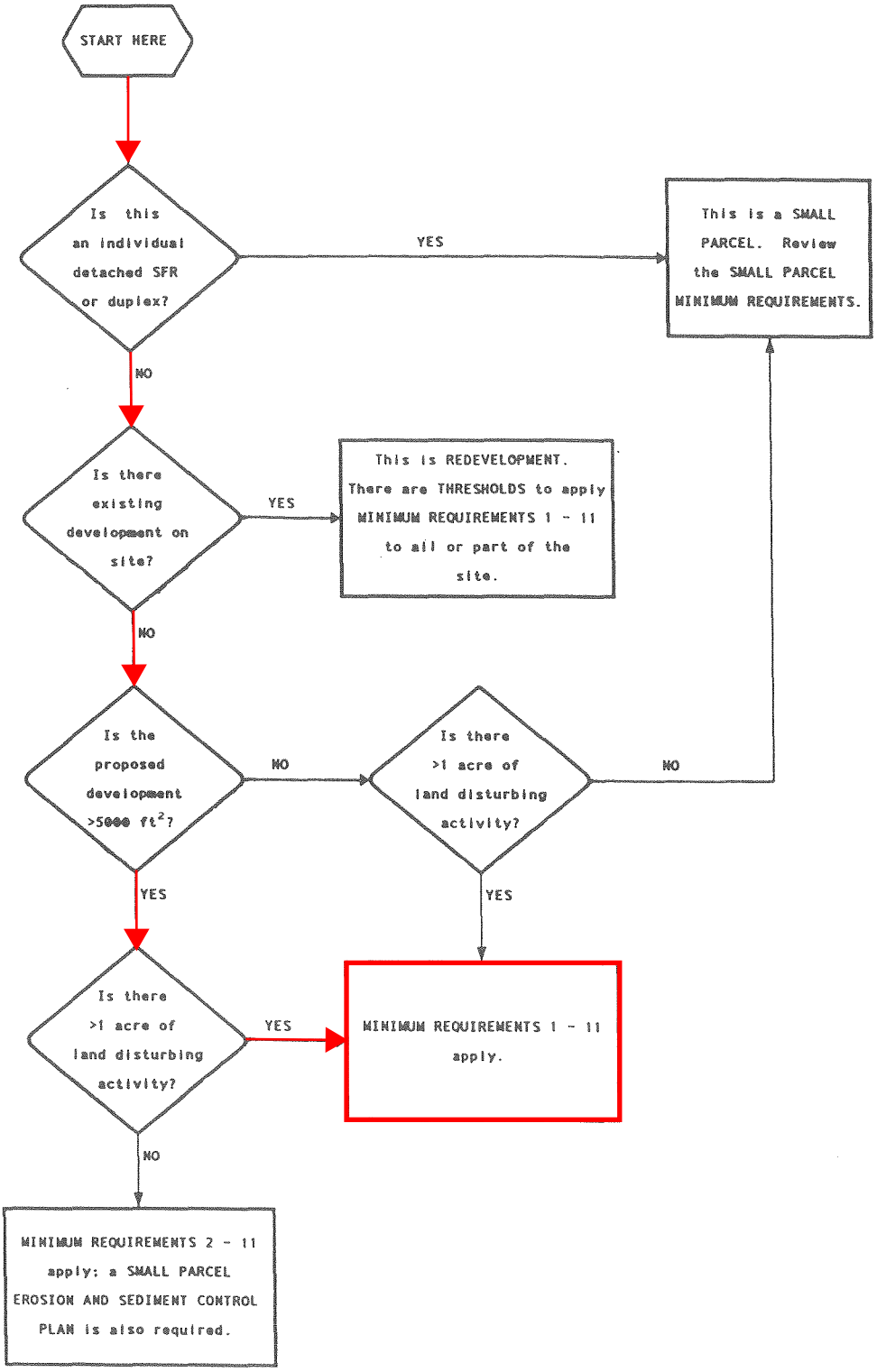

124
123
122
121
120
119
118
117
49
48
47
46
FRIDAY HARBOR
PORT STANLEY
OLGA
BELLINGHAM
EVERETT
SEATTLE
TACOMA
OLYMPIA
ABERDEEN
CENTRALIA
CHEHALIS
YAKIMA
ELLENSBURG
ELLENSBURG
WENATCHEE
EPHRATA
MOSES LAKE
ODESSA
RITZVILLE
DAVENPORT
ALMIRA
SPOKANE
COLFAX
PULLMAN
CONNELL
ROSALIA
COLFAX
MOSCOW
LEWISTON
GRANGEVILLE
GRANGEVILLE
PALOUSE
PALOUSE
ASOTIN
CLARKSTON
DAYTON
DAYTON
PRESCOTT
WALLA WALLA
WALLA WALLA
DIXIE
PRESCOTT
DIXIE
PRESCOTT
DIXIE
PRESCOTT

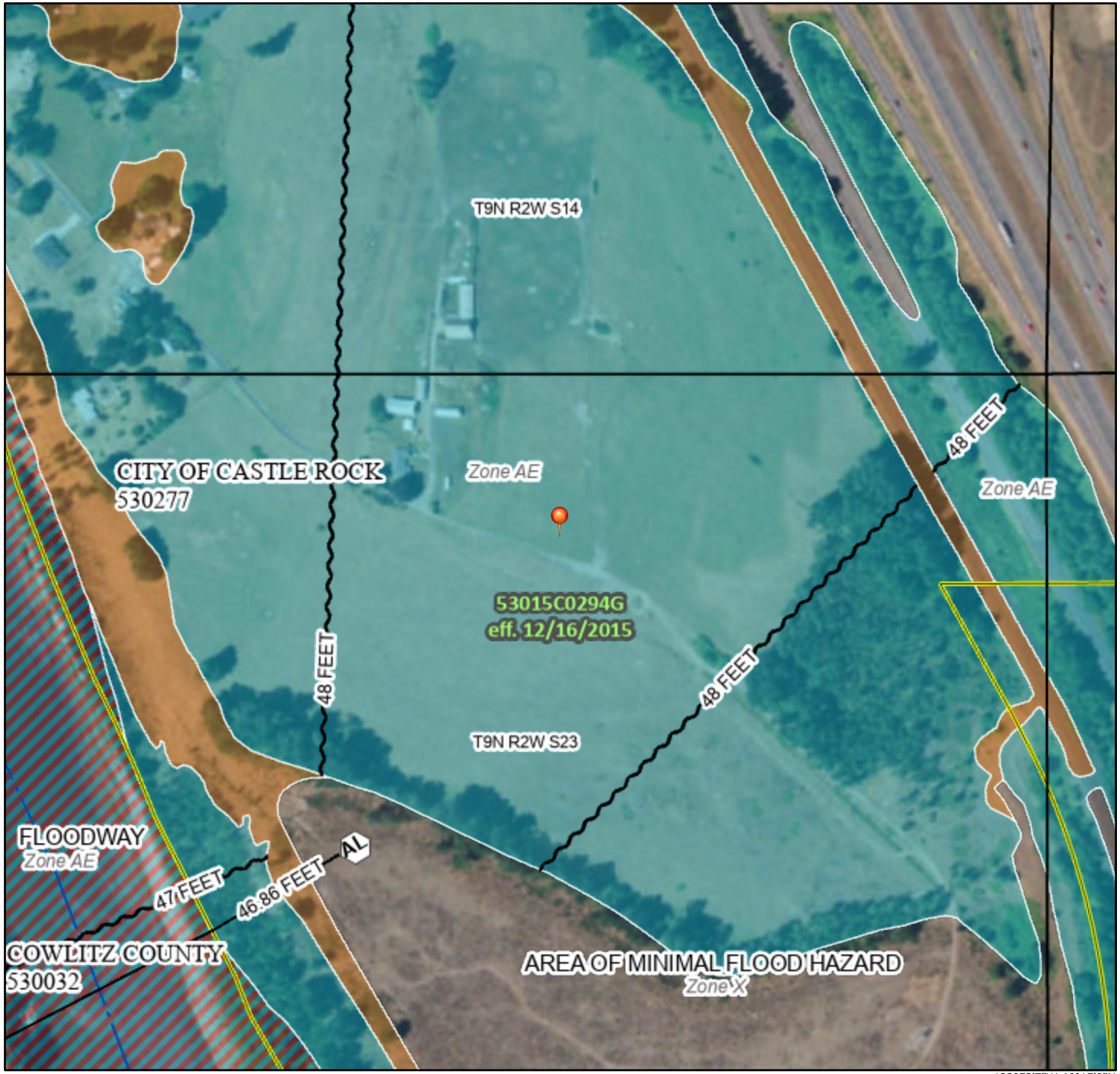
Figure I-2.1 Flowchart Demonstrating Minimum Requirements



National Flood Hazard Layer FIRMette

FEMA

122°53'44"W 46°15'34"N



0 250 500 1,000 1,500 2,000 Feet

1:6,000

122°53'7"W 46°15'9"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

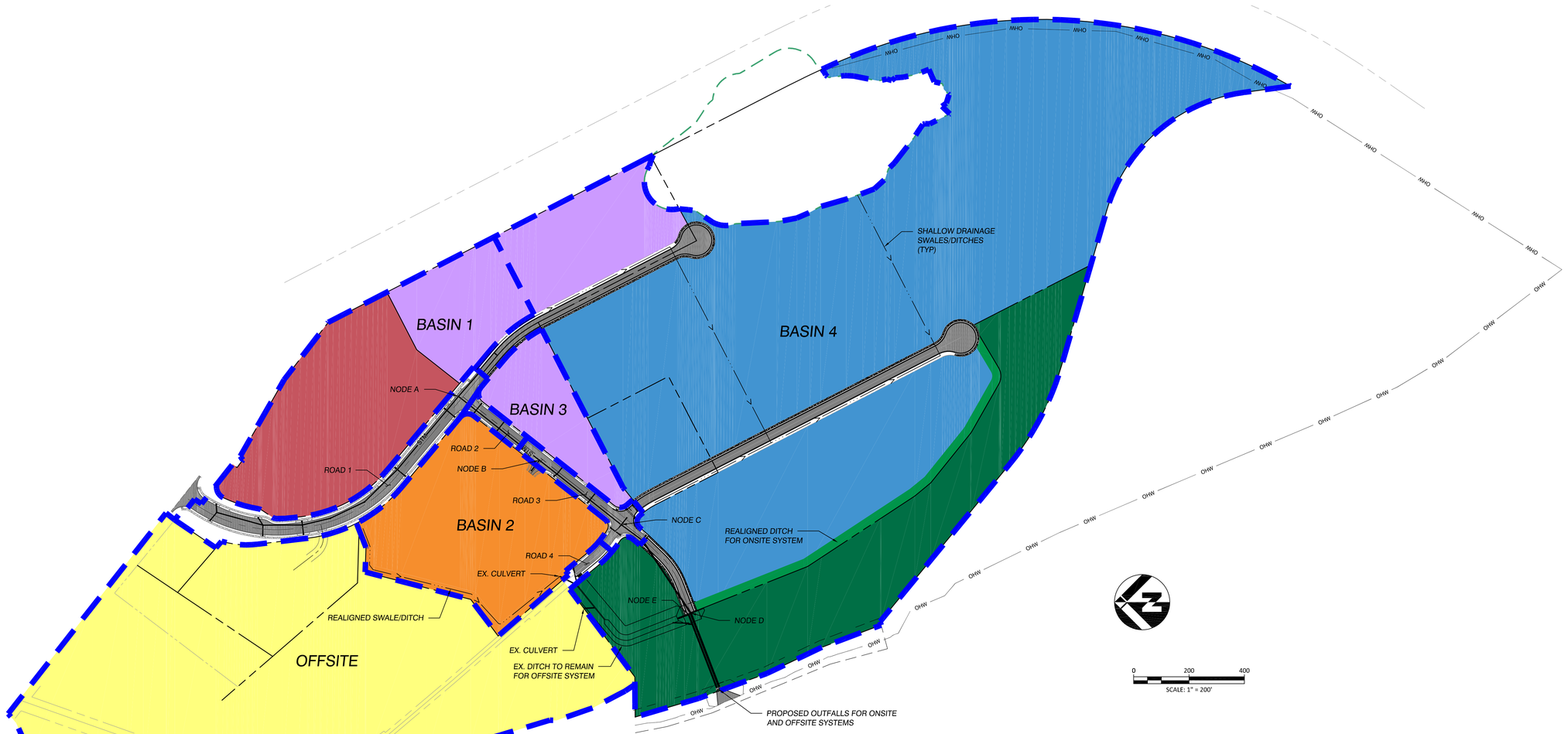
N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/16/2021 at 1:53 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



PROPOSED ONSITE BASIN SUMMARY

BASIN	ROOF AREA (AC)	IMPERVIOUS AREA (AC)	PERVIOUS AREA (AC)	TOTAL AREA	NODE CONNECTED TO
ROAD 1	---	1.684	1.160	2.844	A
BASIN 1	3.373	7.516	1.210	12.099	A
ROAD 2	---	0.250	0.091	0.341	B
BASIN 2	2.100	2.176	4.645	8.921	B
ROAD 3	---	0.710	0.239	0.949	C
BASIN 3	1.072	1.685	0.306	3.063	C
BASIN 4	20.159	46.237	9.462	75.858	D
TOTAL	26.704	60.258	17.113	104.075	

PROPOSED OFFSITE BASIN SUMMARY

BASIN	ROOF AREA (AC)	IMPERVIOUS AREA (AC)	PERVIOUS AREA (AC)	TOTAL AREA	NODE CONNECTED TO
OFFSITE	---	6.346	25.386	31.732	E
ROAD 4	---	0.156	0.107	0.263	E
TOTAL	---	6.502	25.493	31.995	

NOTES:

1. SURFACE COVERAGE PERCENTAGES HAVE BEEN ASSUMED FOR THE LIGHT INDUSTRIAL, FLEX, AND COMMERCIAL ZONES BASED ON TYPICAL LOT COVERAGE FOR THOSE USES. THE PERCENTAGES APPLIED TO THOSE PARCELS ARE AS FOLLOWS:

   BLUE ZONE: LIGHT INDUSTRIAL
   ROOF AREA - 35%
   IMPERVIOUS - 55%
   LAWN & LANDSCAPE - 10%

   PURPLE ZONE: FLEX
   ROOF AREA - 35%
   IMPERVIOUS - 55%
   LAWN & LANDSCAPE - 10%

   MAROON ZONE: COMMERCIAL
   ROOF AREA - 25%
   IMPERVIOUS - 65%
   LAWN & LANDSCAPE - 10%

2. PROPOSED LOT COVERAGE AREAS HAVE BEEN CALCULATED FOR THE RESIDENTIAL, RV PARK, AND ONSITE ROADS BASED ON THE LATEST AVAILABLE SITE PLANS.
3. THE CALCULATED OFFSITE AREAS ARE BASED ON THE EXISTING BASIN MAPS INCLUDED IN THE MASS GRADING DESIGN. PROPERTY LINES HAVE SINCE BEEN ADJUSTED, THEREFORE THE AREAS HAVE BEEN ADJUSTED ACCORDINGLY. IT WAS ASSUMED THAT THE SAME PERVIOUS/IMPERVIOUS RATIO APPLIES TO THE NEW AREA.
4. CONVEYANCE FOR BASIN 4 IS ANTICIPATED TO BE ACHIEVED WITH ABOVE GROUND CONVEYANCE TOWARDS THE ONSITE DRAINAGE DITCH USING ROADSIDE SWALES, DITCHES, AND CULVERTS. EARLY CONCEPTS OF THESE ARE SHOWN ON THE PLAN ABOVE FOR REFERENCE.

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

PRELIMINARY

1/29/2025

MASTER STORM CONVEYANCE PLAN

LANDING ON THE COWLITZ
CITY OF CASTLE ROCK, WA

REVISIONS:

JOB NO.:	18591
DATE:	1/29/2025
SCALE: H: 1"= 200'	V: N/A
DESIGNED BY:	TAW
DRAWN BY:	TAW
CHECKED BY:	PAT

LANDING ON THE COWLITZ

C1.0

FILE: W:\18591 LOTC Phase 1\500 Design\501 Documents\Technical Files\Working Docs\Stormwater\Stormwater Master Plan_Working Docs\18591_Conceptual Master Drainage.dwg PLOTSTYLE: Storm.stb

Appendix B: River and Rainfall Data

Cowlitz River - Castle Rock River Gauge Information

City of Castle Rock Rainfall Data Summary

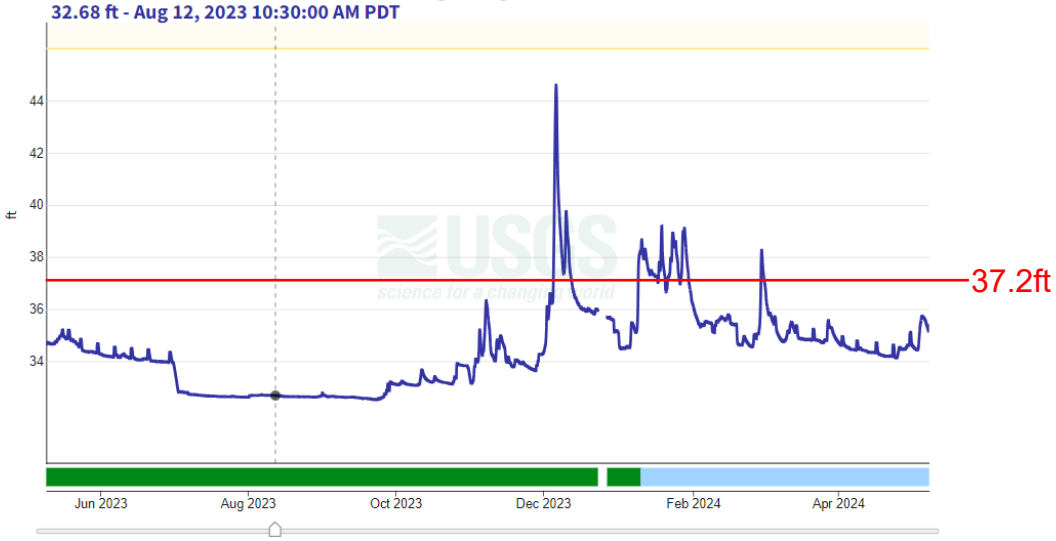
7 days 30 days 1 year

Cowlitz River at Castle Rock, WA - 14243000

May 9, 2023 - May 8, 2024

Gage height, feet

32.68 ft - Aug 12, 2023 10:30:00 AM PDT



IMPORTANT Data may be provisional

Show legend

	Value	Status	Time
Latest value	35.18 ft	Provisional	May 08, 2024 09:30:00 AM PDT
Selected	32.68 ft	Approved	Aug 12, 2023 10:30:00 AM PDT

High 44.60ft, Dec 6, 2023

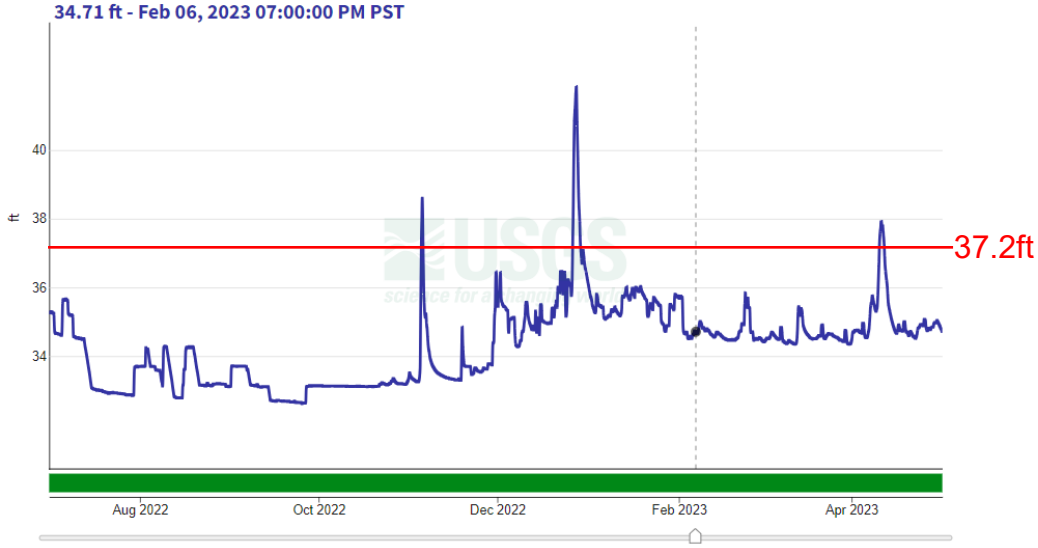
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

July 1, 2022 - May 1, 2023

Gage height, feet

34.71 ft - Feb 06, 2023 07:00:00 PM PST



IMPORTANT Data may be provisional

Show legend

	Value	Status	Time
Latest value	35.18 ft	Provisional	May 08, 2024 09:30:00 AM PDT
Selected	34.71 ft	Approved	Feb 06, 2023 07:00:00 PM PST

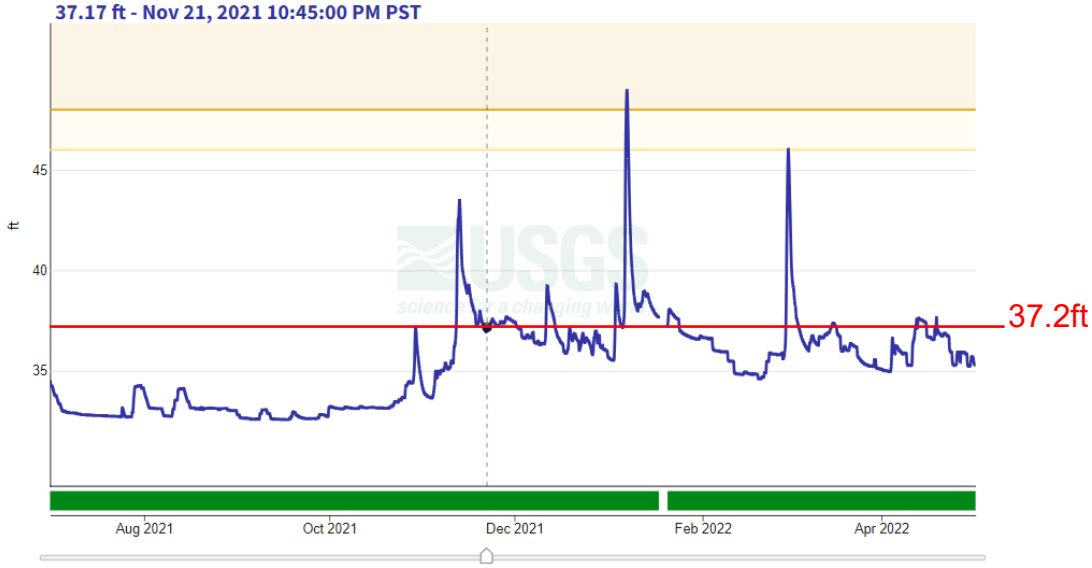
High 41.84, Dec 27, 2022

Cowlitz River at Castle Rock, WA - 14243000

July 1, 2021 - May 1, 2022

Gage height, feet

37.17 ft - Nov 21, 2021 10:45:00 PM PST



IMPORTANT Data may be provisional

Show legend

	Value	Status	Time
Latest value	35.18 ft	Provisional	May 08, 2024 09:30:00 AM PDT
Selected	37.17 ft	Approved	Nov 21, 2021

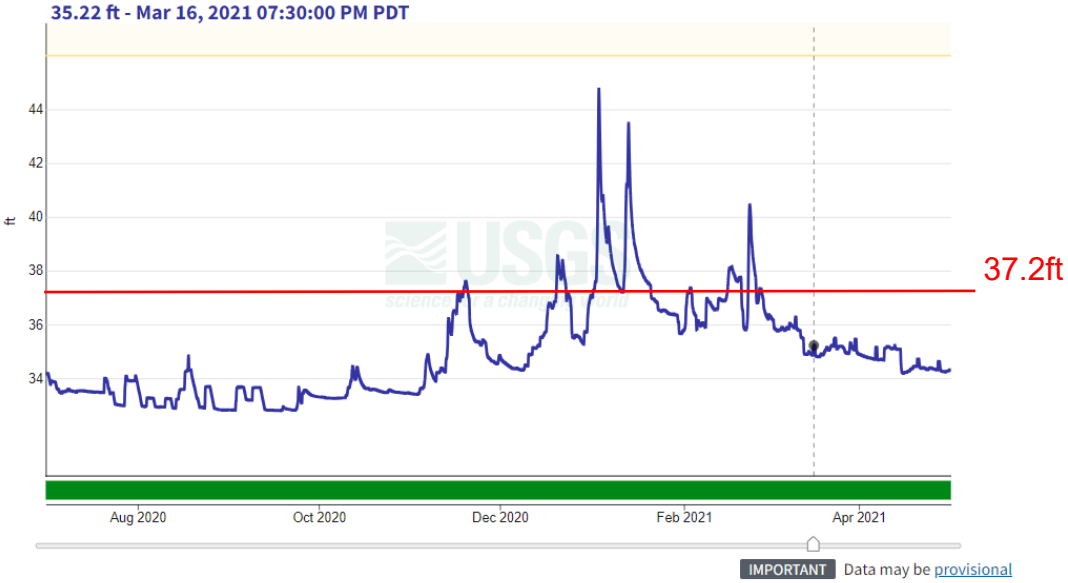
High 48.86 Jan 07, 2022

Cowlitz River at Castle Rock, WA - 14243000

July 1, 2020 - May 1, 2021

Gage height, feet

35.22 ft - Mar 16, 2021 07:30:00 PM PDT



IMPORTANT Data may be provisional

Show legend

	Value	Status	Time
Latest value	35.18 ft	Provisional	May 08, 2024 09:30:00 AM PDT
Selected	35.22 ft	Approved	Mar 16, 2021

High 44.70ft Jan 3, 2021

An official website of the United States government Here's how you know

MENU

IMPORTANT Legacy real-time page

7 days 30 days 1 year

Scale Linear Log

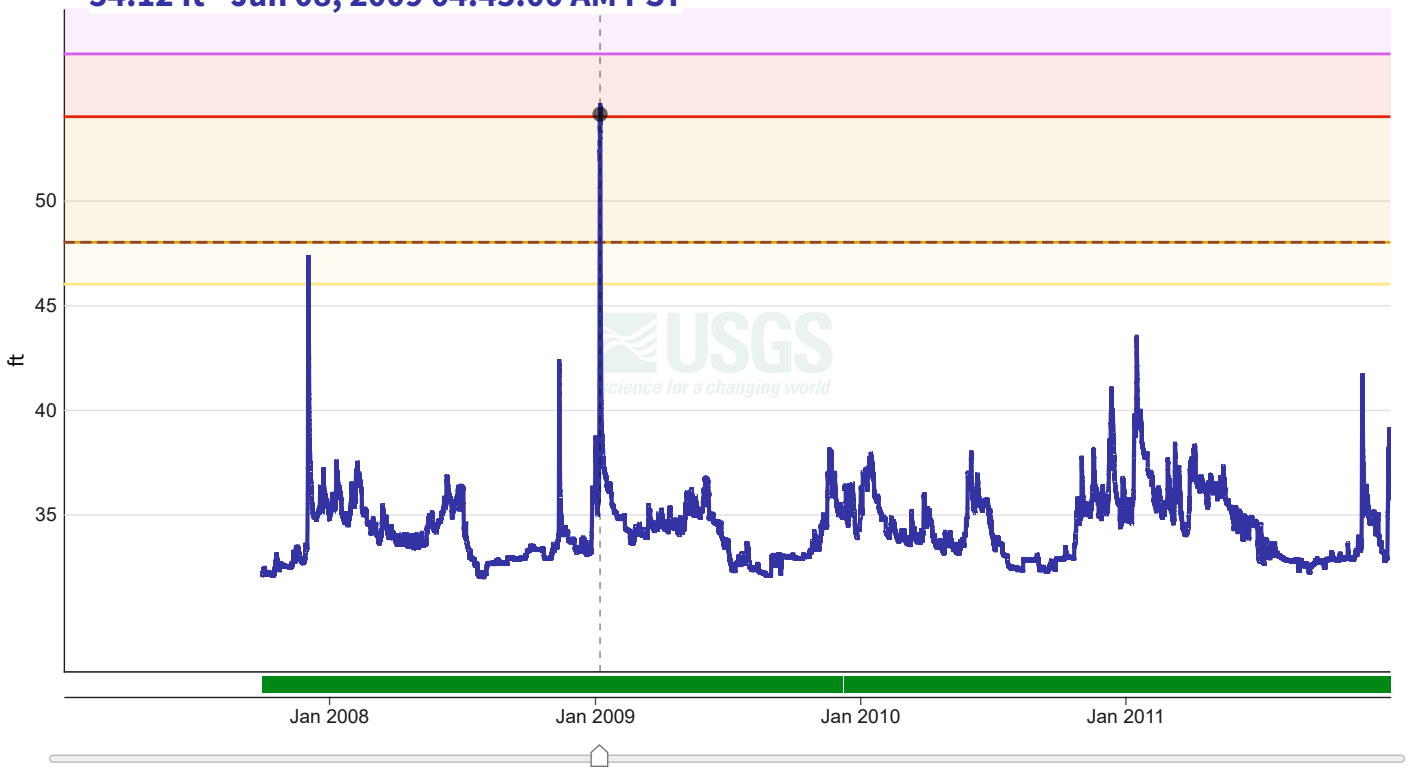
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

January 1, 2007 - December 31, 2011

Gage height, feet [NAVD 1988, feet]

54.12 ft - Jan 08, 2009 04:45:00 AM PST



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Jan 08, 2009 04:45:00 AM PST	54.12	Approved
Compare		

Not available with custom time spans

An official website of the United States government Here's how you know

MENU

IMPORTANT Legacy real-time page

7 days 30 days 1 year

Scale Linear Log

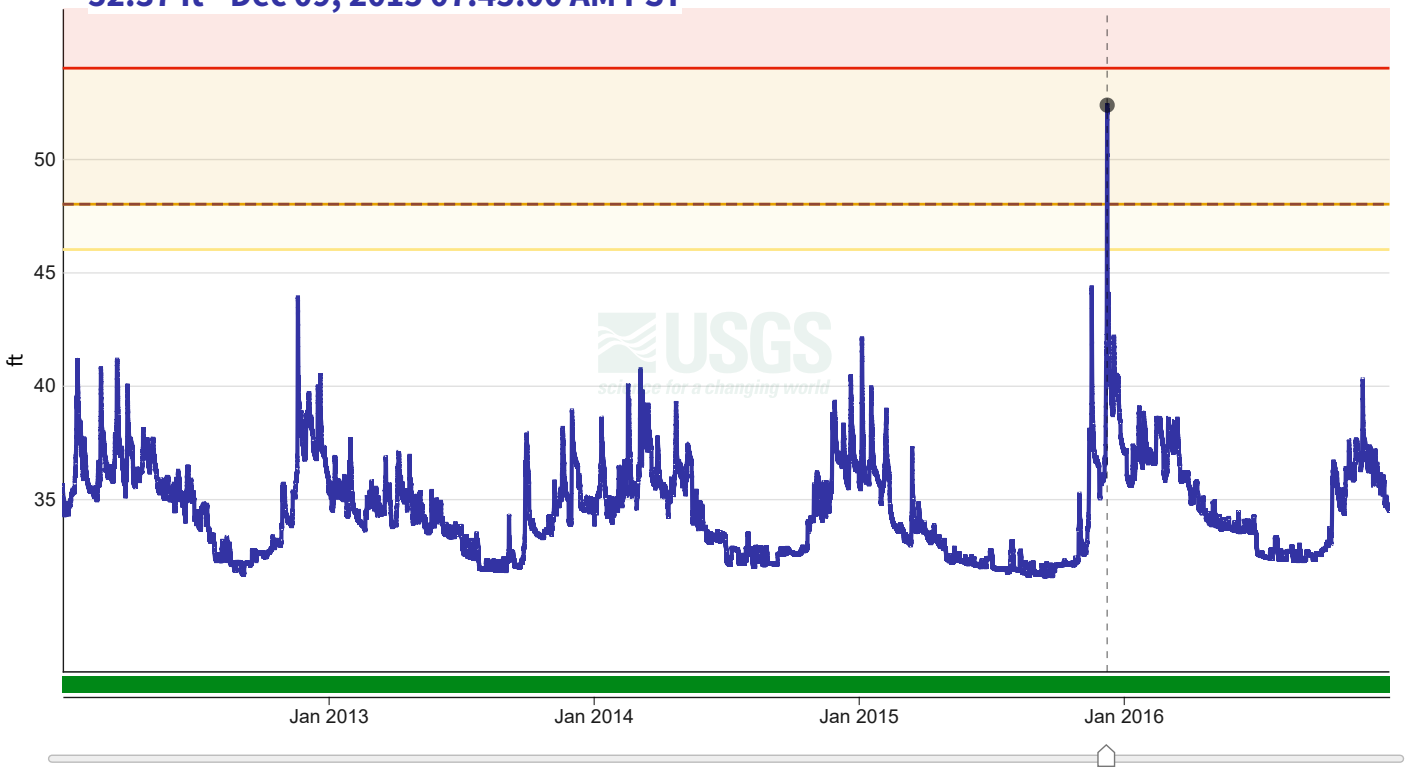
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

January 1, 2012 - December 31, 2016

Gage height, feet [NAVD 1988, feet]

52.37 ft - Dec 09, 2015 07:45:00 AM PST



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Dec 09, 2015 07:45:00 AM PST	52.37	Approved
Compare Not available with custom time spans		

An official website of the United States government Here's how you know

MENU

IMPORTANT Legacy real-time page

7 days 30 days 1 year

Scale Linear Log

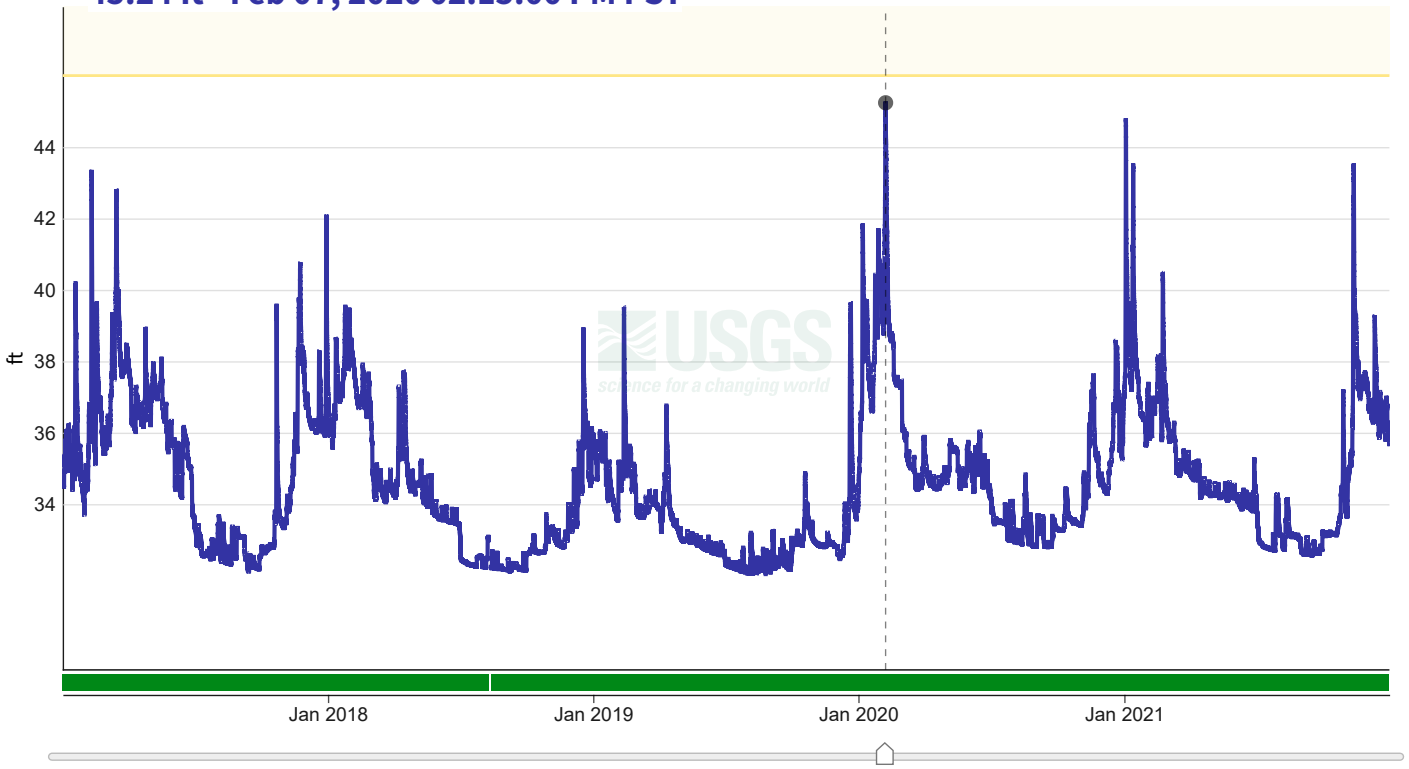
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

January 1, 2017 - December 31, 2021

Gage height, feet [NAVD 1988, feet]

45.24 ft - Feb 07, 2020 02:15:00 PM PST



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Feb 07, 2020 02:15:00 PM PST	45.24	Approved
Compare		

Not available with custom time spans

An official website of the United States government Here's how you know

MENU

IMPORTANT Legacy real-time page

7 days 30 days 1 year

Scale Linear Log

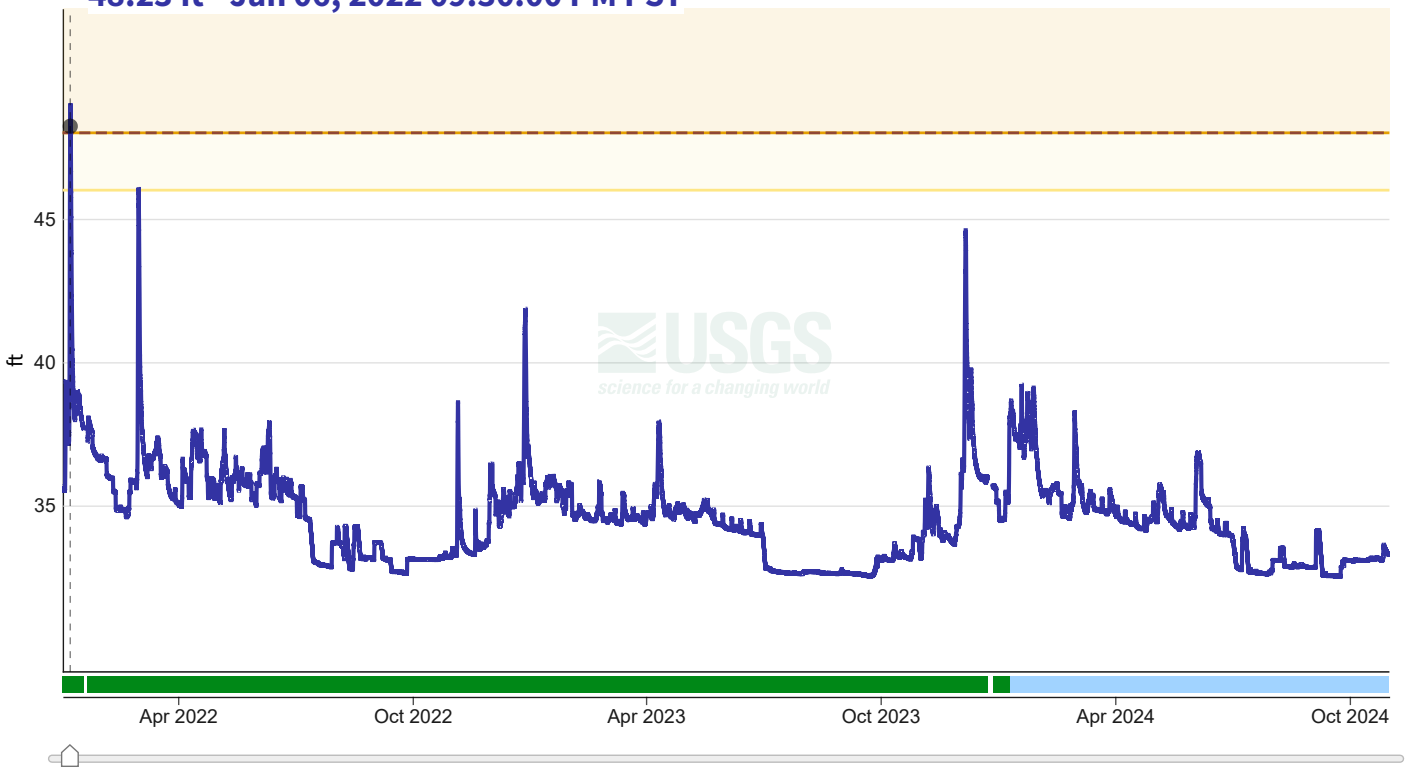
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

January 1, 2022 - October 31, 2024

Gage height, feet [NAVD 1988, feet]

48.23 ft - Jan 06, 2022 09:30:00 PM PST



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Jan 06, 2022 09:30:00 PM PST	48.23	Approved
Compare		

Not available with custom time spans

An official website of the United States government Here's how you know

MENU

IMPORTANT Legacy real-time page

7 days 30 days 1 year

Scale Linear Log

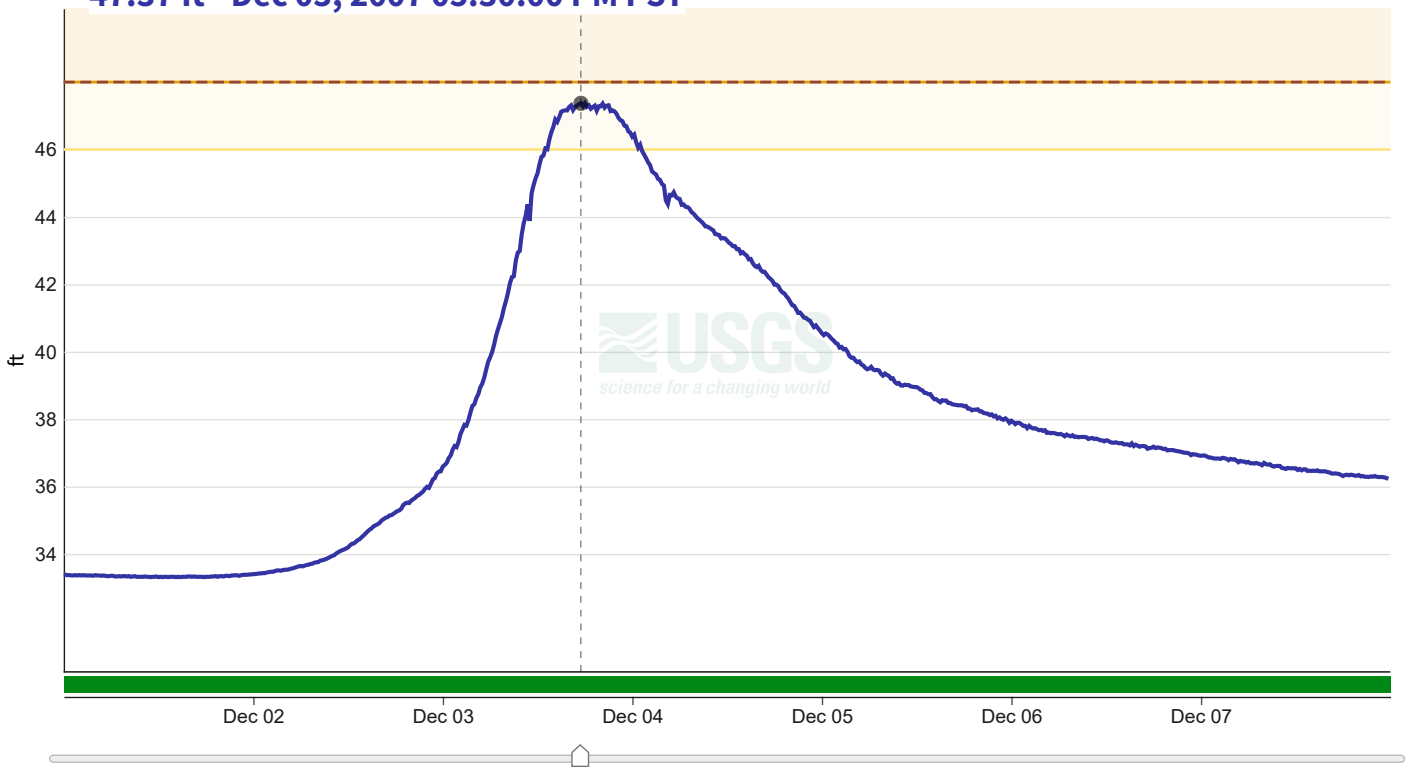
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

December 1, 2007 - December 7, 2007

Gage height, feet [NAVD 1988, feet]

47.37 ft - Dec 03, 2007 05:30:00 PM PST



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Dec 03, 2007 05:30:00 PM PST	47.37	Approved
Compare		

Not available with custom time spans

Questions or Comments

An official website of the United States government Here's how you know

MENU

IMPORTANT Legacy real-time page

7 days 30 days 1 year

Scale Linear Log

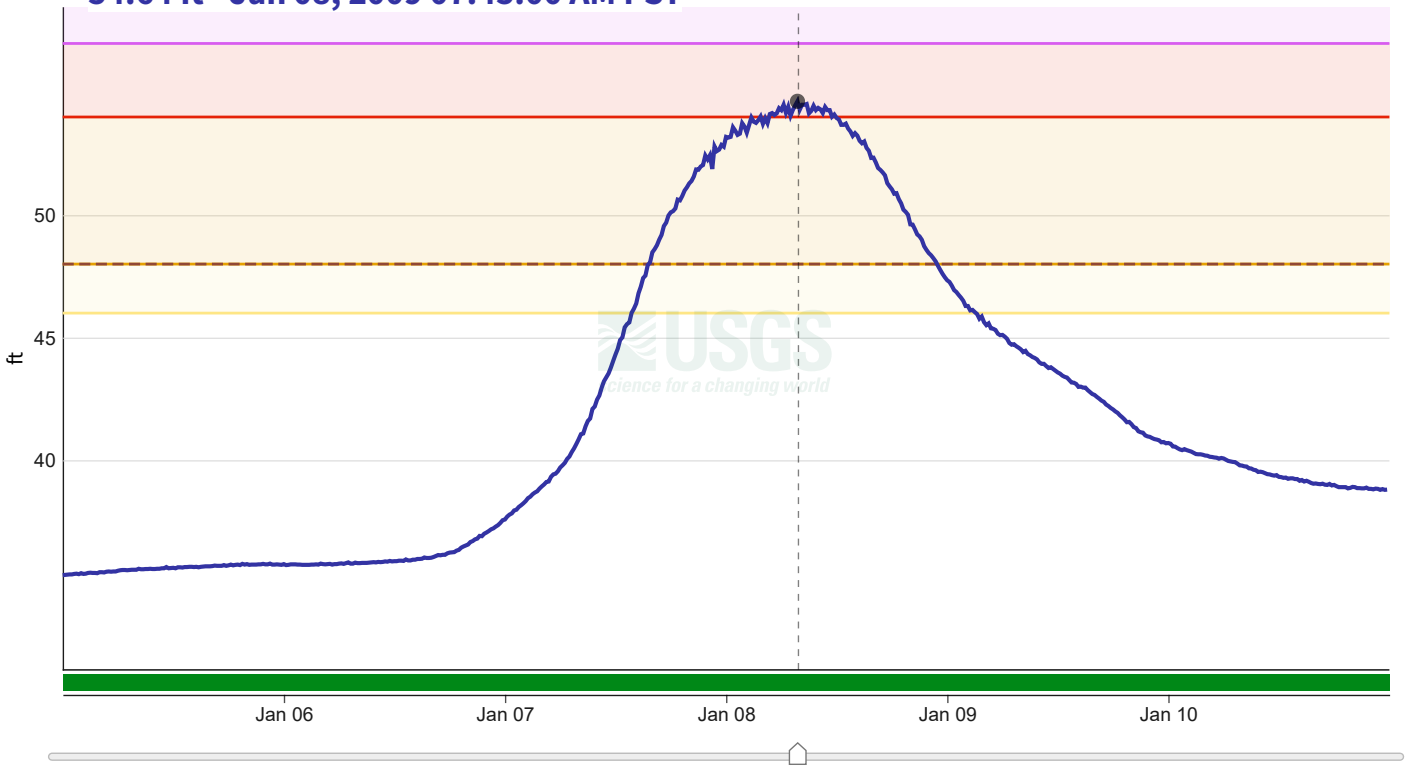
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

January 5, 2009 - January 10, 2009

Gage height, feet [NAVD 1988, feet]

54.64 ft - Jan 08, 2009 07:45:00 AM PST



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Jan 08, 2009 07:45:00 AM PST	54.64	Approved
Compare		

Not available with custom time spans

Questions or Comments

An official website of the United States government Here's how you know

MENU

IMPORTANT Legacy real-time page

7 days 30 days 1 year

Scale Linear Log

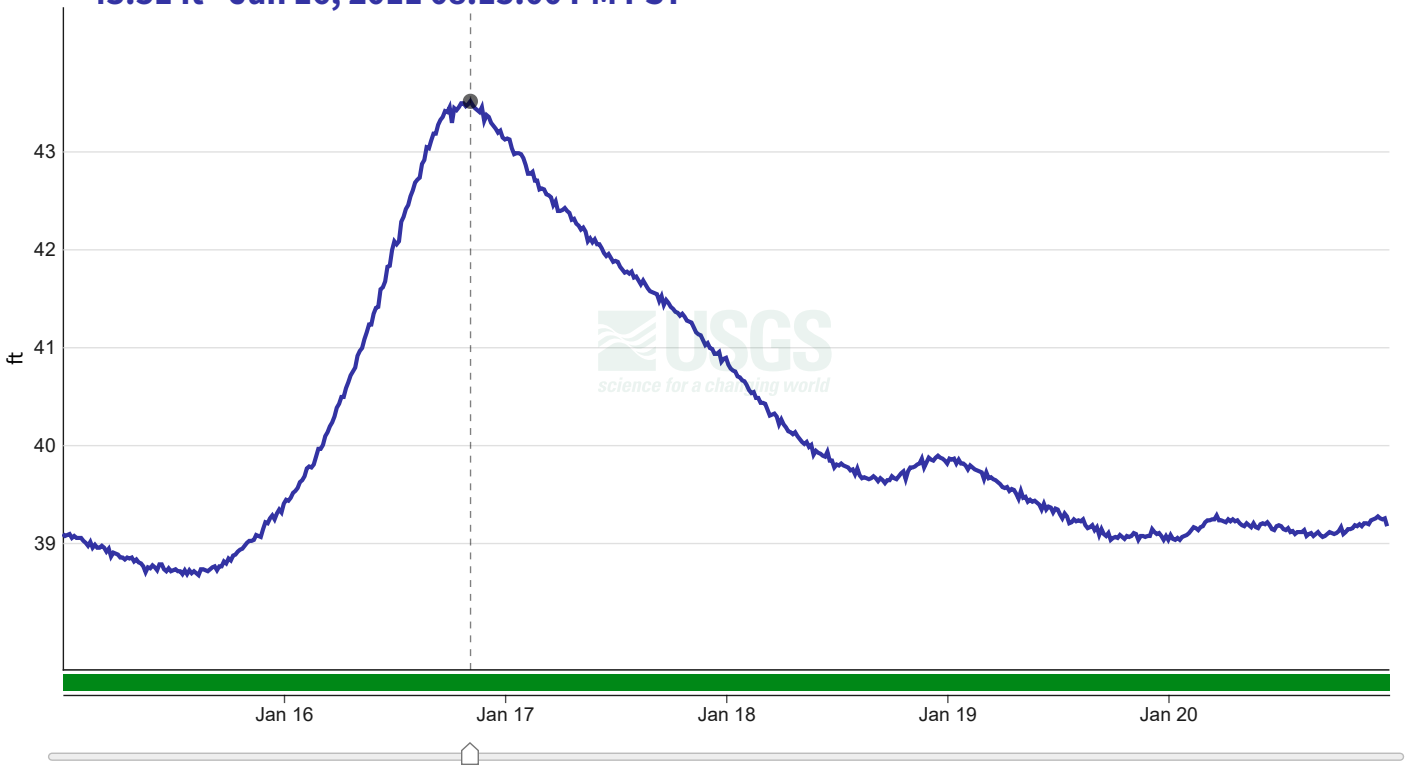
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

January 15, 2011 - January 20, 2011

Gage height, feet [NAVD 1988, feet]

43.51 ft - Jan 16, 2011 08:15:00 PM PST



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Jan 16, 2011 08:15:00 PM PST	43.51	Approved
Compare		

Not available with custom time spans

Questions or Comments

An official website of the United States government Here's how you know

MENU

IMPORTANT Legacy real-time page

7 days 30 days 1 year

Scale Linear Log

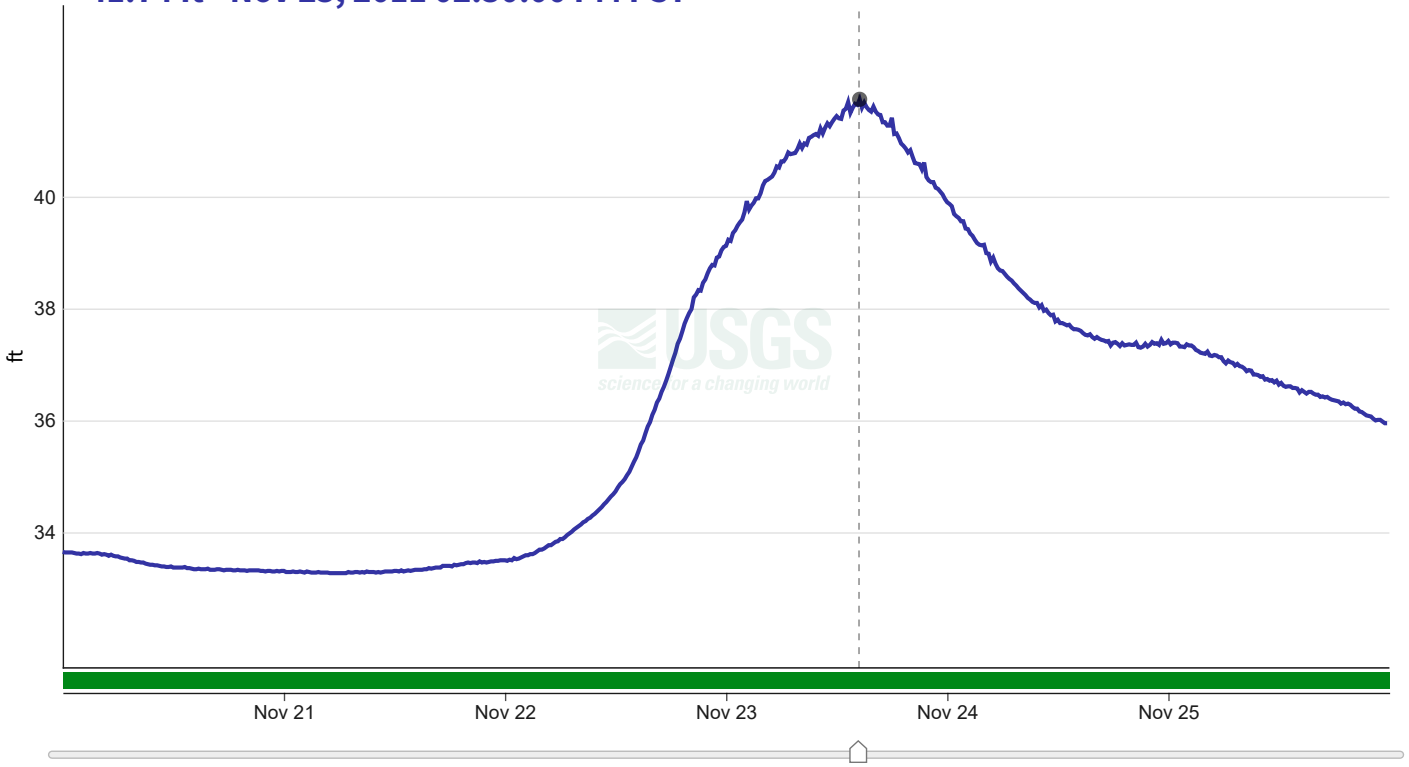
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

November 20, 2011 - November 25, 2011

Gage height, feet [NAVD 1988, feet]

41.74 ft - Nov 23, 2011 02:30:00 PM PST



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Nov 23, 2011 02:30:00 PM PST	41.74	Approved
Compare		

Not available with custom time spans

Questions or Comments

An official website of the United States government Here's how you know

MENU

IMPORTANT Legacy real-time page

7 days 30 days 1 year

Scale Linear Log

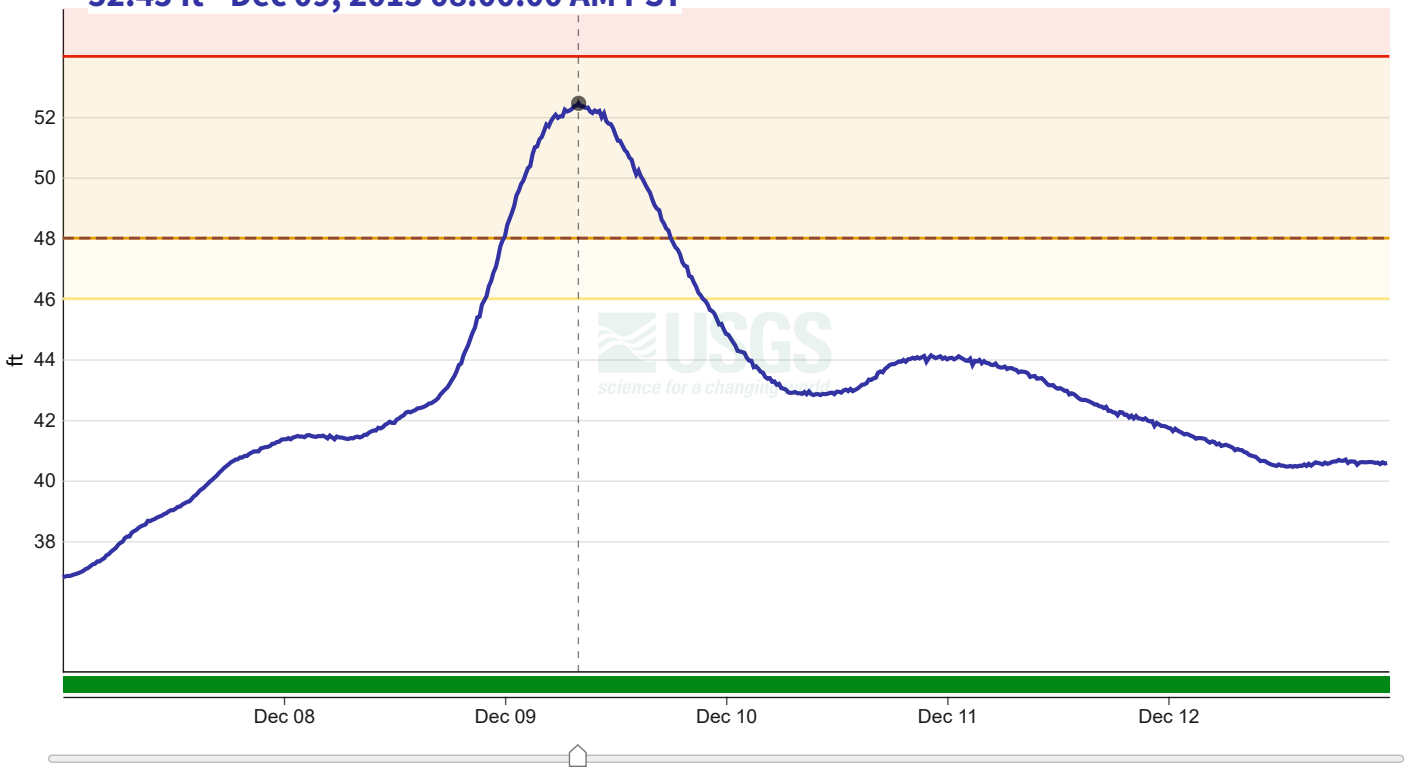
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

December 7, 2015 - December 12, 2015

Gage height, feet [NAVD 1988, feet]

52.45 ft - Dec 09, 2015 08:00:00 AM PST



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Dec 09, 2015 08:00:00 AM PST	52.45	Approved
Compare		

Not available with custom time spans

Questions or Comments

An official website of the United States government Here's how you know

MENU

IMPORTANT Legacy real-time page

7 days 30 days 1 year

Scale Linear Log

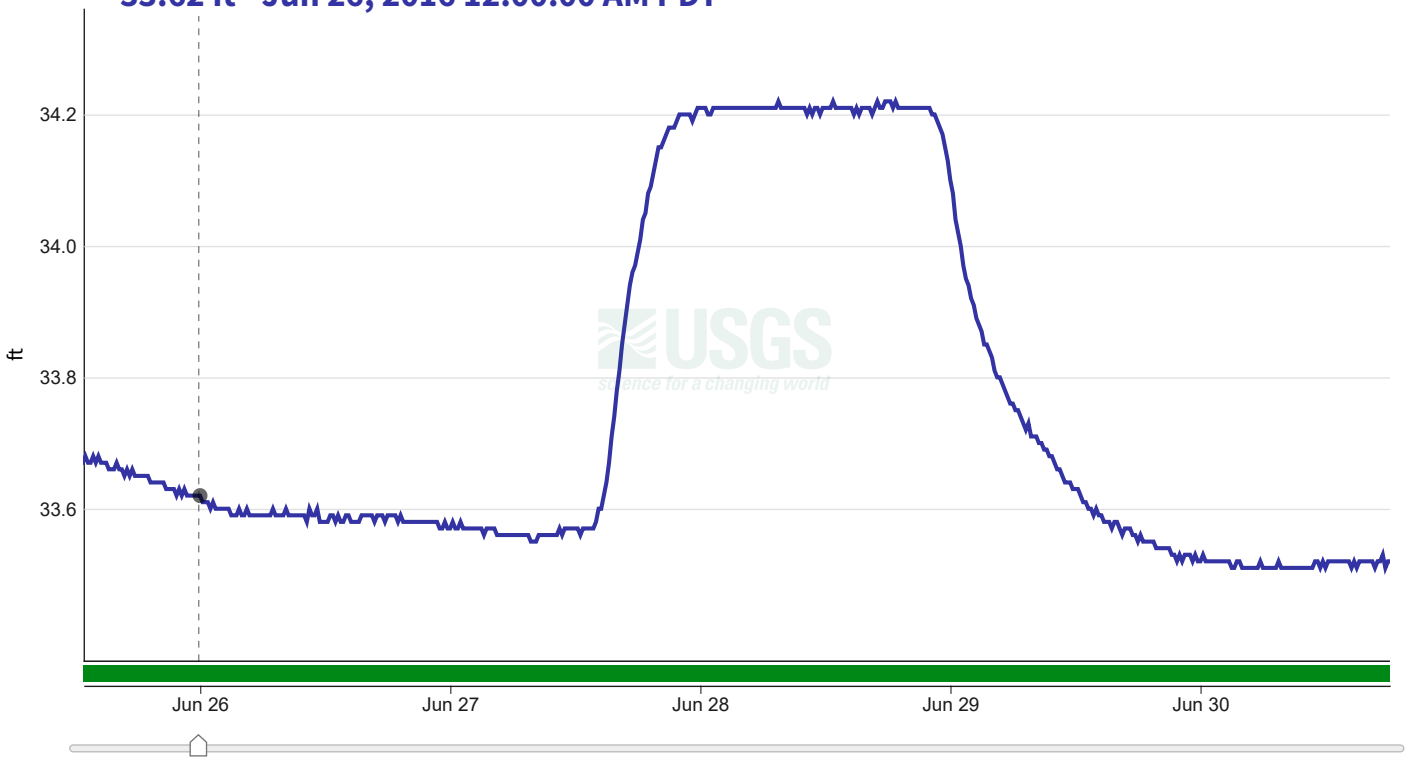
- using custom time span -
- using graph zoom -

Cowlitz River at Castle Rock, WA - 14243000

June 25, 2016 - June 30, 2016

Gage height, feet [NAVD 1988, feet]

33.62 ft - Jun 26, 2016 12:00:00 AM PDT



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Jun 26, 2016 12:00:00 AM PDT	33.62	Approved
Compare		

Not available with custom time spans

An official website of the United States government Here's how you know

MENU

IMPORTANT Legacy real-time page

7 days 30 days 1 year

Scale Linear Log

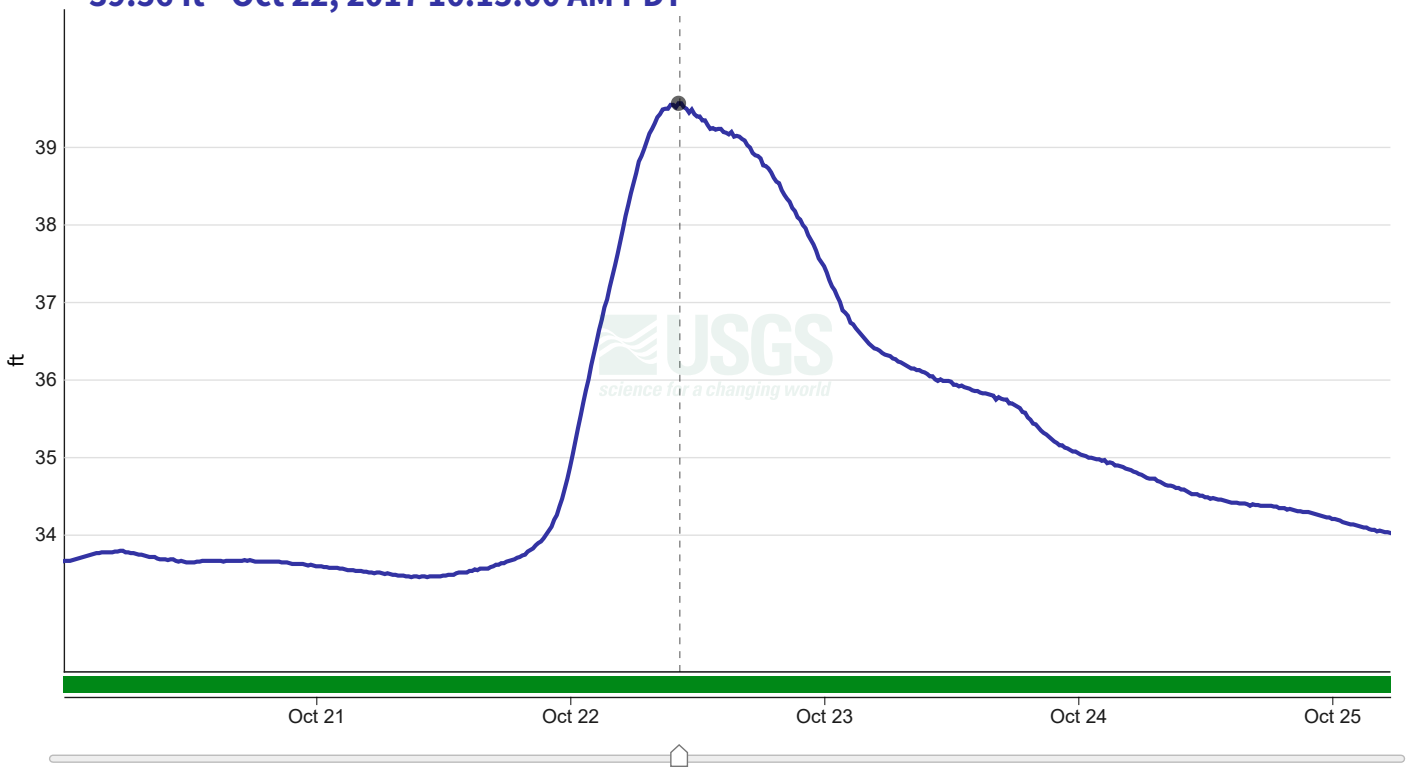
- using custom time span -
- using graph zoom -

Cowlitz River at Castle Rock, WA - 14243000

October 20, 2017 - October 25, 2017

Gage height, feet [NAVD 1988, feet]

39.56 ft - Oct 22, 2017 10:15:00 AM PDT



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Oct 22, 2017 10:15:00 AM PDT	39.56	Approved
Compare Not available with custom time spans		

An official website of the United States government Here's how you know

MENU

IMPORTANT Legacy real-time page

7 days 30 days 1 year

Scale Linear Log

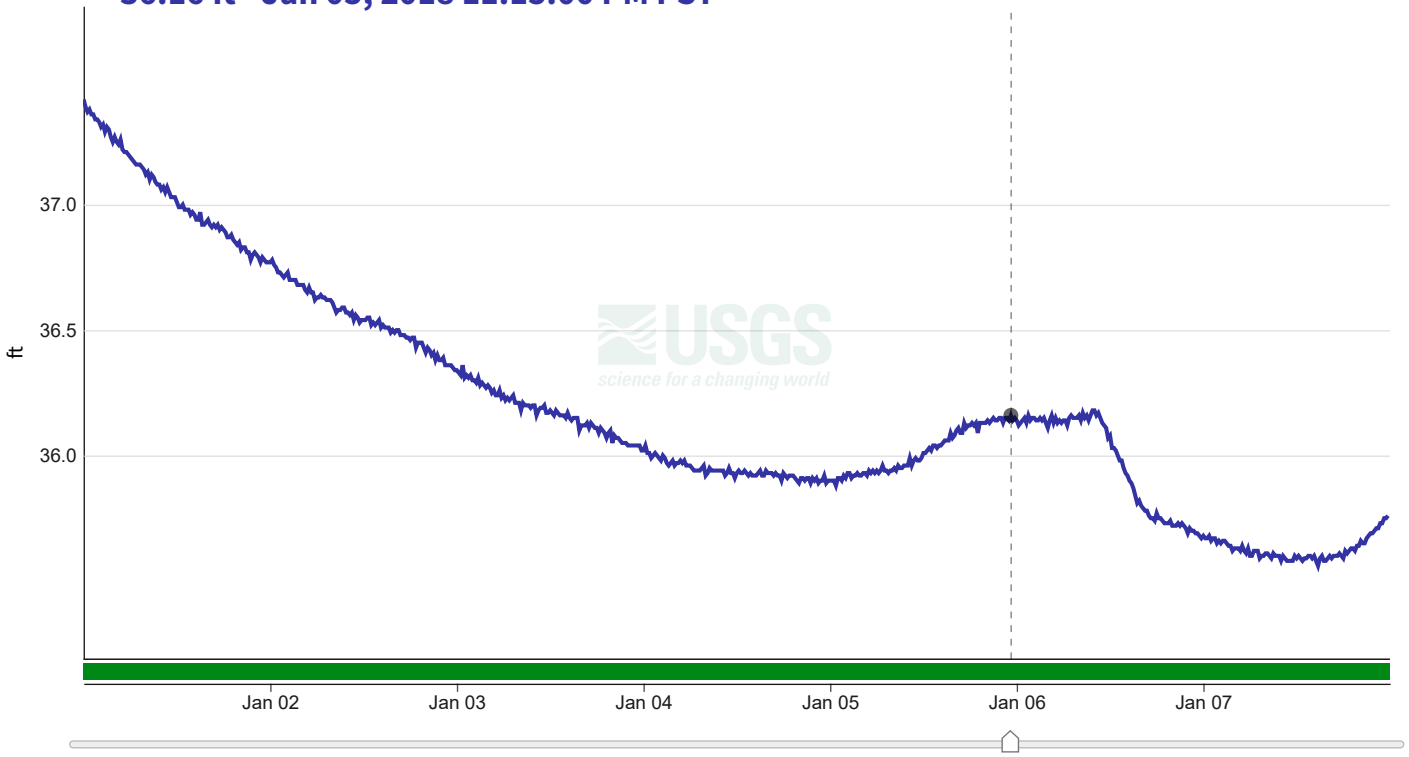
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

January 1, 2018 - January 7, 2018

Gage height, feet [NAVD 1988, feet]

36.16 ft - Jan 05, 2018 11:15:00 PM PST



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Jan 05, 2018 11:15:00 PM PST	36.16	Approved
Compare Not available with custom time spans		
Median Add median data to graph		

An official website of the United States government Here's how you know

MENU

IMPORTANT Legacy real-time page

7 days 30 days 1 year

Scale Linear Log

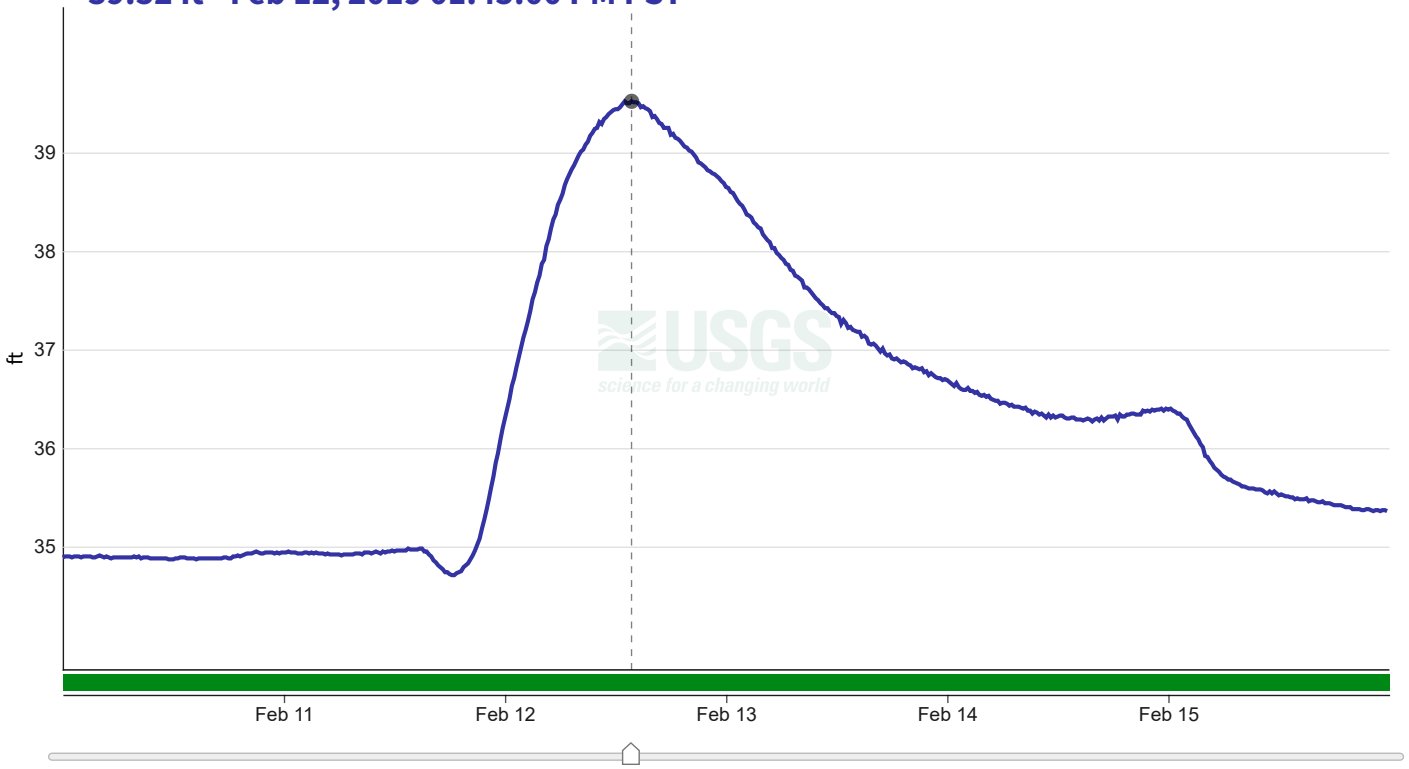
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

February 10, 2019 - February 15, 2019

Gage height, feet [NAVD 1988, feet]

39.52 ft - Feb 12, 2019 01:45:00 PM PST



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Feb 12, 2019 01:45:00 PM PST	39.52	Approved
Compare		

Not available with custom time spans

An official website of the United States government Here's how you know

MENU

IMPORTANT Legacy real-time page

7 days 30 days 1 year

Scale Linear Log

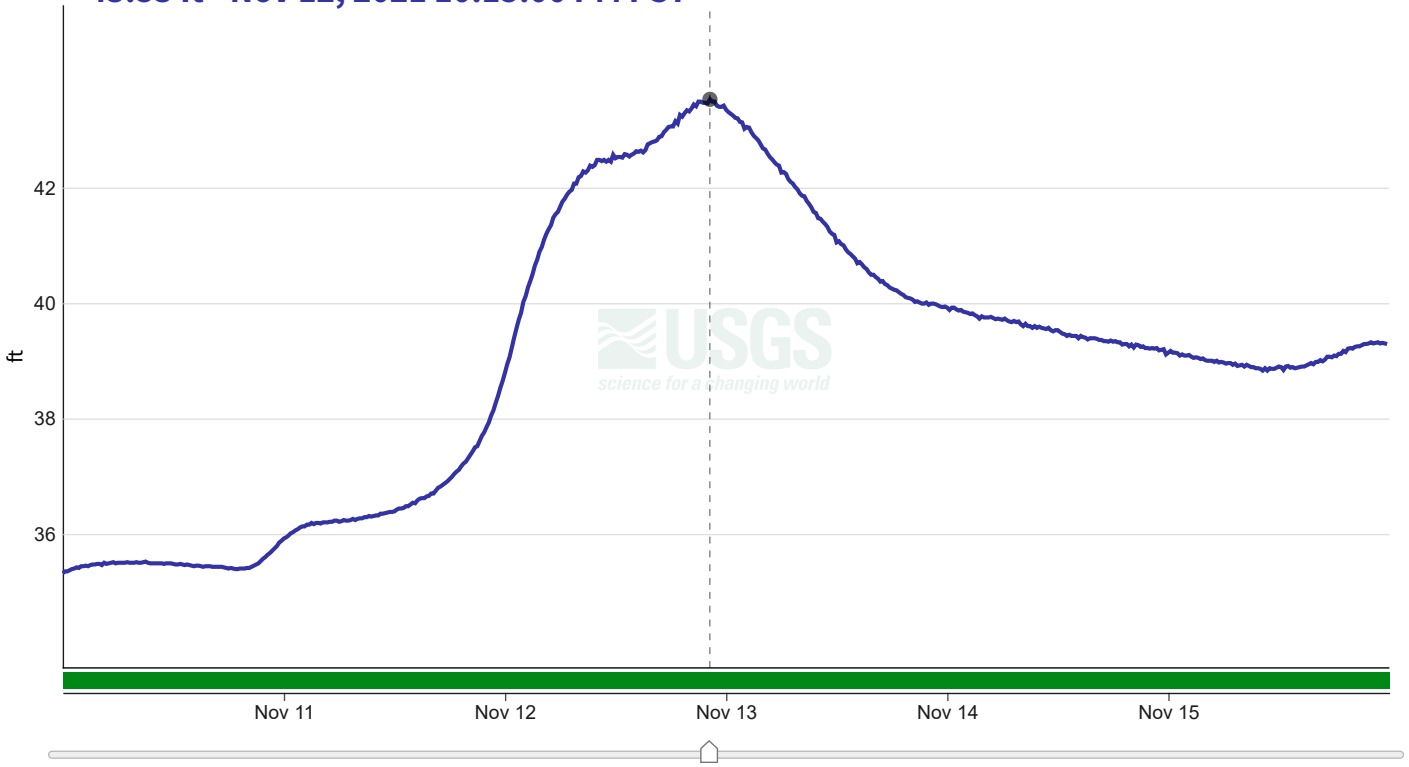
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

November 10, 2021 - November 15, 2021

Gage height, feet [NAVD 1988, feet]

43.53 ft - Nov 12, 2021 10:15:00 PM PST



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Nov 12, 2021 10:15:00 PM PST	43.53	Approved
Compare Not available with custom time spans		

An official website of the United States government Here's how you know

MENU

IMPORTANT Legacy real-time page

7 days 30 days 1 year

Scale Linear Log

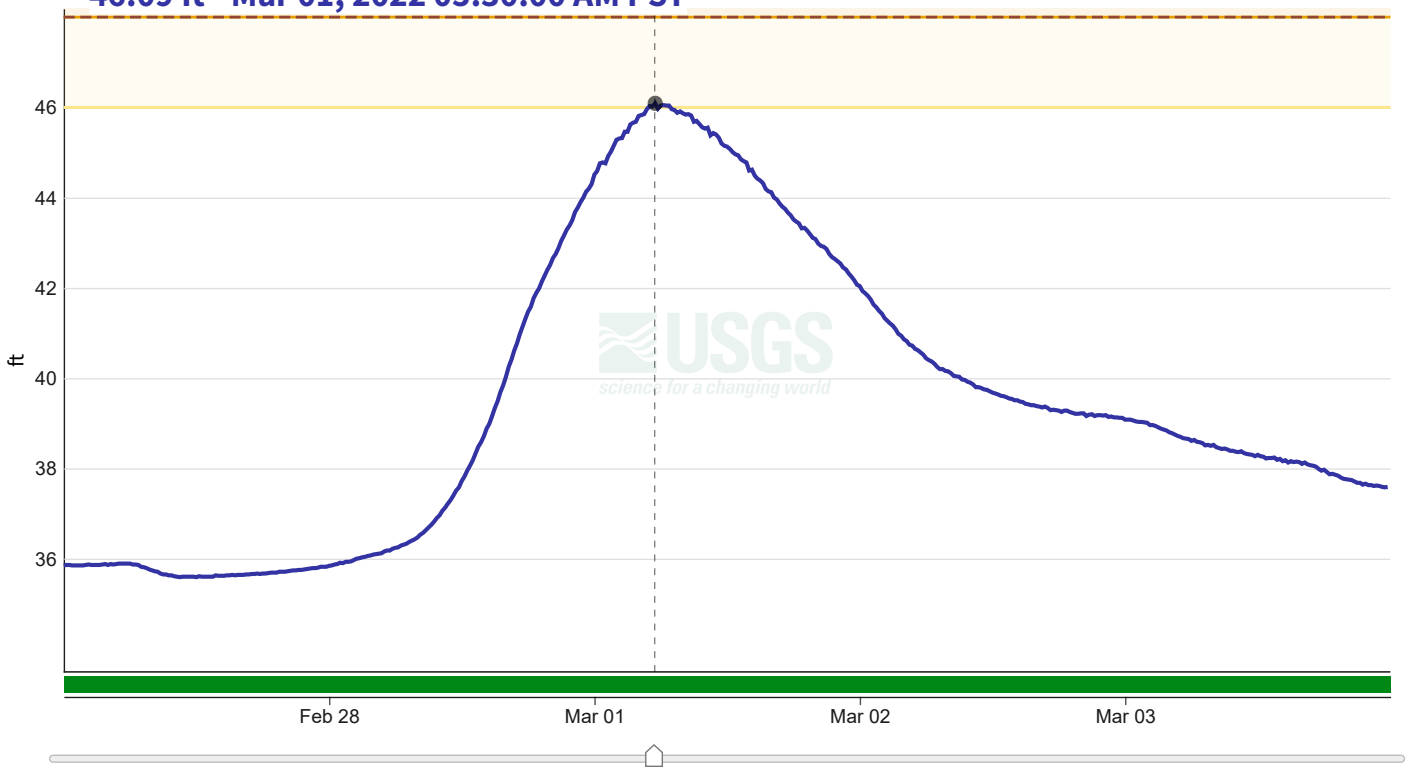
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

February 27, 2022 - March 3, 2022

Gage height, feet [NAVD 1988, feet]

46.09 ft - Mar 01, 2022 05:30:00 AM PST



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Mar 01, 2022 05:30:00 AM PST	46.09	Approved
Compare		

Not available with custom time spans

City of Castler Rock Actual Rainfall Data from 1/1/07 to 10/31/24

Date	Daily Rainfall (inches)	Event Size
12/3/2007	3.79	2-year
1/8/2009	3.31	2-year
1/17/2011	4.00	2-year
11/23/2011	3.35	2-year
12/9/2015	3.37	2-year
6/26/2016	6.50	100-year
10/22/2017	4.12	2-year
1/5/2018	4.00	2-year
2/12/2019	3.42	2-year
11/12/2021	3.41	2-year
3/1/2022	4.50	10-year

USGS Cowlitz River Gage Data at Castle Rock During Heavy Rain Events

Date	River Elevation @ Gage*	Equivalent Elevation @ Site**
12/3/2007	47.37	40.37
1/8/2009	54.64	47.64
1/17/2011	43.51	36.51
11/23/2011	41.74	34.74
12/9/2015	52.45	45.45
6/26/2016	33.62	26.62
10/22/2017	39.56	32.56
1/5/2018	36.16	29.16
2/12/2019	39.52	32.52
11/12/2021	43.53	36.53
3/1/2022	46.09	39.09

* This is the actual reading at the gage

** This equivalent includes a 6.3' drop from the gage to our site, plus a 0.7' drop for datum change

Appendix C: Stormwater Volume Calculations

WWHM Reports for:

Node A

Node B

Node C

Node D

Node E

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: 18591_Node A

Site Name:	LOTC
Site Address:	
City:	Castle Rock, WA
Report Date:	1/21/2025
Gage:	Longview
Data Start:	1955/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.429
Version Date:	2024/06/28
Version:	4.3.1

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year
Low Flow Threshold for POC2:	50 Percent of the 2 Year
High Flow Threshold for POC2:	50 Year

Landuse Basin Data
Predeveloped Land Use

Node A - Existing Public

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Forest, Mod	2.844
Pervious Total	2.844

Impervious Land Use	acre
Impervious Total	0
Basin Total	2.844

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 1	POC 1	

Node A - Existng C/F

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Mod	12.099
Pervious Total	12.099
Impervious Land Use	acre
Impervious Total	0
Basin Total	12.099

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 2	POC 2

Mitigated Land Use

Node A - Public PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	1.684
Impervious Total	1.684
Basin Total	1.684

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Surface	Interflow	Groundwater
Bioretention	Bioretention	

Node A - C/F PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	7.516
Impervious Total	7.516
Basin Total	7.516

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Surface	Interflow	Groundwater
Bioretention	Bioretention	

Node A - Public Non-PGIS

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Mod	1.16
Pervious Total	1.16
Impervious Land Use	acre
Impervious Total	0
Basin Total	1.16

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 1	POC 1

Node A - C/F Non-PGIS

Bypass:	Yes
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Mod	1.21
Pervious Total	1.21

Impervious Land Use	acre
ROOF TOPS FLAT	3.373
Impervious Total	3.373
Basin Total	4.583

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 2	POC 2	

Mitigated Routing

Road Bioretention

Bottom Length:	250.00 ft.
Bottom Width:	5.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	1.5
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	1
Orifice Diameter (in.):	12
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	381.644
Total Outflow (ac-ft.):	404.722
Percent Through Underdrain:	94.3
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	
Gravel Trench Bed 2	

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0287	0.0000	0.0000	0.0000
0.0440	0.0287	0.0006	0.0000	0.0000
0.0879	0.0287	0.0012	0.0000	0.0000
0.1319	0.0287	0.0017	0.0000	0.0000
0.1758	0.0287	0.0023	0.0000	0.0000
0.2198	0.0287	0.0029	0.0008	0.0000
0.2637	0.0287	0.0035	0.0013	0.0000
0.3077	0.0287	0.0040	0.0021	0.0000
0.3516	0.0287	0.0046	0.0030	0.0000
0.3956	0.0287	0.0052	0.0042	0.0000
0.4396	0.0287	0.0058	0.0056	0.0000
0.4835	0.0287	0.0063	0.0073	0.0000
0.5275	0.0287	0.0069	0.0090	0.0000
0.5714	0.0287	0.0075	0.0092	0.0000
0.6154	0.0287	0.0081	0.0115	0.0000
0.6593	0.0287	0.0087	0.0141	0.0000
0.7033	0.0287	0.0092	0.0170	0.0000
0.7473	0.0287	0.0098	0.0202	0.0000
0.7912	0.0287	0.0104	0.0218	0.0000
0.8352	0.0287	0.0110	0.0238	0.0000
0.8791	0.0287	0.0115	0.0278	0.0000
0.9231	0.0287	0.0121	0.0321	0.0000
0.9670	0.0287	0.0127	0.0369	0.0000
1.0110	0.0287	0.0133	0.0417	0.0000
1.0549	0.0287	0.0138	0.0420	0.0000
1.0989	0.0287	0.0144	0.0475	0.0000
1.1429	0.0287	0.0150	0.0535	0.0000
1.1868	0.0287	0.0156	0.0599	0.0000

1.2308	0.0287	0.0162	0.0667	0.0000
1.2747	0.0287	0.0167	0.0697	0.0000
1.3187	0.0287	0.0173	0.0740	0.0000
1.3626	0.0287	0.0179	0.0818	0.0000
1.4066	0.0287	0.0185	0.0900	0.0000
1.4505	0.0287	0.0190	0.0987	0.0000
1.4945	0.0287	0.0196	0.1069	0.0000
1.5385	0.0287	0.0201	0.1078	0.0000
1.5824	0.0287	0.0207	0.1175	0.0000
1.6264	0.0287	0.0212	0.1276	0.0000
1.6703	0.0287	0.0217	0.1383	0.0000
1.7143	0.0287	0.0222	0.1494	0.0000
1.7582	0.0287	0.0228	0.1538	0.0000
1.8022	0.0287	0.0233	0.1609	0.0000
1.8462	0.0287	0.0238	0.1726	0.0000
1.8901	0.0287	0.0243	0.2315	0.0000
1.9341	0.0287	0.0248	0.2315	0.0000
1.9780	0.0287	0.0254	0.2315	0.0000
2.0220	0.0287	0.0259	0.2315	0.0000
2.0659	0.0287	0.0264	0.2315	0.0000
2.1099	0.0287	0.0269	0.2315	0.0000
2.1538	0.0287	0.0275	0.2315	0.0000
2.1978	0.0287	0.0280	0.2315	0.0000
2.2418	0.0287	0.0285	0.2315	0.0000
2.2857	0.0287	0.0290	0.2315	0.0000
2.3297	0.0287	0.0296	0.2315	0.0000
2.3736	0.0287	0.0301	0.2315	0.0000
2.4176	0.0287	0.0306	0.2315	0.0000
2.4615	0.0287	0.0311	0.2315	0.0000
2.5055	0.0287	0.0317	0.2315	0.0000
2.5495	0.0287	0.0322	0.2315	0.0000
2.5934	0.0287	0.0327	0.2315	0.0000
2.6374	0.0287	0.0332	0.2315	0.0000
2.6813	0.0287	0.0337	0.2315	0.0000
2.7253	0.0287	0.0343	0.2315	0.0000
2.7692	0.0287	0.0348	0.2315	0.0000
2.8132	0.0287	0.0353	0.2315	0.0000
2.8571	0.0287	0.0358	0.2315	0.0000
2.9011	0.0287	0.0364	0.2315	0.0000
2.9451	0.0287	0.0369	0.2315	0.0000
2.9890	0.0287	0.0374	0.2315	0.0000
3.0000	0.0287	0.0375	0.2315	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0287	0.0375	0.0000	0.1736	0.0000
3.0440	0.0287	0.0388	0.0000	0.1736	0.0000
3.0879	0.0287	0.0401	0.0000	0.1838	0.0000
3.1319	0.0287	0.0413	0.0000	0.1889	0.0000
3.1758	0.0287	0.0426	0.0000	0.1940	0.0000
3.2198	0.0287	0.0438	0.0000	0.1990	0.0000
3.2637	0.0287	0.0451	0.0000	0.2041	0.0000
3.3077	0.0287	0.0464	0.0000	0.2092	0.0000
3.3516	0.0287	0.0476	0.0000	0.2143	0.0000
3.3956	0.0287	0.0489	0.0000	0.2194	0.0000
3.4396	0.0287	0.0502	0.0000	0.2245	0.0000
3.4835	0.0287	0.0514	0.0000	0.2296	0.0000
3.5275	0.0287	0.0527	0.0483	0.2315	0.0000

3.5714	0.0287	0.0539	0.2020	0.2315	0.0000
3.6154	0.0287	0.0552	0.4122	0.2315	0.0000
3.6593	0.0287	0.0565	0.6597	0.2315	0.0000
3.7033	0.0287	0.0577	0.9282	0.2315	0.0000
3.7473	0.0287	0.0590	1.2008	0.2315	0.0000
3.7912	0.0287	0.0602	1.4606	0.2315	0.0000
3.8352	0.0287	0.0615	1.6924	0.2315	0.0000
3.8791	0.0287	0.0628	1.8845	0.2315	0.0000
3.9231	0.0287	0.0640	2.0318	0.2315	0.0000
3.9670	0.0287	0.0653	2.1391	0.2315	0.0000
4.0000	0.0287	0.0662	2.2515	0.2315	0.0000

Commerical/Flex Bioretention

Bottom Length:	120.00 ft.
Bottom Width:	50.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	1.5
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	1
Orifice Diameter (in.):	12
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	1771.377
Total Outflow (ac-ft.):	1808.386
Percent Through Underdrain:	97.95
Discharge Structure	
Riser Height:	1 ft.
Riser Diameter:	24 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	
Road Infiltration Trench	

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.1377	0.0000	0.0000	0.0000
0.0549	0.1377	0.0035	0.0000	0.0000
0.1099	0.1377	0.0069	0.0000	0.0000
0.1648	0.1377	0.0104	0.0000	0.0000
0.2198	0.1377	0.0138	0.0057	0.0000
0.2747	0.1377	0.0173	0.0099	0.0000
0.3297	0.1377	0.0208	0.0156	0.0000
0.3846	0.1377	0.0242	0.0165	0.0000
0.4396	0.1377	0.0277	0.0232	0.0000
0.4945	0.1377	0.0311	0.0327	0.0000
0.5495	0.1377	0.0346	0.0442	0.0000
0.6044	0.1377	0.0381	0.0581	0.0000
0.6593	0.1377	0.0415	0.0699	0.0000
0.7143	0.1377	0.0450	0.0743	0.0000
0.7692	0.1377	0.0485	0.0930	0.0000
0.8242	0.1377	0.0519	0.1143	0.0000
0.8791	0.1377	0.0554	0.1384	0.0000
0.9341	0.1377	0.0588	0.1653	0.0000
0.9890	0.1377	0.0623	0.1727	0.0000
1.0440	0.1377	0.0658	0.1952	0.0000
1.0989	0.1377	0.0692	0.2282	0.0000
1.1538	0.1377	0.0727	0.2643	0.0000
1.2088	0.1377	0.0761	0.3036	0.0000
1.2637	0.1377	0.0796	0.3347	0.0000
1.3187	0.1377	0.0831	0.3464	0.0000
1.3736	0.1377	0.0865	0.3925	0.0000
1.4286	0.1377	0.0900	0.4421	0.0000
1.4835	0.1377	0.0934	0.4953	0.0000
1.5385	0.1377	0.0966	0.5521	0.0000
1.5934	0.1377	0.0997	0.5647	0.0000

1.6484	0.1377	0.1029	0.6126	0.0000
1.7033	0.1377	0.1060	0.6767	0.0000
1.7582	0.1377	0.1091	0.7444	0.0000
1.8132	0.1377	0.1123	0.8147	0.0000
1.8681	0.1377	0.1154	1.3889	0.0000
1.9231	0.1377	0.1186	1.3889	0.0000
1.9780	0.1377	0.1217	1.3889	0.0000
2.0330	0.1377	0.1249	1.3889	0.0000
2.0879	0.1377	0.1280	1.3889	0.0000
2.1429	0.1377	0.1311	1.3889	0.0000
2.1978	0.1377	0.1343	1.3889	0.0000
2.2527	0.1377	0.1374	1.3889	0.0000
2.3077	0.1377	0.1406	1.3889	0.0000
2.3626	0.1377	0.1437	1.3889	0.0000
2.4176	0.1377	0.1468	1.3889	0.0000
2.4725	0.1377	0.1500	1.3889	0.0000
2.5275	0.1377	0.1531	1.3889	0.0000
2.5824	0.1377	0.1563	1.3889	0.0000
2.6374	0.1377	0.1594	1.3889	0.0000
2.6923	0.1377	0.1625	1.3889	0.0000
2.7473	0.1377	0.1657	1.3889	0.0000
2.8022	0.1377	0.1688	1.3889	0.0000
2.8571	0.1377	0.1720	1.3889	0.0000
2.9121	0.1377	0.1751	1.3889	0.0000
2.9670	0.1377	0.1782	1.3889	0.0000
3.0000	0.1377	0.1801	1.3889	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.1377	0.1801	0.0000	0.8333	0.0000
3.0549	0.1377	0.1877	0.0000	0.8333	0.0000
3.1099	0.1377	0.1953	0.0000	0.8944	0.0000
3.1648	0.1377	0.2028	0.0000	0.9249	0.0000
3.2198	0.1377	0.2104	0.0000	0.9554	0.0000
3.2747	0.1377	0.2180	0.0000	0.9860	0.0000
3.3297	0.1377	0.2255	0.0000	1.0165	0.0000
3.3846	0.1377	0.2331	0.0000	1.0470	0.0000
3.4396	0.1377	0.2407	0.0000	1.0775	0.0000
3.4945	0.1377	0.2482	0.0000	1.1081	0.0000
3.5495	0.1377	0.2558	0.0000	1.1386	0.0000
3.6044	0.1377	0.2634	0.0000	1.1691	0.0000
3.6593	0.1377	0.2709	0.0000	1.1996	0.0000
3.7143	0.1377	0.2785	0.0000	1.2302	0.0000
3.7692	0.1377	0.2861	0.0000	1.2607	0.0000
3.8242	0.1377	0.2937	0.0000	1.2912	0.0000
3.8791	0.1377	0.3012	0.0000	1.3217	0.0000
3.9341	0.1377	0.3088	0.0000	1.3523	0.0000
3.9890	0.1377	0.3164	0.0000	1.3828	0.0000
4.0440	0.1377	0.3239	0.1956	1.3889	0.0000
4.0989	0.1377	0.3315	0.6592	1.3889	0.0000
4.1538	0.1377	0.3391	1.2766	1.3889	0.0000
4.2088	0.1377	0.3466	2.0109	1.3889	0.0000
4.2637	0.1377	0.3542	2.8369	1.3889	0.0000
4.3187	0.1377	0.3618	3.7318	1.3889	0.0000
4.3736	0.1377	0.3693	4.6731	1.3889	0.0000
4.4286	0.1377	0.3769	5.6376	1.3889	0.0000
4.4835	0.1377	0.3845	6.6018	1.3889	0.0000
4.5385	0.1377	0.3920	7.5423	1.3889	0.0000

4.5934	0.1377	0.3996	8.4368	1.3889	0.0000
4.6484	0.1377	0.4072	9.2649	1.3889	0.0000
4.7033	0.1377	0.4147	10.010	1.3889	0.0000
4.7582	0.1377	0.4223	10.660	1.3889	0.0000
4.8132	0.1377	0.4299	11.211	1.3889	0.0000
4.8681	0.1377	0.4374	11.664	1.3889	0.0000
4.9231	0.1377	0.4450	12.034	1.3889	0.0000
4.9780	0.1377	0.4526	12.347	1.3889	0.0000
5.0000	0.1377	0.4556	12.805	1.3889	0.0000

Road Infiltration Trench

Bottom Length:	120.00 ft.
Bottom Width:	50.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	5
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	28.422
Total Volume Through Riser (ac-ft.):	8.597
Total Volume Through Facility (ac-ft.):	37.019
Percent Infiltrated:	76.78
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	4.5 ft.
Riser Diameter:	24 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.137	0.000	0.000	0.000
0.0556	0.137	0.002	0.000	0.277
0.1111	0.137	0.005	0.000	0.277
0.1667	0.137	0.008	0.000	0.277
0.2222	0.137	0.010	0.000	0.277
0.2778	0.137	0.013	0.000	0.277
0.3333	0.137	0.016	0.000	0.277
0.3889	0.137	0.018	0.000	0.277
0.4444	0.137	0.021	0.000	0.277
0.5000	0.137	0.024	0.000	0.277
0.5556	0.137	0.026	0.000	0.277
0.6111	0.137	0.029	0.000	0.277
0.6667	0.137	0.032	0.000	0.277
0.7222	0.137	0.034	0.000	0.277
0.7778	0.137	0.037	0.000	0.277
0.8333	0.137	0.040	0.000	0.277
0.8889	0.137	0.042	0.000	0.277
0.9444	0.137	0.045	0.000	0.277
1.0000	0.137	0.048	0.000	0.277
1.0556	0.137	0.050	0.000	0.277
1.1111	0.137	0.053	0.000	0.277
1.1667	0.137	0.056	0.000	0.277
1.2222	0.137	0.058	0.000	0.277
1.2778	0.137	0.061	0.000	0.277
1.3333	0.137	0.064	0.000	0.277

1.3889	0.137	0.067	0.000	0.277
1.4444	0.137	0.069	0.000	0.277
1.5000	0.137	0.072	0.000	0.277
1.5556	0.137	0.075	0.000	0.277
1.6111	0.137	0.077	0.000	0.277
1.6667	0.137	0.080	0.000	0.277
1.7222	0.137	0.083	0.000	0.277
1.7778	0.137	0.085	0.000	0.277
1.8333	0.137	0.088	0.000	0.277
1.8889	0.137	0.091	0.000	0.277
1.9444	0.137	0.093	0.000	0.277
2.0000	0.137	0.096	0.000	0.277
2.0556	0.137	0.099	0.000	0.277
2.1111	0.137	0.101	0.000	0.277
2.1667	0.137	0.104	0.000	0.277
2.2222	0.137	0.107	0.000	0.277
2.2778	0.137	0.109	0.000	0.277
2.3333	0.137	0.112	0.000	0.277
2.3889	0.137	0.115	0.000	0.277
2.4444	0.137	0.117	0.000	0.277
2.5000	0.137	0.120	0.000	0.277
2.5556	0.137	0.123	0.000	0.277
2.6111	0.137	0.125	0.000	0.277
2.6667	0.137	0.128	0.000	0.277
2.7222	0.137	0.131	0.000	0.277
2.7778	0.137	0.133	0.000	0.277
2.8333	0.137	0.136	0.000	0.277
2.8889	0.137	0.139	0.000	0.277
2.9444	0.137	0.141	0.000	0.277
3.0000	0.137	0.144	0.000	0.277
3.0556	0.137	0.147	0.000	0.277
3.1111	0.137	0.150	0.000	0.277
3.1667	0.137	0.152	0.000	0.277
3.2222	0.137	0.155	0.000	0.277
3.2778	0.137	0.158	0.000	0.277
3.3333	0.137	0.160	0.000	0.277
3.3889	0.137	0.163	0.000	0.277
3.4444	0.137	0.166	0.000	0.277
3.5000	0.137	0.168	0.000	0.277
3.5556	0.137	0.171	0.000	0.277
3.6111	0.137	0.174	0.000	0.277
3.6667	0.137	0.176	0.000	0.277
3.7222	0.137	0.179	0.000	0.277
3.7778	0.137	0.182	0.000	0.277
3.8333	0.137	0.184	0.000	0.277
3.8889	0.137	0.187	0.000	0.277
3.9444	0.137	0.190	0.000	0.277
4.0000	0.137	0.192	0.000	0.277
4.0556	0.137	0.195	0.000	0.277
4.1111	0.137	0.198	0.000	0.277
4.1667	0.137	0.200	0.000	0.277
4.2222	0.137	0.203	0.000	0.277
4.2778	0.137	0.206	0.000	0.277
4.3333	0.137	0.208	0.000	0.277
4.3889	0.137	0.211	0.000	0.277
4.4444	0.137	0.214	0.000	0.277
4.5000	0.137	0.216	0.000	0.277
4.5556	0.137	0.219	0.277	0.277

4.6111	0.137	0.222	0.784	0.277
4.6667	0.137	0.225	1.438	0.277
4.7222	0.137	0.227	2.205	0.277
4.7778	0.137	0.230	3.059	0.277
4.8333	0.137	0.233	3.979	0.277
4.8889	0.137	0.235	4.939	0.277
4.9444	0.137	0.238	5.917	0.277
5.0000	0.137	0.241	6.887	0.277

Gravel Trench Bed 2

Bottom Length:	250.00 ft.
Bottom Width:	5.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	5
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	16.401
Total Volume Through Riser (ac-ft.):	6.676
Total Volume Through Facility (ac-ft.):	23.076
Percent Infiltrated:	71.07
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	3 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

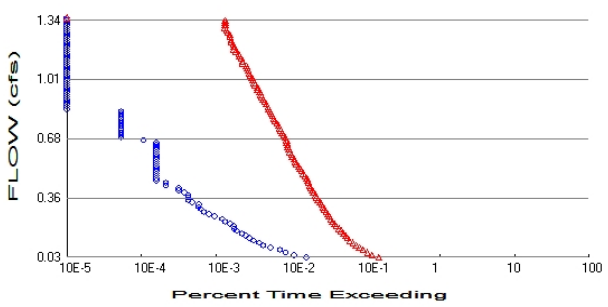
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.028	0.000	0.000	0.000
0.0556	0.028	0.000	0.000	0.057
0.1111	0.028	0.001	0.000	0.057
0.1667	0.028	0.001	0.000	0.057
0.2222	0.028	0.002	0.000	0.057
0.2778	0.028	0.002	0.000	0.057
0.3333	0.028	0.003	0.000	0.057
0.3889	0.028	0.003	0.000	0.057
0.4444	0.028	0.004	0.000	0.057
0.5000	0.028	0.005	0.000	0.057
0.5556	0.028	0.005	0.000	0.057
0.6111	0.028	0.006	0.000	0.057
0.6667	0.028	0.006	0.000	0.057
0.7222	0.028	0.007	0.000	0.057
0.7778	0.028	0.007	0.000	0.057
0.8333	0.028	0.008	0.000	0.057
0.8889	0.028	0.008	0.000	0.057
0.9444	0.028	0.009	0.000	0.057
1.0000	0.028	0.010	0.000	0.057
1.0556	0.028	0.010	0.000	0.057
1.1111	0.028	0.011	0.000	0.057
1.1667	0.028	0.011	0.000	0.057
1.2222	0.028	0.012	0.000	0.057
1.2778	0.028	0.012	0.000	0.057
1.3333	0.028	0.013	0.000	0.057

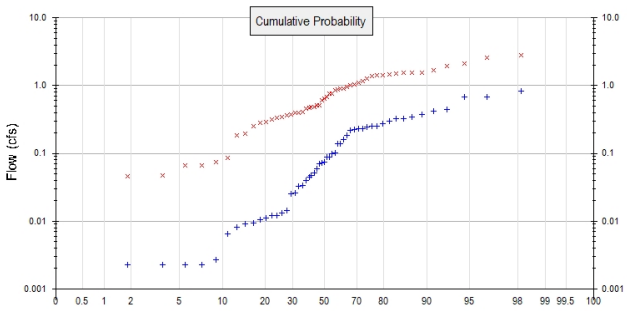
1.3889	0.028	0.013	0.000	0.057
1.4444	0.028	0.014	0.000	0.057
1.5000	0.028	0.015	0.000	0.057
1.5556	0.028	0.015	0.000	0.057
1.6111	0.028	0.016	0.000	0.057
1.6667	0.028	0.016	0.000	0.057
1.7222	0.028	0.017	0.000	0.057
1.7778	0.028	0.017	0.000	0.057
1.8333	0.028	0.018	0.000	0.057
1.8889	0.028	0.019	0.000	0.057
1.9444	0.028	0.019	0.000	0.057
2.0000	0.028	0.020	0.000	0.057
2.0556	0.028	0.020	0.000	0.057
2.1111	0.028	0.021	0.000	0.057
2.1667	0.028	0.021	0.000	0.057
2.2222	0.028	0.022	0.000	0.057
2.2778	0.028	0.022	0.000	0.057
2.3333	0.028	0.023	0.000	0.057
2.3889	0.028	0.024	0.000	0.057
2.4444	0.028	0.024	0.000	0.057
2.5000	0.028	0.025	0.000	0.057
2.5556	0.028	0.025	0.000	0.057
2.6111	0.028	0.026	0.000	0.057
2.6667	0.028	0.026	0.000	0.057
2.7222	0.028	0.027	0.000	0.057
2.7778	0.028	0.027	0.000	0.057
2.8333	0.028	0.028	0.000	0.057
2.8889	0.028	0.029	0.000	0.057
2.9444	0.028	0.029	0.000	0.057
3.0000	0.028	0.030	0.000	0.057
3.0556	0.028	0.030	0.138	0.057
3.1111	0.028	0.031	0.389	0.057
3.1667	0.028	0.031	0.703	0.057
3.2222	0.028	0.032	1.046	0.057
3.2778	0.028	0.032	1.383	0.057
3.3333	0.028	0.033	1.683	0.057
3.3889	0.028	0.034	1.921	0.057
3.4444	0.028	0.034	2.088	0.057
3.5000	0.028	0.035	2.203	0.057
3.5556	0.028	0.035	2.347	0.057
3.6111	0.028	0.036	2.462	0.057
3.6667	0.028	0.036	2.571	0.057
3.7222	0.028	0.037	2.676	0.057
3.7778	0.028	0.037	2.777	0.057
3.8333	0.028	0.038	2.875	0.057
3.8889	0.028	0.039	2.969	0.057
3.9444	0.028	0.039	3.060	0.057
4.0000	0.028	0.040	3.149	0.057
4.0556	0.028	0.040	3.235	0.057
4.1111	0.028	0.041	3.320	0.057
4.1667	0.028	0.041	3.402	0.057
4.2222	0.028	0.042	3.482	0.057
4.2778	0.028	0.043	3.560	0.057
4.3333	0.028	0.043	3.636	0.057
4.3889	0.028	0.044	3.711	0.057
4.4444	0.028	0.044	3.785	0.057
4.5000	0.028	0.045	3.857	0.057
4.5556	0.028	0.045	3.928	0.057

4.6111	0.028	0.046	3.997	0.057
4.6667	0.028	0.046	4.066	0.057
4.7222	0.028	0.047	4.133	0.057
4.7778	0.028	0.048	4.199	0.057
4.8333	0.028	0.048	4.264	0.057
4.8889	0.028	0.049	4.328	0.057
4.9444	0.028	0.049	4.391	0.057
5.0000	0.028	0.050	4.454	0.057

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 2.844
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 1.16
Total Impervious Area: 1.684

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.062613
5 year	0.245299
10 year	0.47044
25 year	0.899944
50 year	1.335307
100 year	1.873996

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.615424
5 year	1.548871
10 year	2.243406
25 year	3.088672
50 year	3.657997
100 year	4.163853

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	0.442	1.567
1957	0.045	1.366
1958	0.678	1.403
1959	0.161	0.757
1960	0.673	1.536
1961	0.328	0.863
1962	0.836	1.150
1963	0.246	2.107
1964	0.138	0.900
1965	0.073	0.195

1966	0.009	0.046
1967	0.033	0.516
1968	0.006	0.395
1969	0.033	0.286
1970	0.047	0.184
1971	0.299	0.505
1972	0.222	0.613
1973	0.011	0.480
1974	0.321	1.041
1975	0.346	1.501
1976	0.187	0.398
1977	0.002	0.075
1978	0.375	1.264
1979	0.012	0.471
1980	0.025	0.451
1981	0.040	0.413
1982	0.218	0.945
1983	0.089	0.643
1984	0.272	0.891
1985	0.008	0.379
1986	0.254	1.463
1987	0.013	1.016
1988	0.003	0.287
1989	0.009	0.067
1990	0.099	0.676
1991	0.235	0.361
1992	0.012	0.086
1993	0.059	0.254
1994	0.051	0.066
1995	0.014	1.566
1996	0.424	1.961
1997	0.103	0.870
1998	0.087	2.542
1999	0.011	0.315
2000	0.026	0.481
2001	0.002	0.001
2002	0.072	2.772
2003	0.002	1.678
2004	0.002	0.047
2005	0.002	0.342
2006	0.139	0.338
2007	0.230	1.433
2008	0.071	0.768
2009	0.254	1.096

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.8355	2.7716
2	0.6783	2.5416
3	0.6728	2.1065
4	0.4418	1.9614
5	0.4244	1.6777
6	0.3752	1.5671
7	0.3460	1.5662
8	0.3276	1.5360
9	0.3210	1.5011
10	0.2994	1.4632

11	0.2721	1.4325
12	0.2541	1.4032
13	0.2538	1.3658
14	0.2461	1.2635
15	0.2346	1.1495
16	0.2303	1.0961
17	0.2224	1.0414
18	0.2183	1.0159
19	0.1869	0.9448
20	0.1614	0.8997
21	0.1394	0.8913
22	0.1382	0.8696
23	0.1028	0.8631
24	0.0993	0.7678
25	0.0892	0.7573
26	0.0870	0.6762
27	0.0733	0.6433
28	0.0715	0.6132
29	0.0711	0.5163
30	0.0592	0.5047
31	0.0512	0.4814
32	0.0467	0.4801
33	0.0448	0.4709
34	0.0398	0.4512
35	0.0335	0.4130
36	0.0329	0.3982
37	0.0256	0.3954
38	0.0250	0.3786
39	0.0142	0.3608
40	0.0130	0.3417
41	0.0122	0.3385
42	0.0120	0.3152
43	0.0111	0.2866
44	0.0106	0.2860
45	0.0094	0.2536
46	0.0092	0.1946
47	0.0081	0.1839
48	0.0064	0.0864
49	0.0027	0.0749
50	0.0023	0.0667
51	0.0023	0.0658
52	0.0023	0.0469
53	0.0023	0.0456
54	0.0020	0.0009

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0313	303	2874	948	Fail
0.0445	207	2342	1131	Fail
0.0576	161	2028	1259	Fail
0.0708	135	1759	1302	Fail
0.0840	101	1579	1563	Fail
0.0972	81	1416	1748	Fail
0.1103	71	1294	1822	Fail
0.1235	60	1167	1945	Fail
0.1367	52	1086	2088	Fail
0.1499	47	1033	2197	Fail
0.1630	42	965	2297	Fail
0.1762	36	895	2486	Fail
0.1894	33	832	2521	Fail
0.2025	32	775	2421	Fail
0.2157	29	732	2524	Fail
0.2289	25	683	2732	Fail
0.2421	23	649	2821	Fail
0.2552	18	619	3438	Fail
0.2684	15	591	3940	Fail
0.2816	13	565	4346	Fail
0.2947	12	534	4450	Fail
0.3079	11	507	4609	Fail
0.3211	11	490	4454	Fail
0.3343	9	468	5200	Fail
0.3474	8	441	5512	Fail
0.3606	8	423	5287	Fail
0.3738	8	405	5062	Fail
0.3869	7	384	5485	Fail
0.4001	6	368	6133	Fail
0.4133	6	350	5833	Fail
0.4265	4	340	8500	Fail
0.4396	4	325	8125	Fail
0.4528	3	318	10600	Fail
0.4660	3	310	10333	Fail
0.4791	3	292	9733	Fail
0.4923	3	279	9300	Fail
0.5055	3	264	8800	Fail
0.5187	3	252	8400	Fail
0.5318	3	240	8000	Fail
0.5450	3	226	7533	Fail
0.5582	3	214	7133	Fail
0.5713	3	209	6966	Fail
0.5845	3	199	6633	Fail
0.5977	3	193	6433	Fail
0.6109	3	185	6166	Fail
0.6240	3	179	5966	Fail
0.6372	3	173	5766	Fail
0.6504	3	170	5666	Fail
0.6635	3	166	5533	Fail
0.6767	2	166	8300	Fail
0.6899	1	159	15900	Fail
0.7031	1	152	15200	Fail
0.7162	1	146	14600	Fail
0.7294	1	140	14000	Fail

0.7426	1	135	13500	Fail
0.7558	1	130	13000	Fail
0.7689	1	123	12300	Fail
0.7821	1	116	11600	Fail
0.7953	1	111	11100	Fail
0.8084	1	108	10800	Fail
0.8216	1	104	10400	Fail
0.8348	1	100	10000	Fail
0.8480	0	96	n/a	Fail
0.8611	0	94	n/a	Fail
0.8743	0	89	n/a	Fail
0.8875	0	85	n/a	Fail
0.9006	0	80	n/a	Fail
0.9138	0	78	n/a	Fail
0.9270	0	75	n/a	Fail
0.9402	0	73	n/a	Fail
0.9533	0	68	n/a	Fail
0.9665	0	68	n/a	Fail
0.9797	0	63	n/a	Fail
0.9928	0	61	n/a	Fail
1.0060	0	59	n/a	Fail
1.0192	0	57	n/a	Fail
1.0324	0	54	n/a	Fail
1.0455	0	53	n/a	Fail
1.0587	0	51	n/a	Fail
1.0719	0	49	n/a	Fail
1.0850	0	48	n/a	Fail
1.0982	0	43	n/a	Fail
1.1114	0	43	n/a	Fail
1.1246	0	41	n/a	Fail
1.1377	0	39	n/a	Fail
1.1509	0	38	n/a	Fail
1.1641	0	35	n/a	Fail
1.1772	0	33	n/a	Fail
1.1904	0	33	n/a	Fail
1.2036	0	32	n/a	Fail
1.2168	0	30	n/a	Fail
1.2299	0	30	n/a	Fail
1.2431	0	29	n/a	Fail
1.2563	0	29	n/a	Fail
1.2694	0	27	n/a	Fail
1.2826	0	26	n/a	Fail
1.2958	0	25	n/a	Fail
1.3090	0	25	n/a	Fail
1.3221	0	25	n/a	Fail
1.3353	0	25	n/a	Fail

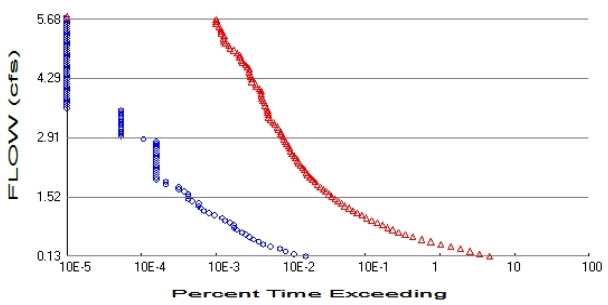
The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

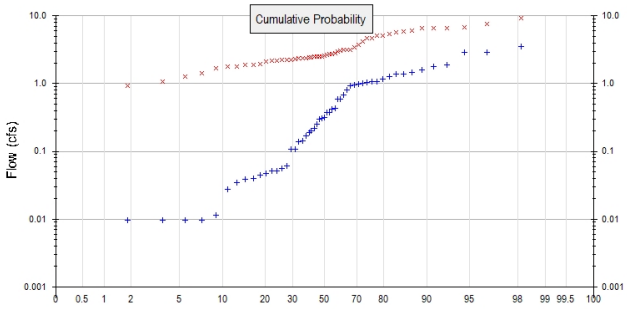
Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

POC 2





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 12.099
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2
Total Pervious Area: 1.21
Total Impervious Area: 10.889

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.26637
5 year	1.043554
10 year	2.001356
25 year	3.82856
50 year	5.68069
100 year	7.972395

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	2.889243
5 year	4.566276
10 year	5.800523
25 year	7.486366
50 year	8.827735
100 year	10.23843

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	**Predeveloped**	**Mitigated**
1956	1.879	5.091
1957	0.191	5.953
1958	2.885	5.077
1959	0.687	2.521
1960	2.862	6.767
1961	1.394	3.176
1962	3.555	4.703
1963	1.047	9.185
1964	0.588	2.726
1965	0.312	2.577
1966	0.039	2.396

1967	0.142	1.911
1968	0.027	1.674
1969	0.140	2.397
1970	0.199	1.801
1971	1.274	2.833
1972	0.946	2.361
1973	0.045	1.799
1974	1.366	3.180
1975	1.472	5.331
1976	0.795	3.163
1977	0.010	2.183
1978	1.596	5.737
1979	0.051	1.891
1980	0.106	2.320
1981	0.169	2.674
1982	0.929	2.226
1983	0.380	3.092
1984	1.158	2.262
1985	0.035	2.422
1986	1.080	6.547
1987	0.055	2.983
1988	0.011	2.199
1989	0.040	1.067
1990	0.423	2.518
1991	0.998	2.714
1992	0.052	2.117
1993	0.252	1.965
1994	0.218	1.437
1995	0.060	3.467
1996	1.805	6.540
1997	0.437	2.516
1998	0.370	6.571
1999	0.047	1.273
2000	0.109	2.431
2001	0.009	0.700
2002	0.304	7.511
2003	0.010	5.888
2004	0.010	0.931
2005	0.010	2.526
2006	0.593	2.238
2007	0.980	4.638
2008	0.302	3.725
2009	1.081	4.165

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	3.5546	9.1846
2	2.8854	7.5112
3	2.8624	6.7666
4	1.8793	6.5715
5	1.8054	6.5471
6	1.5962	6.5399
7	1.4721	5.9535
8	1.3935	5.8880
9	1.3658	5.7369
10	1.2736	5.3314
11	1.1576	5.0914

12	1.0812	5.0766
13	1.0798	4.7033
14	1.0469	4.6378
15	0.9979	4.1648
16	0.9797	3.7254
17	0.9460	3.4669
18	0.9287	3.1801
19	0.7950	3.1759
20	0.6868	3.1629
21	0.5928	3.0922
22	0.5877	2.9830
23	0.4373	2.8334
24	0.4226	2.7256
25	0.3796	2.7137
26	0.3700	2.6741
27	0.3118	2.5769
28	0.3044	2.5263
29	0.3023	2.5212
30	0.2516	2.5180
31	0.2180	2.5160
32	0.1988	2.4307
33	0.1907	2.4217
34	0.1694	2.3967
35	0.1424	2.3960
36	0.1401	2.3606
37	0.1091	2.3201
38	0.1064	2.2620
39	0.0602	2.2380
40	0.0553	2.2258
41	0.0521	2.1991
42	0.0510	2.1831
43	0.0474	2.1171
44	0.0450	1.9647
45	0.0398	1.9106
46	0.0391	1.8910
47	0.0346	1.8006
48	0.0272	1.7992
49	0.0113	1.6743
50	0.0097	1.4372
51	0.0097	1.2734
52	0.0096	1.0675
53	0.0096	0.9313
54	0.0087	0.7003

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1332	300	87442	29147	Fail
0.1892	207	64303	31064	Fail
0.2453	161	48000	29813	Fail
0.3013	135	35541	26326	Fail
0.3573	100	26301	26301	Fail
0.4134	81	19333	23867	Fail
0.4694	70	14353	20504	Fail
0.5254	60	10730	17883	Fail
0.5815	52	8188	15746	Fail
0.6375	47	6497	13823	Fail
0.6935	42	5283	12578	Fail
0.7496	36	4454	12372	Fail
0.8056	33	3757	11384	Fail
0.8616	32	3198	9993	Fail
0.9177	29	2740	9448	Fail
0.9737	25	2314	9256	Fail
1.0298	23	1971	8569	Fail
1.0858	18	1715	9527	Fail
1.1418	15	1468	9786	Fail
1.1979	13	1298	9984	Fail
1.2539	12	1150	9583	Fail
1.3099	11	1011	9190	Fail
1.3660	11	909	8263	Fail
1.4220	9	821	9122	Fail
1.4780	8	742	9275	Fail
1.5341	8	675	8437	Fail
1.5901	8	622	7775	Fail
1.6461	7	556	7942	Fail
1.7022	6	516	8600	Fail
1.7582	6	472	7866	Fail
1.8142	4	430	10750	Fail
1.8703	4	401	10025	Fail
1.9263	3	371	12366	Fail
1.9824	3	345	11500	Fail
2.0384	3	320	10666	Fail
2.0944	3	303	10100	Fail
2.1505	3	289	9633	Fail
2.2065	3	273	9100	Fail
2.2625	3	256	8533	Fail
2.3186	3	244	8133	Fail
2.3746	3	234	7800	Fail
2.4306	3	221	7366	Fail
2.4867	3	210	7000	Fail
2.5427	3	197	6566	Fail
2.5987	3	187	6233	Fail
2.6548	3	182	6066	Fail
2.7108	3	177	5900	Fail
2.7668	3	165	5500	Fail
2.8229	3	159	5300	Fail
2.8789	2	156	7800	Fail
2.9350	1	149	14900	Fail
2.9910	1	140	14000	Fail
3.0470	1	138	13800	Fail
3.1031	1	130	13000	Fail

3.1591	1	126	12600	Fail
3.2151	1	116	11600	Fail
3.2712	1	110	11000	Fail
3.3272	1	101	10100	Fail
3.3832	1	96	9600	Fail
3.4393	1	95	9500	Fail
3.4953	1	93	9300	Fail
3.5513	1	93	9300	Fail
3.6074	0	91	n/a	Fail
3.6634	0	87	n/a	Fail
3.7195	0	85	n/a	Fail
3.7755	0	81	n/a	Fail
3.8315	0	78	n/a	Fail
3.8876	0	76	n/a	Fail
3.9436	0	76	n/a	Fail
3.9996	0	75	n/a	Fail
4.0557	0	72	n/a	Fail
4.1117	0	66	n/a	Fail
4.1677	0	64	n/a	Fail
4.2238	0	57	n/a	Fail
4.2798	0	57	n/a	Fail
4.3358	0	55	n/a	Fail
4.3919	0	54	n/a	Fail
4.4479	0	53	n/a	Fail
4.5039	0	53	n/a	Fail
4.5600	0	50	n/a	Fail
4.6160	0	47	n/a	Fail
4.6721	0	43	n/a	Fail
4.7281	0	41	n/a	Fail
4.7841	0	39	n/a	Fail
4.8402	0	39	n/a	Fail
4.8962	0	36	n/a	Fail
4.9522	0	33	n/a	Fail
5.0083	0	29	n/a	Fail
5.0643	0	28	n/a	Fail
5.1203	0	25	n/a	Fail
5.1764	0	24	n/a	Fail
5.2324	0	24	n/a	Fail
5.2884	0	24	n/a	Fail
5.3445	0	22	n/a	Fail
5.4005	0	22	n/a	Fail
5.4565	0	22	n/a	Fail
5.5126	0	21	n/a	Fail
5.5686	0	19	n/a	Fail
5.6247	0	19	n/a	Fail
5.6807	0	19	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #2

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

Model Default Modifications

Total of 0 changes have been made.

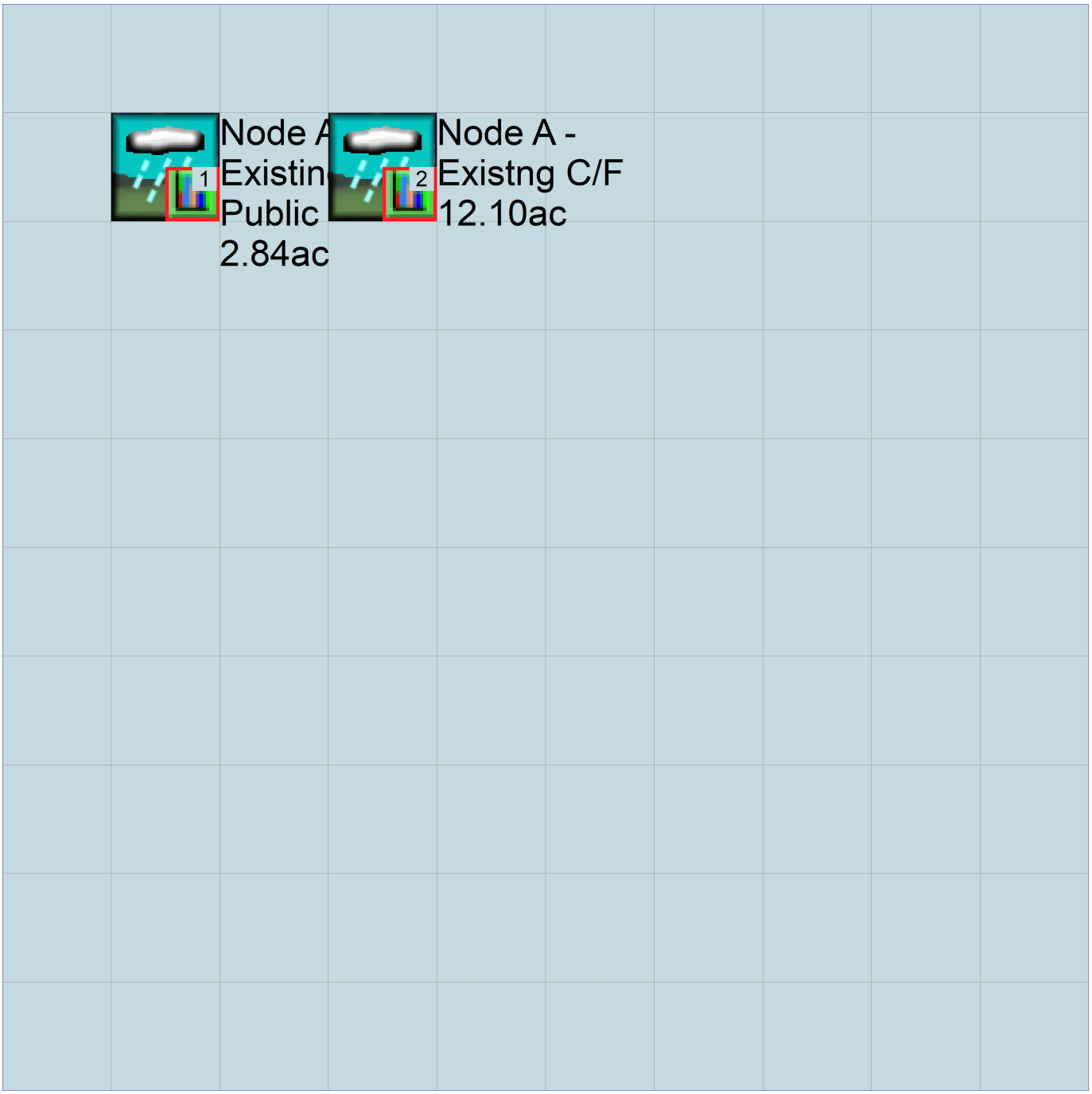
PERLND Changes

No PERLND changes have been made.

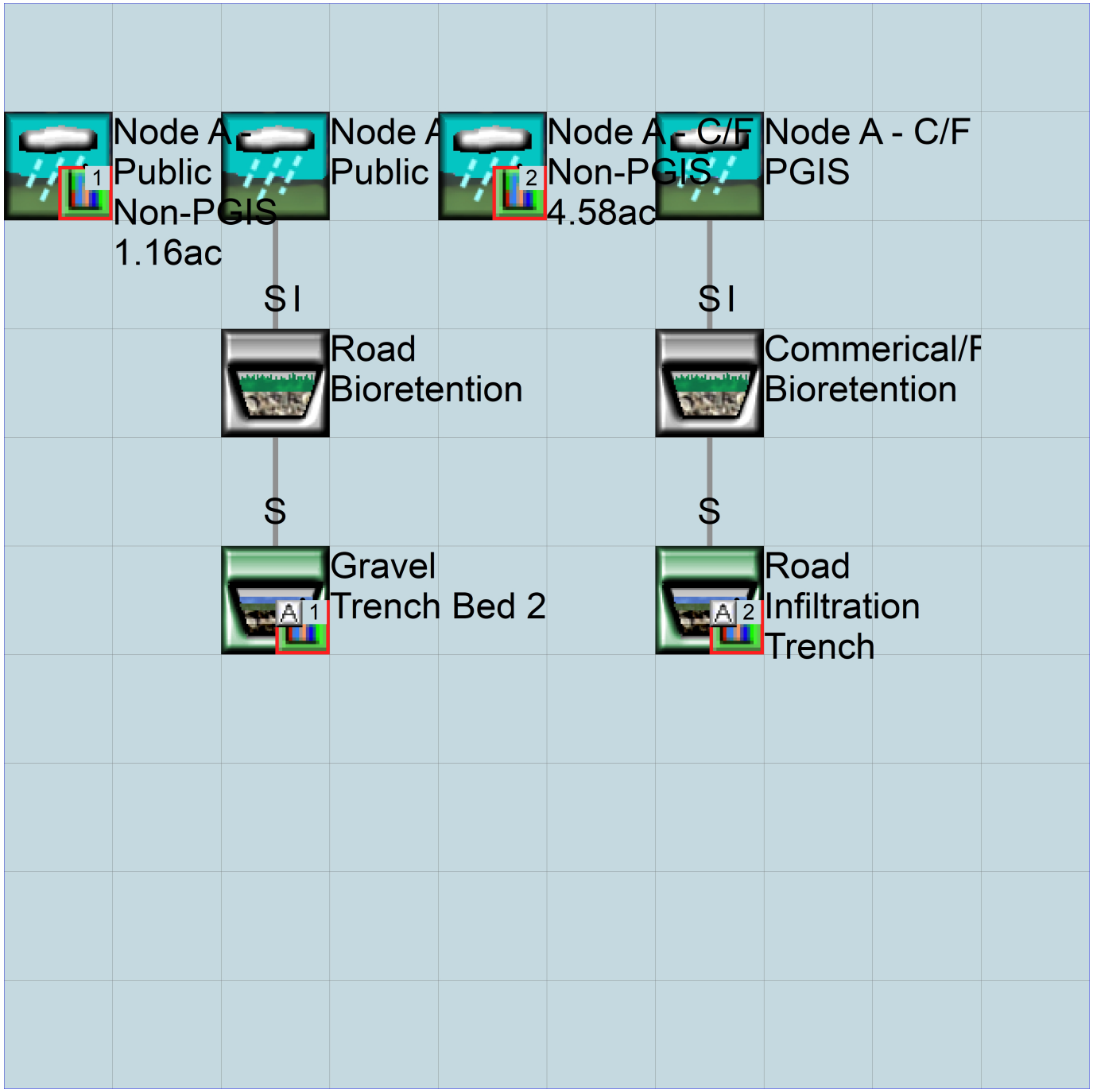
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node A.wdm
MESSU       25   Pre18591_Node A.MES
            27   Pre18591_Node A.L61
            28   Pre18591_Node A.L62
            30   POC18591_Node A1.dat
            31   POC18591_Node A2.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       2
      COPY       501
      COPY       502
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Node A - Existing Public    MAX                   1    2   30    9
    2        Node A - Existng C/F        MAX                   1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  502         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    2     A/B, Forest, Mod        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    2         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
```

```
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    2         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    2         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    2              0         5         2       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    2              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    2          0.2       0.5      0.35         0       0.7       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    2              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                    in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3
```

```
  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node A - Existing Public***
PERLND   2                       2.844     COPY   501     12
PERLND   2                       2.844     COPY   501     13
Node A - Existng C/F***
PERLND   2                      12.099     COPY   502     12
PERLND   2                      12.099     COPY   502     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                     ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><--->
```

```
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    502 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node A.wdm
MESSU       25   Mit18591_Node A.MES
            27   Mit18591_Node A.L61
            28   Mit18591_Node A.L62
            31   POC18591_Node A2.dat
            30   POC18591_Node A1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       1
      PERLND       8
      IMPLND       4
      RCHRES       1
      RCHRES       2
      RCHRES       3
      RCHRES       4
      RCHRES       5
      RCHRES       6
      COPY         2
      COPY       502
      COPY       602
      COPY         1
      COPY       501
      COPY       601
      DISPLY       2
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    2        Road Infiltration Trench    MAX                   1    2   31    9
    1        Gravel Trench Bed 2         MAX                   1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
    2         1    1
  502         1    1
  602         1    1
  501         1    1
  601         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
```

```
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                        in  out           ***
    8     A/B, Lawn, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    8         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    8         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    8         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    8             0         5       0.8       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    8             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    8          0.1       0.5      0.25         0       0.7      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS       IFWS       LZS       AGWS      GWVS
    8             0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
    4      ROOF TOPS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    4         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
```

```
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    4    1    9
    4         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    4         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    4            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    4              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    4              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node A - Public PGIS***
IMPLND   1                       1.684     RCHRES   1      5
Node A - C/F PGIS***
IMPLND   1                       7.516     RCHRES   3      5
Node A - Public Non-PGIS***
PERLND   8                        1.16     COPY   501     12
PERLND   8                        1.16     COPY   601     12
PERLND   8                        1.16     COPY   501     13
PERLND   8                        1.16     COPY   601     13
Node A - C/F Non-PGIS***
PERLND   8                        1.21     COPY   502     12
PERLND   8                        1.21     COPY   602     12
PERLND   8                        1.21     COPY   502     13
PERLND   8                        1.21     COPY   602     13
IMPLND   4                       3.373     COPY   502     15
IMPLND   4                       3.373     COPY   602     15

******Routing******
RCHRES   1                           1     RCHRES   6      7
RCHRES   1                                 COPY     1     17
RCHRES   1                           1     RCHRES   2      8
RCHRES   3                           1     RCHRES   5      7
RCHRES   3                                 COPY     2     17
RCHRES   3                           1     RCHRES   4      8
RCHRES   5                           1     COPY   502     17
RCHRES   6                           1     COPY   501     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
```

```
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1


<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<-----------------><---> User T-series  Engl Metr LKFG             ***
                                       in  out                               ***
    1     Surface Bioreten-009    2    1    1    1   28    0    1
    2     Road Bioretentio-008    1    1    1    1   28    0    1
    3     Surface Bioreten-011    2    1    1    1   28    0    1
    4     Commerical/Flex -010    1    1    1    1   28    0    1
    5     Road Infiltratio-013    2    1    1    1   28    0    1
    6     Gravel Trench Be-020    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
    4         1    0    0    0    0    0    0    0    0    0
    5         1    0    0    0    0    0    0    0    0    0
    6         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
    4         4    0    0    0    0    0    0    0    0    0    1    9
    5         4    0    0    0    0    0    0    0    0    0    1    9
    6         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    2       0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    3       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    4       0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    5       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    6       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------->      ***
    1             1      0.01       0.0       0.0       0.0       0.0
    2             2      0.05       0.0       0.0       0.0       0.0
    3             3      0.01       0.0       0.0       0.0       0.0
    4             4      0.02       0.0       0.0       0.0       0.0
    5             5      0.02       0.0       0.0       0.5       0.0
    6             6      0.05       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
```

```
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
           *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    4            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    5            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    6            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      2
   70    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.028696  0.000000  0.000000
  0.043956  0.028696  0.000577  0.000000
  0.087912  0.028696  0.001154  0.000000
  0.131868  0.028696  0.001730  0.000000
  0.175824  0.028696  0.002307  0.000000
  0.219780  0.028696  0.002884  0.000792
  0.263736  0.028696  0.003461  0.001329
  0.307692  0.028696  0.004038  0.002053
  0.351648  0.028696  0.004615  0.002988
  0.395604  0.028696  0.005191  0.004154
  0.439560  0.028696  0.005768  0.005569
  0.483516  0.028696  0.006345  0.007252
  0.527473  0.028696  0.006922  0.009007
  0.571429  0.028696  0.007499  0.009218
  0.615385  0.028696  0.008076  0.011483
  0.659341  0.028696  0.008652  0.014061
  0.703297  0.028696  0.009229  0.016967
  0.747253  0.028696  0.009806  0.020214
  0.791209  0.028696  0.010383  0.021769
  0.835165  0.028696  0.010960  0.023814
  0.879121  0.028696  0.011536  0.027781
  0.923077  0.028696  0.012113  0.032125
  0.967033  0.028696  0.012690  0.036858
  1.010989  0.028696  0.013267  0.041677
  1.054945  0.028696  0.013844  0.041991
  1.098901  0.028696  0.014421  0.047536
  1.142857  0.028696  0.014997  0.053501
  1.186813  0.028696  0.015574  0.059897
  1.230769  0.028696  0.016151  0.066734
  1.274725  0.028696  0.016728  0.069738
  1.318681  0.028696  0.017305  0.074021
  1.362637  0.028696  0.017881  0.081766
  1.406593  0.028696  0.018458  0.089978
  1.450549  0.028696  0.019035  0.098664
  1.494505  0.028696  0.019612  0.106852
  1.538462  0.028696  0.020135  0.107830
  1.582418  0.028696  0.020659  0.117482
  1.626374  0.028696  0.021182  0.127623
  1.670330  0.028696  0.021706  0.138252
  1.714286  0.028696  0.022229  0.149359
  1.758242  0.028696  0.022753  0.153837
  1.802198  0.028696  0.023276  0.160904
  1.846154  0.028696  0.023800  0.172605
  1.890110  0.028696  0.024323  0.231481
  1.934066  0.028696  0.024847  0.231481
  1.978022  0.028696  0.025370  0.231481
  2.021978  0.028696  0.025894  0.231481
  2.065934  0.028696  0.026417  0.231481
  2.109890  0.028696  0.026940  0.231481
  2.153846  0.028696  0.027464  0.231481
  2.197802  0.028696  0.027987  0.231481
```

```
2.241758  0.028696  0.028511  0.231481
2.285714  0.028696  0.029034  0.231481
2.329670  0.028696  0.029558  0.231481
2.373626  0.028696  0.030081  0.231481
2.417582  0.028696  0.030605  0.231481
2.461538  0.028696  0.031128  0.231481
2.505495  0.028696  0.031652  0.231481
2.549451  0.028696  0.032175  0.231481
2.593407  0.028696  0.032699  0.231481
2.637363  0.028696  0.033222  0.231481
2.681319  0.028696  0.033746  0.231481
2.725275  0.028696  0.034269  0.231481
2.769231  0.028696  0.034792  0.231481
2.813187  0.028696  0.035316  0.231481
2.857143  0.028696  0.035839  0.231481
2.901099  0.028696  0.036363  0.231481
2.945055  0.028696  0.036886  0.231481
2.989011  0.028696  0.037410  0.231481
3.000000  0.028696  0.042323  0.231481
END FTABLE  2
FTABLE      1
 24    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.028696  0.000000  0.000000  0.000000
0.043956  0.028696  0.001261  0.000000  0.173611
0.087912  0.028696  0.002523  0.000000  0.183786
0.131868  0.028696  0.003784  0.000000  0.188874
0.175824  0.028696  0.005045  0.000000  0.193961
0.219780  0.028696  0.006307  0.000000  0.199049
0.263736  0.028696  0.007568  0.000000  0.204136
0.307692  0.028696  0.008830  0.000000  0.209224
0.351648  0.028696  0.010091  0.000000  0.214311
0.395604  0.028696  0.011352  0.000000  0.219399
0.439560  0.028696  0.012614  0.000000  0.224486
0.483516  0.028696  0.013875  0.000000  0.229574
0.527473  0.028696  0.015136  0.048301  0.231481
0.571429  0.028696  0.016398  0.202028  0.231481
0.615385  0.028696  0.017659  0.412175  0.231481
0.659341  0.028696  0.018920  0.659695  0.231481
0.703297  0.028696  0.020182  0.928167  0.231481
0.747253  0.028696  0.021443  1.200769  0.231481
0.791209  0.028696  0.022705  1.460630  0.231481
0.835165  0.028696  0.023966  1.692395  0.231481
0.879121  0.028696  0.025227  1.884482  0.231481
0.923077  0.028696  0.026489  2.031838  0.231481
0.967033  0.028696  0.027750  2.139092  0.231481
1.000000  0.028696  0.028696  2.251466  0.231481
END FTABLE  1
FTABLE      4
 56    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.137741  0.000000  0.000000
0.054945  0.137741  0.003461  0.000000
0.109890  0.137741  0.006922  0.000000
0.164835  0.137741  0.010383  0.000000
0.219780  0.137741  0.013844  0.005654
0.274725  0.137741  0.017305  0.009856
0.329670  0.137741  0.020766  0.015634
0.384615  0.137741  0.024227  0.016455
0.439560  0.137741  0.027687  0.023180
0.494505  0.137741  0.031148  0.032664
0.549451  0.137741  0.034609  0.044245
0.604396  0.137741  0.038070  0.058067
0.659341  0.137741  0.041531  0.069906
0.714286  0.137741  0.044992  0.074267
0.769231  0.137741  0.048453  0.092974
0.824176  0.137741  0.051914  0.114309
0.879121  0.137741  0.055375  0.138388
```

```
0.934066  0.137741  0.058836  0.165321
0.989011  0.137741  0.062297  0.172669
1.043956  0.137741  0.065758  0.195215
1.098901  0.137741  0.069219  0.228171
1.153846  0.137741  0.072680  0.264285
1.208791  0.137741  0.076141  0.303649
1.263736  0.137741  0.079601  0.334742
1.318681  0.137741  0.083062  0.346353
1.373626  0.137741  0.086523  0.392478
1.428571  0.137741  0.089984  0.442103
1.483516  0.137741  0.093445  0.495294
1.538462  0.137741  0.096586  0.552112
1.593407  0.137741  0.099727  0.564683
1.648352  0.137741  0.102868  0.612591
1.703297  0.137741  0.106008  0.676727
1.758242  0.137741  0.109149  0.744394
1.813187  0.137741  0.112290  0.814747
1.868132  0.137741  0.115431  1.388889
1.923077  0.137741  0.118572  1.388889
1.978022  0.137741  0.121712  1.388889
2.032967  0.137741  0.124853  1.388889
2.087912  0.137741  0.127994  1.388889
2.142857  0.137741  0.131135  1.388889
2.197802  0.137741  0.134276  1.388889
2.252747  0.137741  0.137416  1.388889
2.307692  0.137741  0.140557  1.388889
2.362637  0.137741  0.143698  1.388889
2.417582  0.137741  0.146839  1.388889
2.472527  0.137741  0.149980  1.388889
2.527473  0.137741  0.153120  1.388889
2.582418  0.137741  0.156261  1.388889
2.637363  0.137741  0.159402  1.388889
2.692308  0.137741  0.162543  1.388889
2.747253  0.137741  0.165684  1.388889
2.802198  0.137741  0.168824  1.388889
2.857143  0.137741  0.171965  1.388889
2.912088  0.137741  0.175106  1.388889
2.967033  0.137741  0.178247  1.388889
3.000000  0.137741  0.208827  1.388889
END FTABLE  4
FTABLE      3
 38    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.137741  0.000000  0.000000  0.000000
0.054945  0.137741  0.007568  0.000000  0.833334
0.109890  0.137741  0.015136  0.000000  0.894384
0.164835  0.137741  0.022705  0.000000  0.924909
0.219780  0.137741  0.030273  0.000000  0.955434
0.274725  0.137741  0.037841  0.000000  0.985959
0.329670  0.137741  0.045409  0.000000  1.016484
0.384615  0.137741  0.052977  0.000000  1.047009
0.439560  0.137741  0.060546  0.000000  1.077534
0.494505  0.137741  0.068114  0.000000  1.108059
0.549451  0.137741  0.075682  0.000000  1.138585
0.604396  0.137741  0.083250  0.000000  1.169110
0.659341  0.137741  0.090818  0.000000  1.199635
0.714286  0.137741  0.098386  0.000000  1.230160
0.769231  0.137741  0.105955  0.000000  1.260685
0.824176  0.137741  0.113523  0.000000  1.291210
0.879121  0.137741  0.121091  0.000000  1.321735
0.934066  0.137741  0.128659  0.000000  1.352260
0.989011  0.137741  0.136227  0.000000  1.382785
1.043956  0.137741  0.143796  0.195553  1.388889
1.098901  0.137741  0.151364  0.659242  1.388889
1.153846  0.137741  0.158932  1.276591  1.388889
1.208791  0.137741  0.166500  2.010935  1.388889
1.263736  0.137741  0.174068  2.836899  1.388889
1.318681  0.137741  0.181637  3.731796  1.388889
1.373626  0.137741  0.189205  4.673072  1.388889
```

```
1.428571  0.137741  0.196773  5.637608  1.388889
1.483516  0.137741  0.204341  6.601841  1.388889
1.538462  0.137741  0.211909  7.542349  1.388889
1.593407  0.137741  0.219477  8.436754  1.388889
1.648352  0.137741  0.227046  9.264852  1.388889
1.703297  0.137741  0.234614  10.00993  1.388889
1.758242  0.137741  0.242182  10.66024  1.388889
1.813187  0.137741  0.249750  11.21062  1.388889
1.868132  0.137741  0.257318  11.66425  1.388889
1.923077  0.137741  0.264887  12.03449  1.388889
1.978022  0.137741  0.272455  12.34684  1.388889
2.000000  0.137741  0.275482  12.80450  1.388889
END FTABLE  3
FTABLE      5
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.137741  0.000000  0.000000  0.000000
0.055556  0.137741  0.002678  0.000000  0.277778
0.111111  0.137741  0.005357  0.000000  0.277778
0.166667  0.137741  0.008035  0.000000  0.277778
0.222222  0.137741  0.010713  0.000000  0.277778
0.277778  0.137741  0.013391  0.000000  0.277778
0.333333  0.137741  0.016070  0.000000  0.277778
0.388889  0.137741  0.018748  0.000000  0.277778
0.444444  0.137741  0.021426  0.000000  0.277778
0.500000  0.137741  0.024105  0.000000  0.277778
0.555556  0.137741  0.026783  0.000000  0.277778
0.611111  0.137741  0.029461  0.000000  0.277778
0.666667  0.137741  0.032140  0.000000  0.277778
0.722222  0.137741  0.034818  0.000000  0.277778
0.777778  0.137741  0.037496  0.000000  0.277778
0.833333  0.137741  0.040174  0.000000  0.277778
0.888889  0.137741  0.042853  0.000000  0.277778
0.944444  0.137741  0.045531  0.000000  0.277778
1.000000  0.137741  0.048209  0.000000  0.277778
1.055556  0.137741  0.050888  0.000000  0.277778
1.111111  0.137741  0.053566  0.000000  0.277778
1.166667  0.137741  0.056244  0.000000  0.277778
1.222222  0.137741  0.058923  0.000000  0.277778
1.277778  0.137741  0.061601  0.000000  0.277778
1.333333  0.137741  0.064279  0.000000  0.277778
1.388889  0.137741  0.066957  0.000000  0.277778
1.444444  0.137741  0.069636  0.000000  0.277778
1.500000  0.137741  0.072314  0.000000  0.277778
1.555556  0.137741  0.074992  0.000000  0.277778
1.611111  0.137741  0.077671  0.000000  0.277778
1.666667  0.137741  0.080349  0.000000  0.277778
1.722222  0.137741  0.083027  0.000000  0.277778
1.777778  0.137741  0.085706  0.000000  0.277778
1.833333  0.137741  0.088384  0.000000  0.277778
1.888889  0.137741  0.091062  0.000000  0.277778
1.944444  0.137741  0.093740  0.000000  0.277778
2.000000  0.137741  0.096419  0.000000  0.277778
2.055556  0.137741  0.099097  0.000000  0.277778
2.111111  0.137741  0.101775  0.000000  0.277778
2.166667  0.137741  0.104454  0.000000  0.277778
2.222222  0.137741  0.107132  0.000000  0.277778
2.277778  0.137741  0.109810  0.000000  0.277778
2.333333  0.137741  0.112489  0.000000  0.277778
2.388889  0.137741  0.115167  0.000000  0.277778
2.444444  0.137741  0.117845  0.000000  0.277778
2.500000  0.137741  0.120523  0.000000  0.277778
2.555556  0.137741  0.123202  0.000000  0.277778
2.611111  0.137741  0.125880  0.000000  0.277778
2.666667  0.137741  0.128558  0.000000  0.277778
2.722222  0.137741  0.131237  0.000000  0.277778
2.777778  0.137741  0.133915  0.000000  0.277778
2.833333  0.137741  0.136593  0.000000  0.277778
2.888889  0.137741  0.139272  0.000000  0.277778
```

```
2.944444  0.137741  0.141950  0.000000  0.277778
3.000000  0.137741  0.144628  0.000000  0.277778
3.055556  0.137741  0.147306  0.000000  0.277778
3.111111  0.137741  0.149985  0.000000  0.277778
3.166667  0.137741  0.152663  0.000000  0.277778
3.222222  0.137741  0.155341  0.000000  0.277778
3.277778  0.137741  0.158020  0.000000  0.277778
3.333333  0.137741  0.160698  0.000000  0.277778
3.388889  0.137741  0.163376  0.000000  0.277778
3.444444  0.137741  0.166054  0.000000  0.277778
3.500000  0.137741  0.168733  0.000000  0.277778
3.555556  0.137741  0.171411  0.000000  0.277778
3.611111  0.137741  0.174089  0.000000  0.277778
3.666667  0.137741  0.176768  0.000000  0.277778
3.722222  0.137741  0.179446  0.000000  0.277778
3.777778  0.137741  0.182124  0.000000  0.277778
3.833333  0.137741  0.184803  0.000000  0.277778
3.888889  0.137741  0.187481  0.000000  0.277778
3.944444  0.137741  0.190159  0.000000  0.277778
4.000000  0.137741  0.192837  0.000000  0.277778
4.055556  0.137741  0.195516  0.000000  0.277778
4.111111  0.137741  0.198194  0.000000  0.277778
4.166667  0.137741  0.200872  0.000000  0.277778
4.222222  0.137741  0.203551  0.000000  0.277778
4.277778  0.137741  0.206229  0.000000  0.277778
4.333333  0.137741  0.208907  0.000000  0.277778
4.388889  0.137741  0.211586  0.000000  0.277778
4.444444  0.137741  0.214264  0.000000  0.277778
4.500000  0.137741  0.216942  0.000000  0.277778
4.555556  0.137741  0.219620  0.277796  0.277778
4.611111  0.137741  0.222299  0.784769  0.277778
4.666667  0.137741  0.224977  1.438492  0.277778
4.722222  0.137741  0.227655  2.205262  0.277778
4.777778  0.137741  0.230334  3.059929  0.277778
4.833333  0.137741  0.233012  3.979211  0.277778
4.888889  0.137741  0.235690  4.939668  0.277778
4.944444  0.137741  0.238369  5.917238  0.277778
5.000000  0.137741  0.241047  6.887532  0.277778
5.055556  0.137741  0.248699  7.826549  0.277778
END FTABLE  5
FTABLE      6
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.028696  0.000000  0.000000  0.000000
0.055556  0.028696  0.000558  0.000000  0.057870
0.111111  0.028696  0.001116  0.000000  0.057870
0.166667  0.028696  0.001674  0.000000  0.057870
0.222222  0.028696  0.002232  0.000000  0.057870
0.277778  0.028696  0.002790  0.000000  0.057870
0.333333  0.028696  0.003348  0.000000  0.057870
0.388889  0.028696  0.003906  0.000000  0.057870
0.444444  0.028696  0.004464  0.000000  0.057870
0.500000  0.028696  0.005022  0.000000  0.057870
0.555556  0.028696  0.005580  0.000000  0.057870
0.611111  0.028696  0.006138  0.000000  0.057870
0.666667  0.028696  0.006696  0.000000  0.057870
0.722222  0.028696  0.007254  0.000000  0.057870
0.777778  0.028696  0.007812  0.000000  0.057870
0.833333  0.028696  0.008370  0.000000  0.057870
0.888889  0.028696  0.008928  0.000000  0.057870
0.944444  0.028696  0.009486  0.000000  0.057870
1.000000  0.028696  0.010044  0.000000  0.057870
1.055556  0.028696  0.010602  0.000000  0.057870
1.111111  0.028696  0.011160  0.000000  0.057870
1.166667  0.028696  0.011718  0.000000  0.057870
1.222222  0.028696  0.012276  0.000000  0.057870
1.277778  0.028696  0.012834  0.000000  0.057870
1.333333  0.028696  0.013391  0.000000  0.057870
1.388889  0.028696  0.013949  0.000000  0.057870
```

```
  1.444444  0.028696  0.014507  0.000000  0.057870
  1.500000  0.028696  0.015065  0.000000  0.057870
  1.555556  0.028696  0.015623  0.000000  0.057870
  1.611111  0.028696  0.016181  0.000000  0.057870
  1.666667  0.028696  0.016739  0.000000  0.057870
  1.722222  0.028696  0.017297  0.000000  0.057870
  1.777778  0.028696  0.017855  0.000000  0.057870
  1.833333  0.028696  0.018413  0.000000  0.057870
  1.888889  0.028696  0.018971  0.000000  0.057870
  1.944444  0.028696  0.019529  0.000000  0.057870
  2.000000  0.028696  0.020087  0.000000  0.057870
  2.055556  0.028696  0.020645  0.000000  0.057870
  2.111111  0.028696  0.021203  0.000000  0.057870
  2.166667  0.028696  0.021761  0.000000  0.057870
  2.222222  0.028696  0.022319  0.000000  0.057870
  2.277778  0.028696  0.022877  0.000000  0.057870
  2.333333  0.028696  0.023435  0.000000  0.057870
  2.388889  0.028696  0.023993  0.000000  0.057870
  2.444444  0.028696  0.024551  0.000000  0.057870
  2.500000  0.028696  0.025109  0.000000  0.057870
  2.555556  0.028696  0.025667  0.000000  0.057870
  2.611111  0.028696  0.026225  0.000000  0.057870
  2.666667  0.028696  0.026783  0.000000  0.057870
  2.722222  0.028696  0.027341  0.000000  0.057870
  2.777778  0.028696  0.027899  0.000000  0.057870
  2.833333  0.028696  0.028457  0.000000  0.057870
  2.888889  0.028696  0.029015  0.000000  0.057870
  2.944444  0.028696  0.029573  0.000000  0.057870
  3.000000  0.028696  0.030131  0.000000  0.057870
  3.055556  0.028696  0.030689  0.138729  0.057870
  3.111111  0.028696  0.031247  0.389839  0.057870
  3.166667  0.028696  0.031805  0.703432  0.057870
  3.222222  0.028696  0.032363  1.046030  0.057870
  3.277778  0.028696  0.032921  1.383552  0.057870
  3.333333  0.028696  0.033479  1.683468  0.057870
  3.388889  0.028696  0.034037  1.921105  0.057870
  3.444444  0.028696  0.034595  2.088233  0.057870
  3.500000  0.028696  0.035153  2.203335  0.057870
  3.555556  0.028696  0.035711  2.347596  0.057870
  3.611111  0.028696  0.036269  2.462179  0.057870
  3.666667  0.028696  0.036827  2.571662  0.057870
  3.722222  0.028696  0.037385  2.676671  0.057870
  3.777778  0.028696  0.037943  2.777713  0.057870
  3.833333  0.028696  0.038501  2.875206  0.057870
  3.888889  0.028696  0.039059  2.969500  0.057870
  3.944444  0.028696  0.039616  3.060890  0.057870
  4.000000  0.028696  0.040174  3.149630  0.057870
  4.055556  0.028696  0.040732  3.235937  0.057870
  4.111111  0.028696  0.041290  3.320002  0.057870
  4.166667  0.028696  0.041848  3.401989  0.057870
  4.222222  0.028696  0.042406  3.482047  0.057870
  4.277778  0.028696  0.042964  3.560305  0.057870
  4.333333  0.028696  0.043522  3.636879  0.057870
  4.388889  0.028696  0.044080  3.711875  0.057870
  4.444444  0.028696  0.044638  3.785384  0.057870
  4.500000  0.028696  0.045196  3.857493  0.057870
  4.555556  0.028696  0.045754  3.928279  0.057870
  4.611111  0.028696  0.046312  3.997811  0.057870
  4.666667  0.028696  0.046870  4.066155  0.057870
  4.722222  0.028696  0.047428  4.133369  0.057870
  4.777778  0.028696  0.047986  4.199507  0.057870
  4.833333  0.028696  0.048544  4.264619  0.057870
  4.888889  0.028696  0.049102  4.328752  0.057870
  4.944444  0.028696  0.049660  4.391949  0.057870
  5.000000  0.028696  0.050218  4.454250  0.057870
  5.055556  0.028696  0.051812  4.515690  0.057870
  END FTABLE  6
END FTABLES

EXT SOURCES
```

```
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1.429          RCHRES   1     EXTNL  PREC
WDM      2 PREC     ENGL    1.429          RCHRES   3     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   2     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.5            RCHRES   3     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   4     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   5 HYDR   RO     1 1        1      WDM   1004 FLOW     ENGL      REPL
RCHRES   5 HYDR   O      1 1        1      WDM   1005 FLOW     ENGL      REPL
RCHRES   5 HYDR   O      2 1        1      WDM   1006 FLOW     ENGL      REPL
RCHRES   5 HYDR   STAGE  1 1        1      WDM   1007 STAG     ENGL      REPL
COPY     2 OUTPUT MEAN   1 1     48.4      WDM    702 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    802 FLOW     ENGL      REPL
COPY   602 OUTPUT MEAN   1 1     48.4      WDM    902 FLOW     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
RCHRES   6 HYDR   RO     1 1        1      WDM   1014 FLOW     ENGL      REPL
RCHRES   6 HYDR   O      1 1        1      WDM   1015 FLOW     ENGL      REPL
RCHRES   6 HYDR   O      2 1        1      WDM   1016 FLOW     ENGL      REPL
RCHRES   6 HYDR   STAGE  1 1        1      WDM   1017 STAG     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>             <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Mitigated HSPF Message File

Disclaimer

Legal Notice

This program and accompanying documentation are provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc. be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions Inc. or their authorized representatives have been advised of the possibility of such damages. Software Copyright © by : Clear Creek Solutions, Inc. 2005-2025; All Rights Reserved.

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: 18591_Node B

Site Name:	LOTC
Site Address:	
City:	Castle Rock, WA
Report Date:	1/21/2025
Gage:	Longview
Data Start:	1955/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.429
Version Date:	2024/06/28
Version:	4.3.1

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year
Low Flow Threshold for POC2:	50 Percent of the 2 Year
High Flow Threshold for POC2:	50 Year

Landuse Basin Data
Predeveloped Land Use

Node A - Existing Public

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Forest, Mod	0.341
Pervious Total	0.341

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.341

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 1	POC 1	

Node A - Existng C/F

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Mod	8.921
Pervious Total	8.921
Impervious Land Use	acre
Impervious Total	0
Basin Total	8.921

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 2	POC 2

Mitigated Land Use

Node B - Public PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	0.25
Impervious Total	0.25
Basin Total	0.25

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Surface Bioretention	Surface Bioretention	

Node B - Subdivision PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	2.176
Impervious Total	2.176
Basin Total	2.176

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Surface Bioretention	Surface Bioretention

Node B - Public Non-PGIS

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Mod	0.091
Pervious Total	0.091
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.091

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 1	POC 1

Node B - Subdivision Non-PGIS

Bypass:	Yes
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Mod	4.645
Pervious Total	4.645

Impervious Land Use	acre
ROOF TOPS FLAT	2.1
Impervious Total	2.1
Basin Total	6.745

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 2	POC 2	

Mitigated Routing

Road Bioretention

Bottom Length:	40.00 ft.
Bottom Width:	5.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	1.5
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	1
Orifice Diameter (in.):	12
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	57.121
Total Outflow (ac-ft.):	60.09
Percent Through Underdrain:	95.06
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	
Gravel Trench Bed 1	

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0046	0.0000	0.0000	0.0000
0.0440	0.0046	0.0001	0.0000	0.0000
0.0879	0.0046	0.0002	0.0000	0.0000
0.1319	0.0046	0.0003	0.0000	0.0000
0.1758	0.0046	0.0004	0.0000	0.0000
0.2198	0.0046	0.0005	0.0001	0.0000
0.2637	0.0046	0.0006	0.0002	0.0000
0.3077	0.0046	0.0006	0.0003	0.0000
0.3516	0.0046	0.0007	0.0005	0.0000
0.3956	0.0046	0.0008	0.0007	0.0000
0.4396	0.0046	0.0009	0.0009	0.0000
0.4835	0.0046	0.0010	0.0012	0.0000
0.5275	0.0046	0.0011	0.0014	0.0000
0.5714	0.0046	0.0012	0.0015	0.0000
0.6154	0.0046	0.0013	0.0018	0.0000
0.6593	0.0046	0.0014	0.0022	0.0000
0.7033	0.0046	0.0015	0.0027	0.0000
0.7473	0.0046	0.0016	0.0032	0.0000
0.7912	0.0046	0.0017	0.0035	0.0000
0.8352	0.0046	0.0018	0.0038	0.0000
0.8791	0.0046	0.0018	0.0044	0.0000
0.9231	0.0046	0.0019	0.0051	0.0000
0.9670	0.0046	0.0020	0.0059	0.0000
1.0110	0.0046	0.0021	0.0067	0.0000
1.0549	0.0046	0.0022	0.0067	0.0000
1.0989	0.0046	0.0023	0.0076	0.0000
1.1429	0.0046	0.0024	0.0086	0.0000
1.1868	0.0046	0.0025	0.0096	0.0000

1.2308	0.0046	0.0026	0.0107	0.0000
1.2747	0.0046	0.0027	0.0112	0.0000
1.3187	0.0046	0.0028	0.0118	0.0000
1.3626	0.0046	0.0029	0.0131	0.0000
1.4066	0.0046	0.0030	0.0144	0.0000
1.4505	0.0046	0.0030	0.0158	0.0000
1.4945	0.0046	0.0031	0.0171	0.0000
1.5385	0.0046	0.0032	0.0173	0.0000
1.5824	0.0046	0.0033	0.0188	0.0000
1.6264	0.0046	0.0034	0.0204	0.0000
1.6703	0.0046	0.0035	0.0221	0.0000
1.7143	0.0046	0.0036	0.0239	0.0000
1.7582	0.0046	0.0036	0.0246	0.0000
1.8022	0.0046	0.0037	0.0257	0.0000
1.8462	0.0046	0.0038	0.0276	0.0000
1.8901	0.0046	0.0039	0.0370	0.0000
1.9341	0.0046	0.0040	0.0370	0.0000
1.9780	0.0046	0.0041	0.0370	0.0000
2.0220	0.0046	0.0041	0.0370	0.0000
2.0659	0.0046	0.0042	0.0370	0.0000
2.1099	0.0046	0.0043	0.0370	0.0000
2.1538	0.0046	0.0044	0.0370	0.0000
2.1978	0.0046	0.0045	0.0370	0.0000
2.2418	0.0046	0.0046	0.0370	0.0000
2.2857	0.0046	0.0046	0.0370	0.0000
2.3297	0.0046	0.0047	0.0370	0.0000
2.3736	0.0046	0.0048	0.0370	0.0000
2.4176	0.0046	0.0049	0.0370	0.0000
2.4615	0.0046	0.0050	0.0370	0.0000
2.5055	0.0046	0.0051	0.0370	0.0000
2.5495	0.0046	0.0051	0.0370	0.0000
2.5934	0.0046	0.0052	0.0370	0.0000
2.6374	0.0046	0.0053	0.0370	0.0000
2.6813	0.0046	0.0054	0.0370	0.0000
2.7253	0.0046	0.0055	0.0370	0.0000
2.7692	0.0046	0.0056	0.0370	0.0000
2.8132	0.0046	0.0057	0.0370	0.0000
2.8571	0.0046	0.0057	0.0370	0.0000
2.9011	0.0046	0.0058	0.0370	0.0000
2.9451	0.0046	0.0059	0.0370	0.0000
2.9890	0.0046	0.0060	0.0370	0.0000
3.0000	0.0046	0.0060	0.0370	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0046	0.0060	0.0000	0.0278	0.0000
3.0440	0.0046	0.0062	0.0000	0.0278	0.0000
3.0879	0.0046	0.0064	0.0000	0.0294	0.0000
3.1319	0.0046	0.0066	0.0000	0.0302	0.0000
3.1758	0.0046	0.0068	0.0000	0.0310	0.0000
3.2198	0.0046	0.0070	0.0000	0.0318	0.0000
3.2637	0.0046	0.0072	0.0000	0.0327	0.0000
3.3077	0.0046	0.0074	0.0000	0.0335	0.0000
3.3516	0.0046	0.0076	0.0000	0.0343	0.0000
3.3956	0.0046	0.0078	0.0000	0.0351	0.0000
3.4396	0.0046	0.0080	0.0000	0.0359	0.0000
3.4835	0.0046	0.0082	0.0000	0.0367	0.0000
3.5275	0.0046	0.0084	0.0483	0.0370	0.0000

3.5714	0.0046	0.0086	0.2020	0.0370	0.0000
3.6154	0.0046	0.0088	0.4122	0.0370	0.0000
3.6593	0.0046	0.0090	0.6597	0.0370	0.0000
3.7033	0.0046	0.0092	0.9282	0.0370	0.0000
3.7473	0.0046	0.0094	1.2008	0.0370	0.0000
3.7912	0.0046	0.0096	1.4606	0.0370	0.0000
3.8352	0.0046	0.0098	1.6924	0.0370	0.0000
3.8791	0.0046	0.0100	1.8845	0.0370	0.0000
3.9231	0.0046	0.0102	2.0318	0.0370	0.0000
3.9670	0.0046	0.0104	2.1391	0.0370	0.0000
4.0000	0.0046	0.0106	2.2515	0.0370	0.0000

Subdivision Bioretention

Bottom Length:	270.00 ft.
Bottom Width:	5.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	1.5
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	1
Orifice Diameter (in.):	12
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	477.621
Total Outflow (ac-ft.):	521.954
Percent Through Underdrain:	91.51
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	
Gravel Trench Bed 1	

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0310	0.0000	0.0000	0.0000
0.0440	0.0310	0.0006	0.0000	0.0000
0.0879	0.0310	0.0012	0.0000	0.0000
0.1319	0.0310	0.0019	0.0000	0.0000
0.1758	0.0310	0.0025	0.0000	0.0000
0.2198	0.0310	0.0031	0.0009	0.0000
0.2637	0.0310	0.0037	0.0014	0.0000
0.3077	0.0310	0.0044	0.0022	0.0000
0.3516	0.0310	0.0050	0.0032	0.0000
0.3956	0.0310	0.0056	0.0045	0.0000
0.4396	0.0310	0.0062	0.0060	0.0000
0.4835	0.0310	0.0069	0.0078	0.0000
0.5275	0.0310	0.0075	0.0097	0.0000
0.5714	0.0310	0.0081	0.0100	0.0000
0.6154	0.0310	0.0087	0.0124	0.0000
0.6593	0.0310	0.0093	0.0152	0.0000
0.7033	0.0310	0.0100	0.0183	0.0000
0.7473	0.0310	0.0106	0.0218	0.0000
0.7912	0.0310	0.0112	0.0235	0.0000
0.8352	0.0310	0.0118	0.0257	0.0000
0.8791	0.0310	0.0125	0.0300	0.0000
0.9231	0.0310	0.0131	0.0347	0.0000
0.9670	0.0310	0.0137	0.0398	0.0000
1.0110	0.0310	0.0143	0.0450	0.0000
1.0549	0.0310	0.0150	0.0454	0.0000
1.0989	0.0310	0.0156	0.0513	0.0000
1.1429	0.0310	0.0162	0.0578	0.0000
1.1868	0.0310	0.0168	0.0647	0.0000
1.2308	0.0310	0.0174	0.0721	0.0000
1.2747	0.0310	0.0181	0.0753	0.0000

1.3187	0.0310	0.0187	0.0799	0.0000
1.3626	0.0310	0.0193	0.0883	0.0000
1.4066	0.0310	0.0199	0.0972	0.0000
1.4505	0.0310	0.0206	0.1066	0.0000
1.4945	0.0310	0.0212	0.1154	0.0000
1.5385	0.0310	0.0217	0.1165	0.0000
1.5824	0.0310	0.0223	0.1269	0.0000
1.6264	0.0310	0.0229	0.1378	0.0000
1.6703	0.0310	0.0234	0.1493	0.0000
1.7143	0.0310	0.0240	0.1613	0.0000
1.7582	0.0310	0.0246	0.1661	0.0000
1.8022	0.0310	0.0251	0.1738	0.0000
1.8462	0.0310	0.0257	0.1864	0.0000
1.8901	0.0310	0.0263	0.2500	0.0000
1.9341	0.0310	0.0268	0.2500	0.0000
1.9780	0.0310	0.0274	0.2500	0.0000
2.0220	0.0310	0.0280	0.2500	0.0000
2.0659	0.0310	0.0285	0.2500	0.0000
2.1099	0.0310	0.0291	0.2500	0.0000
2.1538	0.0310	0.0297	0.2500	0.0000
2.1978	0.0310	0.0302	0.2500	0.0000
2.2418	0.0310	0.0308	0.2500	0.0000
2.2857	0.0310	0.0314	0.2500	0.0000
2.3297	0.0310	0.0319	0.2500	0.0000
2.3736	0.0310	0.0325	0.2500	0.0000
2.4176	0.0310	0.0331	0.2500	0.0000
2.4615	0.0310	0.0336	0.2500	0.0000
2.5055	0.0310	0.0342	0.2500	0.0000
2.5495	0.0310	0.0347	0.2500	0.0000
2.5934	0.0310	0.0353	0.2500	0.0000
2.6374	0.0310	0.0359	0.2500	0.0000
2.6813	0.0310	0.0364	0.2500	0.0000
2.7253	0.0310	0.0370	0.2500	0.0000
2.7692	0.0310	0.0376	0.2500	0.0000
2.8132	0.0310	0.0381	0.2500	0.0000
2.8571	0.0310	0.0387	0.2500	0.0000
2.9011	0.0310	0.0393	0.2500	0.0000
2.9451	0.0310	0.0398	0.2500	0.0000
2.9890	0.0310	0.0404	0.2500	0.0000
3.0000	0.0310	0.0405	0.2500	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0310	0.0405	0.0000	0.1875	0.0000
3.0440	0.0310	0.0419	0.0000	0.1875	0.0000
3.0879	0.0310	0.0433	0.0000	0.1985	0.0000
3.1319	0.0310	0.0446	0.0000	0.2040	0.0000
3.1758	0.0310	0.0460	0.0000	0.2095	0.0000
3.2198	0.0310	0.0474	0.0000	0.2150	0.0000
3.2637	0.0310	0.0487	0.0000	0.2205	0.0000
3.3077	0.0310	0.0501	0.0000	0.2260	0.0000
3.3516	0.0310	0.0514	0.0000	0.2315	0.0000
3.3956	0.0310	0.0528	0.0000	0.2370	0.0000
3.4396	0.0310	0.0542	0.0000	0.2424	0.0000
3.4835	0.0310	0.0555	0.0000	0.2479	0.0000
3.5275	0.0310	0.0569	0.0483	0.2500	0.0000
3.5714	0.0310	0.0583	0.2020	0.2500	0.0000
3.6154	0.0310	0.0596	0.4122	0.2500	0.0000

3.6593	0.0310	0.0610	0.6597	0.2500	0.0000
3.7033	0.0310	0.0623	0.9282	0.2500	0.0000
3.7473	0.0310	0.0637	1.2008	0.2500	0.0000
3.7912	0.0310	0.0651	1.4606	0.2500	0.0000
3.8352	0.0310	0.0664	1.6924	0.2500	0.0000
3.8791	0.0310	0.0678	1.8845	0.2500	0.0000
3.9231	0.0310	0.0692	2.0318	0.2500	0.0000
3.9670	0.0310	0.0705	2.1391	0.2500	0.0000
4.0000	0.0310	0.0715	2.2515	0.2500	0.0000

Gravel Trench Bed 1

Bottom Length:	40.00 ft.
Bottom Width:	5.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	5
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	1
Wetted surface area On	
Total Volume Infiltrated (ac-ft.):	2.156
Total Volume Through Riser (ac-ft.):	0.813
Total Volume Through Facility (ac-ft.):	2.969
Percent Infiltrated:	72.62
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	3 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.004	0.000	0.000	0.000
0.0556	0.004	0.000	0.000	0.009
0.1111	0.004	0.000	0.000	0.009
0.1667	0.004	0.000	0.000	0.009
0.2222	0.004	0.000	0.000	0.009
0.2778	0.004	0.000	0.000	0.009
0.3333	0.004	0.000	0.000	0.009
0.3889	0.004	0.000	0.000	0.009
0.4444	0.004	0.000	0.000	0.009
0.5000	0.004	0.000	0.000	0.009
0.5556	0.004	0.000	0.000	0.009
0.6111	0.004	0.001	0.000	0.009
0.6667	0.004	0.001	0.000	0.009
0.7222	0.004	0.001	0.000	0.009
0.7778	0.004	0.001	0.000	0.009
0.8333	0.004	0.001	0.000	0.009
0.8889	0.004	0.001	0.000	0.009
0.9444	0.004	0.001	0.000	0.009
1.0000	0.004	0.001	0.000	0.009
1.0556	0.004	0.001	0.000	0.009
1.1111	0.004	0.001	0.000	0.009
1.1667	0.004	0.001	0.000	0.009
1.2222	0.004	0.002	0.000	0.009
1.2778	0.004	0.002	0.000	0.009

1.3333	0.004	0.002	0.000	0.009
1.3889	0.004	0.002	0.000	0.009
1.4444	0.004	0.002	0.000	0.009
1.5000	0.004	0.002	0.000	0.009
1.5556	0.004	0.002	0.000	0.009
1.6111	0.004	0.002	0.000	0.009
1.6667	0.004	0.002	0.000	0.009
1.7222	0.004	0.002	0.000	0.009
1.7778	0.004	0.002	0.000	0.009
1.8333	0.004	0.002	0.000	0.009
1.8889	0.004	0.003	0.000	0.009
1.9444	0.004	0.003	0.000	0.009
2.0000	0.004	0.003	0.000	0.009
2.0556	0.004	0.003	0.000	0.009
2.1111	0.004	0.003	0.000	0.009
2.1667	0.004	0.003	0.000	0.009
2.2222	0.004	0.003	0.000	0.009
2.2778	0.004	0.003	0.000	0.009
2.3333	0.004	0.003	0.000	0.009
2.3889	0.004	0.003	0.000	0.009
2.4444	0.004	0.003	0.000	0.009
2.5000	0.004	0.004	0.000	0.009
2.5556	0.004	0.004	0.000	0.009
2.6111	0.004	0.004	0.000	0.009
2.6667	0.004	0.004	0.000	0.009
2.7222	0.004	0.004	0.000	0.009
2.7778	0.004	0.004	0.000	0.009
2.8333	0.004	0.004	0.000	0.009
2.8889	0.004	0.004	0.000	0.009
2.9444	0.004	0.004	0.000	0.009
3.0000	0.004	0.004	0.000	0.009
3.0556	0.004	0.004	0.138	0.009
3.1111	0.004	0.005	0.389	0.009
3.1667	0.004	0.005	0.703	0.009
3.2222	0.004	0.005	1.046	0.009
3.2778	0.004	0.005	1.383	0.009
3.3333	0.004	0.005	1.683	0.009
3.3889	0.004	0.005	1.921	0.009
3.4444	0.004	0.005	2.088	0.009
3.5000	0.004	0.005	2.203	0.009
3.5556	0.004	0.005	2.347	0.009
3.6111	0.004	0.005	2.462	0.009
3.6667	0.004	0.005	2.571	0.009
3.7222	0.004	0.006	2.676	0.009
3.7778	0.004	0.006	2.777	0.009
3.8333	0.004	0.006	2.875	0.009
3.8889	0.004	0.006	2.969	0.009
3.9444	0.004	0.006	3.060	0.009
4.0000	0.004	0.006	3.149	0.009
4.0556	0.004	0.006	3.235	0.009
4.1111	0.004	0.006	3.320	0.009
4.1667	0.004	0.006	3.402	0.009
4.2222	0.004	0.006	3.482	0.009
4.2778	0.004	0.006	3.560	0.009
4.3333	0.004	0.007	3.636	0.009
4.3889	0.004	0.007	3.711	0.009
4.4444	0.004	0.007	3.785	0.009
4.5000	0.004	0.007	3.857	0.009

4.5556	0.004	0.007	3.928	0.009
4.6111	0.004	0.007	3.997	0.009
4.6667	0.004	0.007	4.066	0.009
4.7222	0.004	0.007	4.133	0.009
4.7778	0.004	0.007	4.199	0.009
4.8333	0.004	0.007	4.264	0.009
4.8889	0.004	0.007	4.328	0.009
4.9444	0.004	0.007	4.391	0.009
5.0000	0.004	0.008	4.454	0.009

Gravel Trench Bed 1

Bottom Length:	270.00 ft.
Bottom Width:	5.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	6
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	1
Wetted surface area On	
Total Volume Infiltrated (ac-ft.):	31.896
Total Volume Through Riser (ac-ft.):	12.447
Total Volume Through Facility (ac-ft.):	44.343
Percent Infiltrated:	71.93
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	4 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

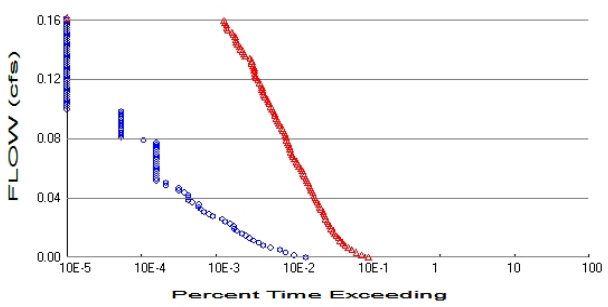
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.031	0.000	0.000	0.000
0.0667	0.031	0.000	0.000	0.062
0.1333	0.031	0.001	0.000	0.062
0.2000	0.031	0.002	0.000	0.062
0.2667	0.031	0.002	0.000	0.062
0.3333	0.031	0.003	0.000	0.062
0.4000	0.031	0.004	0.000	0.062
0.4667	0.031	0.005	0.000	0.062
0.5333	0.031	0.005	0.000	0.062
0.6000	0.031	0.006	0.000	0.062
0.6667	0.031	0.007	0.000	0.062
0.7333	0.031	0.008	0.000	0.062
0.8000	0.031	0.008	0.000	0.062
0.8667	0.031	0.009	0.000	0.062
0.9333	0.031	0.010	0.000	0.062
1.0000	0.031	0.010	0.000	0.062
1.0667	0.031	0.011	0.000	0.062
1.1333	0.031	0.012	0.000	0.062
1.2000	0.031	0.013	0.000	0.062
1.2667	0.031	0.013	0.000	0.062
1.3333	0.031	0.014	0.000	0.062
1.4000	0.031	0.015	0.000	0.062
1.4667	0.031	0.015	0.000	0.062
1.5333	0.031	0.016	0.000	0.062

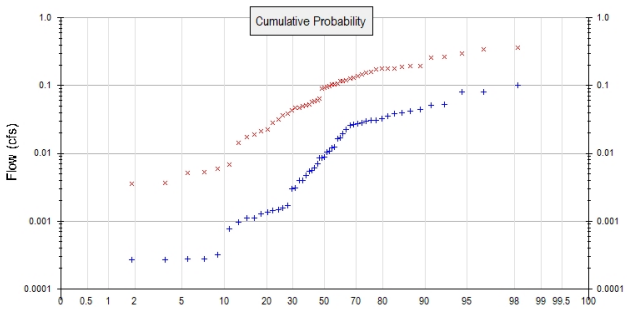
1.6000	0.031	0.017	0.000	0.062
1.6667	0.031	0.018	0.000	0.062
1.7333	0.031	0.018	0.000	0.062
1.8000	0.031	0.019	0.000	0.062
1.8667	0.031	0.020	0.000	0.062
1.9333	0.031	0.021	0.000	0.062
2.0000	0.031	0.021	0.000	0.062
2.0667	0.031	0.022	0.000	0.062
2.1333	0.031	0.023	0.000	0.062
2.2000	0.031	0.023	0.000	0.062
2.2667	0.031	0.024	0.000	0.062
2.3333	0.031	0.025	0.000	0.062
2.4000	0.031	0.026	0.000	0.062
2.4667	0.031	0.026	0.000	0.062
2.5333	0.031	0.027	0.000	0.062
2.6000	0.031	0.028	0.000	0.062
2.6667	0.031	0.028	0.000	0.062
2.7333	0.031	0.029	0.000	0.062
2.8000	0.031	0.030	0.000	0.062
2.8667	0.031	0.031	0.000	0.062
2.9333	0.031	0.031	0.000	0.062
3.0000	0.031	0.032	0.000	0.062
3.0667	0.031	0.033	0.000	0.062
3.1333	0.031	0.034	0.000	0.062
3.2000	0.031	0.034	0.000	0.062
3.2667	0.031	0.035	0.000	0.062
3.3333	0.031	0.036	0.000	0.062
3.4000	0.031	0.036	0.000	0.062
3.4667	0.031	0.037	0.000	0.062
3.5333	0.031	0.038	0.000	0.062
3.6000	0.031	0.039	0.000	0.062
3.6667	0.031	0.039	0.000	0.062
3.7333	0.031	0.040	0.000	0.062
3.8000	0.031	0.041	0.000	0.062
3.8667	0.031	0.041	0.000	0.062
3.9333	0.031	0.042	0.000	0.062
4.0000	0.031	0.043	0.000	0.062
4.0667	0.031	0.044	0.182	0.062
4.1333	0.031	0.044	0.509	0.062
4.2000	0.031	0.045	0.907	0.062
4.2667	0.031	0.046	1.318	0.062
4.3333	0.031	0.047	1.683	0.062
4.4000	0.031	0.047	1.960	0.062
4.4667	0.031	0.048	2.138	0.062
4.5333	0.031	0.049	2.300	0.062
4.6000	0.031	0.049	2.439	0.062
4.6667	0.031	0.050	2.571	0.062
4.7333	0.031	0.051	2.697	0.062
4.8000	0.031	0.052	2.817	0.062
4.8667	0.031	0.052	2.932	0.062
4.9333	0.031	0.053	3.042	0.062
5.0000	0.031	0.054	3.149	0.062
5.0667	0.031	0.055	3.252	0.062
5.1333	0.031	0.055	3.353	0.062
5.2000	0.031	0.056	3.450	0.062
5.2667	0.031	0.057	3.544	0.062
5.3333	0.031	0.057	3.636	0.062
5.4000	0.031	0.058	3.726	0.062

5.4667	0.031	0.059	3.814	0.062
5.5333	0.031	0.060	3.900	0.062
5.6000	0.031	0.060	3.984	0.062
5.6667	0.031	0.061	4.066	0.062
5.7333	0.031	0.062	4.146	0.062
5.8000	0.031	0.062	4.225	0.062
5.8667	0.031	0.063	4.303	0.062
5.9333	0.031	0.064	4.379	0.062
6.0000	0.031	0.065	4.454	0.062

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.341
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.091
Total Impervious Area: 0.25

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.007507
5 year	0.029412
10 year	0.056407
25 year	0.107905
50 year	0.160105
100 year	0.224695

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.070579
5 year	0.199326
10 year	0.302374
25 year	0.433258
50 year	0.524072
100 year	0.606271

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	0.053	0.196
1957	0.005	0.176
1958	0.081	0.196
1959	0.019	0.099
1960	0.081	0.191
1961	0.039	0.120
1962	0.100	0.145
1963	0.030	0.266
1964	0.017	0.117
1965	0.009	0.019

1966	0.001	0.004
1967	0.004	0.061
1968	0.001	0.047
1969	0.004	0.022
1970	0.006	0.014
1971	0.036	0.053
1972	0.027	0.089
1973	0.001	0.064
1974	0.038	0.126
1975	0.041	0.180
1976	0.022	0.031
1977	0.000	0.006
1978	0.045	0.158
1979	0.001	0.058
1980	0.003	0.047
1981	0.005	0.049
1982	0.026	0.104
1983	0.011	0.096
1984	0.033	0.117
1985	0.001	0.051
1986	0.030	0.177
1987	0.002	0.129
1988	0.000	0.036
1989	0.001	0.005
1990	0.012	0.092
1991	0.028	0.028
1992	0.001	0.007
1993	0.007	0.018
1994	0.006	0.005
1995	0.002	0.153
1996	0.051	0.257
1997	0.012	0.108
1998	0.010	0.338
1999	0.001	0.021
2000	0.003	0.059
2001	0.000	0.000
2002	0.009	0.362
2003	0.000	0.295
2004	0.000	0.004
2005	0.000	0.043
2006	0.017	0.039
2007	0.028	0.179
2008	0.009	0.104
2009	0.030	0.139

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1002	0.3619
2	0.0813	0.3384
3	0.0807	0.2950
4	0.0530	0.2656
5	0.0509	0.2572
6	0.0450	0.1964
7	0.0415	0.1962
8	0.0393	0.1911
9	0.0385	0.1800
10	0.0359	0.1785

11	0.0326	0.1766
12	0.0305	0.1756
13	0.0304	0.1579
14	0.0295	0.1533
15	0.0281	0.1451
16	0.0276	0.1390
17	0.0267	0.1287
18	0.0262	0.1257
19	0.0224	0.1196
20	0.0194	0.1172
21	0.0167	0.1170
22	0.0166	0.1080
23	0.0123	0.1038
24	0.0119	0.1037
25	0.0107	0.0988
26	0.0104	0.0958
27	0.0088	0.0921
28	0.0086	0.0891
29	0.0085	0.0637
30	0.0071	0.0613
31	0.0061	0.0591
32	0.0056	0.0580
33	0.0054	0.0532
34	0.0048	0.0508
35	0.0040	0.0493
36	0.0039	0.0475
37	0.0031	0.0469
38	0.0030	0.0434
39	0.0017	0.0390
40	0.0016	0.0359
41	0.0015	0.0312
42	0.0014	0.0283
43	0.0013	0.0224
44	0.0013	0.0210
45	0.0011	0.0190
46	0.0011	0.0176
47	0.0010	0.0144
48	0.0008	0.0068
49	0.0003	0.0059
50	0.0003	0.0052
51	0.0003	0.0052
52	0.0003	0.0037
53	0.0003	0.0036
54	0.0002	0.0001

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0038	300	2071	690	Fail
0.0053	207	1685	814	Fail
0.0069	161	1438	893	Fail
0.0085	135	1246	922	Fail
0.0101	100	1109	1109	Fail
0.0117	81	1022	1261	Fail
0.0132	70	949	1355	Fail
0.0148	60	875	1458	Fail
0.0164	52	823	1582	Fail
0.0180	47	772	1642	Fail
0.0195	42	730	1738	Fail
0.0211	36	702	1950	Fail
0.0227	33	667	2021	Fail
0.0243	32	633	1978	Fail
0.0259	29	607	2093	Fail
0.0274	25	587	2348	Fail
0.0290	23	562	2443	Fail
0.0306	17	543	3194	Fail
0.0322	15	526	3506	Fail
0.0338	13	513	3946	Fail
0.0353	12	485	4041	Fail
0.0369	11	471	4281	Fail
0.0385	11	449	4081	Fail
0.0401	9	427	4744	Fail
0.0417	8	412	5150	Fail
0.0432	8	400	5000	Fail
0.0448	8	387	4837	Fail
0.0464	7	375	5357	Fail
0.0480	6	357	5950	Fail
0.0496	6	350	5833	Fail
0.0511	4	335	8375	Fail
0.0527	4	322	8050	Fail
0.0543	3	311	10366	Fail
0.0559	3	303	10100	Fail
0.0574	3	287	9566	Fail
0.0590	3	280	9333	Fail
0.0606	3	270	9000	Fail
0.0622	3	258	8600	Fail
0.0638	3	244	8133	Fail
0.0653	3	233	7766	Fail
0.0669	3	226	7533	Fail
0.0685	3	210	7000	Fail
0.0701	3	200	6666	Fail
0.0717	3	196	6533	Fail
0.0732	3	190	6333	Fail
0.0748	3	185	6166	Fail
0.0764	3	182	6066	Fail
0.0780	3	177	5900	Fail
0.0796	3	173	5766	Fail
0.0811	2	167	8350	Fail
0.0827	1	164	16400	Fail
0.0843	1	160	16000	Fail
0.0859	1	157	15700	Fail
0.0875	1	150	15000	Fail

0.0890	1	145	14500	Fail
0.0906	1	136	13600	Fail
0.0922	1	131	13100	Fail
0.0938	1	127	12700	Fail
0.0954	1	121	12100	Fail
0.0969	1	116	11600	Fail
0.0985	1	116	11600	Fail
0.1001	1	112	11200	Fail
0.1017	0	107	n/a	Fail
0.1032	0	103	n/a	Fail
0.1048	0	97	n/a	Fail
0.1064	0	95	n/a	Fail
0.1080	0	92	n/a	Fail
0.1096	0	87	n/a	Fail
0.1111	0	82	n/a	Fail
0.1127	0	80	n/a	Fail
0.1143	0	78	n/a	Fail
0.1159	0	78	n/a	Fail
0.1175	0	76	n/a	Fail
0.1190	0	73	n/a	Fail
0.1206	0	69	n/a	Fail
0.1222	0	64	n/a	Fail
0.1238	0	63	n/a	Fail
0.1254	0	62	n/a	Fail
0.1269	0	61	n/a	Fail
0.1285	0	61	n/a	Fail
0.1301	0	59	n/a	Fail
0.1317	0	57	n/a	Fail
0.1333	0	57	n/a	Fail
0.1348	0	54	n/a	Fail
0.1364	0	46	n/a	Fail
0.1380	0	45	n/a	Fail
0.1396	0	43	n/a	Fail
0.1412	0	40	n/a	Fail
0.1427	0	39	n/a	Fail
0.1443	0	36	n/a	Fail
0.1459	0	35	n/a	Fail
0.1475	0	35	n/a	Fail
0.1490	0	34	n/a	Fail
0.1506	0	32	n/a	Fail
0.1522	0	31	n/a	Fail
0.1538	0	27	n/a	Fail
0.1554	0	26	n/a	Fail
0.1569	0	26	n/a	Fail
0.1585	0	25	n/a	Fail
0.1601	0	24	n/a	Fail

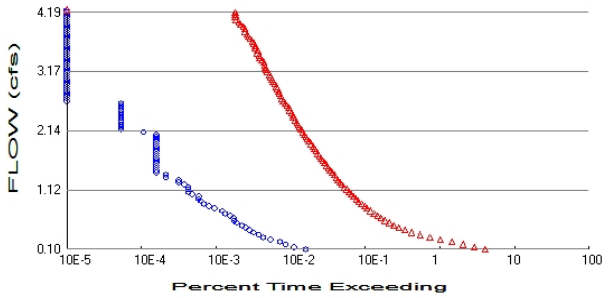
The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

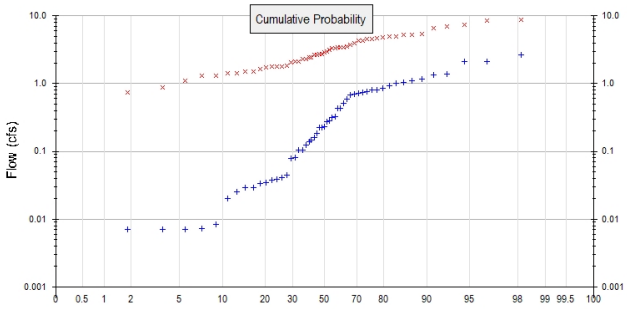
Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

POC 2





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 8.921
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2
Total Pervious Area: 4.645
Total Impervious Area: 4.276

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.196403
5 year	0.769448
10 year	1.475668
25 year	2.822928
50 year	4.188567
100 year	5.878319

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	2.868293
5 year	4.69185
10 year	5.932872
25 year	7.49532
50 year	8.640685
100 year	9.763214

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	**Predeveloped**	**Mitigated**
1956	1.386	5.348
1957	0.141	4.555
1958	2.128	4.802
1959	0.506	2.689
1960	2.111	5.210
1961	1.027	3.955
1962	2.621	4.530
1963	0.772	6.990
1964	0.433	3.370
1965	0.230	1.660
1966	0.029	1.497

1967	0.105	1.822
1968	0.020	1.439
1969	0.103	2.452
1970	0.147	1.738
1971	0.939	3.457
1972	0.698	2.448
1973	0.033	1.764
1974	1.007	4.317
1975	1.085	7.386
1976	0.586	3.305
1977	0.007	1.402
1978	1.177	4.325
1979	0.038	1.778
1980	0.078	2.286
1981	0.125	2.129
1982	0.685	3.376
1983	0.280	3.102
1984	0.854	3.385
1985	0.025	1.515
1986	0.796	4.936
1987	0.041	3.473
1988	0.008	2.117
1989	0.029	0.888
1990	0.312	2.615
1991	0.736	2.900
1992	0.038	1.318
1993	0.186	2.076
1994	0.161	1.110
1995	0.044	5.305
1996	1.331	6.563
1997	0.322	2.997
1998	0.273	8.364
1999	0.035	1.293
2000	0.080	2.319
2001	0.006	0.436
2002	0.224	8.813
2003	0.007	4.955
2004	0.007	0.737
2005	0.007	1.774
2006	0.437	2.765
2007	0.722	4.680
2008	0.223	2.746
2009	0.797	3.732

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	2.6209	8.8125
2	2.1275	8.3638
3	2.1106	7.3857
4	1.3857	6.9896
5	1.3312	6.5631
6	1.1770	5.3481
7	1.0854	5.3052
8	1.0275	5.2096
9	1.0070	4.9547
10	0.9390	4.9359
11	0.8536	4.8018

12	0.7972	4.6799
13	0.7962	4.5549
14	0.7719	4.5303
15	0.7358	4.3252
16	0.7224	4.3172
17	0.6975	3.9553
18	0.6848	3.7317
19	0.5862	3.4734
20	0.5064	3.4571
21	0.4371	3.3854
22	0.4334	3.3764
23	0.3224	3.3704
24	0.3116	3.3051
25	0.2799	3.1021
26	0.2728	2.9973
27	0.2299	2.8999
28	0.2244	2.7653
29	0.2229	2.7457
30	0.1855	2.6888
31	0.1607	2.6153
32	0.1466	2.4515
33	0.1406	2.4484
34	0.1249	2.3191
35	0.1050	2.2856
36	0.1033	2.1292
37	0.0804	2.1169
38	0.0784	2.0765
39	0.0444	1.8221
40	0.0408	1.7776
41	0.0384	1.7736
42	0.0376	1.7640
43	0.0349	1.7380
44	0.0332	1.6603
45	0.0294	1.5147
46	0.0288	1.4970
47	0.0255	1.4394
48	0.0201	1.4024
49	0.0083	1.3182
50	0.0072	1.2933
51	0.0071	1.1102
52	0.0071	0.8885
53	0.0071	0.7370
54	0.0064	0.4364

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0982	300	76687	25562	Fail
0.1395	207	54457	26307	Fail
0.1808	161	38646	24003	Fail
0.2222	135	27229	20169	Fail
0.2635	100	19257	19257	Fail
0.3048	81	13932	17200	Fail
0.3461	70	10282	14688	Fail
0.3874	60	7864	13106	Fail
0.4287	52	6415	12336	Fail
0.4701	47	5328	11336	Fail
0.5114	42	4565	10869	Fail
0.5527	36	3984	11066	Fail
0.5940	33	3475	10530	Fail
0.6353	32	3062	9568	Fail
0.6766	29	2772	9558	Fail
0.7180	25	2465	9860	Fail
0.7593	23	2212	9617	Fail
0.8006	18	1986	11033	Fail
0.8419	15	1842	12280	Fail
0.8832	13	1684	12953	Fail
0.9245	12	1544	12866	Fail
0.9659	11	1433	13027	Fail
1.0072	11	1313	11936	Fail
1.0485	9	1228	13644	Fail
1.0898	8	1147	14337	Fail
1.1311	8	1065	13312	Fail
1.1724	8	983	12287	Fail
1.2138	7	920	13142	Fail
1.2551	6	862	14366	Fail
1.2964	6	810	13500	Fail
1.3377	4	770	19250	Fail
1.3790	4	727	18175	Fail
1.4203	3	681	22700	Fail
1.4617	3	645	21500	Fail
1.5030	3	607	20233	Fail
1.5443	3	569	18966	Fail
1.5856	3	537	17900	Fail
1.6269	3	508	16933	Fail
1.6682	3	483	16100	Fail
1.7096	3	459	15300	Fail
1.7509	3	437	14566	Fail
1.7922	3	414	13800	Fail
1.8335	3	394	13133	Fail
1.8748	3	376	12533	Fail
1.9161	3	354	11800	Fail
1.9575	3	333	11100	Fail
1.9988	3	315	10500	Fail
2.0401	3	304	10133	Fail
2.0814	3	285	9500	Fail
2.1227	2	275	13750	Fail
2.1640	1	260	26000	Fail
2.2054	1	247	24700	Fail
2.2467	1	238	23800	Fail
2.2880	1	230	23000	Fail

2.3293	1	214	21400	Fail
2.3706	1	205	20500	Fail
2.4119	1	202	20200	Fail
2.4533	1	193	19300	Fail
2.4946	1	183	18300	Fail
2.5359	1	178	17800	Fail
2.5772	1	168	16800	Fail
2.6185	1	159	15900	Fail
2.6598	0	150	n/a	Fail
2.7012	0	143	n/a	Fail
2.7425	0	138	n/a	Fail
2.7838	0	132	n/a	Fail
2.8251	0	129	n/a	Fail
2.8664	0	126	n/a	Fail
2.9077	0	122	n/a	Fail
2.9491	0	116	n/a	Fail
2.9904	0	109	n/a	Fail
3.0317	0	106	n/a	Fail
3.0730	0	103	n/a	Fail
3.1143	0	98	n/a	Fail
3.1556	0	91	n/a	Fail
3.1970	0	88	n/a	Fail
3.2383	0	87	n/a	Fail
3.2796	0	85	n/a	Fail
3.3209	0	83	n/a	Fail
3.3622	0	78	n/a	Fail
3.4035	0	72	n/a	Fail
3.4449	0	72	n/a	Fail
3.4862	0	68	n/a	Fail
3.5275	0	68	n/a	Fail
3.5688	0	63	n/a	Fail
3.6101	0	63	n/a	Fail
3.6514	0	61	n/a	Fail
3.6928	0	58	n/a	Fail
3.7341	0	54	n/a	Fail
3.7754	0	51	n/a	Fail
3.8167	0	49	n/a	Fail
3.8580	0	46	n/a	Fail
3.8993	0	46	n/a	Fail
3.9407	0	44	n/a	Fail
3.9820	0	40	n/a	Fail
4.0233	0	38	n/a	Fail
4.0646	0	35	n/a	Fail
4.1059	0	34	n/a	Fail
4.1473	0	34	n/a	Fail
4.1886	0	34	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #2

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

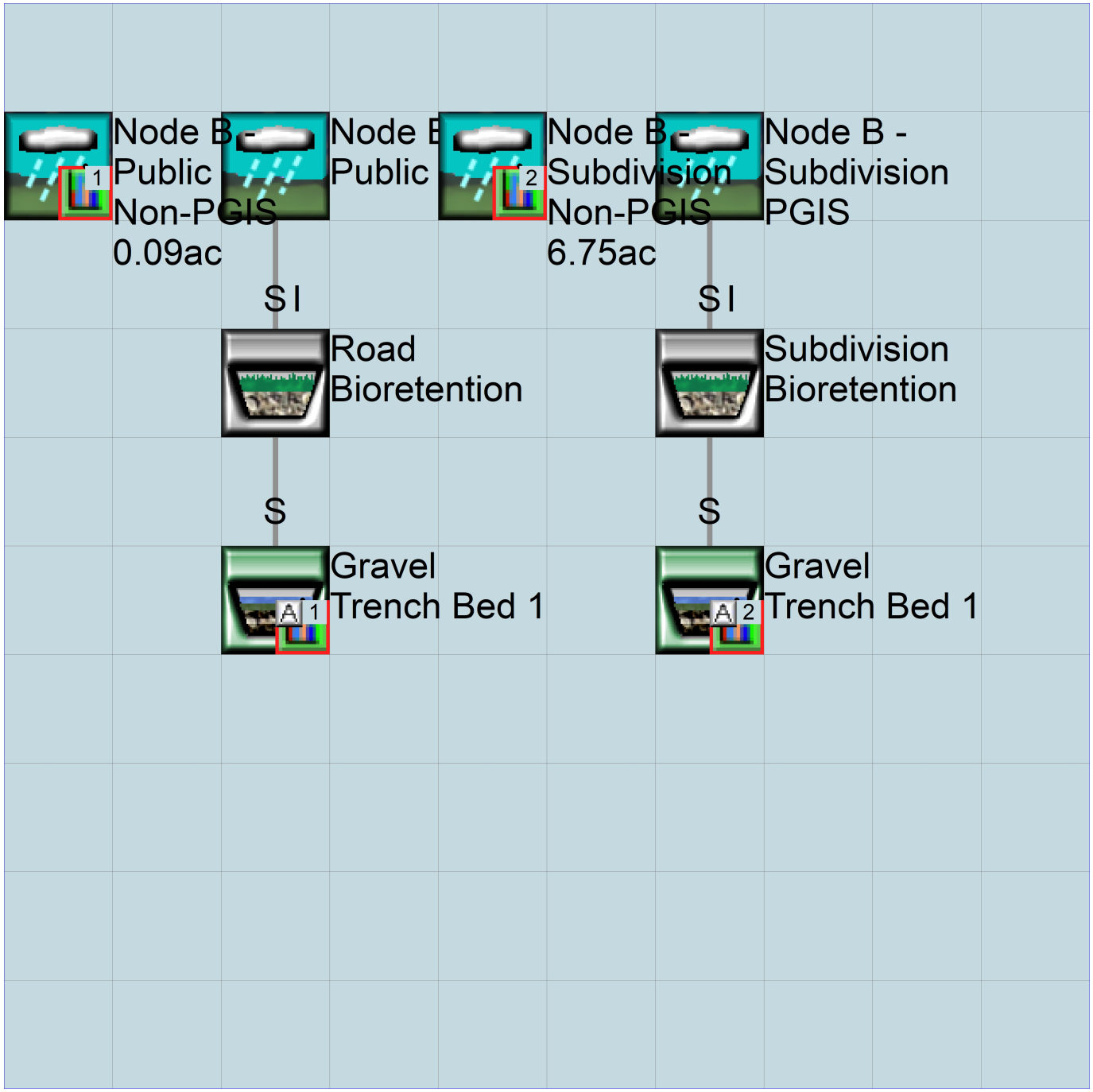
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic

Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node B.wdm
MESSU       25   Pre18591_Node B.MES
            27   Pre18591_Node B.L61
            28   Pre18591_Node B.L62
            30   POC18591_Node B1.dat
            31   POC18591_Node B2.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       2
      COPY       501
      COPY       502
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Node A - Existing Public    MAX                   1    2   30    9
    2        Node A - Existng C/F        MAX                   1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  502         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    2     A/B, Forest, Mod        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    2         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
```

```
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    2         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    2         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    2              0         5         2       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    2              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                 ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    2          0.2       0.5      0.35         0       0.7       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    2              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3
```

```
  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node A - Existing Public***
PERLND   2                       0.341     COPY   501     12
PERLND   2                       0.341     COPY   501     13
Node A - Existng C/F***
PERLND   2                       8.921     COPY   502     12
PERLND   2                       8.921     COPY   502     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                     ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><--->
```

```
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    502 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node B.wdm
MESSU       25   Mit18591_Node B.MES
            27   Mit18591_Node B.L61
            28   Mit18591_Node B.L62
            30   POC18591_Node B1.dat
            31   POC18591_Node B2.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       1
      PERLND       8
      IMPLND       4
      RCHRES       1
      RCHRES       2
      RCHRES       3
      RCHRES       4
      RCHRES       5
      RCHRES       6
      COPY         1
      COPY       501
      COPY       601
      COPY         2
      COPY       502
      COPY       602
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Gravel Trench Bed 1         MAX                    1    2   30    9
    2        Gravel Trench Bed 1         MAX                    1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  601         1    1
    2         1    1
  502         1    1
  602         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
```

```
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                        in  out           ***
    8     A/B, Lawn, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    8         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    8         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    8         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    8              0         5       0.8       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    8              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    8          0.1       0.5      0.25         0       0.7      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS       IFWS       LZS       AGWS      GWVS
    8              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
    4      ROOF TOPS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    4         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
```

```
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    4    1    9
    4         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    4         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    4            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    4              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    4              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node B - Public PGIS***
IMPLND   1                        0.25     RCHRES   1      5
Node B - Subdivision PGIS***
IMPLND   1                       2.176     RCHRES   3      5
Node B - Public Non-PGIS***
PERLND   8                       0.091     COPY   501     12
PERLND   8                       0.091     COPY   601     12
PERLND   8                       0.091     COPY   501     13
PERLND   8                       0.091     COPY   601     13
Node B - Subdivision Non-PGIS***
PERLND   8                       4.645     COPY   502     12
PERLND   8                       4.645     COPY   602     12
PERLND   8                       4.645     COPY   502     13
PERLND   8                       4.645     COPY   602     13
IMPLND   4                         2.1     COPY   502     15
IMPLND   4                         2.1     COPY   602     15

******Routing******
RCHRES   1                           1     RCHRES   5      7
RCHRES   1                                 COPY     1     17
RCHRES   1                           1     RCHRES   2      8
RCHRES   3                           1     RCHRES   6      7
RCHRES   3                                 COPY     2     17
RCHRES   3                           1     RCHRES   4      8
RCHRES   5                           1     COPY   501     17
RCHRES   6                           1     COPY   502     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
```

```
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1


<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                              ***
    1     Surface Bioreten-009    2    1    1    1   28    0    1
    2     Road Bioretentio-008    1    1    1    1   28    0    1
    3     Surface Bioreten-021    2    1    1    1   28    0    1
    4     Subdivision Bior-020    1    1    1    1   28    0    1
    5     Gravel Trench Be-022    2    1    1    1   28    0    1
    6     Gravel Trench Be-023    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
    4         1    0    0    0    0    0    0    0    0    0
    5         1    0    0    0    0    0    0    0    0    0
    6         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
    4         4    0    0    0    0    0    0    0    0    0    1    9
    5         4    0    0    0    0    0    0    0    0    0    1    9
    6         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    2       0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    3       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    4       0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    5       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    6       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------->      ***
    1             1      0.01       0.0       0.0       0.0       0.0
    2             2      0.01       0.0       0.0       0.0       0.0
    3             3      0.01       0.0       0.0       0.0       0.0
    4             4      0.05       0.0       0.0       0.0       0.0
    5             5      0.01       0.0       0.0       0.5       0.0
    6             6      0.05       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                     ***
```

```
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
           *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    4            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    5            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    6            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      2
   70    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.004591  0.000000  0.000000
  0.043956  0.004591  0.000092  0.000000
  0.087912  0.004591  0.000185  0.000000
  0.131868  0.004591  0.000277  0.000000
  0.175824  0.004591  0.000369  0.000000
  0.219780  0.004591  0.000461  0.000127
  0.263736  0.004591  0.000554  0.000213
  0.307692  0.004591  0.000646  0.000329
  0.351648  0.004591  0.000738  0.000478
  0.395604  0.004591  0.000831  0.000665
  0.439560  0.004591  0.000923  0.000891
  0.483516  0.004591  0.001015  0.001160
  0.527473  0.004591  0.001107  0.001441
  0.571429  0.004591  0.001200  0.001475
  0.615385  0.004591  0.001292  0.001837
  0.659341  0.004591  0.001384  0.002250
  0.703297  0.004591  0.001477  0.002715
  0.747253  0.004591  0.001569  0.003234
  0.791209  0.004591  0.001661  0.003483
  0.835165  0.004591  0.001754  0.003810
  0.879121  0.004591  0.001846  0.004445
  0.923077  0.004591  0.001938  0.005140
  0.967033  0.004591  0.002030  0.005897
  1.010989  0.004591  0.002123  0.006668
  1.054945  0.004591  0.002215  0.006719
  1.098901  0.004591  0.002307  0.007606
  1.142857  0.004591  0.002400  0.008560
  1.186813  0.004591  0.002492  0.009584
  1.230769  0.004591  0.002584  0.010678
  1.274725  0.004591  0.002676  0.011158
  1.318681  0.004591  0.002769  0.011843
  1.362637  0.004591  0.002861  0.013083
  1.406593  0.004591  0.002953  0.014396
  1.450549  0.004591  0.003046  0.015786
  1.494505  0.004591  0.003138  0.017096
  1.538462  0.004591  0.003222  0.017253
  1.582418  0.004591  0.003305  0.018797
  1.626374  0.004591  0.003389  0.020420
  1.670330  0.004591  0.003473  0.022120
  1.714286  0.004591  0.003557  0.023897
  1.758242  0.004591  0.003640  0.024614
  1.802198  0.004591  0.003724  0.025745
  1.846154  0.004591  0.003808  0.027617
  1.890110  0.004591  0.003892  0.037037
  1.934066  0.004591  0.003975  0.037037
  1.978022  0.004591  0.004059  0.037037
  2.021978  0.004591  0.004143  0.037037
  2.065934  0.004591  0.004227  0.037037
  2.109890  0.004591  0.004310  0.037037
  2.153846  0.004591  0.004394  0.037037
  2.197802  0.004591  0.004478  0.037037
```

```
2.241758  0.004591  0.004562  0.037037
2.285714  0.004591  0.004645  0.037037
2.329670  0.004591  0.004729  0.037037
2.373626  0.004591  0.004813  0.037037
2.417582  0.004591  0.004897  0.037037
2.461538  0.004591  0.004981  0.037037
2.505495  0.004591  0.005064  0.037037
2.549451  0.004591  0.005148  0.037037
2.593407  0.004591  0.005232  0.037037
2.637363  0.004591  0.005316  0.037037
2.681319  0.004591  0.005399  0.037037
2.725275  0.004591  0.005483  0.037037
2.769231  0.004591  0.005567  0.037037
2.813187  0.004591  0.005651  0.037037
2.857143  0.004591  0.005734  0.037037
2.901099  0.004591  0.005818  0.037037
2.945055  0.004591  0.005902  0.037037
2.989011  0.004591  0.005986  0.037037
3.000000  0.004591  0.006772  0.037037
END FTABLE  2
FTABLE      1
 24    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.004591  0.000000  0.000000  0.000000
0.043956  0.004591  0.000202  0.000000  0.027778
0.087912  0.004591  0.000404  0.000000  0.029406
0.131868  0.004591  0.000605  0.000000  0.030220
0.175824  0.004591  0.000807  0.000000  0.031034
0.219780  0.004591  0.001009  0.000000  0.031848
0.263736  0.004591  0.001211  0.000000  0.032662
0.307692  0.004591  0.001413  0.000000  0.033476
0.351648  0.004591  0.001615  0.000000  0.034290
0.395604  0.004591  0.001816  0.000000  0.035104
0.439560  0.004591  0.002018  0.000000  0.035918
0.483516  0.004591  0.002220  0.000000  0.036732
0.527473  0.004591  0.002422  0.048301  0.037037
0.571429  0.004591  0.002624  0.202028  0.037037
0.615385  0.004591  0.002825  0.412175  0.037037
0.659341  0.004591  0.003027  0.659695  0.037037
0.703297  0.004591  0.003229  0.928167  0.037037
0.747253  0.004591  0.003431  1.200769  0.037037
0.791209  0.004591  0.003633  1.460630  0.037037
0.835165  0.004591  0.003835  1.692395  0.037037
0.879121  0.004591  0.004036  1.884482  0.037037
0.923077  0.004591  0.004238  2.031838  0.037037
0.967033  0.004591  0.004440  2.139092  0.037037
1.000000  0.004591  0.004591  2.251466  0.037037
END FTABLE  1
FTABLE      4
 70    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.030992  0.000000  0.000000
0.043956  0.030992  0.000623  0.000000
0.087912  0.030992  0.001246  0.000000
0.131868  0.030992  0.001869  0.000000
0.175824  0.030992  0.002492  0.000000
0.219780  0.030992  0.003115  0.000855
0.263736  0.030992  0.003738  0.001435
0.307692  0.030992  0.004361  0.002218
0.351648  0.030992  0.004984  0.003227
0.395604  0.030992  0.005607  0.004486
0.439560  0.030992  0.006230  0.006015
0.483516  0.030992  0.006853  0.007832
0.527473  0.030992  0.007476  0.009728
0.571429  0.030992  0.008099  0.009955
0.615385  0.030992  0.008722  0.012401
0.659341  0.030992  0.009345  0.015186
0.703297  0.030992  0.009967  0.018325
```

```
0.747253  0.030992  0.010590  0.021831
0.791209  0.030992  0.011213  0.023511
0.835165  0.030992  0.011836  0.025719
0.879121  0.030992  0.012459  0.030003
0.923077  0.030992  0.013082  0.034695
0.967033  0.030992  0.013705  0.039806
1.010989  0.030992  0.014328  0.045011
1.054945  0.030992  0.014951  0.045351
1.098901  0.030992  0.015574  0.051338
1.142857  0.030992  0.016197  0.057781
1.186813  0.030992  0.016820  0.064689
1.230769  0.030992  0.017443  0.072073
1.274725  0.030992  0.018066  0.075317
1.318681  0.030992  0.018689  0.079943
1.362637  0.030992  0.019312  0.088308
1.406593  0.030992  0.019935  0.097176
1.450549  0.030992  0.020558  0.106557
1.494505  0.030992  0.021181  0.115400
1.538462  0.030992  0.021746  0.116456
1.582418  0.030992  0.022312  0.126881
1.626374  0.030992  0.022877  0.137833
1.670330  0.030992  0.023442  0.149312
1.714286  0.030992  0.024008  0.161308
1.758242  0.030992  0.024573  0.166144
1.802198  0.030992  0.025138  0.173777
1.846154  0.030992  0.025704  0.186414
1.890110  0.030992  0.026269  0.250000
1.934066  0.030992  0.026834  0.250000
1.978022  0.030992  0.027400  0.250000
2.021978  0.030992  0.027965  0.250000
2.065934  0.030992  0.028530  0.250000
2.109890  0.030992  0.029096  0.250000
2.153846  0.030992  0.029661  0.250000
2.197802  0.030992  0.030226  0.250000
2.241758  0.030992  0.030792  0.250000
2.285714  0.030992  0.031357  0.250000
2.329670  0.030992  0.031922  0.250000
2.373626  0.030992  0.032488  0.250000
2.417582  0.030992  0.033053  0.250000
2.461538  0.030992  0.033618  0.250000
2.505495  0.030992  0.034184  0.250000
2.549451  0.030992  0.034749  0.250000
2.593407  0.030992  0.035315  0.250000
2.637363  0.030992  0.035880  0.250000
2.681319  0.030992  0.036445  0.250000
2.725275  0.030992  0.037011  0.250000
2.769231  0.030992  0.037576  0.250000
2.813187  0.030992  0.038141  0.250000
2.857143  0.030992  0.038707  0.250000
2.901099  0.030992  0.039272  0.250000
2.945055  0.030992  0.039837  0.250000
2.989011  0.030992  0.040403  0.250000
3.000000  0.030992  0.045709  0.250000
END FTABLE  4
FTABLE      3
 24    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.030992  0.000000  0.000000  0.000000
0.043956  0.030992  0.001362  0.000000  0.187500
0.087912  0.030992  0.002725  0.000000  0.198489
0.131868  0.030992  0.004087  0.000000  0.203984
0.175824  0.030992  0.005449  0.000000  0.209478
0.219780  0.030992  0.006811  0.000000  0.214973
0.263736  0.030992  0.008174  0.000000  0.220467
0.307692  0.030992  0.009536  0.000000  0.225962
0.351648  0.030992  0.010898  0.000000  0.231456
0.395604  0.030992  0.012260  0.000000  0.236951
0.439560  0.030992  0.013623  0.000000  0.242445
0.483516  0.030992  0.014985  0.000000  0.247940
```

```
0.527473  0.030992  0.016347  0.048301  0.250000
0.571429  0.030992  0.017710  0.202028  0.250000
0.615385  0.030992  0.019072  0.412175  0.250000
0.659341  0.030992  0.020434  0.659695  0.250000
0.703297  0.030992  0.021796  0.928167  0.250000
0.747253  0.030992  0.023159  1.200769  0.250000
0.791209  0.030992  0.024521  1.460630  0.250000
0.835165  0.030992  0.025883  1.692395  0.250000
0.879121  0.030992  0.027245  1.884482  0.250000
0.923077  0.030992  0.028608  2.031838  0.250000
0.967033  0.030992  0.029970  2.139092  0.250000
1.000000  0.030992  0.030992  2.251466  0.250000
END FTABLE  3
FTABLE      5
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.004591  0.000000  0.000000  0.000000
0.055556  0.004591  0.000089  0.000000  0.009259
0.111111  0.004591  0.000179  0.000000  0.009259
0.166667  0.004591  0.000268  0.000000  0.009259
0.222222  0.004591  0.000357  0.000000  0.009259
0.277778  0.004591  0.000446  0.000000  0.009259
0.333333  0.004591  0.000536  0.000000  0.009259
0.388889  0.004591  0.000625  0.000000  0.009259
0.444444  0.004591  0.000714  0.000000  0.009259
0.500000  0.004591  0.000803  0.000000  0.009259
0.555556  0.004591  0.000893  0.000000  0.009259
0.611111  0.004591  0.000982  0.000000  0.009259
0.666667  0.004591  0.001071  0.000000  0.009259
0.722222  0.004591  0.001161  0.000000  0.009259
0.777778  0.004591  0.001250  0.000000  0.009259
0.833333  0.004591  0.001339  0.000000  0.009259
0.888889  0.004591  0.001428  0.000000  0.009259
0.944444  0.004591  0.001518  0.000000  0.009259
1.000000  0.004591  0.001607  0.000000  0.009259
1.055556  0.004591  0.001696  0.000000  0.009259
1.111111  0.004591  0.001786  0.000000  0.009259
1.166667  0.004591  0.001875  0.000000  0.009259
1.222222  0.004591  0.001964  0.000000  0.009259
1.277778  0.004591  0.002053  0.000000  0.009259
1.333333  0.004591  0.002143  0.000000  0.009259
1.388889  0.004591  0.002232  0.000000  0.009259
1.444444  0.004591  0.002321  0.000000  0.009259
1.500000  0.004591  0.002410  0.000000  0.009259
1.555556  0.004591  0.002500  0.000000  0.009259
1.611111  0.004591  0.002589  0.000000  0.009259
1.666667  0.004591  0.002678  0.000000  0.009259
1.722222  0.004591  0.002768  0.000000  0.009259
1.777778  0.004591  0.002857  0.000000  0.009259
1.833333  0.004591  0.002946  0.000000  0.009259
1.888889  0.004591  0.003035  0.000000  0.009259
1.944444  0.004591  0.003125  0.000000  0.009259
2.000000  0.004591  0.003214  0.000000  0.009259
2.055556  0.004591  0.003303  0.000000  0.009259
2.111111  0.004591  0.003393  0.000000  0.009259
2.166667  0.004591  0.003482  0.000000  0.009259
2.222222  0.004591  0.003571  0.000000  0.009259
2.277778  0.004591  0.003660  0.000000  0.009259
2.333333  0.004591  0.003750  0.000000  0.009259
2.388889  0.004591  0.003839  0.000000  0.009259
2.444444  0.004591  0.003928  0.000000  0.009259
2.500000  0.004591  0.004017  0.000000  0.009259
2.555556  0.004591  0.004107  0.000000  0.009259
2.611111  0.004591  0.004196  0.000000  0.009259
2.666667  0.004591  0.004285  0.000000  0.009259
2.722222  0.004591  0.004375  0.000000  0.009259
2.777778  0.004591  0.004464  0.000000  0.009259
2.833333  0.004591  0.004553  0.000000  0.009259
2.888889  0.004591  0.004642  0.000000  0.009259
```

```
2.944444  0.004591  0.004732  0.000000  0.009259
3.000000  0.004591  0.004821  0.000000  0.009259
3.055556  0.004591  0.004910  0.138729  0.009259
3.111111  0.004591  0.004999  0.389839  0.009259
3.166667  0.004591  0.005089  0.703432  0.009259
3.222222  0.004591  0.005178  1.046030  0.009259
3.277778  0.004591  0.005267  1.383552  0.009259
3.333333  0.004591  0.005357  1.683468  0.009259
3.388889  0.004591  0.005446  1.921105  0.009259
3.444444  0.004591  0.005535  2.088233  0.009259
3.500000  0.004591  0.005624  2.203335  0.009259
3.555556  0.004591  0.005714  2.347596  0.009259
3.611111  0.004591  0.005803  2.462179  0.009259
3.666667  0.004591  0.005892  2.571662  0.009259
3.722222  0.004591  0.005982  2.676671  0.009259
3.777778  0.004591  0.006071  2.777713  0.009259
3.833333  0.004591  0.006160  2.875206  0.009259
3.888889  0.004591  0.006249  2.969500  0.009259
3.944444  0.004591  0.006339  3.060890  0.009259
4.000000  0.004591  0.006428  3.149630  0.009259
4.055556  0.004591  0.006517  3.235937  0.009259
4.111111  0.004591  0.006606  3.320002  0.009259
4.166667  0.004591  0.006696  3.401989  0.009259
4.222222  0.004591  0.006785  3.482047  0.009259
4.277778  0.004591  0.006874  3.560305  0.009259
4.333333  0.004591  0.006964  3.636879  0.009259
4.388889  0.004591  0.007053  3.711875  0.009259
4.444444  0.004591  0.007142  3.785384  0.009259
4.500000  0.004591  0.007231  3.857493  0.009259
4.555556  0.004591  0.007321  3.928279  0.009259
4.611111  0.004591  0.007410  3.997811  0.009259
4.666667  0.004591  0.007499  4.066155  0.009259
4.722222  0.004591  0.007589  4.133369  0.009259
4.777778  0.004591  0.007678  4.199507  0.009259
4.833333  0.004591  0.007767  4.264619  0.009259
4.888889  0.004591  0.007856  4.328752  0.009259
4.944444  0.004591  0.007946  4.391949  0.009259
5.000000  0.004591  0.008035  4.454250  0.009259
5.055556  0.004591  0.008290  4.515690  0.009259
END FTABLE  5
FTABLE      6
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.030992  0.000000  0.000000  0.000000
0.066667  0.030992  0.000723  0.000000  0.062500
0.133333  0.030992  0.001446  0.000000  0.062500
0.200000  0.030992  0.002169  0.000000  0.062500
0.266667  0.030992  0.002893  0.000000  0.062500
0.333333  0.030992  0.003616  0.000000  0.062500
0.400000  0.030992  0.004339  0.000000  0.062500
0.466667  0.030992  0.005062  0.000000  0.062500
0.533333  0.030992  0.005785  0.000000  0.062500
0.600000  0.030992  0.006508  0.000000  0.062500
0.666667  0.030992  0.007231  0.000000  0.062500
0.733333  0.030992  0.007955  0.000000  0.062500
0.800000  0.030992  0.008678  0.000000  0.062500
0.866667  0.030992  0.009401  0.000000  0.062500
0.933333  0.030992  0.010124  0.000000  0.062500
1.000000  0.030992  0.010847  0.000000  0.062500
1.066667  0.030992  0.011570  0.000000  0.062500
1.133333  0.030992  0.012293  0.000000  0.062500
1.200000  0.030992  0.013017  0.000000  0.062500
1.266667  0.030992  0.013740  0.000000  0.062500
1.333333  0.030992  0.014463  0.000000  0.062500
1.400000  0.030992  0.015186  0.000000  0.062500
1.466667  0.030992  0.015909  0.000000  0.062500
1.533333  0.030992  0.016632  0.000000  0.062500
1.600000  0.030992  0.017355  0.000000  0.062500
1.666667  0.030992  0.018079  0.000000  0.062500
```

```
  1.733333  0.030992  0.018802  0.000000  0.062500
  1.800000  0.030992  0.019525  0.000000  0.062500
  1.866667  0.030992  0.020248  0.000000  0.062500
  1.933333  0.030992  0.020971  0.000000  0.062500
  2.000000  0.030992  0.021694  0.000000  0.062500
  2.066667  0.030992  0.022417  0.000000  0.062500
  2.133333  0.030992  0.023140  0.000000  0.062500
  2.200000  0.030992  0.023864  0.000000  0.062500
  2.266667  0.030992  0.024587  0.000000  0.062500
  2.333333  0.030992  0.025310  0.000000  0.062500
  2.400000  0.030992  0.026033  0.000000  0.062500
  2.466667  0.030992  0.026756  0.000000  0.062500
  2.533333  0.030992  0.027479  0.000000  0.062500
  2.600000  0.030992  0.028202  0.000000  0.062500
  2.666667  0.030992  0.028926  0.000000  0.062500
  2.733333  0.030992  0.029649  0.000000  0.062500
  2.800000  0.030992  0.030372  0.000000  0.062500
  2.866667  0.030992  0.031095  0.000000  0.062500
  2.933333  0.030992  0.031818  0.000000  0.062500
  3.000000  0.030992  0.032541  0.000000  0.062500
  3.066667  0.030992  0.033264  0.000000  0.062500
  3.133333  0.030992  0.033988  0.000000  0.062500
  3.200000  0.030992  0.034711  0.000000  0.062500
  3.266667  0.030992  0.035434  0.000000  0.062500
  3.333333  0.030992  0.036157  0.000000  0.062500
  3.400000  0.030992  0.036880  0.000000  0.062500
  3.466667  0.030992  0.037603  0.000000  0.062500
  3.533333  0.030992  0.038326  0.000000  0.062500
  3.600000  0.030992  0.039050  0.000000  0.062500
  3.666667  0.030992  0.039773  0.000000  0.062500
  3.733333  0.030992  0.040496  0.000000  0.062500
  3.800000  0.030992  0.041219  0.000000  0.062500
  3.866667  0.030992  0.041942  0.000000  0.062500
  3.933333  0.030992  0.042665  0.000000  0.062500
  4.000000  0.030992  0.043388  0.000000  0.062500
  4.066667  0.030992  0.044112  0.182234  0.062500
  4.133333  0.030992  0.044835  0.509662  0.062500
  4.200000  0.030992  0.045558  0.907676  0.062500
  4.266667  0.030992  0.046281  1.318080  0.062500
  4.333333  0.030992  0.047004  1.683468  0.062500
  4.400000  0.030992  0.047727  1.960035  0.062500
  4.466667  0.030992  0.048450  2.138326  0.062500
  4.533333  0.030992  0.049174  2.300165  0.062500
  4.600000  0.030992  0.049897  2.439693  0.062500
  4.666667  0.030992  0.050620  2.571662  0.062500
  4.733333  0.030992  0.051343  2.697182  0.062500
  4.800000  0.030992  0.052066  2.817115  0.062500
  4.866667  0.030992  0.052789  2.932146  0.062500
  4.933333  0.030992  0.053512  3.042832  0.062500
  5.000000  0.030992  0.054236  3.149630  0.062500
  5.066667  0.030992  0.054959  3.252924  0.062500
  5.133333  0.030992  0.055682  3.353037  0.062500
  5.200000  0.030992  0.056405  3.450247  0.062500
  5.266667  0.030992  0.057128  3.544792  0.062500
  5.333333  0.030992  0.057851  3.636879  0.062500
  5.400000  0.030992  0.058574  3.726693  0.062500
  5.466667  0.030992  0.059298  3.814391  0.062500
  5.533333  0.030992  0.060021  3.900119  0.062500
  5.600000  0.030992  0.060744  3.984002  0.062500
  5.666667  0.030992  0.061467  4.066155  0.062500
  5.733333  0.030992  0.062190  4.146681  0.062500
  5.800000  0.030992  0.062913  4.225672  0.062500
  5.866667  0.030992  0.063636  4.303214  0.062500
  5.933333  0.030992  0.064360  4.379383  0.062500
  6.000000  0.030992  0.065083  4.454250  0.062500
  6.066667  0.030992  0.067149  4.527878  0.062500
  END FTABLE  6
END FTABLES

EXT SOURCES
```

```
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1.429          RCHRES   1     EXTNL  PREC
WDM      2 PREC     ENGL    1.429          RCHRES   3     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   2     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.5            RCHRES   3     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   4     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
COPY     2 OUTPUT MEAN   1 1     48.4      WDM    702 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    802 FLOW     ENGL      REPL
COPY   602 OUTPUT MEAN   1 1     48.4      WDM    902 FLOW     ENGL      REPL
RCHRES   5 HYDR   RO     1 1        1      WDM   1020 FLOW     ENGL      REPL
RCHRES   5 HYDR   O      1 1        1      WDM   1021 FLOW     ENGL      REPL
RCHRES   5 HYDR   O      2 1        1      WDM   1022 FLOW     ENGL      REPL
RCHRES   5 HYDR   STAGE  1 1        1      WDM   1023 STAG     ENGL      REPL
RCHRES   6 HYDR   RO     1 1        1      WDM   1024 FLOW     ENGL      REPL
RCHRES   6 HYDR   O      1 1        1      WDM   1025 FLOW     ENGL      REPL
RCHRES   6 HYDR   O      2 1        1      WDM   1026 FLOW     ENGL      REPL
RCHRES   6 HYDR   STAGE  1 1        1      WDM   1027 STAG     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>             <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

ERROR/WARNING ID: 341 6

DATE/TIME: 1997/10/30 11: 0

RCHRES: 3

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS	V1	V2	VOL
24	1305.5	1350.0	1360.1

ERROR/WARNING ID: 341 5

DATE/TIME: 1997/10/30 11: 0

RCHRES: 3

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	2700.0	-3.311E+03	1.2262	1.2262	2

ERROR/WARNING ID: 341 6

DATE/TIME: 2002/ 1/ 6 17: 0

RCHRES: 3

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS	V1	V2	VOL
24	1305.5	1350.0	1447.7

ERROR/WARNING ID: 341 5

DATE/TIME: 2002/ 1/ 6 17: 0

RCHRES: 3

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	2700.0	-8.625E+03	3.1945	3.1945E+00	2

ERROR/WARNING ID: 341 6

DATE/TIME: 2002/10/19 15: 0

RCHRES: 3

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS	V1	V2	VOL
24	1.3055E+03	1350.0	1458.0

ERROR/WARNING ID: 341 5

DATE/TIME: 2002/10/19 15: 0

RCHRES: 3

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	2700.0	-9.248E+03	3.4253	3.4253E+00	2

Disclaimer

Legal Notice

This program and accompanying documentation are provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc. be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions Inc. or their authorized representatives have been advised of the possibility of such damages. Software Copyright © by : Clear Creek Solutions, Inc. 2005-2025; All Rights Reserved.

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: 18591_Node C

Site Name:	LOTC
Site Address:	
City:	Castle Rock, WA
Report Date:	1/21/2025
Gage:	Longview
Data Start:	1955/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.429
Version Date:	2024/06/28
Version:	4.3.1

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year
Low Flow Threshold for POC2:	50 Percent of the 2 Year
High Flow Threshold for POC2:	50 Year

Landuse Basin Data
Predeveloped Land Use

Node C - Existing Public

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Forest, Mod	0.949
Pervious Total	0.949

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.949

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Node C - Existng Flex

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Mod	3.063
Pervious Total	3.063
Impervious Land Use	acre
Impervious Total	0
Basin Total	3.063

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 2	POC 2

Mitigated Land Use

Node C - Public PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	0.71
Impervious Total	0.71
Basin Total	0.71

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Surface	Interflow	Groundwater
Bioretention	Bioretention	

Node C - Flex PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	1.685
Impervious Total	1.685
Basin Total	1.685

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Surface	Interflow	Groundwater
Surface Bioretention	Surface Bioretention	

Node C - Public Non-PGIS

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Mod	0.239
Pervious Total	0.239
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.239

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 1	POC 1

Node C - Flex Non-PGIS

Bypass:	Yes
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Mod	0.306
Pervious Total	0.306

Impervious Land Use	acre
ROOF TOPS FLAT	1.072
Impervious Total	1.072
Basin Total	1.378

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 2	POC 2	

Mitigated Routing

Road Bioretention

Bottom Length: 120.00 ft.
Bottom Width: 5.00 ft.
Material thickness of first layer: 1.5
Material type for first layer: SMMWW 12 in/hr
Material thickness of second layer: 1.5
Material type for second layer: GRAVEL
Material thickness of third layer: 0
Material type for third layer: GRAVEL
Underdrain used
Underdrain Diameter (feet): 1
Orifice Diameter (in.): 12
Offset (in.): 0
Flow Through Underdrain (ac-ft.): 163.644
Total Outflow (ac-ft.): 170.904
Percent Through Underdrain: 95.75
Discharge Structure
Riser Height: 0.5 ft.
Riser Diameter: 12 in.
Element Outlets:
Outlet 1 Outlet 2
Outlet Flows To:
Gravel Trench Bed 2

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0138	0.0000	0.0000	0.0000
0.0440	0.0138	0.0003	0.0000	0.0000
0.0879	0.0138	0.0006	0.0000	0.0000
0.1319	0.0138	0.0008	0.0000	0.0000
0.1758	0.0138	0.0011	0.0000	0.0000
0.2198	0.0138	0.0014	0.0004	0.0000
0.2637	0.0138	0.0017	0.0006	0.0000
0.3077	0.0138	0.0019	0.0010	0.0000
0.3516	0.0138	0.0022	0.0014	0.0000
0.3956	0.0138	0.0025	0.0020	0.0000
0.4396	0.0138	0.0028	0.0027	0.0000
0.4835	0.0138	0.0030	0.0035	0.0000
0.5275	0.0138	0.0033	0.0043	0.0000
0.5714	0.0138	0.0036	0.0044	0.0000
0.6154	0.0138	0.0039	0.0055	0.0000
0.6593	0.0138	0.0042	0.0067	0.0000
0.7033	0.0138	0.0044	0.0081	0.0000
0.7473	0.0138	0.0047	0.0097	0.0000
0.7912	0.0138	0.0050	0.0104	0.0000
0.8352	0.0138	0.0053	0.0114	0.0000
0.8791	0.0138	0.0055	0.0133	0.0000
0.9231	0.0138	0.0058	0.0154	0.0000
0.9670	0.0138	0.0061	0.0177	0.0000
1.0110	0.0138	0.0064	0.0200	0.0000
1.0549	0.0138	0.0066	0.0202	0.0000
1.0989	0.0138	0.0069	0.0228	0.0000
1.1429	0.0138	0.0072	0.0257	0.0000
1.1868	0.0138	0.0075	0.0288	0.0000

1.2308	0.0138	0.0078	0.0320	0.0000
1.2747	0.0138	0.0080	0.0335	0.0000
1.3187	0.0138	0.0083	0.0355	0.0000
1.3626	0.0138	0.0086	0.0392	0.0000
1.4066	0.0138	0.0089	0.0432	0.0000
1.4505	0.0138	0.0091	0.0474	0.0000
1.4945	0.0138	0.0094	0.0513	0.0000
1.5385	0.0138	0.0097	0.0518	0.0000
1.5824	0.0138	0.0099	0.0564	0.0000
1.6264	0.0138	0.0102	0.0613	0.0000
1.6703	0.0138	0.0104	0.0664	0.0000
1.7143	0.0138	0.0107	0.0717	0.0000
1.7582	0.0138	0.0109	0.0738	0.0000
1.8022	0.0138	0.0112	0.0772	0.0000
1.8462	0.0138	0.0114	0.0829	0.0000
1.8901	0.0138	0.0117	0.1111	0.0000
1.9341	0.0138	0.0119	0.1111	0.0000
1.9780	0.0138	0.0122	0.1111	0.0000
2.0220	0.0138	0.0124	0.1111	0.0000
2.0659	0.0138	0.0127	0.1111	0.0000
2.1099	0.0138	0.0129	0.1111	0.0000
2.1538	0.0138	0.0132	0.1111	0.0000
2.1978	0.0138	0.0134	0.1111	0.0000
2.2418	0.0138	0.0137	0.1111	0.0000
2.2857	0.0138	0.0139	0.1111	0.0000
2.3297	0.0138	0.0142	0.1111	0.0000
2.3736	0.0138	0.0144	0.1111	0.0000
2.4176	0.0138	0.0147	0.1111	0.0000
2.4615	0.0138	0.0149	0.1111	0.0000
2.5055	0.0138	0.0152	0.1111	0.0000
2.5495	0.0138	0.0154	0.1111	0.0000
2.5934	0.0138	0.0157	0.1111	0.0000
2.6374	0.0138	0.0159	0.1111	0.0000
2.6813	0.0138	0.0162	0.1111	0.0000
2.7253	0.0138	0.0164	0.1111	0.0000
2.7692	0.0138	0.0167	0.1111	0.0000
2.8132	0.0138	0.0170	0.1111	0.0000
2.8571	0.0138	0.0172	0.1111	0.0000
2.9011	0.0138	0.0175	0.1111	0.0000
2.9451	0.0138	0.0177	0.1111	0.0000
2.9890	0.0138	0.0180	0.1111	0.0000
3.0000	0.0138	0.0180	0.1111	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0138	0.0180	0.0000	0.0833	0.0000
3.0440	0.0138	0.0186	0.0000	0.0833	0.0000
3.0879	0.0138	0.0192	0.0000	0.0882	0.0000
3.1319	0.0138	0.0198	0.0000	0.0907	0.0000
3.1758	0.0138	0.0204	0.0000	0.0931	0.0000
3.2198	0.0138	0.0210	0.0000	0.0955	0.0000
3.2637	0.0138	0.0217	0.0000	0.0980	0.0000
3.3077	0.0138	0.0223	0.0000	0.1004	0.0000
3.3516	0.0138	0.0229	0.0000	0.1029	0.0000
3.3956	0.0138	0.0235	0.0000	0.1053	0.0000
3.4396	0.0138	0.0241	0.0000	0.1078	0.0000
3.4835	0.0138	0.0247	0.0000	0.1102	0.0000
3.5275	0.0138	0.0253	0.0483	0.1111	0.0000

3.5714	0.0138	0.0259	0.2020	0.1111	0.0000
3.6154	0.0138	0.0265	0.4122	0.1111	0.0000
3.6593	0.0138	0.0271	0.6597	0.1111	0.0000
3.7033	0.0138	0.0277	0.9282	0.1111	0.0000
3.7473	0.0138	0.0283	1.2008	0.1111	0.0000
3.7912	0.0138	0.0289	1.4606	0.1111	0.0000
3.8352	0.0138	0.0295	1.6924	0.1111	0.0000
3.8791	0.0138	0.0301	1.8845	0.1111	0.0000
3.9231	0.0138	0.0307	2.0318	0.1111	0.0000
3.9670	0.0138	0.0313	2.1391	0.1111	0.0000
4.0000	0.0138	0.0318	2.2515	0.1111	0.0000

Commerical/Flex Bioretention

Bottom Length:	60.00 ft.
Bottom Width:	20.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	1.5
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	1
Orifice Diameter (in.):	12
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	392.553
Total Outflow (ac-ft.):	404.757
Percent Through Underdrain:	96.98
Discharge Structure	
Riser Height:	1 ft.
Riser Diameter:	24 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	
Road Infiltration Trench	

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0275	0.0000	0.0000	0.0000
0.0549	0.0275	0.0007	0.0000	0.0000
0.1099	0.0275	0.0014	0.0000	0.0000
0.1648	0.0275	0.0021	0.0000	0.0000
0.2198	0.0275	0.0028	0.0011	0.0000
0.2747	0.0275	0.0035	0.0020	0.0000
0.3297	0.0275	0.0042	0.0031	0.0000
0.3846	0.0275	0.0048	0.0033	0.0000
0.4396	0.0275	0.0055	0.0046	0.0000
0.4945	0.0275	0.0062	0.0065	0.0000
0.5495	0.0275	0.0069	0.0088	0.0000
0.6044	0.0275	0.0076	0.0116	0.0000
0.6593	0.0275	0.0083	0.0140	0.0000
0.7143	0.0275	0.0090	0.0149	0.0000
0.7692	0.0275	0.0097	0.0186	0.0000
0.8242	0.0275	0.0104	0.0229	0.0000
0.8791	0.0275	0.0111	0.0277	0.0000
0.9341	0.0275	0.0118	0.0331	0.0000
0.9890	0.0275	0.0125	0.0345	0.0000
1.0440	0.0275	0.0132	0.0390	0.0000
1.0989	0.0275	0.0138	0.0456	0.0000
1.1538	0.0275	0.0145	0.0529	0.0000
1.2088	0.0275	0.0152	0.0607	0.0000
1.2637	0.0275	0.0159	0.0669	0.0000
1.3187	0.0275	0.0166	0.0693	0.0000
1.3736	0.0275	0.0173	0.0785	0.0000
1.4286	0.0275	0.0180	0.0884	0.0000
1.4835	0.0275	0.0187	0.0991	0.0000
1.5385	0.0275	0.0193	0.1104	0.0000
1.5934	0.0275	0.0199	0.1129	0.0000

1.6484	0.0275	0.0206	0.1225	0.0000
1.7033	0.0275	0.0212	0.1353	0.0000
1.7582	0.0275	0.0218	0.1489	0.0000
1.8132	0.0275	0.0225	0.1629	0.0000
1.8681	0.0275	0.0231	0.2778	0.0000
1.9231	0.0275	0.0237	0.2778	0.0000
1.9780	0.0275	0.0243	0.2778	0.0000
2.0330	0.0275	0.0250	0.2778	0.0000
2.0879	0.0275	0.0256	0.2778	0.0000
2.1429	0.0275	0.0262	0.2778	0.0000
2.1978	0.0275	0.0269	0.2778	0.0000
2.2527	0.0275	0.0275	0.2778	0.0000
2.3077	0.0275	0.0281	0.2778	0.0000
2.3626	0.0275	0.0287	0.2778	0.0000
2.4176	0.0275	0.0294	0.2778	0.0000
2.4725	0.0275	0.0300	0.2778	0.0000
2.5275	0.0275	0.0306	0.2778	0.0000
2.5824	0.0275	0.0313	0.2778	0.0000
2.6374	0.0275	0.0319	0.2778	0.0000
2.6923	0.0275	0.0325	0.2778	0.0000
2.7473	0.0275	0.0331	0.2778	0.0000
2.8022	0.0275	0.0338	0.2778	0.0000
2.8571	0.0275	0.0344	0.2778	0.0000
2.9121	0.0275	0.0350	0.2778	0.0000
2.9670	0.0275	0.0356	0.2778	0.0000
3.0000	0.0275	0.0360	0.2778	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0275	0.0360	0.0000	0.1667	0.0000
3.0549	0.0275	0.0375	0.0000	0.1667	0.0000
3.1099	0.0275	0.0391	0.0000	0.1789	0.0000
3.1648	0.0275	0.0406	0.0000	0.1850	0.0000
3.2198	0.0275	0.0421	0.0000	0.1911	0.0000
3.2747	0.0275	0.0436	0.0000	0.1972	0.0000
3.3297	0.0275	0.0451	0.0000	0.2033	0.0000
3.3846	0.0275	0.0466	0.0000	0.2094	0.0000
3.4396	0.0275	0.0481	0.0000	0.2155	0.0000
3.4945	0.0275	0.0496	0.0000	0.2216	0.0000
3.5495	0.0275	0.0512	0.0000	0.2277	0.0000
3.6044	0.0275	0.0527	0.0000	0.2338	0.0000
3.6593	0.0275	0.0542	0.0000	0.2399	0.0000
3.7143	0.0275	0.0557	0.0000	0.2460	0.0000
3.7692	0.0275	0.0572	0.0000	0.2521	0.0000
3.8242	0.0275	0.0587	0.0000	0.2582	0.0000
3.8791	0.0275	0.0602	0.0000	0.2643	0.0000
3.9341	0.0275	0.0618	0.0000	0.2705	0.0000
3.9890	0.0275	0.0633	0.0000	0.2766	0.0000
4.0440	0.0275	0.0648	0.1956	0.2778	0.0000
4.0989	0.0275	0.0663	0.6592	0.2778	0.0000
4.1538	0.0275	0.0678	1.2766	0.2778	0.0000
4.2088	0.0275	0.0693	2.0109	0.2778	0.0000
4.2637	0.0275	0.0708	2.8369	0.2778	0.0000
4.3187	0.0275	0.0724	3.7318	0.2778	0.0000
4.3736	0.0275	0.0739	4.6731	0.2778	0.0000
4.4286	0.0275	0.0754	5.6376	0.2778	0.0000
4.4835	0.0275	0.0769	6.6018	0.2778	0.0000
4.5385	0.0275	0.0784	7.5423	0.2778	0.0000

4.5934	0.0275	0.0799	8.4368	0.2778	0.0000
4.6484	0.0275	0.0814	9.2649	0.2778	0.0000
4.7033	0.0275	0.0829	10.010	0.2778	0.0000
4.7582	0.0275	0.0845	10.660	0.2778	0.0000
4.8132	0.0275	0.0860	11.211	0.2778	0.0000
4.8681	0.0275	0.0875	11.664	0.2778	0.0000
4.9231	0.0275	0.0890	12.034	0.2778	0.0000
4.9780	0.0275	0.0905	12.347	0.2778	0.0000
5.0000	0.0275	0.0911	12.805	0.2778	0.0000

Road Infiltration Trench

Bottom Length:	60.00 ft.
Bottom Width:	20.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	6
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	1
Wetted surface area On	
Total Volume Infiltrated (ac-ft.):	8.798
Total Volume Through Riser (ac-ft.):	3.405
Total Volume Through Facility (ac-ft.):	12.202
Percent Infiltrated:	72.1
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	4 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.027	0.000	0.000	0.000
0.0556	0.027	0.000	0.000	0.055
0.1111	0.027	0.001	0.000	0.055
0.1667	0.027	0.001	0.000	0.055
0.2222	0.027	0.002	0.000	0.055
0.2778	0.027	0.002	0.000	0.055
0.3333	0.027	0.003	0.000	0.055
0.3889	0.027	0.003	0.000	0.055
0.4444	0.027	0.004	0.000	0.055
0.5000	0.027	0.004	0.000	0.055
0.5556	0.027	0.005	0.000	0.055
0.6111	0.027	0.005	0.000	0.055
0.6667	0.027	0.006	0.000	0.055
0.7222	0.027	0.007	0.000	0.055
0.7778	0.027	0.007	0.000	0.055
0.8333	0.027	0.008	0.000	0.055
0.8889	0.027	0.008	0.000	0.055
0.9444	0.027	0.009	0.000	0.055
1.0000	0.027	0.009	0.000	0.055
1.0556	0.027	0.010	0.000	0.055
1.1111	0.027	0.010	0.000	0.055
1.1667	0.027	0.011	0.000	0.055
1.2222	0.027	0.011	0.000	0.055
1.2778	0.027	0.012	0.000	0.055

1.3333	0.027	0.012	0.000	0.055
1.3889	0.027	0.013	0.000	0.055
1.4444	0.027	0.013	0.000	0.055
1.5000	0.027	0.014	0.000	0.055
1.5556	0.027	0.015	0.000	0.055
1.6111	0.027	0.015	0.000	0.055
1.6667	0.027	0.016	0.000	0.055
1.7222	0.027	0.016	0.000	0.055
1.7778	0.027	0.017	0.000	0.055
1.8333	0.027	0.017	0.000	0.055
1.8889	0.027	0.018	0.000	0.055
1.9444	0.027	0.018	0.000	0.055
2.0000	0.027	0.019	0.000	0.055
2.0556	0.027	0.019	0.000	0.055
2.1111	0.027	0.020	0.000	0.055
2.1667	0.027	0.020	0.000	0.055
2.2222	0.027	0.021	0.000	0.055
2.2778	0.027	0.022	0.000	0.055
2.3333	0.027	0.022	0.000	0.055
2.3889	0.027	0.023	0.000	0.055
2.4444	0.027	0.023	0.000	0.055
2.5000	0.027	0.024	0.000	0.055
2.5556	0.027	0.024	0.000	0.055
2.6111	0.027	0.025	0.000	0.055
2.6667	0.027	0.025	0.000	0.055
2.7222	0.027	0.026	0.000	0.055
2.7778	0.027	0.026	0.000	0.055
2.8333	0.027	0.027	0.000	0.055
2.8889	0.027	0.027	0.000	0.055
2.9444	0.027	0.028	0.000	0.055
3.0000	0.027	0.028	0.000	0.055
3.0556	0.027	0.029	0.000	0.055
3.1111	0.027	0.030	0.000	0.055
3.1667	0.027	0.030	0.000	0.055
3.2222	0.027	0.031	0.000	0.055
3.2778	0.027	0.031	0.000	0.055
3.3333	0.027	0.032	0.000	0.055
3.3889	0.027	0.032	0.000	0.055
3.4444	0.027	0.033	0.000	0.055
3.5000	0.027	0.033	0.000	0.055
3.5556	0.027	0.034	0.000	0.055
3.6111	0.027	0.034	0.000	0.055
3.6667	0.027	0.035	0.000	0.055
3.7222	0.027	0.035	0.000	0.055
3.7778	0.027	0.036	0.000	0.055
3.8333	0.027	0.037	0.000	0.055
3.8889	0.027	0.037	0.000	0.055
3.9444	0.027	0.038	0.000	0.055
4.0000	0.027	0.038	0.000	0.055
4.0556	0.027	0.039	0.138	0.055
4.1111	0.027	0.039	0.389	0.055
4.1667	0.027	0.040	0.703	0.055
4.2222	0.027	0.040	1.046	0.055
4.2778	0.027	0.041	1.383	0.055
4.3333	0.027	0.041	1.683	0.055
4.3889	0.027	0.042	1.921	0.055
4.4444	0.027	0.042	2.088	0.055
4.5000	0.027	0.043	2.203	0.055

4.5556	0.027	0.043	2.347	0.055
4.6111	0.027	0.044	2.462	0.055
4.6667	0.027	0.045	2.571	0.055
4.7222	0.027	0.045	2.676	0.055
4.7778	0.027	0.046	2.777	0.055
4.8333	0.027	0.046	2.875	0.055
4.8889	0.027	0.047	2.969	0.055
4.9444	0.027	0.047	3.060	0.055
5.0000	0.027	0.048	3.149	0.055

Gravel Trench Bed 2

Bottom Length:	120.00 ft.
Bottom Width:	5.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	5
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	1
Wetted surface area On	
Total Volume Infiltrated (ac-ft.):	5.406
Total Volume Through Riser (ac-ft.):	1.854
Total Volume Through Facility (ac-ft.):	7.261
Percent Infiltrated:	74.45
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	3 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

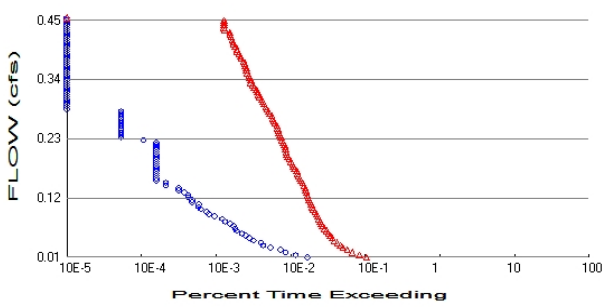
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.013	0.000	0.000	0.000
0.0556	0.013	0.000	0.000	0.027
0.1111	0.013	0.000	0.000	0.027
0.1667	0.013	0.000	0.000	0.027
0.2222	0.013	0.001	0.000	0.027
0.2778	0.013	0.001	0.000	0.027
0.3333	0.013	0.001	0.000	0.027
0.3889	0.013	0.001	0.000	0.027
0.4444	0.013	0.002	0.000	0.027
0.5000	0.013	0.002	0.000	0.027
0.5556	0.013	0.002	0.000	0.027
0.6111	0.013	0.002	0.000	0.027
0.6667	0.013	0.003	0.000	0.027
0.7222	0.013	0.003	0.000	0.027
0.7778	0.013	0.003	0.000	0.027
0.8333	0.013	0.004	0.000	0.027
0.8889	0.013	0.004	0.000	0.027
0.9444	0.013	0.004	0.000	0.027
1.0000	0.013	0.004	0.000	0.027
1.0556	0.013	0.005	0.000	0.027
1.1111	0.013	0.005	0.000	0.027
1.1667	0.013	0.005	0.000	0.027
1.2222	0.013	0.005	0.000	0.027
1.2778	0.013	0.006	0.000	0.027

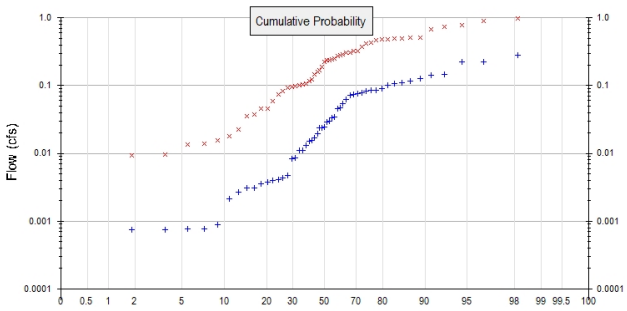
1.3333	0.013	0.006	0.000	0.027
1.3889	0.013	0.006	0.000	0.027
1.4444	0.013	0.007	0.000	0.027
1.5000	0.013	0.007	0.000	0.027
1.5556	0.013	0.007	0.000	0.027
1.6111	0.013	0.007	0.000	0.027
1.6667	0.013	0.008	0.000	0.027
1.7222	0.013	0.008	0.000	0.027
1.7778	0.013	0.008	0.000	0.027
1.8333	0.013	0.008	0.000	0.027
1.8889	0.013	0.009	0.000	0.027
1.9444	0.013	0.009	0.000	0.027
2.0000	0.013	0.009	0.000	0.027
2.0556	0.013	0.009	0.000	0.027
2.1111	0.013	0.010	0.000	0.027
2.1667	0.013	0.010	0.000	0.027
2.2222	0.013	0.010	0.000	0.027
2.2778	0.013	0.011	0.000	0.027
2.3333	0.013	0.011	0.000	0.027
2.3889	0.013	0.011	0.000	0.027
2.4444	0.013	0.011	0.000	0.027
2.5000	0.013	0.012	0.000	0.027
2.5556	0.013	0.012	0.000	0.027
2.6111	0.013	0.012	0.000	0.027
2.6667	0.013	0.012	0.000	0.027
2.7222	0.013	0.013	0.000	0.027
2.7778	0.013	0.013	0.000	0.027
2.8333	0.013	0.013	0.000	0.027
2.8889	0.013	0.013	0.000	0.027
2.9444	0.013	0.014	0.000	0.027
3.0000	0.013	0.014	0.000	0.027
3.0556	0.013	0.014	0.138	0.027
3.1111	0.013	0.015	0.389	0.027
3.1667	0.013	0.015	0.703	0.027
3.2222	0.013	0.015	1.046	0.027
3.2778	0.013	0.015	1.383	0.027
3.3333	0.013	0.016	1.683	0.027
3.3889	0.013	0.016	1.921	0.027
3.4444	0.013	0.016	2.088	0.027
3.5000	0.013	0.016	2.203	0.027
3.5556	0.013	0.017	2.347	0.027
3.6111	0.013	0.017	2.462	0.027
3.6667	0.013	0.017	2.571	0.027
3.7222	0.013	0.017	2.676	0.027
3.7778	0.013	0.018	2.777	0.027
3.8333	0.013	0.018	2.875	0.027
3.8889	0.013	0.018	2.969	0.027
3.9444	0.013	0.019	3.060	0.027
4.0000	0.013	0.019	3.149	0.027
4.0556	0.013	0.019	3.235	0.027
4.1111	0.013	0.019	3.320	0.027
4.1667	0.013	0.020	3.402	0.027
4.2222	0.013	0.020	3.482	0.027
4.2778	0.013	0.020	3.560	0.027
4.3333	0.013	0.020	3.636	0.027
4.3889	0.013	0.021	3.711	0.027
4.4444	0.013	0.021	3.785	0.027
4.5000	0.013	0.021	3.857	0.027

4.5556	0.013	0.022	3.928	0.027
4.6111	0.013	0.022	3.997	0.027
4.6667	0.013	0.022	4.066	0.027
4.7222	0.013	0.022	4.133	0.027
4.7778	0.013	0.023	4.199	0.027
4.8333	0.013	0.023	4.264	0.027
4.8889	0.013	0.023	4.328	0.027
4.9444	0.013	0.023	4.391	0.027
5.0000	0.013	0.024	4.454	0.027

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.949
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.239
Total Impervious Area: 0.71

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.020893
5 year	0.081852
10 year	0.156979
25 year	0.300298
50 year	0.445572
100 year	0.625325

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.171451
5 year	0.492709
10 year	0.752674
25 year	1.084996
50 year	1.316616
100 year	1.526848

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1956	0.147	0.490
1957	0.015	0.486
1958	0.226	0.516
1959	0.054	0.237
1960	0.225	0.516
1961	0.109	0.308
1962	0.279	0.415
1963	0.082	0.726
1964	0.046	0.306
1965	0.024	0.035

1966	0.003	0.009
1967	0.011	0.125
1968	0.002	0.117
1969	0.011	0.059
1970	0.016	0.038
1971	0.100	0.104
1972	0.074	0.222
1973	0.004	0.158
1974	0.107	0.323
1975	0.115	0.490
1976	0.062	0.082
1977	0.001	0.015
1978	0.125	0.425
1979	0.004	0.147
1980	0.008	0.093
1981	0.013	0.099
1982	0.073	0.238
1983	0.030	0.247
1984	0.091	0.244
1985	0.003	0.102
1986	0.085	0.483
1987	0.004	0.327
1988	0.001	0.046
1989	0.003	0.014
1990	0.033	0.190
1991	0.078	0.074
1992	0.004	0.018
1993	0.020	0.046
1994	0.017	0.014
1995	0.005	0.286
1996	0.142	0.673
1997	0.034	0.278
1998	0.029	0.899
1999	0.004	0.023
2000	0.009	0.168
2001	0.001	0.000
2002	0.024	0.982
2003	0.001	0.782
2004	0.001	0.010
2005	0.001	0.106
2006	0.047	0.094
2007	0.077	0.467
2008	0.024	0.271
2009	0.085	0.376

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.2788	0.9817
2	0.2263	0.8995
3	0.2245	0.7819
4	0.1474	0.7258
5	0.1416	0.6733
6	0.1252	0.5162
7	0.1155	0.5156
8	0.1093	0.4905
9	0.1071	0.4903
10	0.0999	0.4864

11	0.0908	0.4828
12	0.0848	0.4674
13	0.0847	0.4246
14	0.0821	0.4145
15	0.0783	0.3760
16	0.0768	0.3266
17	0.0742	0.3233
18	0.0728	0.3078
19	0.0624	0.3061
20	0.0539	0.2860
21	0.0465	0.2782
22	0.0461	0.2709
23	0.0343	0.2474
24	0.0331	0.2437
25	0.0298	0.2378
26	0.0290	0.2372
27	0.0245	0.2224
28	0.0239	0.1896
29	0.0237	0.1683
30	0.0197	0.1583
31	0.0171	0.1475
32	0.0156	0.1246
33	0.0150	0.1169
34	0.0133	0.1056
35	0.0112	0.1040
36	0.0110	0.1019
37	0.0086	0.0991
38	0.0083	0.0945
39	0.0047	0.0928
40	0.0043	0.0820
41	0.0041	0.0743
42	0.0040	0.0589
43	0.0037	0.0463
44	0.0035	0.0459
45	0.0031	0.0379
46	0.0031	0.0355
47	0.0027	0.0226
48	0.0021	0.0178
49	0.0009	0.0154
50	0.0008	0.0137
51	0.0008	0.0136
52	0.0008	0.0097
53	0.0008	0.0094
54	0.0007	0.0002

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0104	315	1950	619	Fail
0.0148	220	1571	714	Fail
0.0192	161	1271	789	Fail
0.0236	137	1093	797	Fail
0.0280	100	948	947	Fail
0.0324	81	873	1077	Fail
0.0368	75	795	1060	Fail
0.0412	60	718	1196	Fail
0.0456	53	679	1281	Fail
0.0500	47	642	1365	Fail
0.0544	42	605	1440	Fail
0.0588	36	571	1586	Fail
0.0632	34	535	1573	Fail
0.0676	32	505	1578	Fail
0.0720	29	483	1665	Fail
0.0764	25	466	1864	Fail
0.0808	23	452	1965	Fail
0.0852	18	436	2422	Fail
0.0896	15	418	2786	Fail
0.0940	14	398	2842	Fail
0.0984	12	384	3200	Fail
0.1027	11	367	3336	Fail
0.1071	11	355	3227	Fail
0.1115	9	348	3866	Fail
0.1159	9	334	3711	Fail
0.1203	8	324	4050	Fail
0.1247	8	318	3975	Fail
0.1291	7	306	4371	Fail
0.1335	6	301	5016	Fail
0.1379	6	295	4916	Fail
0.1423	4	282	7050	Fail
0.1467	4	273	6825	Fail
0.1511	3	258	8600	Fail
0.1555	3	250	8333	Fail
0.1599	3	242	8066	Fail
0.1643	3	233	7766	Fail
0.1687	3	227	7566	Fail
0.1731	3	209	6966	Fail
0.1775	3	205	6833	Fail
0.1819	3	201	6700	Fail
0.1863	3	191	6366	Fail
0.1906	3	180	6000	Fail
0.1950	3	170	5666	Fail
0.1994	3	167	5566	Fail
0.2038	3	165	5500	Fail
0.2082	3	161	5366	Fail
0.2126	3	160	5333	Fail
0.2170	3	156	5200	Fail
0.2214	3	149	4966	Fail
0.2258	2	143	7150	Fail
0.2302	1	141	14100	Fail
0.2346	1	136	13600	Fail
0.2390	1	130	13000	Fail
0.2434	1	129	12900	Fail

0.2478	1	127	12700	Fail
0.2522	1	123	12300	Fail
0.2566	1	115	11500	Fail
0.2610	1	112	11200	Fail
0.2654	1	109	10900	Fail
0.2698	1	105	10500	Fail
0.2742	1	98	9800	Fail
0.2786	1	95	9500	Fail
0.2829	0	91	n/a	Fail
0.2873	0	88	n/a	Fail
0.2917	0	83	n/a	Fail
0.2961	0	80	n/a	Fail
0.3005	0	77	n/a	Fail
0.3049	0	73	n/a	Fail
0.3093	0	69	n/a	Fail
0.3137	0	68	n/a	Fail
0.3181	0	66	n/a	Fail
0.3225	0	61	n/a	Fail
0.3269	0	59	n/a	Fail
0.3313	0	55	n/a	Fail
0.3357	0	55	n/a	Fail
0.3401	0	53	n/a	Fail
0.3445	0	52	n/a	Fail
0.3489	0	50	n/a	Fail
0.3533	0	48	n/a	Fail
0.3577	0	48	n/a	Fail
0.3621	0	46	n/a	Fail
0.3665	0	46	n/a	Fail
0.3709	0	44	n/a	Fail
0.3752	0	41	n/a	Fail
0.3796	0	40	n/a	Fail
0.3840	0	38	n/a	Fail
0.3884	0	36	n/a	Fail
0.3928	0	36	n/a	Fail
0.3972	0	34	n/a	Fail
0.4016	0	32	n/a	Fail
0.4060	0	32	n/a	Fail
0.4104	0	31	n/a	Fail
0.4148	0	30	n/a	Fail
0.4192	0	29	n/a	Fail
0.4236	0	29	n/a	Fail
0.4280	0	25	n/a	Fail
0.4324	0	24	n/a	Fail
0.4368	0	24	n/a	Fail
0.4412	0	24	n/a	Fail
0.4456	0	24	n/a	Fail

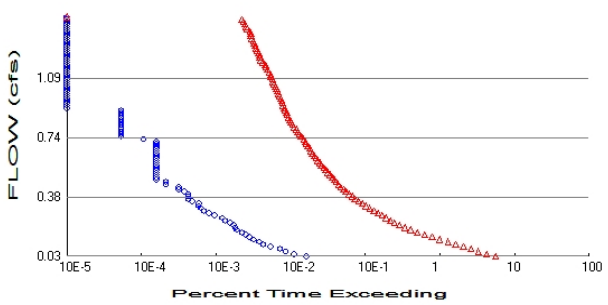
The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

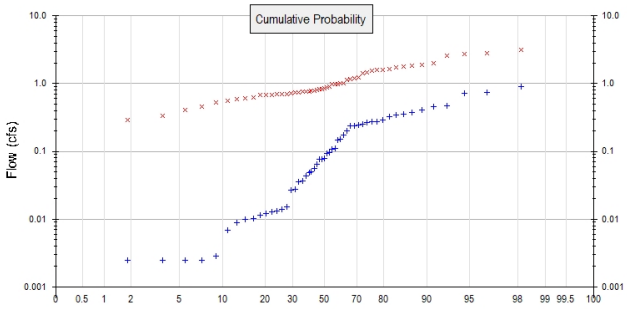
Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

POC 2





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 3.063
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2
Total Pervious Area: 0.306
Total Impervious Area: 2.757

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.067435
5 year	0.264188
10 year	0.506666
25 year	0.969244
50 year	1.438131
100 year	2.018302

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	0.940639
5 year	1.511344
10 year	1.936477
25 year	2.522369
50 year	2.99203
100 year	3.488751

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	**Predeveloped**	**Mitigated**
1956	0.476	1.430
1957	0.048	1.756
1958	0.730	1.819
1959	0.174	0.893
1960	0.725	1.901
1961	0.353	1.009
1962	0.900	1.477
1963	0.265	2.598
1964	0.149	1.015
1965	0.079	0.818
1966	0.010	0.761

1967	0.036	0.599
1968	0.007	0.532
1969	0.035	0.742
1970	0.050	0.560
1971	0.322	0.866
1972	0.239	0.750
1973	0.011	0.677
1974	0.346	0.973
1975	0.373	1.630
1976	0.201	0.978
1977	0.002	0.693
1978	0.404	1.612
1979	0.013	0.594
1980	0.027	0.720
1981	0.043	0.849
1982	0.235	0.786
1983	0.096	1.135
1984	0.293	0.697
1985	0.009	0.770
1986	0.273	1.774
1987	0.014	1.182
1988	0.003	0.684
1989	0.010	0.335
1990	0.107	0.767
1991	0.253	0.838
1992	0.013	0.673
1993	0.064	0.621
1994	0.055	0.457
1995	0.015	1.238
1996	0.457	2.013
1997	0.111	0.987
1998	0.094	2.809
1999	0.012	0.402
2000	0.028	0.772
2001	0.002	0.223
2002	0.077	3.175
2003	0.002	2.704
2004	0.002	0.293
2005	0.002	0.799
2006	0.150	0.689
2007	0.248	1.587
2008	0.077	1.153
2009	0.274	1.545

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	0.8999	3.1751
2	0.7305	2.8089
3	0.7247	2.7045
4	0.4758	2.5985
5	0.4571	2.0129
6	0.4041	1.9010
7	0.3727	1.8190
8	0.3528	1.7738
9	0.3458	1.7558
10	0.3224	1.6296
11	0.2931	1.6117

12	0.2737	1.5869
13	0.2734	1.5448
14	0.2650	1.4773
15	0.2526	1.4305
16	0.2480	1.2383
17	0.2395	1.1822
18	0.2351	1.1531
19	0.2013	1.1346
20	0.1739	1.0154
21	0.1501	1.0090
22	0.1488	0.9873
23	0.1107	0.9783
24	0.1070	0.9734
25	0.0961	0.8926
26	0.0937	0.8663
27	0.0789	0.8487
28	0.0771	0.8380
29	0.0765	0.8179
30	0.0637	0.7989
31	0.0552	0.7862
32	0.0503	0.7724
33	0.0483	0.7695
34	0.0429	0.7670
35	0.0361	0.7614
36	0.0355	0.7502
37	0.0276	0.7424
38	0.0269	0.7204
39	0.0153	0.6965
40	0.0140	0.6935
41	0.0132	0.6893
42	0.0129	0.6838
43	0.0120	0.6771
44	0.0114	0.6728
45	0.0101	0.6214
46	0.0099	0.5992
47	0.0087	0.5935
48	0.0069	0.5598
49	0.0029	0.5321
50	0.0025	0.4567
51	0.0025	0.4024
52	0.0024	0.3347
53	0.0024	0.2928
54	0.0022	0.2226

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0337	306	104673	34206	Fail
0.0479	209	80247	38395	Fail
0.0621	161	62183	38622	Fail
0.0763	135	49458	36635	Fail
0.0905	101	39120	38732	Fail
0.1046	81	30807	38033	Fail
0.1188	72	24350	33819	Fail
0.1330	60	18712	31186	Fail
0.1472	52	14803	28467	Fail
0.1614	47	11766	25034	Fail
0.1756	42	9422	22433	Fail
0.1898	36	7678	21327	Fail
0.2039	34	6436	18929	Fail
0.2181	32	5393	16853	Fail
0.2323	29	4673	16113	Fail
0.2465	25	4094	16375	Fail
0.2607	23	3624	15756	Fail
0.2749	18	3183	17683	Fail
0.2891	15	2804	18693	Fail
0.3033	13	2456	18892	Fail
0.3174	12	2168	18066	Fail
0.3316	11	1937	17609	Fail
0.3458	11	1730	15727	Fail
0.3600	9	1538	17088	Fail
0.3742	8	1379	17237	Fail
0.3884	8	1259	15737	Fail
0.4026	8	1155	14437	Fail
0.4167	7	1046	14942	Fail
0.4309	6	969	16150	Fail
0.4451	6	881	14683	Fail
0.4593	4	829	20725	Fail
0.4735	4	774	19350	Fail
0.4877	3	726	24200	Fail
0.5019	3	686	22866	Fail
0.5160	3	638	21266	Fail
0.5302	3	597	19900	Fail
0.5444	3	556	18533	Fail
0.5586	3	526	17533	Fail
0.5728	3	489	16300	Fail
0.5870	3	465	15500	Fail
0.6012	3	439	14633	Fail
0.6153	3	413	13766	Fail
0.6295	3	392	13066	Fail
0.6437	3	369	12300	Fail
0.6579	3	352	11733	Fail
0.6721	3	341	11366	Fail
0.6863	3	323	10766	Fail
0.7005	3	305	10166	Fail
0.7146	3	296	9866	Fail
0.7288	2	282	14100	Fail
0.7430	1	262	26200	Fail
0.7572	1	248	24800	Fail
0.7714	1	237	23700	Fail
0.7856	1	226	22600	Fail

0.7998	1	207	20700	Fail
0.8139	1	201	20100	Fail
0.8281	1	190	19000	Fail
0.8423	1	184	18400	Fail
0.8565	1	174	17400	Fail
0.8707	1	168	16800	Fail
0.8849	1	167	16700	Fail
0.8991	1	158	15800	Fail
0.9132	0	156	n/a	Fail
0.9274	0	151	n/a	Fail
0.9416	0	147	n/a	Fail
0.9558	0	143	n/a	Fail
0.9700	0	139	n/a	Fail
0.9842	0	134	n/a	Fail
0.9984	0	129	n/a	Fail
1.0126	0	125	n/a	Fail
1.0267	0	122	n/a	Fail
1.0409	0	118	n/a	Fail
1.0551	0	113	n/a	Fail
1.0693	0	109	n/a	Fail
1.0835	0	108	n/a	Fail
1.0977	0	103	n/a	Fail
1.1119	0	102	n/a	Fail
1.1260	0	97	n/a	Fail
1.1402	0	92	n/a	Fail
1.1544	0	88	n/a	Fail
1.1686	0	87	n/a	Fail
1.1828	0	81	n/a	Fail
1.1970	0	75	n/a	Fail
1.2112	0	73	n/a	Fail
1.2253	0	72	n/a	Fail
1.2395	0	70	n/a	Fail
1.2537	0	68	n/a	Fail
1.2679	0	64	n/a	Fail
1.2821	0	63	n/a	Fail
1.2963	0	61	n/a	Fail
1.3105	0	60	n/a	Fail
1.3246	0	57	n/a	Fail
1.3388	0	55	n/a	Fail
1.3530	0	55	n/a	Fail
1.3672	0	54	n/a	Fail
1.3814	0	50	n/a	Fail
1.3956	0	48	n/a	Fail
1.4098	0	46	n/a	Fail
1.4239	0	44	n/a	Fail
1.4381	0	42	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #2

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

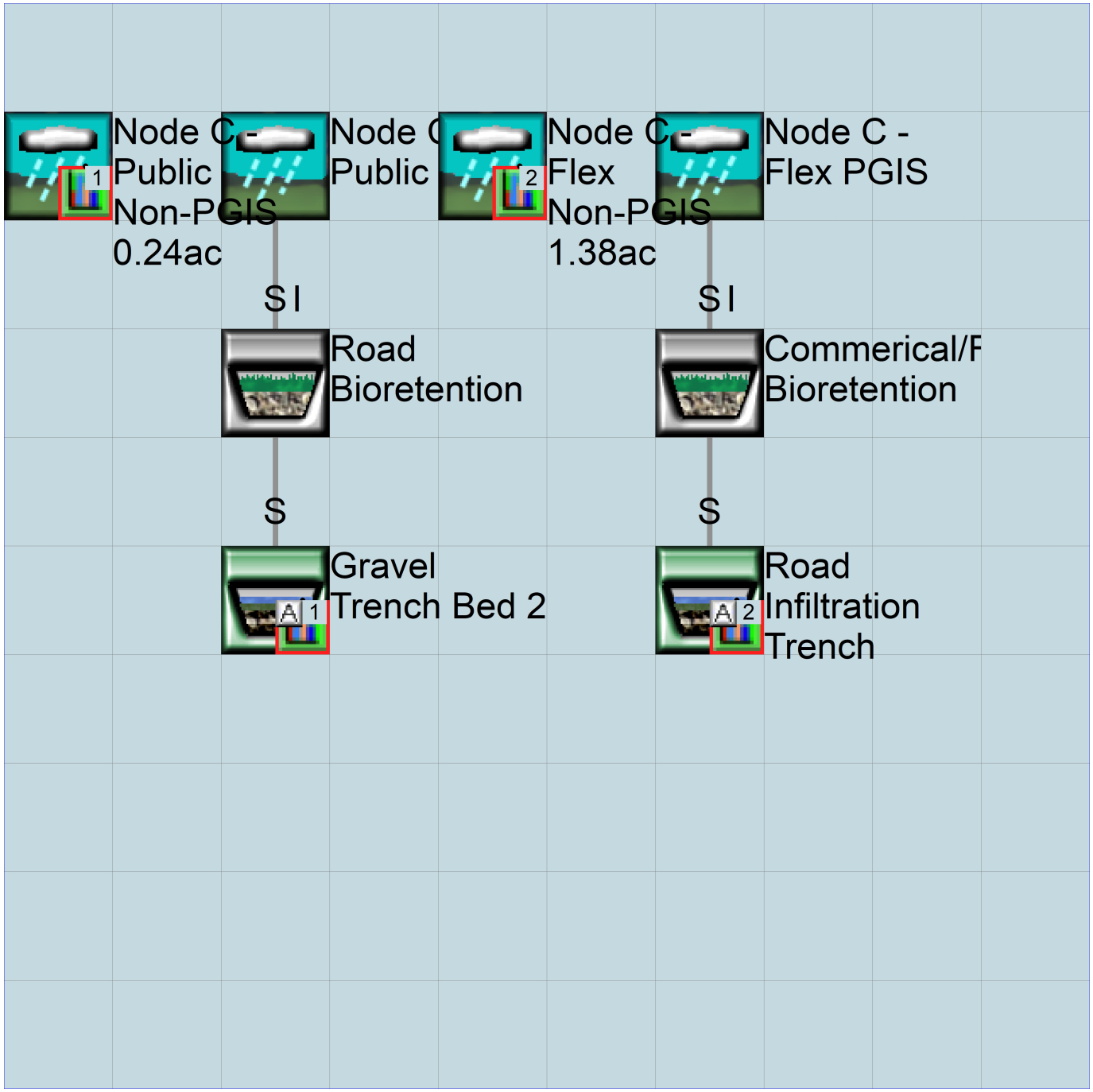
IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic

Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node C.wdm
MESSU       25   Pre18591_Node C.MES
            27   Pre18591_Node C.L61
            28   Pre18591_Node C.L62
            30   POC18591_Node C1.dat
            31   POC18591_Node C2.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      PERLND        2
      COPY        501
      COPY        502
      DISPLY        1
      DISPLY        2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Node C - Existing Public    MAX                   1    2   30    9
    2        Node C - Existng Flex       MAX                   1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  502         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    2     A/B, Forest, Mod        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    2         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
```

```
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    2         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    2         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    2              0         5         2       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    2              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                 ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    2          0.2       0.5      0.35         0       0.7       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    2              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                  in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3
```

```
  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node C - Existing Public***
PERLND   2                       0.949     COPY   501     12
PERLND   2                       0.949     COPY   501     13
Node C - Existng Flex***
PERLND   2                       3.063     COPY   502     12
PERLND   2                       3.063     COPY   502     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                     ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><--->
```

```
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    502 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node C.wdm
MESSU       25   Mit18591_Node C.MES
            27   Mit18591_Node C.L61
            28   Mit18591_Node C.L62
            31   POC18591_Node C2.dat
            30   POC18591_Node C1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       1
      PERLND       8
      IMPLND       4
      RCHRES       1
      RCHRES       2
      RCHRES       3
      RCHRES       4
      RCHRES       5
      RCHRES       6
      COPY         2
      COPY       502
      COPY       602
      COPY         1
      COPY       501
      COPY       601
      DISPLY       2
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    2        Road Infiltration Trench    MAX                    1    2   31    9
    1        Gravel Trench Bed 2         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
    2         1    1
  502         1    1
  602         1    1
  501         1    1
  601         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
```

```
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                        in  out           ***
    8     A/B, Lawn, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    8         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    8         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    8         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    8              0         5       0.8       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    8              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    8          0.1       0.5      0.25         0       0.7      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS       IFWS       LZS       AGWS      GWVS
    8              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
    4      ROOF TOPS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    4         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
```

```
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    4    1    9
    4         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    4         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    4            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    4              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    4              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node C - Public PGIS***
IMPLND   1                       0.71     RCHRES   1      5
Node C - Flex PGIS***
IMPLND   1                      1.685     RCHRES   3      5
Node C - Public Non-PGIS***
PERLND   8                      0.239     COPY   501     12
PERLND   8                      0.239     COPY   601     12
PERLND   8                      0.239     COPY   501     13
PERLND   8                      0.239     COPY   601     13
Node C - Flex Non-PGIS***
PERLND   8                      0.306     COPY   502     12
PERLND   8                      0.306     COPY   602     12
PERLND   8                      0.306     COPY   502     13
PERLND   8                      0.306     COPY   602     13
IMPLND   4                      1.072     COPY   502     15
IMPLND   4                      1.072     COPY   602     15

******Routing******
RCHRES   1                          1     RCHRES   6      7
RCHRES   1                                COPY     1     17
RCHRES   1                          1     RCHRES   2      8
RCHRES   3                          1     RCHRES   5      7
RCHRES   3                                COPY     2     17
RCHRES   3                          1     RCHRES   4      8
RCHRES   5                          1     COPY   502     17
RCHRES   6                          1     COPY   501     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
```

```
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1


<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                              ***
    1     Surface Bioreten-009    2    1    1    1   28    0    1
    2     Road Bioretentio-008    1    1    1    1   28    0    1
    3     Surface Bioreten-011    2    1    1    1   28    0    1
    4     Commerical/Flex -010    1    1    1    1   28    0    1
    5     Road Infiltratio-013    2    1    1    1   28    0    1
    6     Gravel Trench Be-021    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
    4         1    0    0    0    0    0    0    0    0    0
    5         1    0    0    0    0    0    0    0    0    0
    6         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
    4         4    0    0    0    0    0    0    0    0    0    1    9
    5         4    0    0    0    0    0    0    0    0    0    1    9
    6         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    2       0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    3       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    4       0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    5       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    6       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------->      ***
    1             1      0.01       0.0       0.0       0.0       0.0
    2             2      0.02       0.0       0.0       0.0       0.0
    3             3      0.01       0.0       0.0       0.0       0.0
    4             4      0.01       0.0       0.0       0.0       0.0
    5             5      0.01       0.0       0.0       0.5       0.0
    6             6      0.02       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
```

```
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
           *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    4            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    5            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    6            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      2
   70    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.013774  0.000000  0.000000
  0.043956  0.013774  0.000277  0.000000
  0.087912  0.013774  0.000554  0.000000
  0.131868  0.013774  0.000831  0.000000
  0.175824  0.013774  0.001107  0.000000
  0.219780  0.013774  0.001384  0.000380
  0.263736  0.013774  0.001661  0.000638
  0.307692  0.013774  0.001938  0.000986
  0.351648  0.013774  0.002215  0.001434
  0.395604  0.013774  0.002492  0.001994
  0.439560  0.013774  0.002769  0.002673
  0.483516  0.013774  0.003046  0.003481
  0.527473  0.013774  0.003322  0.004323
  0.571429  0.013774  0.003599  0.004425
  0.615385  0.013774  0.003876  0.005512
  0.659341  0.013774  0.004153  0.006749
  0.703297  0.013774  0.004430  0.008144
  0.747253  0.013774  0.004707  0.009703
  0.791209  0.013774  0.004984  0.010449
  0.835165  0.013774  0.005261  0.011431
  0.879121  0.013774  0.005537  0.013335
  0.923077  0.013774  0.005814  0.015420
  0.967033  0.013774  0.006091  0.017692
  1.010989  0.013774  0.006368  0.020005
  1.054945  0.013774  0.006645  0.020156
  1.098901  0.013774  0.006922  0.022817
  1.142857  0.013774  0.007199  0.025680
  1.186813  0.013774  0.007476  0.028751
  1.230769  0.013774  0.007752  0.032033
  1.274725  0.013774  0.008029  0.033474
  1.318681  0.013774  0.008306  0.035530
  1.362637  0.013774  0.008583  0.039248
  1.406593  0.013774  0.008860  0.043189
  1.450549  0.013774  0.009137  0.047359
  1.494505  0.013774  0.009414  0.051289
  1.538462  0.013774  0.009665  0.051758
  1.582418  0.013774  0.009916  0.056391
  1.626374  0.013774  0.010168  0.061259
  1.670330  0.013774  0.010419  0.066361
  1.714286  0.013774  0.010670  0.071692
  1.758242  0.013774  0.010921  0.073842
  1.802198  0.013774  0.011173  0.077234
  1.846154  0.013774  0.011424  0.082851
  1.890110  0.013774  0.011675  0.111111
  1.934066  0.013774  0.011926  0.111111
  1.978022  0.013774  0.012178  0.111111
  2.021978  0.013774  0.012429  0.111111
  2.065934  0.013774  0.012680  0.111111
  2.109890  0.013774  0.012931  0.111111
  2.153846  0.013774  0.013183  0.111111
  2.197802  0.013774  0.013434  0.111111
```

```
2.241758  0.013774  0.013685  0.111111
2.285714  0.013774  0.013936  0.111111
2.329670  0.013774  0.014188  0.111111
2.373626  0.013774  0.014439  0.111111
2.417582  0.013774  0.014690  0.111111
2.461538  0.013774  0.014942  0.111111
2.505495  0.013774  0.015193  0.111111
2.549451  0.013774  0.015444  0.111111
2.593407  0.013774  0.015695  0.111111
2.637363  0.013774  0.015947  0.111111
2.681319  0.013774  0.016198  0.111111
2.725275  0.013774  0.016449  0.111111
2.769231  0.013774  0.016700  0.111111
2.813187  0.013774  0.016952  0.111111
2.857143  0.013774  0.017203  0.111111
2.901099  0.013774  0.017454  0.111111
2.945055  0.013774  0.017705  0.111111
2.989011  0.013774  0.017957  0.111111
3.000000  0.013774  0.020315  0.111111
END FTABLE  2
FTABLE      1
 24    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.013774  0.000000  0.000000  0.000000
0.043956  0.013774  0.000605  0.000000  0.083333
0.087912  0.013774  0.001211  0.000000  0.088217
0.131868  0.013774  0.001816  0.000000  0.090659
0.175824  0.013774  0.002422  0.000000  0.093101
0.219780  0.013774  0.003027  0.000000  0.095543
0.263736  0.013774  0.003633  0.000000  0.097985
0.307692  0.013774  0.004238  0.000000  0.100427
0.351648  0.013774  0.004844  0.000000  0.102869
0.395604  0.013774  0.005449  0.000000  0.105311
0.439560  0.013774  0.006055  0.000000  0.107753
0.483516  0.013774  0.006660  0.000000  0.110195
0.527473  0.013774  0.007265  0.048301  0.111111
0.571429  0.013774  0.007871  0.202028  0.111111
0.615385  0.013774  0.008476  0.412175  0.111111
0.659341  0.013774  0.009082  0.659695  0.111111
0.703297  0.013774  0.009687  0.928167  0.111111
0.747253  0.013774  0.010293  1.200769  0.111111
0.791209  0.013774  0.010898  1.460630  0.111111
0.835165  0.013774  0.011504  1.692395  0.111111
0.879121  0.013774  0.012109  1.884482  0.111111
0.923077  0.013774  0.012715  2.031838  0.111111
0.967033  0.013774  0.013320  2.139092  0.111111
1.000000  0.013774  0.013774  2.251466  0.111111
END FTABLE  1
FTABLE      4
 56    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.027548  0.000000  0.000000
0.054945  0.027548  0.000692  0.000000
0.109890  0.027548  0.001384  0.000000
0.164835  0.027548  0.002077  0.000000
0.219780  0.027548  0.002769  0.001131
0.274725  0.027548  0.003461  0.001971
0.329670  0.027548  0.004153  0.003127
0.384615  0.027548  0.004845  0.003291
0.439560  0.027548  0.005537  0.004636
0.494505  0.027548  0.006230  0.006533
0.549451  0.027548  0.006922  0.008849
0.604396  0.027548  0.007614  0.011613
0.659341  0.027548  0.008306  0.013981
0.714286  0.027548  0.008998  0.014853
0.769231  0.027548  0.009691  0.018595
0.824176  0.027548  0.010383  0.022862
0.879121  0.027548  0.011075  0.027678
```

```
0.934066  0.027548  0.011767  0.033064
0.989011  0.027548  0.012459  0.034534
1.043956  0.027548  0.013152  0.039043
1.098901  0.027548  0.013844  0.045634
1.153846  0.027548  0.014536  0.052857
1.208791  0.027548  0.015228  0.060730
1.263736  0.027548  0.015920  0.066948
1.318681  0.027548  0.016612  0.069271
1.373626  0.027548  0.017305  0.078496
1.428571  0.027548  0.017997  0.088421
1.483516  0.027548  0.018689  0.099059
1.538462  0.027548  0.019317  0.110422
1.593407  0.027548  0.019945  0.112937
1.648352  0.027548  0.020574  0.122518
1.703297  0.027548  0.021202  0.135345
1.758242  0.027548  0.021830  0.148879
1.813187  0.027548  0.022458  0.162949
1.868132  0.027548  0.023086  0.277778
1.923077  0.027548  0.023714  0.277778
1.978022  0.027548  0.024342  0.277778
2.032967  0.027548  0.024971  0.277778
2.087912  0.027548  0.025599  0.277778
2.142857  0.027548  0.026227  0.277778
2.197802  0.027548  0.026855  0.277778
2.252747  0.027548  0.027483  0.277778
2.307692  0.027548  0.028111  0.277778
2.362637  0.027548  0.028740  0.277778
2.417582  0.027548  0.029368  0.277778
2.472527  0.027548  0.029996  0.277778
2.527473  0.027548  0.030624  0.277778
2.582418  0.027548  0.031252  0.277778
2.637363  0.027548  0.031880  0.277778
2.692308  0.027548  0.032509  0.277778
2.747253  0.027548  0.033137  0.277778
2.802198  0.027548  0.033765  0.277778
2.857143  0.027548  0.034393  0.277778
2.912088  0.027548  0.035021  0.277778
2.967033  0.027548  0.035649  0.277778
3.000000  0.027548  0.041765  0.277778
END FTABLE  4
FTABLE      3
 38    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.027548  0.000000  0.000000  0.000000
0.054945  0.027548  0.001514  0.000000  0.166667
0.109890  0.027548  0.003027  0.000000  0.178877
0.164835  0.027548  0.004541  0.000000  0.184982
0.219780  0.027548  0.006055  0.000000  0.191087
0.274725  0.027548  0.007568  0.000000  0.197192
0.329670  0.027548  0.009082  0.000000  0.203297
0.384615  0.027548  0.010595  0.000000  0.209402
0.439560  0.027548  0.012109  0.000000  0.215507
0.494505  0.027548  0.013623  0.000000  0.221612
0.549451  0.027548  0.015136  0.000000  0.227717
0.604396  0.027548  0.016650  0.000000  0.233822
0.659341  0.027548  0.018164  0.000000  0.239927
0.714286  0.027548  0.019677  0.000000  0.246032
0.769231  0.027548  0.021191  0.000000  0.252137
0.824176  0.027548  0.022705  0.000000  0.258242
0.879121  0.027548  0.024218  0.000000  0.264347
0.934066  0.027548  0.025732  0.000000  0.270452
0.989011  0.027548  0.027245  0.000000  0.276557
1.043956  0.027548  0.028759  0.195553  0.277778
1.098901  0.027548  0.030273  0.659242  0.277778
1.153846  0.027548  0.031786  1.276591  0.277778
1.208791  0.027548  0.033300  2.010935  0.277778
1.263736  0.027548  0.034814  2.836899  0.277778
1.318681  0.027548  0.036327  3.731796  0.277778
1.373626  0.027548  0.037841  4.673072  0.277778
```

```
1.428571  0.027548  0.039355  5.637608  0.277778
1.483516  0.027548  0.040868  6.601841  0.277778
1.538462  0.027548  0.042382  7.542349  0.277778
1.593407  0.027548  0.043895  8.436754  0.277778
1.648352  0.027548  0.045409  9.264852  0.277778
1.703297  0.027548  0.046923  10.00993  0.277778
1.758242  0.027548  0.048436  10.66024  0.277778
1.813187  0.027548  0.049950  11.21062  0.277778
1.868132  0.027548  0.051464  11.66425  0.277778
1.923077  0.027548  0.052977  12.03449  0.277778
1.978022  0.027548  0.054491  12.34684  0.277778
2.000000  0.027548  0.055096  12.80450  0.277778
END FTABLE  3
FTABLE      5
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.027548  0.000000  0.000000  0.000000
0.055556  0.027548  0.000536  0.000000  0.055556
0.111111  0.027548  0.001071  0.000000  0.055556
0.166667  0.027548  0.001607  0.000000  0.055556
0.222222  0.027548  0.002143  0.000000  0.055556
0.277778  0.027548  0.002678  0.000000  0.055556
0.333333  0.027548  0.003214  0.000000  0.055556
0.388889  0.027548  0.003750  0.000000  0.055556
0.444444  0.027548  0.004285  0.000000  0.055556
0.500000  0.027548  0.004821  0.000000  0.055556
0.555556  0.027548  0.005357  0.000000  0.055556
0.611111  0.027548  0.005892  0.000000  0.055556
0.666667  0.027548  0.006428  0.000000  0.055556
0.722222  0.027548  0.006964  0.000000  0.055556
0.777778  0.027548  0.007499  0.000000  0.055556
0.833333  0.027548  0.008035  0.000000  0.055556
0.888889  0.027548  0.008571  0.000000  0.055556
0.944444  0.027548  0.009106  0.000000  0.055556
1.000000  0.027548  0.009642  0.000000  0.055556
1.055556  0.027548  0.010178  0.000000  0.055556
1.111111  0.027548  0.010713  0.000000  0.055556
1.166667  0.027548  0.011249  0.000000  0.055556
1.222222  0.027548  0.011785  0.000000  0.055556
1.277778  0.027548  0.012320  0.000000  0.055556
1.333333  0.027548  0.012856  0.000000  0.055556
1.388889  0.027548  0.013391  0.000000  0.055556
1.444444  0.027548  0.013927  0.000000  0.055556
1.500000  0.027548  0.014463  0.000000  0.055556
1.555556  0.027548  0.014998  0.000000  0.055556
1.611111  0.027548  0.015534  0.000000  0.055556
1.666667  0.027548  0.016070  0.000000  0.055556
1.722222  0.027548  0.016605  0.000000  0.055556
1.777778  0.027548  0.017141  0.000000  0.055556
1.833333  0.027548  0.017677  0.000000  0.055556
1.888889  0.027548  0.018212  0.000000  0.055556
1.944444  0.027548  0.018748  0.000000  0.055556
2.000000  0.027548  0.019284  0.000000  0.055556
2.055556  0.027548  0.019819  0.000000  0.055556
2.111111  0.027548  0.020355  0.000000  0.055556
2.166667  0.027548  0.020891  0.000000  0.055556
2.222222  0.027548  0.021426  0.000000  0.055556
2.277778  0.027548  0.021962  0.000000  0.055556
2.333333  0.027548  0.022498  0.000000  0.055556
2.388889  0.027548  0.023033  0.000000  0.055556
2.444444  0.027548  0.023569  0.000000  0.055556
2.500000  0.027548  0.024105  0.000000  0.055556
2.555556  0.027548  0.024640  0.000000  0.055556
2.611111  0.027548  0.025176  0.000000  0.055556
2.666667  0.027548  0.025712  0.000000  0.055556
2.722222  0.027548  0.026247  0.000000  0.055556
2.777778  0.027548  0.026783  0.000000  0.055556
2.833333  0.027548  0.027319  0.000000  0.055556
2.888889  0.027548  0.027854  0.000000  0.055556
```

```
2.944444  0.027548  0.028390  0.000000  0.055556
3.000000  0.027548  0.028926  0.000000  0.055556
3.055556  0.027548  0.029461  0.000000  0.055556
3.111111  0.027548  0.029997  0.000000  0.055556
3.166667  0.027548  0.030533  0.000000  0.055556
3.222222  0.027548  0.031068  0.000000  0.055556
3.277778  0.027548  0.031604  0.000000  0.055556
3.333333  0.027548  0.032140  0.000000  0.055556
3.388889  0.027548  0.032675  0.000000  0.055556
3.444444  0.027548  0.033211  0.000000  0.055556
3.500000  0.027548  0.033747  0.000000  0.055556
3.555556  0.027548  0.034282  0.000000  0.055556
3.611111  0.027548  0.034818  0.000000  0.055556
3.666667  0.027548  0.035354  0.000000  0.055556
3.722222  0.027548  0.035889  0.000000  0.055556
3.777778  0.027548  0.036425  0.000000  0.055556
3.833333  0.027548  0.036961  0.000000  0.055556
3.888889  0.027548  0.037496  0.000000  0.055556
3.944444  0.027548  0.038032  0.000000  0.055556
4.000000  0.027548  0.038567  0.000000  0.055556
4.055556  0.027548  0.039103  0.138729  0.055556
4.111111  0.027548  0.039639  0.389839  0.055556
4.166667  0.027548  0.040174  0.703432  0.055556
4.222222  0.027548  0.040710  1.046030  0.055556
4.277778  0.027548  0.041246  1.383552  0.055556
4.333333  0.027548  0.041781  1.683468  0.055556
4.388889  0.027548  0.042317  1.921105  0.055556
4.444444  0.027548  0.042853  2.088233  0.055556
4.500000  0.027548  0.043388  2.203335  0.055556
4.555556  0.027548  0.043924  2.347596  0.055556
4.611111  0.027548  0.044460  2.462179  0.055556
4.666667  0.027548  0.044995  2.571662  0.055556
4.722222  0.027548  0.045531  2.676671  0.055556
4.777778  0.027548  0.046067  2.777713  0.055556
4.833333  0.027548  0.046602  2.875206  0.055556
4.888889  0.027548  0.047138  2.969500  0.055556
4.944444  0.027548  0.047674  3.060890  0.055556
5.000000  0.027548  0.048209  3.149630  0.055556
5.055556  0.027548  0.048745  3.235937  0.055556
END FTABLE  5
FTABLE      6
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.013774  0.000000  0.000000  0.000000
0.055556  0.013774  0.000268  0.000000  0.027778
0.111111  0.013774  0.000536  0.000000  0.027778
0.166667  0.013774  0.000803  0.000000  0.027778
0.222222  0.013774  0.001071  0.000000  0.027778
0.277778  0.013774  0.001339  0.000000  0.027778
0.333333  0.013774  0.001607  0.000000  0.027778
0.388889  0.013774  0.001875  0.000000  0.027778
0.444444  0.013774  0.002143  0.000000  0.027778
0.500000  0.013774  0.002410  0.000000  0.027778
0.555556  0.013774  0.002678  0.000000  0.027778
0.611111  0.013774  0.002946  0.000000  0.027778
0.666667  0.013774  0.003214  0.000000  0.027778
0.722222  0.013774  0.003482  0.000000  0.027778
0.777778  0.013774  0.003750  0.000000  0.027778
0.833333  0.013774  0.004017  0.000000  0.027778
0.888889  0.013774  0.004285  0.000000  0.027778
0.944444  0.013774  0.004553  0.000000  0.027778
1.000000  0.013774  0.004821  0.000000  0.027778
1.055556  0.013774  0.005089  0.000000  0.027778
1.111111  0.013774  0.005357  0.000000  0.027778
1.166667  0.013774  0.005624  0.000000  0.027778
1.222222  0.013774  0.005892  0.000000  0.027778
1.277778  0.013774  0.006160  0.000000  0.027778
1.333333  0.013774  0.006428  0.000000  0.027778
1.388889  0.013774  0.006696  0.000000  0.027778
```

```
  1.444444  0.013774  0.006964  0.000000  0.027778
  1.500000  0.013774  0.007231  0.000000  0.027778
  1.555556  0.013774  0.007499  0.000000  0.027778
  1.611111  0.013774  0.007767  0.000000  0.027778
  1.666667  0.013774  0.008035  0.000000  0.027778
  1.722222  0.013774  0.008303  0.000000  0.027778
  1.777778  0.013774  0.008571  0.000000  0.027778
  1.833333  0.013774  0.008838  0.000000  0.027778
  1.888889  0.013774  0.009106  0.000000  0.027778
  1.944444  0.013774  0.009374  0.000000  0.027778
  2.000000  0.013774  0.009642  0.000000  0.027778
  2.055556  0.013774  0.009910  0.000000  0.027778
  2.111111  0.013774  0.010178  0.000000  0.027778
  2.166667  0.013774  0.010445  0.000000  0.027778
  2.222222  0.013774  0.010713  0.000000  0.027778
  2.277778  0.013774  0.010981  0.000000  0.027778
  2.333333  0.013774  0.011249  0.000000  0.027778
  2.388889  0.013774  0.011517  0.000000  0.027778
  2.444444  0.013774  0.011785  0.000000  0.027778
  2.500000  0.013774  0.012052  0.000000  0.027778
  2.555556  0.013774  0.012320  0.000000  0.027778
  2.611111  0.013774  0.012588  0.000000  0.027778
  2.666667  0.013774  0.012856  0.000000  0.027778
  2.722222  0.013774  0.013124  0.000000  0.027778
  2.777778  0.013774  0.013391  0.000000  0.027778
  2.833333  0.013774  0.013659  0.000000  0.027778
  2.888889  0.013774  0.013927  0.000000  0.027778
  2.944444  0.013774  0.014195  0.000000  0.027778
  3.000000  0.013774  0.014463  0.000000  0.027778
  3.055556  0.013774  0.014731  0.138729  0.027778
  3.111111  0.013774  0.014998  0.389839  0.027778
  3.166667  0.013774  0.015266  0.703432  0.027778
  3.222222  0.013774  0.015534  1.046030  0.027778
  3.277778  0.013774  0.015802  1.383552  0.027778
  3.333333  0.013774  0.016070  1.683468  0.027778
  3.388889  0.013774  0.016338  1.921105  0.027778
  3.444444  0.013774  0.016605  2.088233  0.027778
  3.500000  0.013774  0.016873  2.203335  0.027778
  3.555556  0.013774  0.017141  2.347596  0.027778
  3.611111  0.013774  0.017409  2.462179  0.027778
  3.666667  0.013774  0.017677  2.571662  0.027778
  3.722222  0.013774  0.017945  2.676671  0.027778
  3.777778  0.013774  0.018212  2.777713  0.027778
  3.833333  0.013774  0.018480  2.875206  0.027778
  3.888889  0.013774  0.018748  2.969500  0.027778
  3.944444  0.013774  0.019016  3.060890  0.027778
  4.000000  0.013774  0.019284  3.149630  0.027778
  4.055556  0.013774  0.019552  3.235937  0.027778
  4.111111  0.013774  0.019819  3.320002  0.027778
  4.166667  0.013774  0.020087  3.401989  0.027778
  4.222222  0.013774  0.020355  3.482047  0.027778
  4.277778  0.013774  0.020623  3.560305  0.027778
  4.333333  0.013774  0.020891  3.636879  0.027778
  4.388889  0.013774  0.021159  3.711875  0.027778
  4.444444  0.013774  0.021426  3.785384  0.027778
  4.500000  0.013774  0.021694  3.857493  0.027778
  4.555556  0.013774  0.021962  3.928279  0.027778
  4.611111  0.013774  0.022230  3.997811  0.027778
  4.666667  0.013774  0.022498  4.066155  0.027778
  4.722222  0.013774  0.022766  4.133369  0.027778
  4.777778  0.013774  0.023033  4.199507  0.027778
  4.833333  0.013774  0.023301  4.264619  0.027778
  4.888889  0.013774  0.023569  4.328752  0.027778
  4.944444  0.013774  0.023837  4.391949  0.027778
  5.000000  0.013774  0.024105  4.454250  0.027778
  5.055556  0.013774  0.024870  4.515690  0.027778
  END FTABLE  6
END FTABLES

EXT SOURCES
```

```
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1.429          RCHRES   1     EXTNL  PREC
WDM      2 PREC     ENGL    1.429          RCHRES   3     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   2     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.5            RCHRES   3     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   4     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   5 HYDR   RO     1 1        1      WDM   1004 FLOW     ENGL      REPL
RCHRES   5 HYDR   O      1 1        1      WDM   1005 FLOW     ENGL      REPL
RCHRES   5 HYDR   O      2 1        1      WDM   1006 FLOW     ENGL      REPL
RCHRES   5 HYDR   STAGE  1 1        1      WDM   1007 STAG     ENGL      REPL
COPY     2 OUTPUT MEAN   1 1     48.4      WDM    702 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    802 FLOW     ENGL      REPL
COPY   602 OUTPUT MEAN   1 1     48.4      WDM    902 FLOW     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
RCHRES   6 HYDR   RO     1 1        1      WDM   1014 FLOW     ENGL      REPL
RCHRES   6 HYDR   O      1 1        1      WDM   1015 FLOW     ENGL      REPL
RCHRES   6 HYDR   O      2 1        1      WDM   1016 FLOW     ENGL      REPL
RCHRES   6 HYDR   STAGE  1 1        1      WDM   1017 STAG     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>             <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Mitigated HSPF Message File

Disclaimer

Legal Notice

This program and accompanying documentation are provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc. be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions Inc. or their authorized representatives have been advised of the possibility of such damages. Software Copyright © by : Clear Creek Solutions, Inc. 2005-2025; All Rights Reserved.

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: 18591_Node D

Site Name:	LOTC
Site Address:	
City:	Castle Rock, WA
Report Date:	3/7/2025
Gage:	Longview
Data Start:	1955/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.429
Version Date:	2024/06/28
Version:	4.3.1

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Node D - Remaining Onsite Areas

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Forest, Mod	75.858
Pervious Total	75.858

Impervious Land Use	acre
Impervious Total	0
Basin Total	75.858

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Mitigated Land Use

Node D - Non-PGIS

Bypass:	Yes
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Mod	9.462
Pervious Total	9.462

Impervious Land Use	acre
ROOF TOPS FLAT	20.159
Impervious Total	20.159
Basin Total	29.621

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 1	POC 1	

Node D - PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	46.237
Impervious Total	46.237
Basin Total	46.237

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Surface retention	1	Surface retention	1POC 1

Mitigated Routing

Bioretention 1

Bottom Length:	270.00 ft.
Bottom Width:	270.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	3
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	2
Orifice Diameter (in.):	24
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	11251.882
Total Outflow (ac-ft.):	11264.741
Percent Through Underdrain:	99.89
Discharge Structure	
Riser Height:	1 ft.
Riser Diameter:	60 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	
Gravel Trench Bed 1	

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	1.6736	0.0000	0.0000	0.0000
0.0714	1.6736	0.0547	0.0000	0.0000
0.1429	1.6736	0.1093	0.0000	0.0000
0.2143	1.6736	0.1640	0.0000	0.0000
0.2857	1.6736	0.2187	0.0000	0.0000
0.3571	1.6736	0.2733	0.0000	0.0000
0.4286	1.6736	0.3280	0.0000	0.0000
0.5000	1.6736	0.3827	0.0000	0.0000
0.5714	1.6736	0.4373	0.0000	0.0000
0.6429	1.6736	0.4920	0.0000	0.0000
0.7143	1.6736	0.5467	0.0000	0.0000
0.7857	1.6736	0.6013	0.0000	0.0000
0.8571	1.6736	0.6560	0.0000	0.0000
0.9286	1.6736	0.7107	0.0000	0.0000
1.0000	1.6736	0.7653	0.0000	0.0000
1.0714	1.6736	0.8200	0.0000	0.0000
1.1429	1.6736	0.8746	0.0000	0.0000
1.2143	1.6736	0.9293	0.0000	0.0000
1.2857	1.6736	0.9840	0.0000	0.0000
1.3571	1.6736	1.0386	0.0000	0.0000
1.4286	1.6736	1.0933	0.0000	0.0000
1.5000	1.6736	1.1480	0.0000	0.0000
1.5714	1.6736	1.1976	0.0000	0.0000
1.6429	1.6736	1.2472	0.0000	0.0000
1.7143	1.6736	1.2968	0.0000	0.0000
1.7857	1.6736	1.3464	0.0000	0.0000
1.8571	1.6736	1.3960	0.0000	0.0000
1.9286	1.6736	1.4456	0.0000	0.0000

2.0000	1.6736	1.4952	0.0000	0.0000
2.0714	1.6736	1.5448	0.0000	0.0000
2.1429	1.6736	1.5945	0.0000	0.0000
2.2143	1.6736	1.6441	0.0000	0.0000
2.2857	1.6736	1.6937	0.0000	0.0000
2.3571	1.6736	1.7433	0.0000	0.0000
2.4286	1.6736	1.7929	0.0000	0.0000
2.5000	1.6736	1.8425	0.0000	0.0000
2.5714	1.6736	1.8921	0.0000	0.0000
2.6429	1.6736	1.9417	0.0000	0.0000
2.7143	1.6736	1.9913	0.0000	0.0000
2.7857	1.6736	2.0409	0.0000	0.0000
2.8571	1.6736	2.0905	0.0000	0.0000
2.9286	1.6736	2.1402	0.0000	0.0000
3.0000	1.6736	2.1898	0.0000	0.0000
3.0714	1.6736	2.2394	0.0000	0.0000
3.1429	1.6736	2.2890	0.0000	0.0000
3.2143	1.6736	2.3386	0.0000	0.0000
3.2857	1.6736	2.3882	0.0000	0.0000
3.3571	1.6736	2.4378	0.0000	0.0000
3.4286	1.6736	2.4874	0.0000	0.0000
3.5000	1.6736	2.5370	0.0000	0.0000
3.5714	1.6736	2.5866	0.0000	0.0000
3.6429	1.6736	2.6362	0.0000	0.0000
3.7143	1.6736	2.6859	0.0000	0.0000
3.7857	1.6736	2.7355	0.0000	0.0000
3.8571	1.6736	2.7851	0.0000	0.0000
3.9286	1.6736	2.8347	0.0000	0.0000
4.0000	1.6736	2.8843	0.0000	0.0000
4.0714	1.6736	2.9339	0.0000	0.0000
4.1429	1.6736	2.9835	0.0000	0.0000
4.2143	1.6736	3.0331	0.0000	0.0000
4.2857	1.6736	3.0827	0.0000	0.0000
4.3571	1.6736	3.1323	0.0000	0.0000
4.4286	1.6736	3.1819	0.0000	0.0000
4.5000	1.6736	3.2315	0.0000	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
4.5000	1.6736	3.2315	0.0000	10.125	0.0000
4.5714	1.6736	3.3511	0.0000	10.125	0.0000
4.6429	1.6736	3.4706	0.0000	11.089	0.0000
4.7143	1.6736	3.5902	0.0531	11.571	0.0000
4.7857	1.6736	3.7097	0.0620	12.054	0.0000
4.8571	1.6736	3.8292	0.1138	12.536	0.0000
4.9286	1.6736	3.9488	0.2065	13.018	0.0000
5.0000	1.6736	4.0683	0.2736	13.500	0.0000
5.0714	1.6736	4.1879	0.3362	13.982	0.0000
5.1429	1.6736	4.3074	0.5073	14.464	0.0000
5.2143	1.6736	4.4269	0.6872	14.946	0.0000
5.2857	1.6736	4.5465	0.7239	15.429	0.0000
5.3571	1.6736	4.6660	0.9895	15.911	0.0000
5.4286	1.6736	4.7856	1.3076	16.393	0.0000
5.5000	1.6736	4.9051	1.3450	16.875	0.0000
5.5714	1.6736	5.0246	1.6814	16.875	0.0000
5.6429	1.6736	5.1442	2.1138	16.875	0.0000
5.7143	1.6736	5.2637	2.2825	16.875	0.0000
5.7857	1.6736	5.3833	2.6076	16.875	0.0000

5.8571	1.6736	5.5028	3.1654	16.875	0.0000
5.9286	1.6736	5.6223	3.5316	16.875	0.0000
6.0000	1.6736	5.7419	3.7898	16.875	0.0000
6.0714	1.6736	5.8614	4.4831	16.875	0.0000
6.1429	1.6736	5.9810	5.1210	16.875	0.0000
6.2143	1.6736	6.1005	5.2475	16.875	0.0000
6.2857	1.6736	6.2200	6.0849	16.875	0.0000
6.3571	1.6736	6.3396	6.9967	16.875	0.0000
6.4286	1.6736	6.4591	7.0772	16.875	0.0000
6.5000	1.6736	6.5787	7.9838	16.875	0.0000
6.5000	1.6736	6.5787	9.0444	16.875	0.0000

Gravel Trench Bed 1

Bottom Length:	270.00 ft.
Bottom Width:	270.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	5
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	1
Wetted surface area On	
Total Volume Infiltrated (ac-ft.):	12.558
Total Volume Through Riser (ac-ft.):	0.301
Total Volume Through Facility (ac-ft.):	12.859
Percent Infiltrated:	97.66
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	3 ft.
Riser Diameter:	24 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

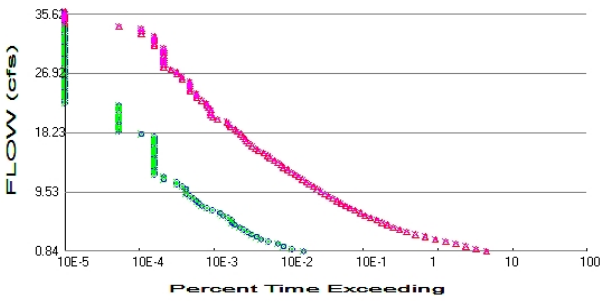
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	1.673	0.000	0.000	0.000
0.0556	1.673	0.032	0.000	3.375
0.1111	1.673	0.065	0.000	3.375
0.1667	1.673	0.097	0.000	3.375
0.2222	1.673	0.130	0.000	3.375
0.2778	1.673	0.162	0.000	3.375
0.3333	1.673	0.195	0.000	3.375
0.3889	1.673	0.227	0.000	3.375
0.4444	1.673	0.260	0.000	3.375
0.5000	1.673	0.292	0.000	3.375
0.5556	1.673	0.325	0.000	3.375
0.6111	1.673	0.358	0.000	3.375
0.6667	1.673	0.390	0.000	3.375
0.7222	1.673	0.423	0.000	3.375
0.7778	1.673	0.455	0.000	3.375
0.8333	1.673	0.488	0.000	3.375
0.8889	1.673	0.520	0.000	3.375
0.9444	1.673	0.553	0.000	3.375
1.0000	1.673	0.585	0.000	3.375
1.0556	1.673	0.618	0.000	3.375
1.1111	1.673	0.650	0.000	3.375
1.1667	1.673	0.683	0.000	3.375
1.2222	1.673	0.715	0.000	3.375
1.2778	1.673	0.748	0.000	3.375

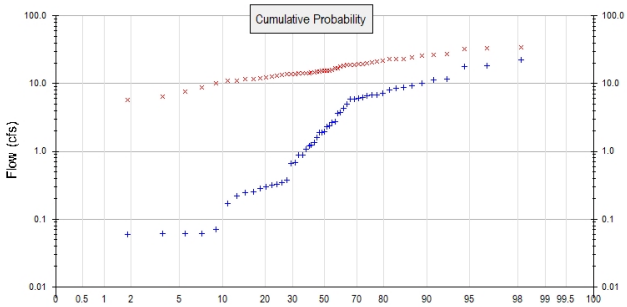
1.3333	1.673	0.781	0.000	3.375
1.3889	1.673	0.813	0.000	3.375
1.4444	1.673	0.846	0.000	3.375
1.5000	1.673	0.878	0.000	3.375
1.5556	1.673	0.911	0.000	3.375
1.6111	1.673	0.943	0.000	3.375
1.6667	1.673	0.976	0.000	3.375
1.7222	1.673	1.008	0.000	3.375
1.7778	1.673	1.041	0.000	3.375
1.8333	1.673	1.073	0.000	3.375
1.8889	1.673	1.106	0.000	3.375
1.9444	1.673	1.138	0.000	3.375
2.0000	1.673	1.171	0.000	3.375
2.0556	1.673	1.204	0.000	3.375
2.1111	1.673	1.236	0.000	3.375
2.1667	1.673	1.269	0.000	3.375
2.2222	1.673	1.301	0.000	3.375
2.2778	1.673	1.334	0.000	3.375
2.3333	1.673	1.366	0.000	3.375
2.3889	1.673	1.399	0.000	3.375
2.4444	1.673	1.431	0.000	3.375
2.5000	1.673	1.464	0.000	3.375
2.5556	1.673	1.496	0.000	3.375
2.6111	1.673	1.529	0.000	3.375
2.6667	1.673	1.562	0.000	3.375
2.7222	1.673	1.594	0.000	3.375
2.7778	1.673	1.627	0.000	3.375
2.8333	1.673	1.659	0.000	3.375
2.8889	1.673	1.692	0.000	3.375
2.9444	1.673	1.724	0.000	3.375
3.0000	1.673	1.757	0.000	3.375
3.0556	1.673	1.789	0.277	3.375
3.1111	1.673	1.822	0.784	3.375
3.1667	1.673	1.854	1.438	3.375
3.2222	1.673	1.887	2.205	3.375
3.2778	1.673	1.919	3.059	3.375
3.3333	1.673	1.952	3.979	3.375
3.3889	1.673	1.985	4.939	3.375
3.4444	1.673	2.017	5.917	3.375
3.5000	1.673	2.050	6.887	3.375
3.5556	1.673	2.082	7.826	3.375
3.6111	1.673	2.115	8.711	3.375
3.6667	1.673	2.147	9.523	3.375
3.7222	1.673	2.180	10.24	3.375
3.7778	1.673	2.212	10.86	3.375
3.8333	1.673	2.245	11.38	3.375
3.8889	1.673	2.277	11.81	3.375
3.9444	1.673	2.310	12.16	3.375
4.0000	1.673	2.343	12.46	3.375
4.0556	1.673	2.375	12.94	3.375
4.1111	1.673	2.408	13.28	3.375
4.1667	1.673	2.440	13.60	3.375
4.2222	1.673	2.473	13.92	3.375
4.2778	1.673	2.505	14.24	3.375
4.3333	1.673	2.538	14.54	3.375
4.3889	1.673	2.570	14.84	3.375
4.4444	1.673	2.603	15.14	3.375
4.5000	1.673	2.635	15.43	3.375

4.5556	1.673	2.668	15.71	3.375
4.6111	1.673	2.700	15.99	3.375
4.6667	1.673	2.733	16.26	3.375
4.7222	1.673	2.766	16.53	3.375
4.7778	1.673	2.798	16.79	3.375
4.8333	1.673	2.831	17.05	3.375
4.8889	1.673	2.863	17.31	3.375
4.9444	1.673	2.896	17.56	3.375
5.0000	1.673	2.928	17.81	3.375

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 75.858
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 9.462
Total Impervious Area: 66.396

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	1.670079
5 year	6.542852
10 year	12.548052
25 year	24.004219
50 year	35.616656
100 year	49.985137

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	16.233163
5 year	22.237087
10 year	25.642726
25 year	29.385321
50 year	31.824944
100 year	34.011067

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1956	11.783	20.849
1957	1.196	23.161
1958	18.091	23.233
1959	4.306	15.629
1960	17.947	24.220
1961	8.737	18.992
1962	22.286	22.757
1963	6.564	26.517
1964	3.685	16.922
1965	1.955	15.433

1966	0.245	14.323
1967	0.893	11.648
1968	0.171	10.007
1969	0.878	14.874
1970	1.246	11.115
1971	7.985	17.904
1972	5.931	14.145
1973	0.282	11.049
1974	8.563	20.064
1975	9.230	33.703
1976	4.984	19.669
1977	0.061	13.058
1978	10.008	20.342
1979	0.320	11.515
1980	0.667	14.348
1981	1.062	16.016
1982	5.823	13.914
1983	2.380	19.155
1984	7.258	14.153
1985	0.217	14.478
1986	6.770	18.775
1987	0.347	18.336
1988	0.071	13.572
1989	0.250	6.508
1990	2.649	13.690
1991	6.257	16.913
1992	0.326	12.653
1993	1.578	11.828
1994	1.367	8.665
1995	0.378	21.604
1996	11.319	25.823
1997	2.742	15.649
1998	2.320	32.629
1999	0.297	7.677
2000	0.684	14.529
2001	0.054	4.186
2002	1.908	34.153
2003	0.060	27.586
2004	0.060	5.656
2005	0.061	15.214
2006	3.717	13.999
2007	6.143	18.747
2008	1.895	12.420
2009	6.779	15.371

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	22.2864	34.1531
2	18.0910	33.7027
3	17.9468	32.6294
4	11.7830	27.5863
5	11.3193	26.5168
6	10.0080	25.8225
7	9.2298	24.2195
8	8.7370	23.2331
9	8.5630	23.1614
10	7.9849	22.7572

11	7.2581	21.6043
12	6.7787	20.8486
13	6.7703	20.3423
14	6.5635	20.0637
15	6.2565	19.6689
16	6.1427	19.1554
17	5.9314	18.9916
18	5.8228	18.7749
19	4.9844	18.7467
20	4.3062	18.3363
21	3.7170	17.9043
22	3.6851	16.9224
23	2.7417	16.9125
24	2.6495	16.0159
25	2.3802	15.6489
26	2.3197	15.6294
27	1.9547	15.4333
28	1.9082	15.3714
29	1.8954	15.2138
30	1.5777	14.8740
31	1.3666	14.5286
32	1.2462	14.4775
33	1.1956	14.3481
34	1.0620	14.3226
35	0.8929	14.1533
36	0.8782	14.1449
37	0.6839	13.9987
38	0.6671	13.9144
39	0.3777	13.6904
40	0.3468	13.5717
41	0.3264	13.0576
42	0.3199	12.6530
43	0.2971	12.4203
44	0.2819	11.8284
45	0.2497	11.6482
46	0.2449	11.5151
47	0.2167	11.1151
48	0.1708	11.0490
49	0.0708	10.0069
50	0.0611	8.6654
51	0.0608	7.6767
52	0.0604	6.5083
53	0.0603	5.6563
54	0.0543	4.1859

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.8350	300	84223	28074	Fail
1.1864	207	61179	29555	Fail
1.5377	161	45046	27978	Fail
1.8890	135	32758	24265	Fail
2.2404	100	24010	24010	Fail
2.5917	81	17430	21518	Fail
2.9430	70	12757	18224	Fail
3.2943	60	9483	15805	Fail
3.6457	52	7239	13921	Fail
3.9970	47	5771	12278	Fail
4.3483	42	4743	11292	Fail
4.6997	36	3969	11025	Fail
5.0510	33	3348	10145	Fail
5.4023	32	2857	8928	Fail
5.7537	29	2361	8141	Fail
6.1050	25	1979	7916	Fail
6.4563	23	1720	7478	Fail
6.8076	18	1454	8077	Fail
7.1590	15	1254	8360	Fail
7.5103	13	1093	8407	Fail
7.8616	12	951	7925	Fail
8.2130	11	833	7572	Fail
8.5643	10	740	7400	Fail
8.9156	9	647	7188	Fail
9.2669	8	579	7237	Fail
9.6183	8	512	6400	Fail
9.9696	8	452	5650	Fail
10.3209	7	404	5771	Fail
10.6723	6	355	5916	Fail
11.0236	6	326	5433	Fail
11.3749	4	289	7225	Fail
11.7263	4	255	6375	Fail
12.0776	3	230	7666	Fail
12.4289	3	205	6833	Fail
12.7802	3	182	6066	Fail
13.1316	3	159	5300	Fail
13.4829	3	148	4933	Fail
13.8342	3	136	4533	Fail
14.1856	3	121	4033	Fail
14.5369	3	107	3566	Fail
14.8882	3	99	3300	Fail
15.2395	3	88	2933	Fail
15.5909	3	74	2466	Fail
15.9422	3	68	2266	Fail
16.2935	3	61	2033	Fail
16.6449	3	55	1833	Fail
16.9962	3	51	1700	Fail
17.3475	3	49	1633	Fail
17.6989	3	46	1533	Fail
18.0502	2	43	2150	Fail
18.4015	1	38	3800	Fail
18.7528	1	36	3600	Fail
19.1042	1	31	3100	Fail
19.4555	1	30	3000	Fail

19.8068	1	28	2800	Fail
20.1582	1	21	2100	Fail
20.5095	1	18	1800	Fail
20.8608	1	17	1700	Fail
21.2121	1	17	1700	Fail
21.5635	1	17	1700	Fail
21.9148	1	16	1600	Fail
22.2661	1	15	1500	Fail
22.6175	0	15	n/a	Fail
22.9688	0	13	n/a	Fail
23.3201	0	11	n/a	Fail
23.6715	0	11	n/a	Fail
24.0228	0	11	n/a	Fail
24.3741	0	9	n/a	Fail
24.7254	0	9	n/a	Fail
25.0768	0	9	n/a	Fail
25.4281	0	9	n/a	Fail
25.7794	0	9	n/a	Fail
26.1308	0	7	n/a	Fail
26.4821	0	7	n/a	Fail
26.8334	0	6	n/a	Fail
27.1847	0	6	n/a	Fail
27.5361	0	5	n/a	Fail
27.8874	0	4	n/a	Fail
28.2387	0	4	n/a	Fail
28.5901	0	4	n/a	Fail
28.9414	0	4	n/a	Fail
29.2927	0	4	n/a	Fail
29.6441	0	4	n/a	Fail
29.9954	0	4	n/a	Fail
30.3467	0	4	n/a	Fail
30.6980	0	4	n/a	Fail
31.0494	0	3	n/a	Fail
31.4007	0	3	n/a	Fail
31.7520	0	3	n/a	Fail
32.1034	0	3	n/a	Fail
32.4547	0	3	n/a	Fail
32.8060	0	2	n/a	Fail
33.1573	0	2	n/a	Fail
33.5087	0	2	n/a	Fail
33.8600	0	1	n/a	Fail
34.2113	0	0	n/a	Pass
34.5627	0	0	0	Pass
34.9140	0	0	0	Pass
35.2653	0	0	0	Pass
35.6167	0	0	0	Pass

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

Model Default Modifications

Total of 0 changes have been made.

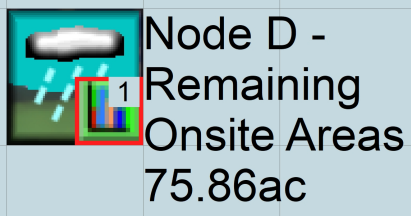
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node D.wdm
MESSU       25   Pre18591_Node D.MES
            27   Pre18591_Node D.L61
            28   Pre18591_Node D.L62
            30   POC18591_Node D1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       2
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Node D - Remaining Onsite   MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                       in  out           ***
    2     A/B, Forest, Mod        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    2         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    2         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    2         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    2               0         5         2       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    2              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    2          0.2       0.5      0.35         0       0.7       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    2              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1
```

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node D - Remaining Onsite Areas***
PERLND   2                      75.858     COPY   501     12
PERLND   2                      75.858     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *      *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------><--------> ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                     ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><--->
```

```
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM         26   18591_Node D.wdm
MESSU       25   Mit18591_Node D.MES
            27   Mit18591_Node D.L61
            28   Mit18591_Node D.L62
            30   POC18591_Node D1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       8
      IMPLND       4
      IMPLND       1
      RCHRES       1
      RCHRES       2
      RCHRES       3
      COPY         1
      COPY       501
      COPY       601
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Gravel Trench Bed 1         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  601         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    8     A/B, Lawn, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    8         0    0    1    0    0    0    0    0    0    0    0    0
```

```
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    8         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    8         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    8              0         5       0.8       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    8              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    8          0.1       0.5      0.25         0       0.7      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    8              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                    in  out           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         0    0    4    0    0    4    1    9
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    4         0    0    0    0    0
    1         0    0    0    0    0
  END IWAT-PARM1
```

```
  IWAT-PARM2
    <PLS >       IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >       IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Node D - PGIS***
IMPLND   1                     46.237     RCHRES   1      5
Node D - Non-PGIS***
PERLND   8                      9.462     COPY   501     12
PERLND   8                      9.462     COPY   601     12
PERLND   8                      9.462     COPY   501     13
PERLND   8                      9.462     COPY   601     13
IMPLND   4                     20.159     COPY   501     15
IMPLND   4                     20.159     COPY   601     15

******Routing******
RCHRES   1                           1     RCHRES   3      7
RCHRES   1                                 COPY     1     17
RCHRES   1                           1     RCHRES   2      8
RCHRES   3                           1     COPY   501     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<----------------><---> User T-series  Engl Metr LKFG             ***
                                        in  out                             ***
    1     Surface retentio-007    2    1    1    1   28    0    1
    2     Bioretention  1         1    1    1    1   28    0    1
    3     Gravel Trench Be-008    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
```

```
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1        0  1  0  0    4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
    2        0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
    3        0  1  0  0    4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN      DELTH     STCOR        KS      DB50        ***
  <------><--------><--------><--------><--------><--------><--------><--------> ***
    1              1      0.01       0.0       0.0       0.0       0.0
    2              2      0.05       0.0       0.0       0.0       0.0
    3              3      0.05       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
           *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      2
   64    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  1.673554  0.000000  0.000000
  0.071429  1.673554  0.054665  0.000000
  0.142857  1.673554  0.109331  0.000000
  0.214286  1.673554  0.163996  0.053063
  0.285714  1.673554  0.218662  0.062046
  0.357143  1.673554  0.273327  0.113823
  0.428571  1.673554  0.327993  0.206503
  0.500000  1.673554  0.382658  0.273592
  0.571429  1.673554  0.437323  0.336186
  0.642857  1.673554  0.491989  0.507312
  0.714286  1.673554  0.546654  0.687248
  0.785714  1.673554  0.601320  0.723873
  0.857143  1.673554  0.655985  0.989523
  0.928571  1.673554  0.710651  1.307648
  1.000000  1.673554  0.765316  1.344970
  1.071429  1.673554  0.819982  1.681409
  1.142857  1.673554  0.874647  2.113782
  1.214286  1.673554  0.929312  2.282526
  1.285714  1.673554  0.983978  2.607569
  1.357143  1.673554  1.038643  3.165420
  1.428571  1.673554  1.093309  3.531615
  1.500000  1.673554  1.147974  3.789831
  1.571429  1.673554  1.197583  4.483143
```

```
1.642857  1.673554  1.247192  5.121006
1.714286  1.673554  1.296801  5.247516
1.785714  1.673554  1.346410  6.084869
1.857143  1.673554  1.396019  6.996734
1.928571  1.673554  1.445628  7.077219
2.000000  1.673554  1.495237  7.983839
2.071429  1.673554  1.544845  9.044384
2.142857  1.673554  1.594454  9.424985
2.214286  1.673554  1.644063  10.12500
2.285714  1.673554  1.693672  12.82566
2.357143  1.673554  1.743281  14.15858
2.428571  1.673554  1.792890  15.05991
2.500000  1.673554  1.842499  15.63173
2.571429  1.673554  1.892108  16.18322
2.642857  1.673554  1.941717  16.71641
2.714286  1.673554  1.991326  16.87500
2.785714  1.673554  2.040935  16.87500
2.857143  1.673554  2.090544  16.87500
2.928571  1.673554  2.140152  16.87500
3.000000  1.673554  2.189761  16.87500
3.071429  1.673554  2.239370  16.87500
3.142857  1.673554  2.288979  16.87500
3.214286  1.673554  2.338588  16.87500
3.285714  1.673554  2.388197  16.87500
3.357143  1.673554  2.437806  16.87500
3.428571  1.673554  2.487415  16.87500
3.500000  1.673554  2.537024  16.87500
3.571429  1.673554  2.586633  16.87500
3.642857  1.673554  2.636242  16.87500
3.714286  1.673554  2.685851  16.87500
3.785714  1.673554  2.735459  16.87500
3.857143  1.673554  2.785068  16.87500
3.928571  1.673554  2.834677  16.87500
4.000000  1.673554  2.884286  16.87500
4.071429  1.673554  2.933895  16.87500
4.142857  1.673554  2.983504  16.87500
4.214286  1.673554  3.033113  16.87500
4.285714  1.673554  3.082722  16.87500
4.357143  1.673554  3.132331  16.87500
4.428571  1.673554  3.181940  16.87500
4.500000  1.673554  3.580206  16.87500
END FTABLE  2
FTABLE      1
 30    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  1.673554  0.000000  0.000000  0.000000
0.071429  1.673554  0.119540  0.000000  10.12501
0.142857  1.673554  0.239079  0.000000  11.08929
0.214286  1.673554  0.358619  0.000000  11.57144
0.285714  1.673554  0.478158  0.000000  12.05358
0.357143  1.673554  0.597698  0.000000  12.53572
0.428571  1.673554  0.717237  0.000000  13.01787
0.500000  1.673554  0.836777  0.000000  13.50001
0.571429  1.673554  0.956316  0.000000  13.98215
0.642857  1.673554  1.075856  0.000000  14.46430
0.714286  1.673554  1.195396  0.000000  14.94644
0.785714  1.673554  1.314935  0.000000  15.42858
0.857143  1.673554  1.434475  0.000000  15.91073
0.928571  1.673554  1.554014  0.000000  16.39287
1.000000  1.673554  1.673554  0.000000  16.87500
1.071429  1.673554  1.793093  1.013052  16.87500
1.142857  1.673554  1.912633  2.863613  16.87500
1.214286  1.673554  2.032172  5.257786  16.87500
1.285714  1.673554  2.151712  8.089179  16.87500
1.357143  1.673554  2.271251  11.29374  16.87500
1.428571  1.673554  2.390791  14.82485  16.87500
1.500000  1.673554  2.510331  18.64436  16.87500
1.571429  1.673554  2.629870  22.71831  16.87500
1.642857  1.673554  2.749410  27.01478  16.87500
```

```
1.714286  1.673554  2.868949  31.50260  16.87500
1.785714  1.673554  2.988489  36.15072  16.87500
1.857143  1.673554  3.108028  40.92774  16.87500
1.928571  1.673554  3.227568  45.80182  16.87500
2.000000  1.673554  3.347107  50.74064  16.87500
2.000000  1.673554  3.347107  55.71151  16.87500
END FTABLE  1
FTABLE      3
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  1.673554  0.000000  0.000000  0.000000
0.055556  1.673554  0.032541  0.000000  3.375000
0.111111  1.673554  0.065083  0.000000  3.375000
0.166667  1.673554  0.097624  0.000000  3.375000
0.222222  1.673554  0.130165  0.000000  3.375000
0.277778  1.673554  0.162707  0.000000  3.375000
0.333333  1.673554  0.195248  0.000000  3.375000
0.388889  1.673554  0.227789  0.000000  3.375000
0.444444  1.673554  0.260331  0.000000  3.375000
0.500000  1.673554  0.292872  0.000000  3.375000
0.555556  1.673554  0.325413  0.000000  3.375000
0.611111  1.673554  0.357955  0.000000  3.375000
0.666667  1.673554  0.390496  0.000000  3.375000
0.722222  1.673554  0.423037  0.000000  3.375000
0.777778  1.673554  0.455579  0.000000  3.375000
0.833333  1.673554  0.488120  0.000000  3.375000
0.888889  1.673554  0.520661  0.000000  3.375000
0.944444  1.673554  0.553202  0.000000  3.375000
1.000000  1.673554  0.585744  0.000000  3.375000
1.055556  1.673554  0.618285  0.000000  3.375000
1.111111  1.673554  0.650826  0.000000  3.375000
1.166667  1.673554  0.683368  0.000000  3.375000
1.222222  1.673554  0.715909  0.000000  3.375000
1.277778  1.673554  0.748450  0.000000  3.375000
1.333333  1.673554  0.780992  0.000000  3.375000
1.388889  1.673554  0.813533  0.000000  3.375000
1.444444  1.673554  0.846074  0.000000  3.375000
1.500000  1.673554  0.878616  0.000000  3.375000
1.555556  1.673554  0.911157  0.000000  3.375000
1.611111  1.673554  0.943698  0.000000  3.375000
1.666667  1.673554  0.976240  0.000000  3.375000
1.722222  1.673554  1.008781  0.000000  3.375000
1.777778  1.673554  1.041322  0.000000  3.375000
1.833333  1.673554  1.073864  0.000000  3.375000
1.888889  1.673554  1.106405  0.000000  3.375000
1.944444  1.673554  1.138946  0.000000  3.375000
2.000000  1.673554  1.171488  0.000000  3.375000
2.055556  1.673554  1.204029  0.000000  3.375000
2.111111  1.673554  1.236570  0.000000  3.375000
2.166667  1.673554  1.269112  0.000000  3.375000
2.222222  1.673554  1.301653  0.000000  3.375000
2.277778  1.673554  1.334194  0.000000  3.375000
2.333333  1.673554  1.366736  0.000000  3.375000
2.388889  1.673554  1.399277  0.000000  3.375000
2.444444  1.673554  1.431818  0.000000  3.375000
2.500000  1.673554  1.464360  0.000000  3.375000
2.555556  1.673554  1.496901  0.000000  3.375000
2.611111  1.673554  1.529442  0.000000  3.375000
2.666667  1.673554  1.561983  0.000000  3.375000
2.722222  1.673554  1.594525  0.000000  3.375000
2.777778  1.673554  1.627066  0.000000  3.375000
2.833333  1.673554  1.659607  0.000000  3.375000
2.888889  1.673554  1.692149  0.000000  3.375000
2.944444  1.673554  1.724690  0.000000  3.375000
3.000000  1.673554  1.757231  0.000000  3.375000
3.055556  1.673554  1.789773  0.277796  3.375000
3.111111  1.673554  1.822314  0.784769  3.375000
3.166667  1.673554  1.854855  1.438492  3.375000
3.222222  1.673554  1.887397  2.205262  3.375000
```

```
  3.277778  1.673554  1.919938  3.059929  3.375000
  3.333333  1.673554  1.952479  3.979211  3.375000
  3.388889  1.673554  1.985021  4.939668  3.375000
  3.444444  1.673554  2.017562  5.917238  3.375000
  3.500000  1.673554  2.050103  6.887532  3.375000
  3.555556  1.673554  2.082645  7.826549  3.375000
  3.611111  1.673554  2.115186  8.711714  3.375000
  3.666667  1.673554  2.147727  9.523132  3.375000
  3.722222  1.673554  2.180269  10.24504  3.375000
  3.777778  1.673554  2.212810  10.86741  3.375000
  3.833333  1.673554  2.245351  11.38772  3.375000
  3.888889  1.673554  2.277893  11.81283  3.375000
  3.944444  1.673554  2.310434  12.16099  3.375000
  4.000000  1.673554  2.342975  12.46394  3.375000
  4.055556  1.673554  2.375517  12.94375  3.375000
  4.111111  1.673554  2.408058  13.28001  3.375000
  4.166667  1.673554  2.440599  13.60796  3.375000
  4.222222  1.673554  2.473140  13.92819  3.375000
  4.277778  1.673554  2.505682  14.24122  3.375000
  4.333333  1.673554  2.538223  14.54752  3.375000
  4.388889  1.673554  2.570764  14.84750  3.375000
  4.444444  1.673554  2.603306  15.14154  3.375000
  4.500000  1.673554  2.635847  15.42997  3.375000
  4.555556  1.673554  2.668388  15.71312  3.375000
  4.611111  1.673554  2.700930  15.99125  3.375000
  4.666667  1.673554  2.733471  16.26462  3.375000
  4.722222  1.673554  2.766012  16.53347  3.375000
  4.777778  1.673554  2.798554  16.79803  3.375000
  4.833333  1.673554  2.831095  17.05848  3.375000
  4.888889  1.673554  2.863636  17.31501  3.375000
  4.944444  1.673554  2.896178  17.56780  3.375000
  5.000000  1.673554  2.928719  17.81700  3.375000
  5.055556  1.673554  3.021694  18.06276  3.375000
  END FTABLE  3
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1.429          RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   2     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
RCHRES   3 HYDR   RO     1 1        1      WDM   1006 FLOW     ENGL      REPL
RCHRES   3 HYDR   O      1 1        1      WDM   1008 FLOW     ENGL      REPL
RCHRES   3 HYDR   O      2 1        1      WDM   1009 FLOW     ENGL      REPL
RCHRES   3 HYDR   STAGE  1 1        1      WDM   1007 STAG     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>             <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
```

```
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Mitigated HSPF Message File

Disclaimer

Legal Notice

This program and accompanying documentation are provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc. be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions Inc. or their authorized representatives have been advised of the possibility of such damages. Software Copyright © by : Clear Creek Solutions, Inc. 2005-2025; All Rights Reserved.

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: 18591_Node E

Site Name:	LOTC
Site Address:	
City:	Castle Rock, WA
Report Date:	3/7/2025
Gage:	Longview
Data Start:	1955/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.429
Version Date:	2024/06/28
Version:	4.3.1

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year
Low Flow Threshold for POC2:	50 Percent of the 2 Year
High Flow Threshold for POC2:	50 Year

Landuse Basin Data
Predeveloped Land Use

Node E - Offsite

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Forest, Mod	31.732
Pervious Total	31.732

Impervious Land Use	acre
Impervious Total	0
Basin Total	31.732

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Node E - Larson Runoff

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Mod	0.263
Pervious Total	0.263
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.263

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 2	POC 2

Mitigated Land Use

Node E - Offsite

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Mod	25.386
Pervious Total	25.386

Impervious Land Use	acre
ROOF TOPS FLAT	6.346
Impervious Total	6.346
Basin Total	31.732

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Node E - Larson Runoff

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Mod	0.107
Pervious Total	0.107

Impervious Land Use	acre
ROADS FLAT	0.156
Impervious Total	0.156
Basin Total	0.263

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Surface retention 1	Surface retention 1	POC 1

Mitigated Routing

Bioretention 1

Bottom Length:	20.00 ft.
Bottom Width:	5.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	1.5
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	1
Orifice Diameter (in.):	12
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	34.447
Total Outflow (ac-ft.):	38.031
Percent Through Underdrain:	90.58
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	
Gravel Trench Bed 1	

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0023	0.0000	0.0000	0.0000
0.0440	0.0023	0.0000	0.0000	0.0000
0.0879	0.0023	0.0001	0.0000	0.0000
0.1319	0.0023	0.0001	0.0000	0.0000
0.1758	0.0023	0.0002	0.0000	0.0000
0.2198	0.0023	0.0002	0.0000	0.0000
0.2637	0.0023	0.0003	0.0000	0.0000
0.3077	0.0023	0.0003	0.0000	0.0000
0.3516	0.0023	0.0004	0.0000	0.0000
0.3956	0.0023	0.0004	0.0000	0.0000
0.4396	0.0023	0.0005	0.0000	0.0000
0.4835	0.0023	0.0005	0.0000	0.0000
0.5275	0.0023	0.0006	0.0000	0.0000
0.5714	0.0023	0.0006	0.0000	0.0000
0.6154	0.0023	0.0006	0.0000	0.0000
0.6593	0.0023	0.0007	0.0000	0.0000
0.7033	0.0023	0.0007	0.0000	0.0000
0.7473	0.0023	0.0008	0.0000	0.0000
0.7912	0.0023	0.0008	0.0000	0.0000
0.8352	0.0023	0.0009	0.0000	0.0000
0.8791	0.0023	0.0009	0.0000	0.0000
0.9231	0.0023	0.0010	0.0000	0.0000
0.9670	0.0023	0.0010	0.0000	0.0000
1.0110	0.0023	0.0011	0.0000	0.0000
1.0549	0.0023	0.0011	0.0000	0.0000
1.0989	0.0023	0.0012	0.0000	0.0000
1.1429	0.0023	0.0012	0.0000	0.0000
1.1868	0.0023	0.0012	0.0000	0.0000

1.2308	0.0023	0.0013	0.0000	0.0000
1.2747	0.0023	0.0013	0.0000	0.0000
1.3187	0.0023	0.0014	0.0000	0.0000
1.3626	0.0023	0.0014	0.0000	0.0000
1.4066	0.0023	0.0015	0.0000	0.0000
1.4505	0.0023	0.0015	0.0000	0.0000
1.4945	0.0023	0.0016	0.0000	0.0000
1.5385	0.0023	0.0016	0.0000	0.0000
1.5824	0.0023	0.0017	0.0000	0.0000
1.6264	0.0023	0.0017	0.0000	0.0000
1.6703	0.0023	0.0017	0.0000	0.0000
1.7143	0.0023	0.0018	0.0000	0.0000
1.7582	0.0023	0.0018	0.0000	0.0000
1.8022	0.0023	0.0019	0.0000	0.0000
1.8462	0.0023	0.0019	0.0000	0.0000
1.8901	0.0023	0.0019	0.0000	0.0000
1.9341	0.0023	0.0020	0.0000	0.0000
1.9780	0.0023	0.0020	0.0000	0.0000
2.0220	0.0023	0.0021	0.0000	0.0000
2.0659	0.0023	0.0021	0.0000	0.0000
2.1099	0.0023	0.0022	0.0000	0.0000
2.1538	0.0023	0.0022	0.0000	0.0000
2.1978	0.0023	0.0022	0.0000	0.0000
2.2418	0.0023	0.0023	0.0000	0.0000
2.2857	0.0023	0.0023	0.0000	0.0000
2.3297	0.0023	0.0024	0.0000	0.0000
2.3736	0.0023	0.0024	0.0000	0.0000
2.4176	0.0023	0.0024	0.0000	0.0000
2.4615	0.0023	0.0025	0.0000	0.0000
2.5055	0.0023	0.0025	0.0000	0.0000
2.5495	0.0023	0.0026	0.0000	0.0000
2.5934	0.0023	0.0026	0.0000	0.0000
2.6374	0.0023	0.0027	0.0000	0.0000
2.6813	0.0023	0.0027	0.0000	0.0000
2.7253	0.0023	0.0027	0.0000	0.0000
2.7692	0.0023	0.0028	0.0000	0.0000
2.8132	0.0023	0.0028	0.0000	0.0000
2.8571	0.0023	0.0029	0.0000	0.0000
2.9011	0.0023	0.0029	0.0000	0.0000
2.9451	0.0023	0.0030	0.0000	0.0000
2.9890	0.0023	0.0030	0.0000	0.0000
3.0000	0.0023	0.0030	0.0000	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0023	0.0030	0.0000	0.0139	0.0000
3.0440	0.0023	0.0031	0.0000	0.0139	0.0000
3.0879	0.0023	0.0032	0.0000	0.0147	0.0000
3.1319	0.0023	0.0033	0.0000	0.0151	0.0000
3.1758	0.0023	0.0034	0.0000	0.0155	0.0000
3.2198	0.0023	0.0035	0.0001	0.0159	0.0000
3.2637	0.0023	0.0036	0.0001	0.0163	0.0000
3.3077	0.0023	0.0037	0.0002	0.0167	0.0000
3.3516	0.0023	0.0038	0.0002	0.0171	0.0000
3.3956	0.0023	0.0039	0.0003	0.0176	0.0000
3.4396	0.0023	0.0040	0.0004	0.0180	0.0000
3.4835	0.0023	0.0041	0.0006	0.0184	0.0000
3.5275	0.0023	0.0042	0.0007	0.0185	0.0000

3.5714	0.0023	0.0043	0.0007	0.0185	0.0000
3.6154	0.0023	0.0044	0.0009	0.0185	0.0000
3.6593	0.0023	0.0045	0.0011	0.0185	0.0000
3.7033	0.0023	0.0046	0.0014	0.0185	0.0000
3.7473	0.0023	0.0047	0.0016	0.0185	0.0000
3.7912	0.0023	0.0048	0.0017	0.0185	0.0000
3.8352	0.0023	0.0049	0.0019	0.0185	0.0000
3.8791	0.0023	0.0050	0.0022	0.0185	0.0000
3.9231	0.0023	0.0051	0.0026	0.0185	0.0000
3.9670	0.0023	0.0052	0.0029	0.0185	0.0000
4.0000	0.0023	0.0053	0.0033	0.0185	0.0000

Gravel Trench Bed 1

Bottom Length:	20.00 ft.
Bottom Width:	5.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	5
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	1
Wetted surface area On	
Total Volume Infiltrated (ac-ft.):	2.163
Total Volume Through Riser (ac-ft.):	1.42
Total Volume Through Facility (ac-ft.):	3.584
Percent Infiltrated:	60.35
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	3 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

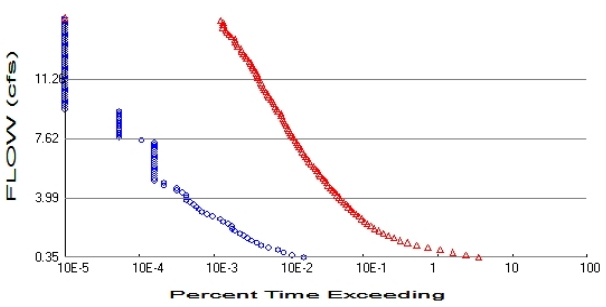
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.002	0.000	0.000	0.000
0.0556	0.002	0.000	0.000	0.004
0.1111	0.002	0.000	0.000	0.004
0.1667	0.002	0.000	0.000	0.004
0.2222	0.002	0.000	0.000	0.004
0.2778	0.002	0.000	0.000	0.004
0.3333	0.002	0.000	0.000	0.004
0.3889	0.002	0.000	0.000	0.004
0.4444	0.002	0.000	0.000	0.004
0.5000	0.002	0.000	0.000	0.004
0.5556	0.002	0.000	0.000	0.004
0.6111	0.002	0.000	0.000	0.004
0.6667	0.002	0.000	0.000	0.004
0.7222	0.002	0.000	0.000	0.004
0.7778	0.002	0.000	0.000	0.004
0.8333	0.002	0.000	0.000	0.004
0.8889	0.002	0.000	0.000	0.004
0.9444	0.002	0.000	0.000	0.004
1.0000	0.002	0.000	0.000	0.004
1.0556	0.002	0.000	0.000	0.004
1.1111	0.002	0.000	0.000	0.004
1.1667	0.002	0.000	0.000	0.004
1.2222	0.002	0.001	0.000	0.004
1.2778	0.002	0.001	0.000	0.004

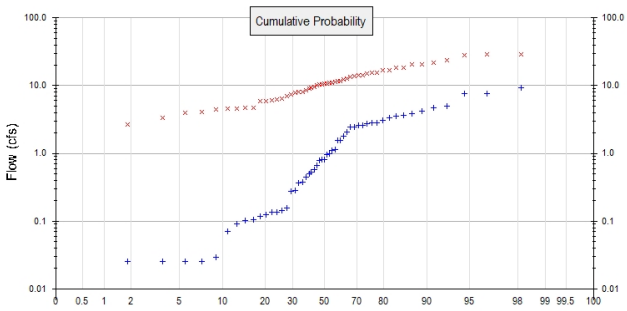
1.3333	0.002	0.001	0.000	0.004
1.3889	0.002	0.001	0.000	0.004
1.4444	0.002	0.001	0.000	0.004
1.5000	0.002	0.001	0.000	0.004
1.5556	0.002	0.001	0.000	0.004
1.6111	0.002	0.001	0.000	0.004
1.6667	0.002	0.001	0.000	0.004
1.7222	0.002	0.001	0.000	0.004
1.7778	0.002	0.001	0.000	0.004
1.8333	0.002	0.001	0.000	0.004
1.8889	0.002	0.001	0.000	0.004
1.9444	0.002	0.001	0.000	0.004
2.0000	0.002	0.001	0.000	0.004
2.0556	0.002	0.001	0.000	0.004
2.1111	0.002	0.001	0.000	0.004
2.1667	0.002	0.001	0.000	0.004
2.2222	0.002	0.001	0.000	0.004
2.2778	0.002	0.001	0.000	0.004
2.3333	0.002	0.001	0.000	0.004
2.3889	0.002	0.001	0.000	0.004
2.4444	0.002	0.002	0.000	0.004
2.5000	0.002	0.002	0.000	0.004
2.5556	0.002	0.002	0.000	0.004
2.6111	0.002	0.002	0.000	0.004
2.6667	0.002	0.002	0.000	0.004
2.7222	0.002	0.002	0.000	0.004
2.7778	0.002	0.002	0.000	0.004
2.8333	0.002	0.002	0.000	0.004
2.8889	0.002	0.002	0.000	0.004
2.9444	0.002	0.002	0.000	0.004
3.0000	0.002	0.002	0.000	0.004
3.0556	0.002	0.002	0.138	0.004
3.1111	0.002	0.002	0.389	0.004
3.1667	0.002	0.002	0.703	0.004
3.2222	0.002	0.002	1.046	0.004
3.2778	0.002	0.002	1.383	0.004
3.3333	0.002	0.002	1.683	0.004
3.3889	0.002	0.002	1.921	0.004
3.4444	0.002	0.002	2.088	0.004
3.5000	0.002	0.002	2.203	0.004
3.5556	0.002	0.002	2.347	0.004
3.6111	0.002	0.002	2.462	0.004
3.6667	0.002	0.002	2.571	0.004
3.7222	0.002	0.003	2.676	0.004
3.7778	0.002	0.003	2.777	0.004
3.8333	0.002	0.003	2.875	0.004
3.8889	0.002	0.003	2.969	0.004
3.9444	0.002	0.003	3.060	0.004
4.0000	0.002	0.003	3.149	0.004
4.0556	0.002	0.003	3.235	0.004
4.1111	0.002	0.003	3.320	0.004
4.1667	0.002	0.003	3.402	0.004
4.2222	0.002	0.003	3.482	0.004
4.2778	0.002	0.003	3.560	0.004
4.3333	0.002	0.003	3.636	0.004
4.3889	0.002	0.003	3.711	0.004
4.4444	0.002	0.003	3.785	0.004
4.5000	0.002	0.003	3.857	0.004

4.5556	0.002	0.003	3.928	0.004
4.6111	0.002	0.003	3.997	0.004
4.6667	0.002	0.003	4.066	0.004
4.7222	0.002	0.003	4.133	0.004
4.7778	0.002	0.003	4.199	0.004
4.8333	0.002	0.003	4.264	0.004
4.8889	0.002	0.003	4.328	0.004
4.9444	0.002	0.004	4.391	0.004
5.0000	0.002	0.004	4.454	0.004

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 31.732
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 25.386
Total Impervious Area: 6.346

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.698607
5 year	2.736926
10 year	5.248949
25 year	10.041153
50 year	14.898727
100 year	20.909175

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	10.181605
5 year	16.645989
10 year	20.920649
25 year	26.152545
50 year	29.881953
100 year	33.451577

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	4.929	18.492
1957	0.500	14.150
1958	7.568	18.468
1959	1.801	11.186
1960	7.507	20.649
1961	3.655	13.271
1962	9.323	20.388
1963	2.746	23.662
1964	1.541	11.684
1965	0.818	6.157

1966	0.102	4.539
1967	0.374	5.969
1968	0.071	4.412
1969	0.367	10.206
1970	0.521	7.051
1971	3.340	15.385
1972	2.481	10.422
1973	0.118	6.455
1974	3.582	16.943
1975	3.861	29.087
1976	2.085	13.884
1977	0.025	4.692
1978	4.186	14.240
1979	0.134	5.997
1980	0.279	9.360
1981	0.444	7.936
1982	2.436	10.529
1983	0.996	12.806
1984	3.036	10.830
1985	0.091	4.597
1986	2.832	16.637
1987	0.145	10.877
1988	0.030	8.578
1989	0.104	3.338
1990	1.108	9.592
1991	2.617	12.293
1992	0.137	4.696
1993	0.660	8.007
1994	0.572	3.999
1995	0.158	15.682
1996	4.735	21.445
1997	1.147	11.075
1998	0.970	28.091
1999	0.124	4.137
2000	0.286	7.504
2001	0.023	1.320
2002	0.798	28.796
2003	0.025	8.959
2004	0.025	2.686
2005	0.026	5.945
2006	1.555	10.670
2007	2.570	14.987
2008	0.793	8.057
2009	2.836	11.702

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	9.3226	29.0871
2	7.5676	28.7959
3	7.5073	28.0914
4	4.9289	23.6615
5	4.7350	21.4449
6	4.1865	20.6489
7	3.8609	20.3880
8	3.6548	18.4916
9	3.5820	18.4681
10	3.3401	16.9431

11	3.0361	16.6366
12	2.8356	15.6821
13	2.8321	15.3847
14	2.7456	14.9865
15	2.6171	14.2395
16	2.5696	14.1504
17	2.4811	13.8837
18	2.4357	13.2711
19	2.0850	12.8064
20	1.8013	12.2932
21	1.5549	11.7017
22	1.5415	11.6841
23	1.1469	11.1855
24	1.1083	11.0754
25	0.9957	10.8771
26	0.9703	10.8299
27	0.8177	10.6703
28	0.7982	10.5291
29	0.7928	10.4224
30	0.6600	10.2060
31	0.5717	9.5925
32	0.5213	9.3598
33	0.5001	8.9586
34	0.4442	8.5780
35	0.3735	8.0573
36	0.3674	8.0067
37	0.2861	7.9357
38	0.2790	7.5044
39	0.1580	7.0513
40	0.1451	6.4546
41	0.1365	6.1567
42	0.1338	5.9974
43	0.1243	5.9695
44	0.1179	5.9449
45	0.1045	4.6964
46	0.1024	4.6918
47	0.0906	4.5974
48	0.0715	4.5392
49	0.0296	4.4116
50	0.0255	4.1370
51	0.0254	3.9986
52	0.0253	3.3379
53	0.0252	2.6857
54	0.0227	1.3197

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.3493	300	66557	22185	Fail
0.4963	207	44706	21597	Fail
0.6432	161	30031	18652	Fail
0.7902	135	20204	14965	Fail
0.9372	100	13879	13878	Fail
1.0841	81	9877	12193	Fail
1.2311	70	7426	10608	Fail
1.3781	60	5889	9815	Fail
1.5250	52	4874	9373	Fail
1.6720	47	4115	8755	Fail
1.8189	42	3511	8359	Fail
1.9659	36	3056	8488	Fail
2.1129	33	2687	8142	Fail
2.2598	32	2373	7415	Fail
2.4068	29	2123	7320	Fail
2.5538	25	1952	7808	Fail
2.7007	23	1787	7769	Fail
2.8477	18	1648	9155	Fail
2.9947	15	1504	10026	Fail
3.1416	13	1380	10615	Fail
3.2886	12	1290	10750	Fail
3.4355	11	1198	10890	Fail
3.5825	10	1115	11150	Fail
3.7295	9	1030	11444	Fail
3.8764	8	952	11900	Fail
4.0234	8	898	11225	Fail
4.1704	8	842	10525	Fail
4.3173	7	788	11257	Fail
4.4643	6	739	12316	Fail
4.6113	6	687	11450	Fail
4.7582	4	637	15925	Fail
4.9052	4	610	15250	Fail
5.0521	3	578	19266	Fail
5.1991	3	543	18100	Fail
5.3461	3	502	16733	Fail
5.4930	3	480	16000	Fail
5.6400	3	456	15200	Fail
5.7870	3	430	14333	Fail
5.9339	3	404	13466	Fail
6.0809	3	375	12500	Fail
6.2279	3	356	11866	Fail
6.3748	3	335	11166	Fail
6.5218	3	319	10633	Fail
6.6688	3	304	10133	Fail
6.8157	3	290	9666	Fail
6.9627	3	276	9200	Fail
7.1096	3	260	8666	Fail
7.2566	3	252	8400	Fail
7.4036	3	242	8066	Fail
7.5505	2	231	11550	Fail
7.6975	1	217	21700	Fail
7.8445	1	206	20600	Fail
7.9914	1	198	19800	Fail
8.1384	1	189	18900	Fail

8.2854	1	182	18200	Fail
8.4323	1	174	17400	Fail
8.5793	1	168	16800	Fail
8.7262	1	163	16300	Fail
8.8732	1	158	15800	Fail
9.0202	1	150	15000	Fail
9.1671	1	148	14800	Fail
9.3141	1	136	13600	Fail
9.4611	0	131	n/a	Fail
9.6080	0	123	n/a	Fail
9.7550	0	120	n/a	Fail
9.9020	0	115	n/a	Fail
10.0489	0	109	n/a	Fail
10.1959	0	103	n/a	Fail
10.3428	0	98	n/a	Fail
10.4898	0	94	n/a	Fail
10.6368	0	89	n/a	Fail
10.7837	0	86	n/a	Fail
10.9307	0	83	n/a	Fail
11.0777	0	81	n/a	Fail
11.2246	0	77	n/a	Fail
11.3716	0	73	n/a	Fail
11.5186	0	71	n/a	Fail
11.6655	0	70	n/a	Fail
11.8125	0	65	n/a	Fail
11.9594	0	62	n/a	Fail
12.1064	0	61	n/a	Fail
12.2534	0	59	n/a	Fail
12.4003	0	56	n/a	Fail
12.5473	0	51	n/a	Fail
12.6943	0	50	n/a	Fail
12.8412	0	46	n/a	Fail
12.9882	0	45	n/a	Fail
13.1352	0	44	n/a	Fail
13.2821	0	39	n/a	Fail
13.4291	0	38	n/a	Fail
13.5761	0	36	n/a	Fail
13.7230	0	36	n/a	Fail
13.8700	0	32	n/a	Fail
14.0169	0	30	n/a	Fail
14.1639	0	28	n/a	Fail
14.3109	0	27	n/a	Fail
14.4578	0	25	n/a	Fail
14.6048	0	25	n/a	Fail
14.7518	0	25	n/a	Fail
14.8987	0	23	n/a	Fail

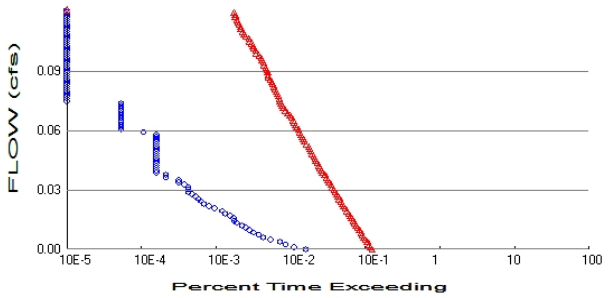
The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

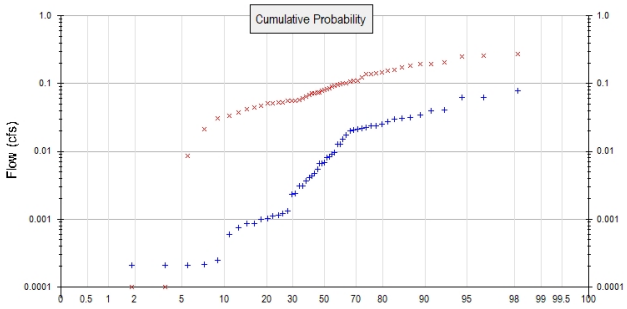
Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

POC 2





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 0.263
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2
Total Pervious Area: 0.107
Total Impervious Area: 0.156

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.00579
5 year	0.022684
10 year	0.043504
25 year	0.083223
50 year	0.123483
100 year	0.173299

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	0.105461
5 year	0.168787
10 year	0.205135
25 year	0.243928
50 year	0.268061
100 year	0.288656

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	**Predeveloped**	**Mitigated**
1956	0.041	0.155
1957	0.004	0.143
1958	0.063	0.172
1959	0.015	0.078
1960	0.062	0.181
1961	0.030	0.111
1962	0.077	0.111
1963	0.023	0.205
1964	0.013	0.102
1965	0.007	0.051
1966	0.001	0.031

1967	0.003	0.056
1968	0.001	0.052
1969	0.003	0.044
1970	0.004	0.056
1971	0.028	0.064
1972	0.021	0.093
1973	0.001	0.051
1974	0.030	0.148
1975	0.032	0.248
1976	0.017	0.058
1977	0.000	0.022
1978	0.035	0.123
1979	0.001	0.047
1980	0.002	0.089
1981	0.004	0.074
1982	0.020	0.096
1983	0.008	0.071
1984	0.025	0.097
1985	0.001	0.056
1986	0.023	0.140
1987	0.001	0.101
1988	0.000	0.038
1989	0.001	0.000
1990	0.009	0.072
1991	0.022	0.061
1992	0.001	0.042
1993	0.005	0.074
1994	0.005	0.009
1995	0.001	0.160
1996	0.039	0.196
1997	0.010	0.084
1998	0.008	0.259
1999	0.001	0.034
2000	0.002	0.085
2001	0.000	0.000
2002	0.007	0.273
2003	0.000	0.193
2004	0.000	0.000
2005	0.000	0.052
2006	0.013	0.069
2007	0.021	0.137
2008	0.007	0.080
2009	0.024	0.108

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	0.0773	0.2727
2	0.0627	0.2588
3	0.0622	0.2484
4	0.0409	0.2052
5	0.0392	0.1964
6	0.0347	0.1934
7	0.0320	0.1809
8	0.0303	0.1720
9	0.0297	0.1599
10	0.0277	0.1547
11	0.0252	0.1478

12	0.0235	0.1425
13	0.0235	0.1400
14	0.0228	0.1374
15	0.0217	0.1226
16	0.0213	0.1112
17	0.0206	0.1110
18	0.0202	0.1081
19	0.0173	0.1020
20	0.0149	0.1010
21	0.0129	0.0975
22	0.0128	0.0963
23	0.0095	0.0934
24	0.0092	0.0893
25	0.0083	0.0849
26	0.0080	0.0835
27	0.0068	0.0797
28	0.0066	0.0783
29	0.0066	0.0737
30	0.0055	0.0735
31	0.0047	0.0717
32	0.0043	0.0710
33	0.0041	0.0688
34	0.0037	0.0643
35	0.0031	0.0612
36	0.0030	0.0576
37	0.0024	0.0564
38	0.0023	0.0561
39	0.0013	0.0559
40	0.0012	0.0520
41	0.0011	0.0520
42	0.0011	0.0512
43	0.0010	0.0507
44	0.0010	0.0475
45	0.0009	0.0443
46	0.0008	0.0425
47	0.0008	0.0377
48	0.0006	0.0338
49	0.0002	0.0311
50	0.0002	0.0215
51	0.0002	0.0085
52	0.0002	0.0000
53	0.0002	0.0000
54	0.0002	0.0000

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0029	300	2335	778	Fail
0.0041	207	2210	1067	Fail
0.0053	161	2113	1312	Fail
0.0065	135	2001	1482	Fail
0.0078	100	1893	1893	Fail
0.0090	81	1797	2218	Fail
0.0102	70	1721	2458	Fail
0.0114	60	1656	2760	Fail
0.0126	52	1573	3025	Fail
0.0139	47	1493	3176	Fail
0.0151	42	1427	3397	Fail
0.0163	36	1361	3780	Fail
0.0175	33	1296	3927	Fail
0.0187	32	1234	3856	Fail
0.0199	29	1184	4082	Fail
0.0212	25	1134	4536	Fail
0.0224	23	1069	4647	Fail
0.0236	18	1016	5644	Fail
0.0248	15	963	6419	Fail
0.0260	13	927	7130	Fail
0.0273	12	893	7441	Fail
0.0285	11	850	7727	Fail
0.0297	10	813	8130	Fail
0.0309	9	782	8688	Fail
0.0321	8	747	9337	Fail
0.0333	8	721	9012	Fail
0.0346	8	683	8537	Fail
0.0358	7	653	9328	Fail
0.0370	6	622	10366	Fail
0.0382	6	594	9900	Fail
0.0394	4	569	14225	Fail
0.0407	4	541	13525	Fail
0.0419	3	506	16866	Fail
0.0431	3	485	16166	Fail
0.0443	3	470	15666	Fail
0.0455	3	451	15033	Fail
0.0467	3	427	14233	Fail
0.0480	3	411	13700	Fail
0.0492	3	400	13333	Fail
0.0504	3	385	12833	Fail
0.0516	3	369	12300	Fail
0.0528	3	353	11766	Fail
0.0541	3	340	11333	Fail
0.0553	3	328	10933	Fail
0.0565	3	303	10100	Fail
0.0577	3	287	9566	Fail
0.0589	3	281	9366	Fail
0.0601	3	269	8966	Fail
0.0614	3	258	8600	Fail
0.0626	2	251	12550	Fail
0.0638	1	241	24100	Fail
0.0650	1	226	22600	Fail
0.0662	1	218	21800	Fail
0.0675	1	209	20900	Fail

0.0687	1	205	20500	Fail
0.0699	1	194	19400	Fail
0.0711	1	185	18500	Fail
0.0723	1	170	17000	Fail
0.0735	1	161	16100	Fail
0.0748	1	149	14900	Fail
0.0760	1	146	14600	Fail
0.0772	1	138	13800	Fail
0.0784	0	136	n/a	Fail
0.0796	0	134	n/a	Fail
0.0809	0	129	n/a	Fail
0.0821	0	125	n/a	Fail
0.0833	0	121	n/a	Fail
0.0845	0	117	n/a	Fail
0.0857	0	112	n/a	Fail
0.0869	0	108	n/a	Fail
0.0882	0	105	n/a	Fail
0.0894	0	100	n/a	Fail
0.0906	0	94	n/a	Fail
0.0918	0	94	n/a	Fail
0.0930	0	93	n/a	Fail
0.0942	0	91	n/a	Fail
0.0955	0	88	n/a	Fail
0.0967	0	84	n/a	Fail
0.0979	0	82	n/a	Fail
0.0991	0	78	n/a	Fail
0.1003	0	76	n/a	Fail
0.1016	0	71	n/a	Fail
0.1028	0	65	n/a	Fail
0.1040	0	64	n/a	Fail
0.1052	0	60	n/a	Fail
0.1064	0	59	n/a	Fail
0.1076	0	57	n/a	Fail
0.1089	0	53	n/a	Fail
0.1101	0	52	n/a	Fail
0.1113	0	47	n/a	Fail
0.1125	0	45	n/a	Fail
0.1137	0	43	n/a	Fail
0.1150	0	40	n/a	Fail
0.1162	0	40	n/a	Fail
0.1174	0	38	n/a	Fail
0.1186	0	37	n/a	Fail
0.1198	0	36	n/a	Fail
0.1210	0	34	n/a	Fail
0.1223	0	34	n/a	Fail
0.1235	0	33	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #2

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

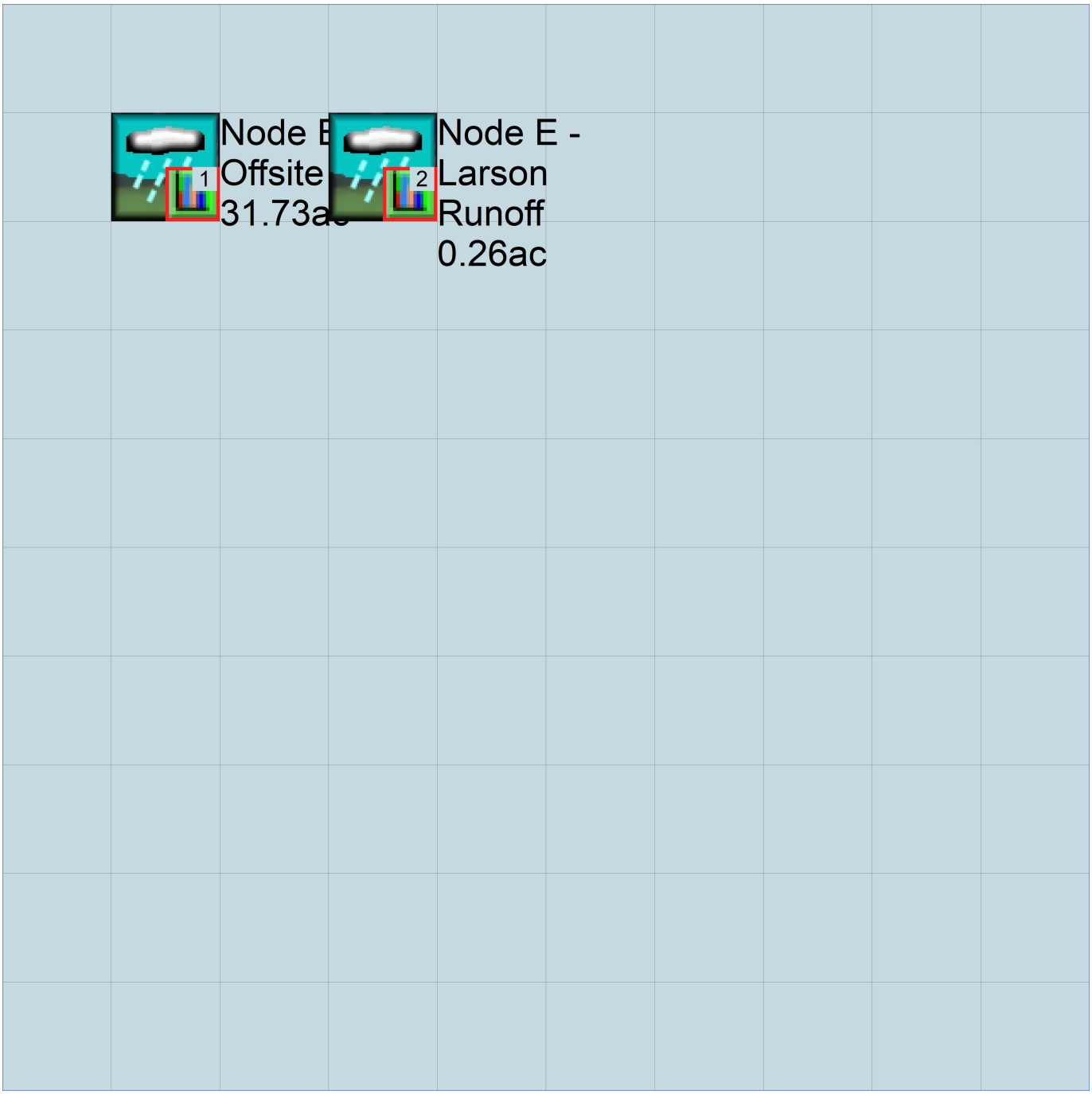
No PERLND changes have been made.

IMPLND Changes

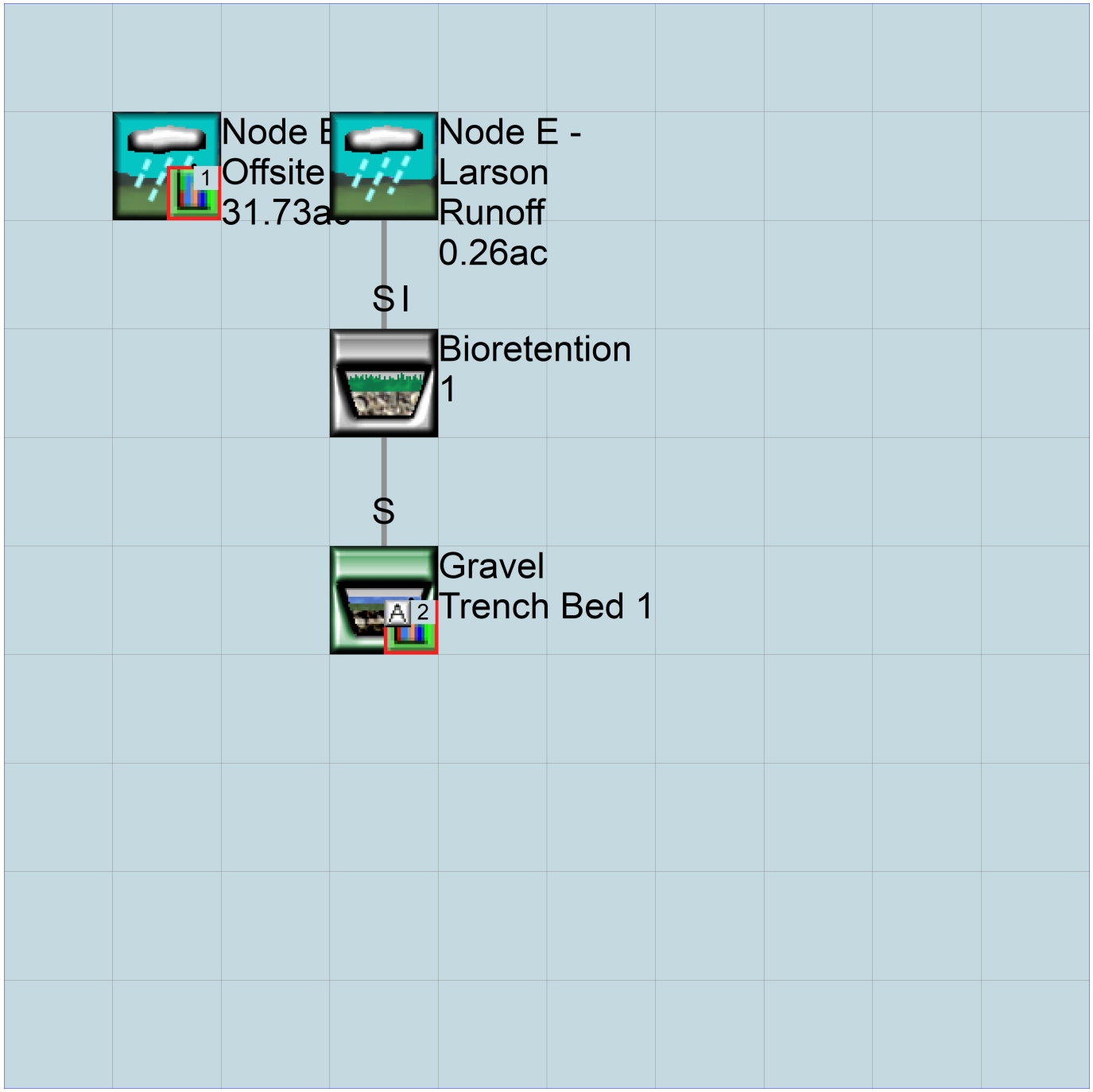
No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node E.wdm
MESSU       25   Pre18591_Node E.MES
            27   Pre18591_Node E.L61
            28   Pre18591_Node E.L62
            30   POC18591_Node E1.dat
            31   POC18591_Node E2.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      PERLND       2
      COPY       501
      COPY       502
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Node E - Offsite           MAX                    1    2   30    9
    2        Node E - Larson Runoff     MAX                    1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  502         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    2     A/B, Forest, Mod        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    2         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
```

```
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    2         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    2         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    2              0         5         2       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    2              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    2          0.2       0.5      0.35         0       0.7       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    2              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3
```

```
  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node E - Offsite***
PERLND   2                      31.732     COPY   501     12
PERLND   2                      31.732     COPY   501     13
Node E - Larson Runoff***
PERLND   2                       0.263     COPY   502     12
PERLND   2                       0.263     COPY   502     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                     ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><--->
```

```
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    502 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node E.wdm
MESSU       25   Mit18591_Node E.MES
            27   Mit18591_Node E.L61
            28   Mit18591_Node E.L62
            30   POC18591_Node E1.dat
            31   POC18591_Node E2.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      PERLND       8
      IMPLND       4
      IMPLND       1
      RCHRES       1
      RCHRES       2
      RCHRES       3
      COPY       501
      COPY         2
      COPY       502
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Node E - Offsite           MAX                    1    2   30    9
    2        Gravel Trench Bed 1        MAX                    1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
    2         1    1
  502         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    8     A/B, Lawn, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***
```

```
  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    8         0    0    1    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    8         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    8         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    8              0         5       0.8       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    8              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    8          0.1       0.5      0.25         0       0.7      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    8              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         0    0    4    0    0    4    1    9
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
```

```
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    4         0    0    0    0    0
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node E - Larson Runoff***
PERLND   8                       0.107     RCHRES   1      2
PERLND   8                       0.107     RCHRES   1      3
IMPLND   1                       0.156     RCHRES   1      5
Node E - Offsite***
PERLND   8                      25.386     COPY   501     12
PERLND   8                      25.386     COPY   501     13
IMPLND   4                       6.346     COPY   501     15

******Routing******
RCHRES   1                           1     RCHRES   3      7
RCHRES   1                                 COPY     2     17
RCHRES   1                           1     RCHRES   2      8
RCHRES   3                           1     COPY   502     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
    1     Surface retentio-007    2    1    1    1   28    0    1
    2     Bioretention  1         1    1    1    1   28    0    1
    3     Gravel Trench Be-011    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***
```

```
  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    2        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    3        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN      DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1              1      0.01       0.0       0.0       0.0       0.0
    2              2      0.01       0.0       0.0       0.0       0.0
    3              3      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                     ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      2
   70    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.002296  0.000000  0.000000
  0.043956  0.002296  0.000046  0.000000
  0.087912  0.002296  0.000092  0.000000
  0.131868  0.002296  0.000138  0.000000
  0.175824  0.002296  0.000185  0.000000
  0.219780  0.002296  0.000231  0.000063
  0.263736  0.002296  0.000277  0.000106
  0.307692  0.002296  0.000323  0.000164
  0.351648  0.002296  0.000369  0.000239
  0.395604  0.002296  0.000415  0.000332
  0.439560  0.002296  0.000461  0.000446
  0.483516  0.002296  0.000508  0.000580
  0.527473  0.002296  0.000554  0.000721
  0.571429  0.002296  0.000600  0.000737
  0.615385  0.002296  0.000646  0.000919
  0.659341  0.002296  0.000692  0.001125
  0.703297  0.002296  0.000738  0.001357
  0.747253  0.002296  0.000784  0.001617
  0.791209  0.002296  0.000831  0.001742
```

```
0.835165  0.002296  0.000877  0.001905
0.879121  0.002296  0.000923  0.002222
0.923077  0.002296  0.000969  0.002570
0.967033  0.002296  0.001015  0.002949
1.010989  0.002296  0.001061  0.003334
1.054945  0.002296  0.001107  0.003359
1.098901  0.002296  0.001154  0.003803
1.142857  0.002296  0.001200  0.004280
1.186813  0.002296  0.001246  0.004792
1.230769  0.002296  0.001292  0.005339
1.274725  0.002296  0.001338  0.005579
1.318681  0.002296  0.001384  0.005922
1.362637  0.002296  0.001431  0.006541
1.406593  0.002296  0.001477  0.007198
1.450549  0.002296  0.001523  0.007893
1.494505  0.002296  0.001569  0.008548
1.538462  0.002296  0.001611  0.008626
1.582418  0.002296  0.001653  0.009399
1.626374  0.002296  0.001695  0.010210
1.670330  0.002296  0.001736  0.011060
1.714286  0.002296  0.001778  0.011949
1.758242  0.002296  0.001820  0.012307
1.802198  0.002296  0.001862  0.012872
1.846154  0.002296  0.001904  0.013808
1.890110  0.002296  0.001946  0.018519
1.934066  0.002296  0.001988  0.018519
1.978022  0.002296  0.002030  0.018519
2.021978  0.002296  0.002071  0.018519
2.065934  0.002296  0.002113  0.018519
2.109890  0.002296  0.002155  0.018519
2.153846  0.002296  0.002197  0.018519
2.197802  0.002296  0.002239  0.018519
2.241758  0.002296  0.002281  0.018519
2.285714  0.002296  0.002323  0.018519
2.329670  0.002296  0.002365  0.018519
2.373626  0.002296  0.002407  0.018519
2.417582  0.002296  0.002448  0.018519
2.461538  0.002296  0.002490  0.018519
2.505495  0.002296  0.002532  0.018519
2.549451  0.002296  0.002574  0.018519
2.593407  0.002296  0.002616  0.018519
2.637363  0.002296  0.002658  0.018519
2.681319  0.002296  0.002700  0.018519
2.725275  0.002296  0.002742  0.018519
2.769231  0.002296  0.002783  0.018519
2.813187  0.002296  0.002825  0.018519
2.857143  0.002296  0.002867  0.018519
2.901099  0.002296  0.002909  0.018519
2.945055  0.002296  0.002951  0.018519
2.989011  0.002296  0.002993  0.018519
3.000000  0.002296  0.003386  0.018519
END FTABLE  2
FTABLE      1
 24    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.002296  0.000000  0.000000  0.000000
0.043956  0.002296  0.000101  0.000000  0.013889
0.087912  0.002296  0.000202  0.000000  0.014703
0.131868  0.002296  0.000303  0.000000  0.015110
0.175824  0.002296  0.000404  0.000000  0.015517
0.219780  0.002296  0.000505  0.000000  0.015924
0.263736  0.002296  0.000605  0.000000  0.016331
0.307692  0.002296  0.000706  0.000000  0.016738
0.351648  0.002296  0.000807  0.000000  0.017145
0.395604  0.002296  0.000908  0.000000  0.017552
0.439560  0.002296  0.001009  0.000000  0.017959
0.483516  0.002296  0.001110  0.000000  0.018366
0.527473  0.002296  0.001211  0.048301  0.018519
0.571429  0.002296  0.001312  0.202028  0.018519
```

```
0.615385  0.002296  0.001413  0.412175  0.018519
0.659341  0.002296  0.001514  0.659695  0.018519
0.703297  0.002296  0.001615  0.928167  0.018519
0.747253  0.002296  0.001715  1.200769  0.018519
0.791209  0.002296  0.001816  1.460630  0.018519
0.835165  0.002296  0.001917  1.692395  0.018519
0.879121  0.002296  0.002018  1.884482  0.018519
0.923077  0.002296  0.002119  2.031838  0.018519
0.967033  0.002296  0.002220  2.139092  0.018519
1.000000  0.002296  0.002296  2.251466  0.018519
END FTABLE  1
FTABLE      3
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.002296  0.000000  0.000000  0.000000
0.055556  0.002296  0.000045  0.000000  0.004630
0.111111  0.002296  0.000089  0.000000  0.004630
0.166667  0.002296  0.000134  0.000000  0.004630
0.222222  0.002296  0.000179  0.000000  0.004630
0.277778  0.002296  0.000223  0.000000  0.004630
0.333333  0.002296  0.000268  0.000000  0.004630
0.388889  0.002296  0.000312  0.000000  0.004630
0.444444  0.002296  0.000357  0.000000  0.004630
0.500000  0.002296  0.000402  0.000000  0.004630
0.555556  0.002296  0.000446  0.000000  0.004630
0.611111  0.002296  0.000491  0.000000  0.004630
0.666667  0.002296  0.000536  0.000000  0.004630
0.722222  0.002296  0.000580  0.000000  0.004630
0.777778  0.002296  0.000625  0.000000  0.004630
0.833333  0.002296  0.000670  0.000000  0.004630
0.888889  0.002296  0.000714  0.000000  0.004630
0.944444  0.002296  0.000759  0.000000  0.004630
1.000000  0.002296  0.000803  0.000000  0.004630
1.055556  0.002296  0.000848  0.000000  0.004630
1.111111  0.002296  0.000893  0.000000  0.004630
1.166667  0.002296  0.000937  0.000000  0.004630
1.222222  0.002296  0.000982  0.000000  0.004630
1.277778  0.002296  0.001027  0.000000  0.004630
1.333333  0.002296  0.001071  0.000000  0.004630
1.388889  0.002296  0.001116  0.000000  0.004630
1.444444  0.002296  0.001161  0.000000  0.004630
1.500000  0.002296  0.001205  0.000000  0.004630
1.555556  0.002296  0.001250  0.000000  0.004630
1.611111  0.002296  0.001295  0.000000  0.004630
1.666667  0.002296  0.001339  0.000000  0.004630
1.722222  0.002296  0.001384  0.000000  0.004630
1.777778  0.002296  0.001428  0.000000  0.004630
1.833333  0.002296  0.001473  0.000000  0.004630
1.888889  0.002296  0.001518  0.000000  0.004630
1.944444  0.002296  0.001562  0.000000  0.004630
2.000000  0.002296  0.001607  0.000000  0.004630
2.055556  0.002296  0.001652  0.000000  0.004630
2.111111  0.002296  0.001696  0.000000  0.004630
2.166667  0.002296  0.001741  0.000000  0.004630
2.222222  0.002296  0.001786  0.000000  0.004630
2.277778  0.002296  0.001830  0.000000  0.004630
2.333333  0.002296  0.001875  0.000000  0.004630
2.388889  0.002296  0.001919  0.000000  0.004630
2.444444  0.002296  0.001964  0.000000  0.004630
2.500000  0.002296  0.002009  0.000000  0.004630
2.555556  0.002296  0.002053  0.000000  0.004630
2.611111  0.002296  0.002098  0.000000  0.004630
2.666667  0.002296  0.002143  0.000000  0.004630
2.722222  0.002296  0.002187  0.000000  0.004630
2.777778  0.002296  0.002232  0.000000  0.004630
2.833333  0.002296  0.002277  0.000000  0.004630
2.888889  0.002296  0.002321  0.000000  0.004630
2.944444  0.002296  0.002366  0.000000  0.004630
3.000000  0.002296  0.002410  0.000000  0.004630
```

```
  3.055556  0.002296  0.002455  0.138729  0.004630
  3.111111  0.002296  0.002500  0.389839  0.004630
  3.166667  0.002296  0.002544  0.703432  0.004630
  3.222222  0.002296  0.002589  1.046030  0.004630
  3.277778  0.002296  0.002634  1.383552  0.004630
  3.333333  0.002296  0.002678  1.683468  0.004630
  3.388889  0.002296  0.002723  1.921105  0.004630
  3.444444  0.002296  0.002768  2.088233  0.004630
  3.500000  0.002296  0.002812  2.203335  0.004630
  3.555556  0.002296  0.002857  2.347596  0.004630
  3.611111  0.002296  0.002901  2.462179  0.004630
  3.666667  0.002296  0.002946  2.571662  0.004630
  3.722222  0.002296  0.002991  2.676671  0.004630
  3.777778  0.002296  0.003035  2.777713  0.004630
  3.833333  0.002296  0.003080  2.875206  0.004630
  3.888889  0.002296  0.003125  2.969500  0.004630
  3.944444  0.002296  0.003169  3.060890  0.004630
  4.000000  0.002296  0.003214  3.149630  0.004630
  4.055556  0.002296  0.003259  3.235937  0.004630
  4.111111  0.002296  0.003303  3.320002  0.004630
  4.166667  0.002296  0.003348  3.401989  0.004630
  4.222222  0.002296  0.003393  3.482047  0.004630
  4.277778  0.002296  0.003437  3.560305  0.004630
  4.333333  0.002296  0.003482  3.636879  0.004630
  4.388889  0.002296  0.003526  3.711875  0.004630
  4.444444  0.002296  0.003571  3.785384  0.004630
  4.500000  0.002296  0.003616  3.857493  0.004630
  4.555556  0.002296  0.003660  3.928279  0.004630
  4.611111  0.002296  0.003705  3.997811  0.004630
  4.666667  0.002296  0.003750  4.066155  0.004630
  4.722222  0.002296  0.003794  4.133369  0.004630
  4.777778  0.002296  0.003839  4.199507  0.004630
  4.833333  0.002296  0.003884  4.264619  0.004630
  4.888889  0.002296  0.003928  4.328752  0.004630
  4.944444  0.002296  0.003973  4.391949  0.004630
  5.000000  0.002296  0.004017  4.454250  0.004630
  5.055556  0.002296  0.004145  4.515690  0.004630
  END FTABLE  3
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1.429          RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   2     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL       REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL       REPL
RCHRES   3 HYDR   RO     1 1        1      WDM   1010 FLOW     ENGL       REPL
RCHRES   3 HYDR   O      1 1        1      WDM   1011 FLOW     ENGL       REPL
RCHRES   3 HYDR   O      2 1        1      WDM   1012 FLOW     ENGL       REPL
RCHRES   3 HYDR   STAGE  1 1        1      WDM   1013 STAG     ENGL       REPL
COPY     2 OUTPUT MEAN   1 1     48.4      WDM    702 FLOW     ENGL       REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    802 FLOW     ENGL       REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>           <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
```

```
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Disclaimer

Legal Notice

This program and accompanying documentation are provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc. be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions Inc. or their authorized representatives have been advised of the possibility of such damages. Software Copyright © by : Clear Creek Solutions, Inc. 2005-2025; All Rights Reserved.

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

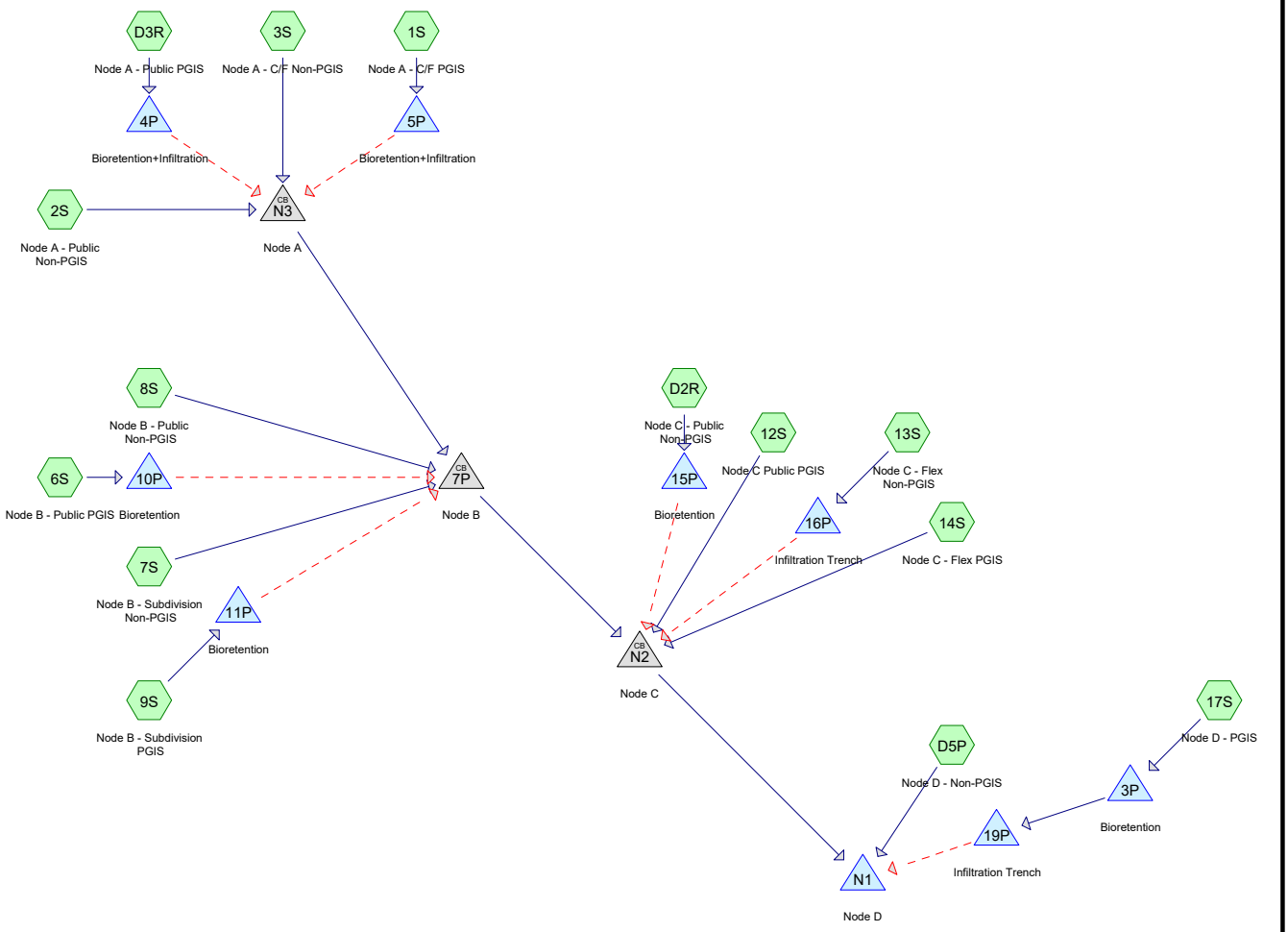
Appendix D: Stormwater Conveyance Calculations

HydroCAD Reports for:

- **Onsite 25-Year – OHWM or Below**
- **Onsite 100-Year – OHWM or Below**
- **Onsite 25-Year – Minor Flood Stage**
- **Onsite 100-Year – Minor Flood Stage**
- **Onsite 25-Year – Moderate Flood Stage**
- **Onsite 100-Year – Moderate Flood Stage**
- **Onsite 100-Year – Flooded and Closed**
- **Offsite 25-Year – OHWM or Below**
- **Offsite 100-Year – OHWM or Below**
- **Offsite 25-Year – Valves Closed**
- **Offsite 25-Year – Valves Closed**

Brochure for Tideflex CheckMate UltraFlex Check Valve

Pump Cut Sheet



Subcat Reach Pond Link

Routing Diagram for ALTERNATE _Onsite 25-Year Storm - Water @ OHWM or Below

Prepared by MacKay & Sposito, Inc, Printed 3/10/2025

HydroCAD® 10.20-5c s/n 01662 © 2023 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	**38.896**	**0.000**	**0.000**	**0.000**	**104.075**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=8.64 cfs 3.046 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.29"
Tc=20.0 min CN=59 Runoff=0.20 cfs 0.125 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=3.76"
Tc=20.0 min CN=88 Runoff=4.22 cfs 1.438 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=0.29 cfs 0.101 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=3.46"
Tc=20.0 min CN=85 Runoff=5.62 cfs 1.945 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=2.89"
Tc=20.0 min CN=79 Runoff=0.06 cfs 0.022 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=2.50 cfs 0.882 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=0.82 cfs 0.288 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=4.19"
Tc=20.0 min CN=92 Runoff=1.42 cfs 0.481 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=1.94 cfs 0.683 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=53.15 cfs 18.738 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=1.95"
Tc=20.0 min CN=68 Runoff=0.09 cfs 0.039 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=1.94 cfs 0.682 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=3.17"
Tc=20.0 min CN=82 Runoff=22.11 cfs 7.822 af

Pond 3P: Bioretention Peak Elev=54.62' Storage=2.845 af Inflow=53.15 cfs 18.738 af
Outflow=28.78 cfs 18.424 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.73' Storage=0.037 af Inflow=1.94 cfs 0.682 af
Primary=0.15 cfs 0.277 af Secondary=1.78 cfs 0.406 af Outflow=1.93 cfs 0.682 af

Pond 5P: Bioretention+Infiltration Peak Elev=4.97' Storage=0.240 af Inflow=8.64 cfs 3.046 af
Primary=0.36 cfs 0.882 af Secondary=8.26 cfs 2.164 af Outflow=8.62 cfs 3.046 af

Pond 7P: Node B Peak Elev=48.56' Inflow=22.70 cfs 6.681 af
24.0" Round Culvert n=0.012 L=379.7' S=0.0030 '/' Outflow=22.70 cfs 6.681 af

Pond 10P: Bioretention Peak Elev=3.25' Storage=0.005 af Inflow=0.29 cfs 0.101 af
Primary=0.02 cfs 0.045 af Secondary=0.26 cfs 0.056 af Outflow=0.29 cfs 0.101 af

Pond 11P: Bioretention Peak Elev=4.87' Storage=0.053 af Inflow=2.50 cfs 0.882 af
Primary=0.19 cfs 0.356 af Secondary=2.30 cfs 0.526 af Outflow=2.48 cfs 0.882 af

Pond 15P: Bioretention Peak Elev=0.73' Storage=0.004 af Inflow=0.09 cfs 0.039 af
Primary=0.04 cfs 0.039 af Secondary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.039 af

Pond 16P: Infiltration Trench Peak Elev=4.61' Storage=0.044 af Inflow=1.42 cfs 0.481 af
Primary=0.09 cfs 0.189 af Secondary=1.32 cfs 0.292 af Outflow=1.41 cfs 0.481 af

Pond 19P: Infiltration Trench Peak Elev=3.86' Storage=2.259 af Inflow=28.78 cfs 18.424 af
Primary=3.57 cfs 8.564 af Secondary=24.41 cfs 9.860 af Outflow=27.97 cfs 18.424 af

Pond N1: Node D Peak Elev=42.27' Storage=9,485 cf Inflow=65.60 cfs 25.625 af
42.0" Round Culvert n=0.012 L=270.3' S=0.0018 '/' Outflow=57.61 cfs 25.625 af

Pond N2: Node C Peak Elev=44.32' Inflow=26.76 cfs 7.943 af
30.0" Round Culvert n=0.012 L=410.7' S=0.0029 '/' Outflow=26.76 cfs 7.943 af

Pond N3: Node A Peak Elev=50.24' Inflow=14.45 cfs 4.132 af
24.0" Round Culvert n=0.012 L=369.0' S=0.0030 '/' Outflow=14.45 cfs 4.132 af

Total Runoff Area = 104.075 ac Runoff Volume = 36.290 af Average Runoff Depth = 4.18"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

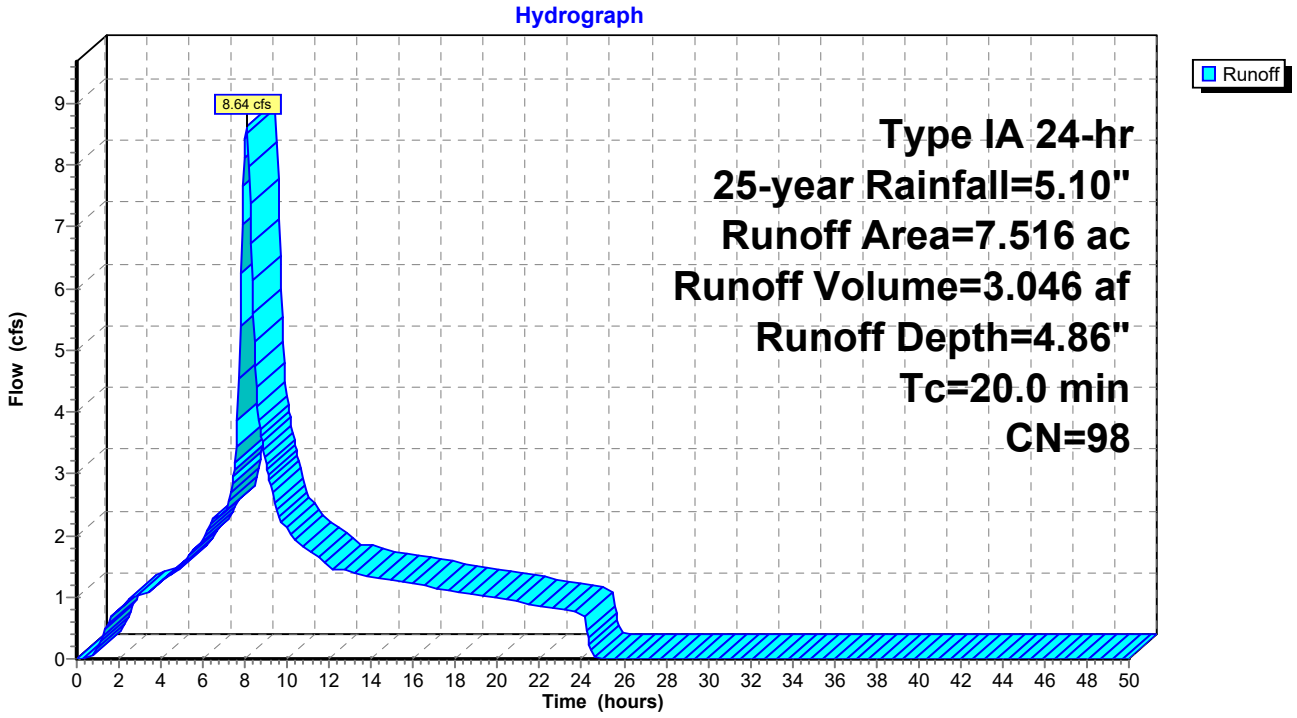
Runoff = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af, Depth= 4.86"
Routed to Pond 5P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 1S: Node A - C/F PGIS



Summary for Subcatchment 2S: Node A - Public Non-PGIS

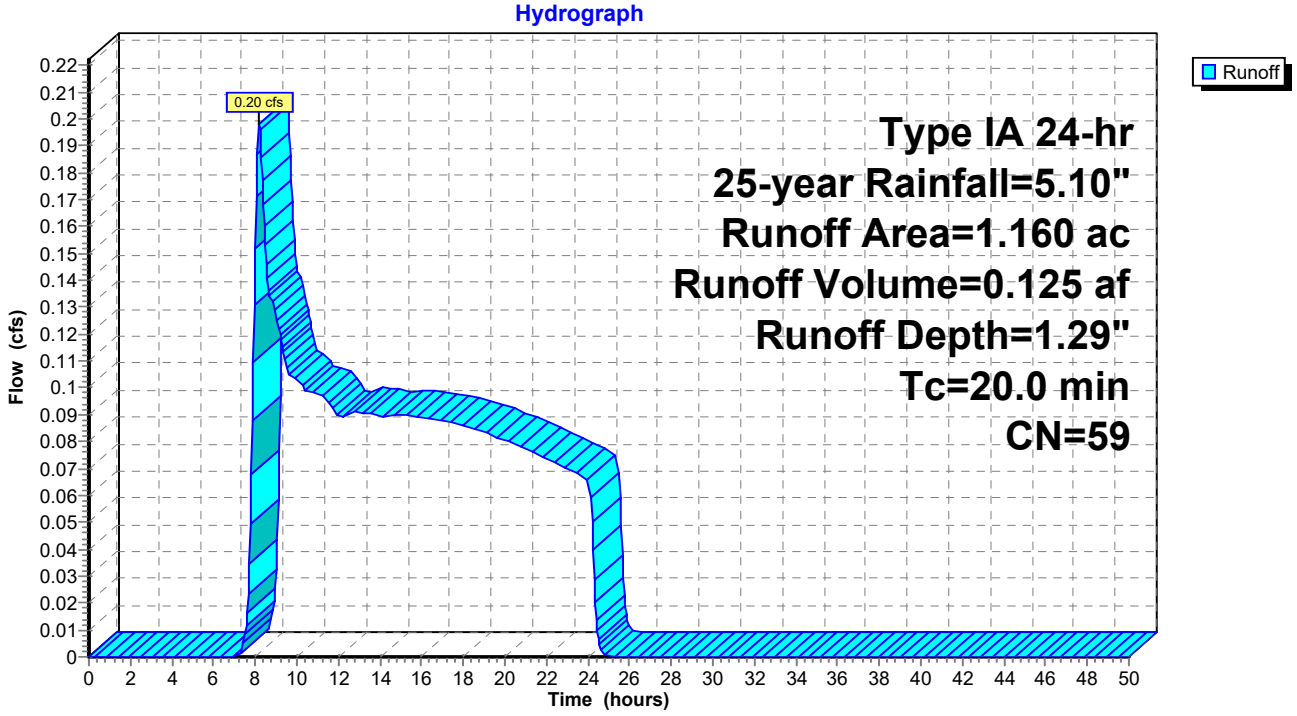
Runoff = 0.20 cfs @ 8.19 hrs, Volume= 0.125 af, Depth= 1.29"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

	Area (ac)	CN	Description
*	1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
	1.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 2S: Node A - Public Non-PGIS



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

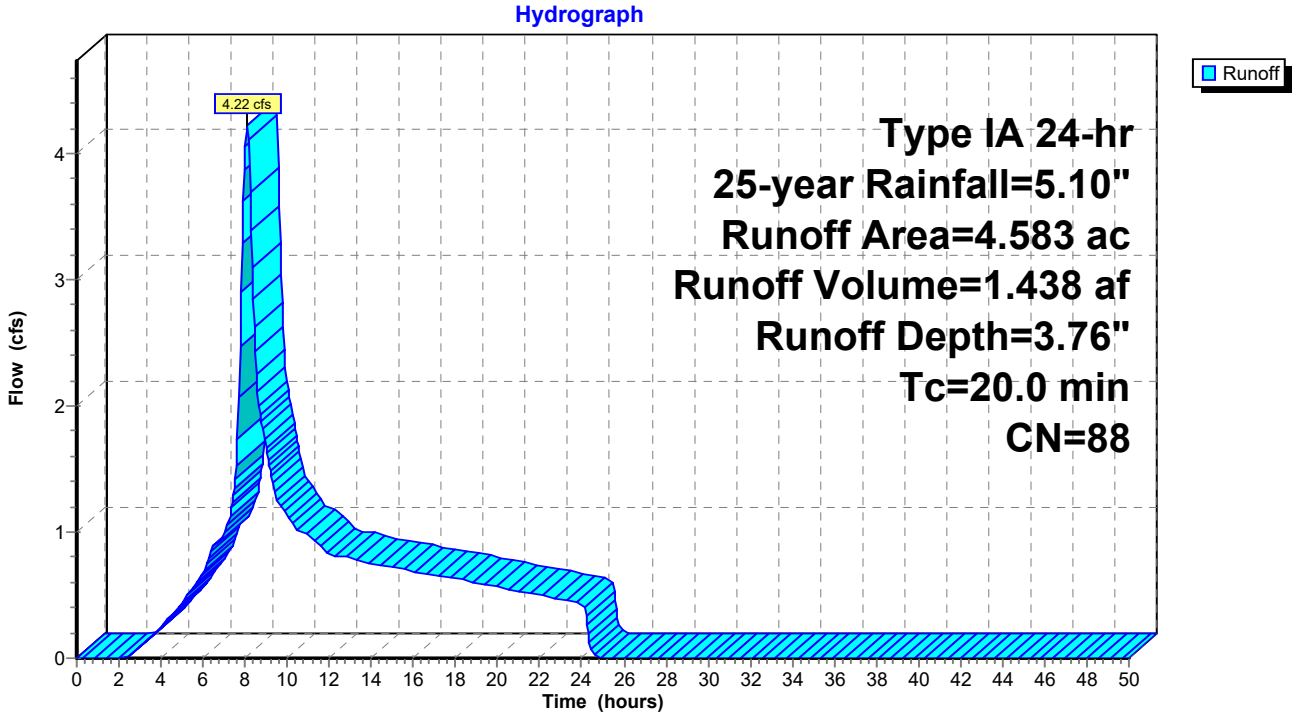
Runoff = 4.22 cfs @ 8.09 hrs, Volume= 1.438 af, Depth= 3.76"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

	Area (ac)	CN	Description
*	1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
	3.373	98	Roofs, HSG A
	4.583	88	Weighted Average
	1.210		26.40% Pervious Area
	3.373		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 3S: Node A - C/F Non-PGIS



Summary for Subcatchment 6S: Node B - Public PGIS

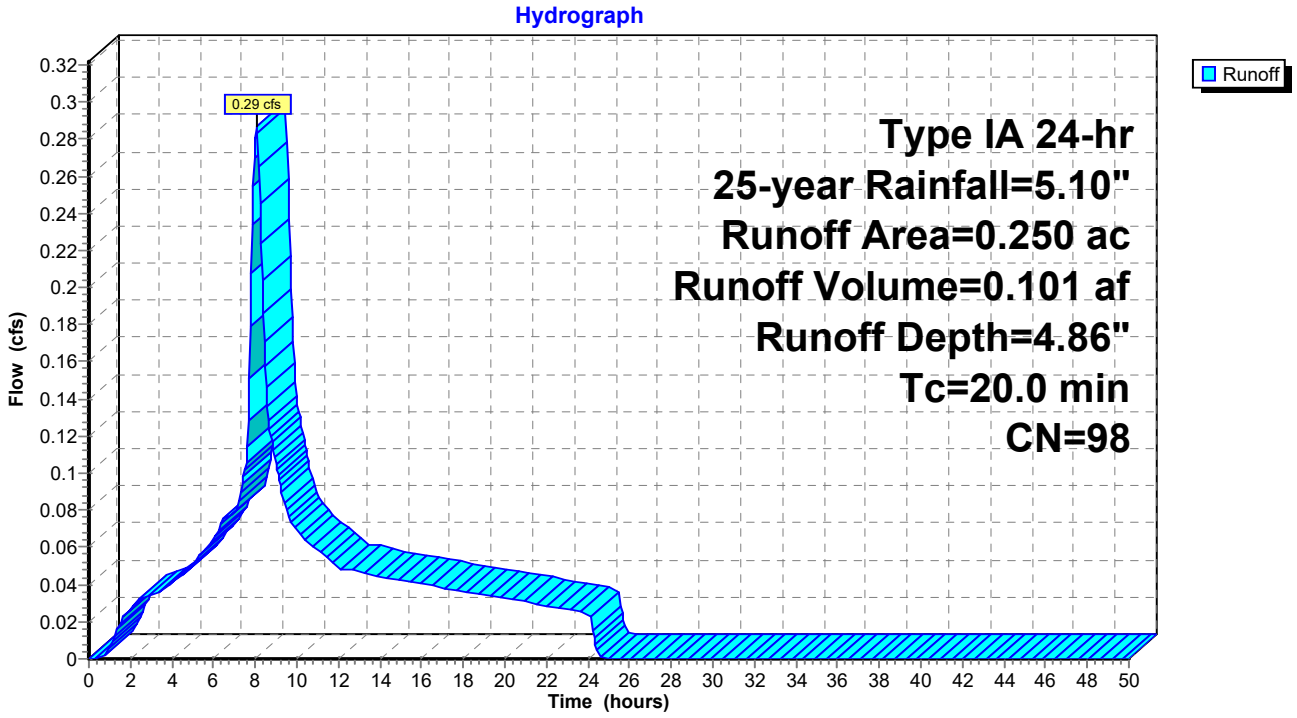
Runoff = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af, Depth= 4.86"
Routed to Pond 10P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 6S: Node B - Public PGIS



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

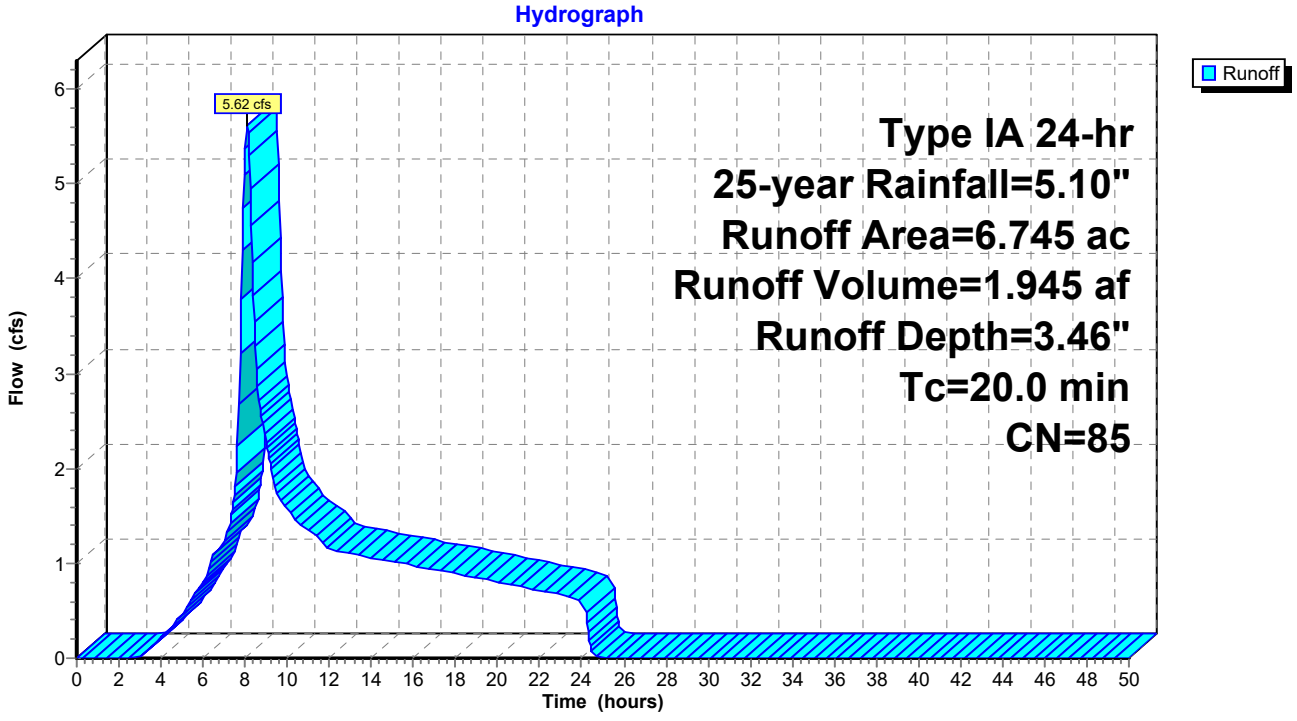
Runoff = 5.62 cfs @ 8.10 hrs, Volume= 1.945 af, Depth= 3.46"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 7S: Node B - Subdivision Non-PGIS



Summary for Subcatchment 8S: Node B - Public Non-PGIS

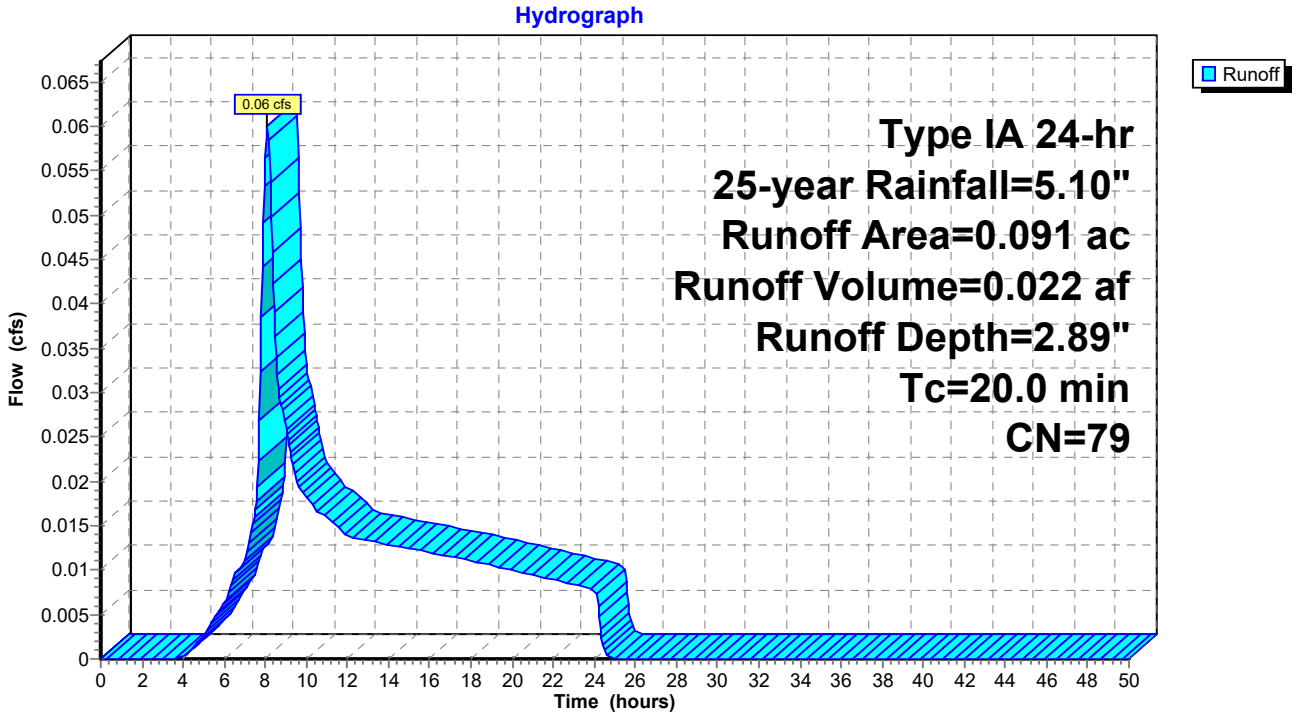
Runoff = 0.06 cfs @ 8.11 hrs, Volume= 0.022 af, Depth= 2.89"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 8S: Node B - Public Non-PGIS



Summary for Subcatchment 9S: Node B - Subdivision PGIS

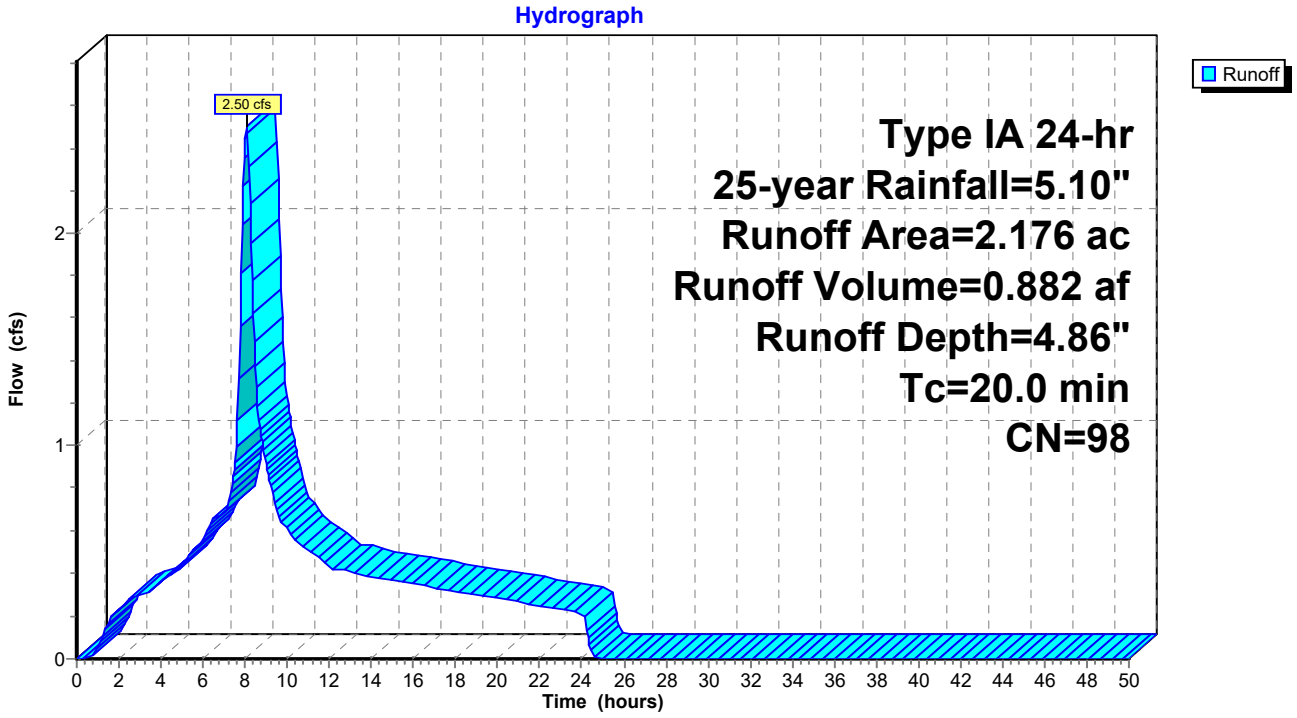
Runoff = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af, Depth= 4.86"
Routed to Pond 11P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 9S: Node B - Subdivision PGIS



Summary for Subcatchment 12S: Node C Public PGIS

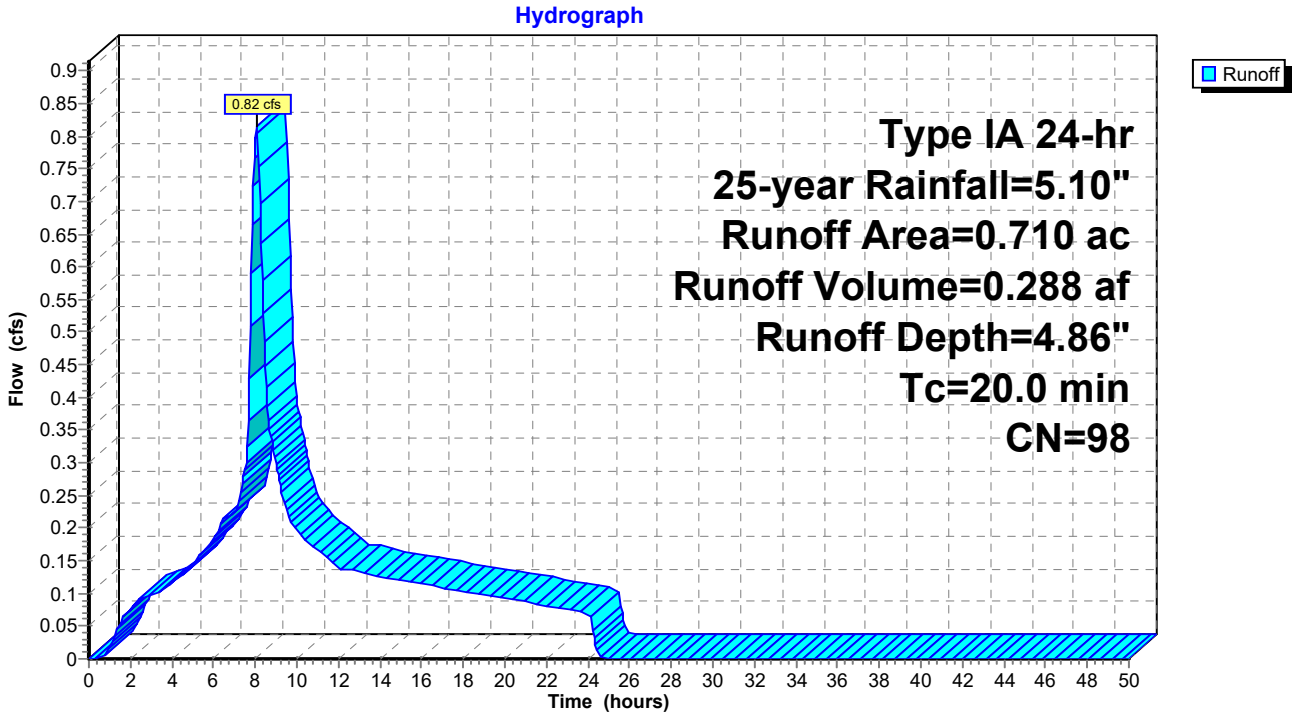
Runoff = 0.82 cfs @ 8.08 hrs, Volume= 0.288 af, Depth= 4.86"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 12S: Node C Public PGIS



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

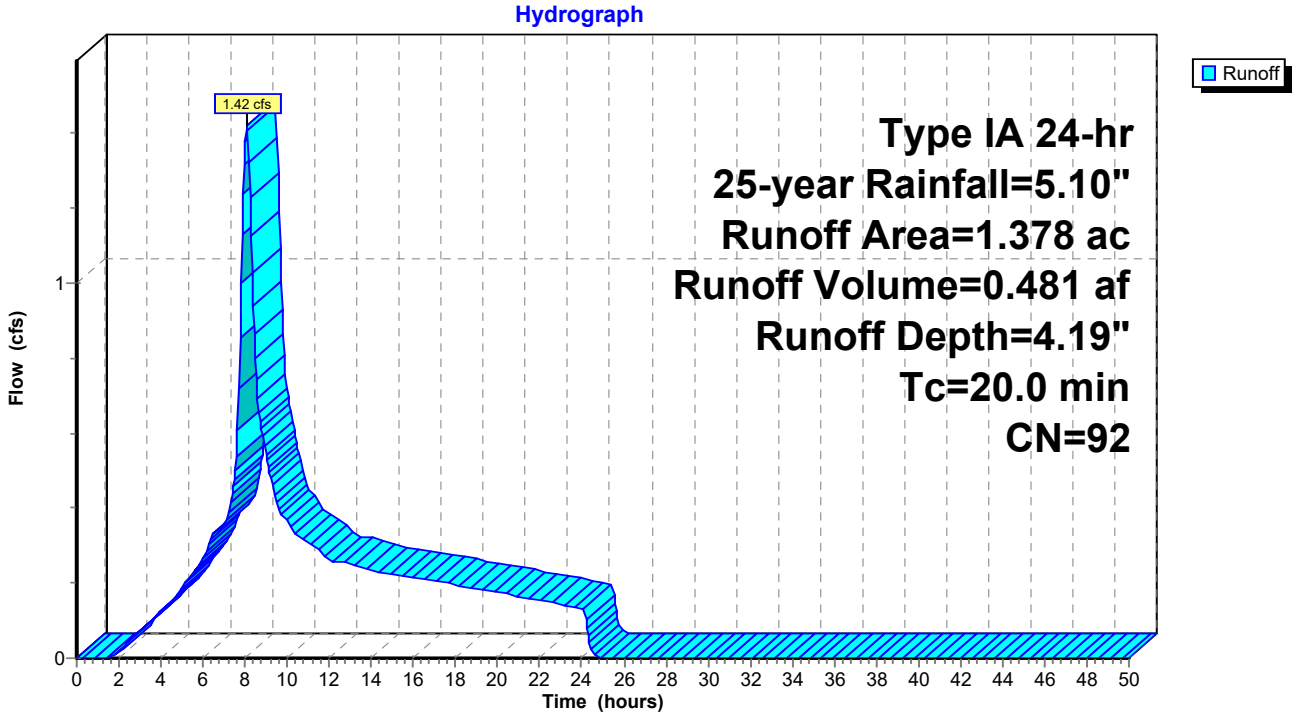
Runoff = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af, Depth= 4.19"
Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

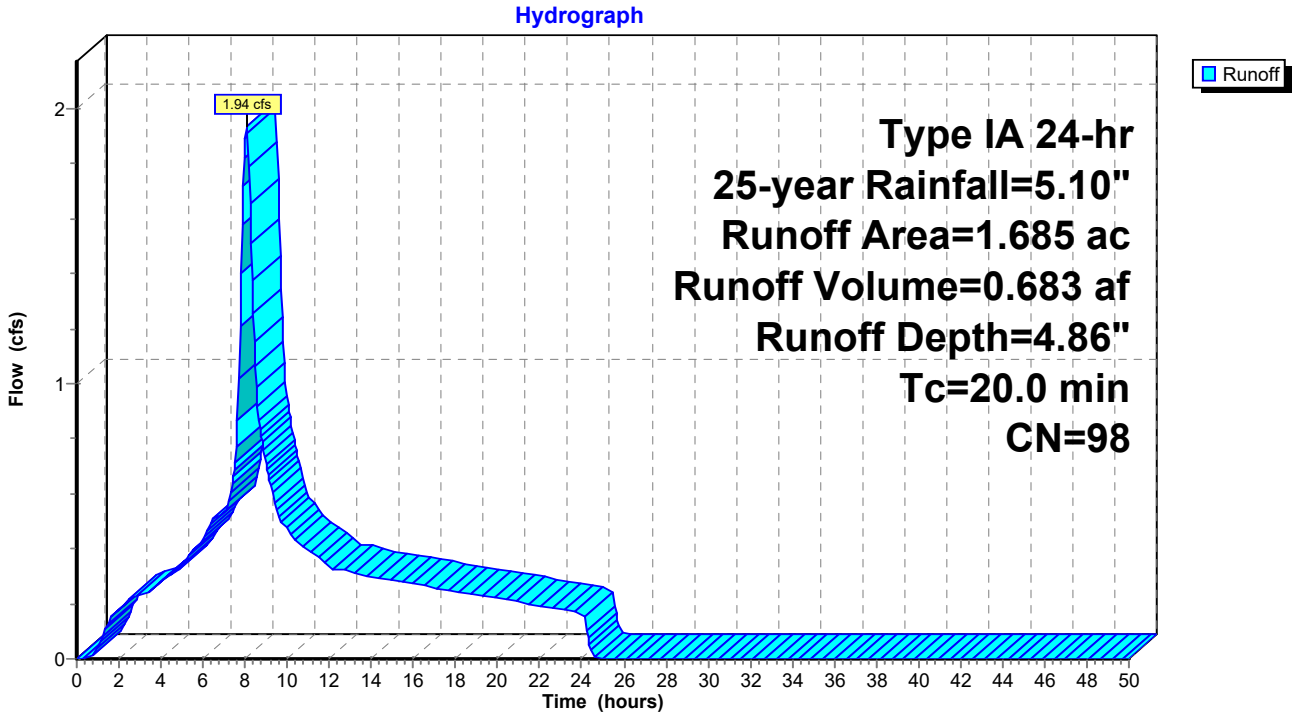
Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.683 af, Depth= 4.86"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 14S: Node C - Flex PGIS



Summary for Subcatchment 17S: Node D - PGIS

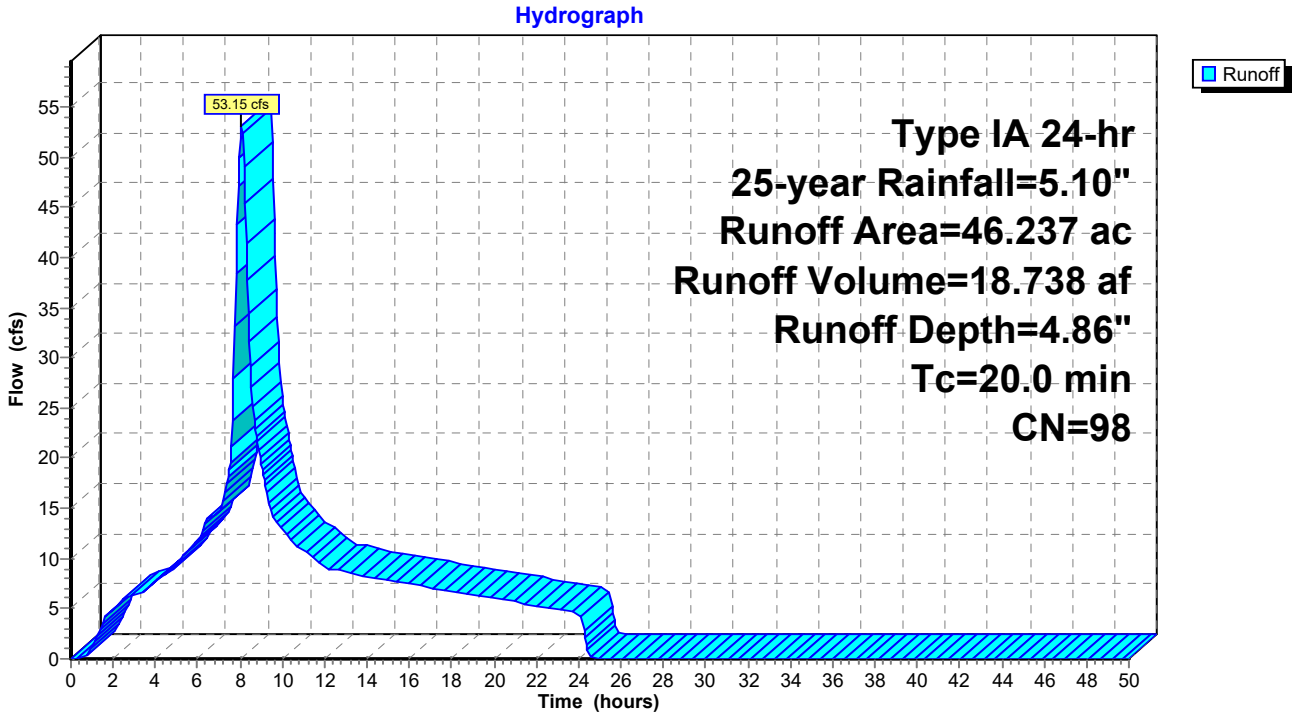
Runoff = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af, Depth= 4.86"
Routed to Pond 3P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 17S: Node D - PGIS



Summary for Subcatchment D2R: Node C - Public Non-PGIS

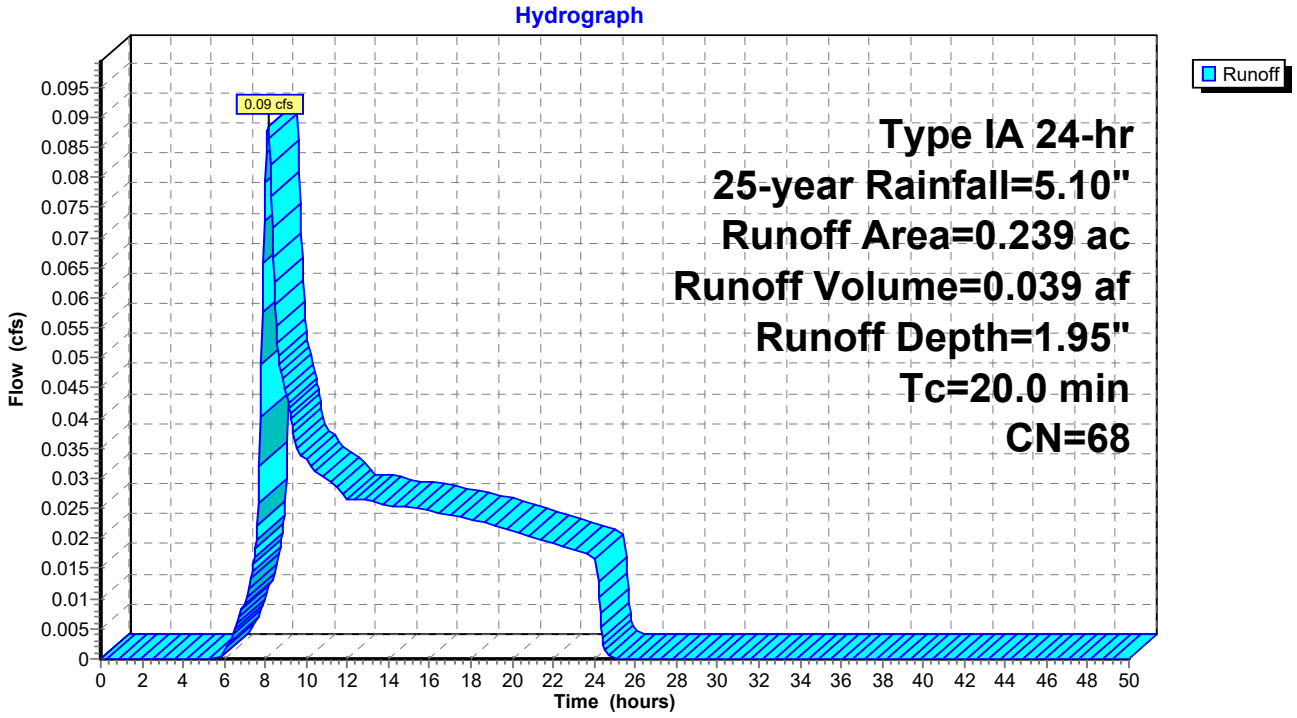
Runoff = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af, Depth= 1.95"
Routed to Pond 15P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D2R: Node C - Public Non-PGIS



Summary for Subcatchment D3R: Node A - Public PGIS

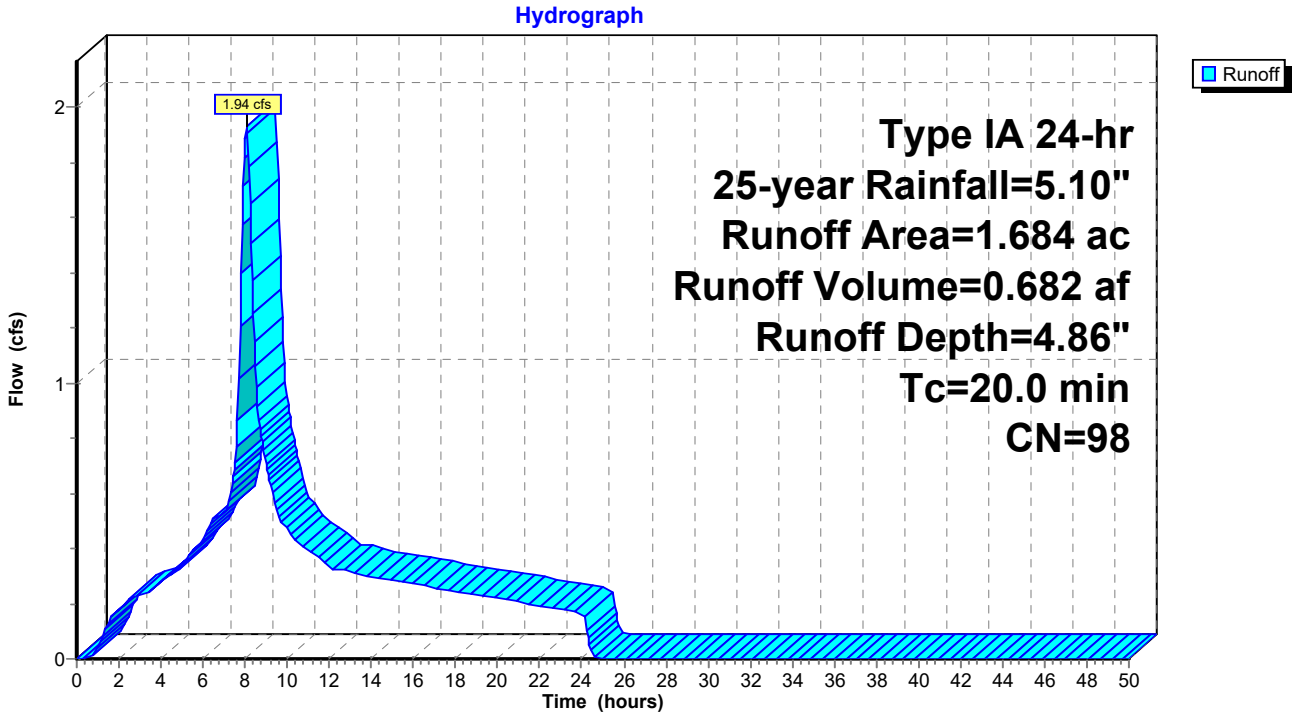
Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af, Depth= 4.86"
Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

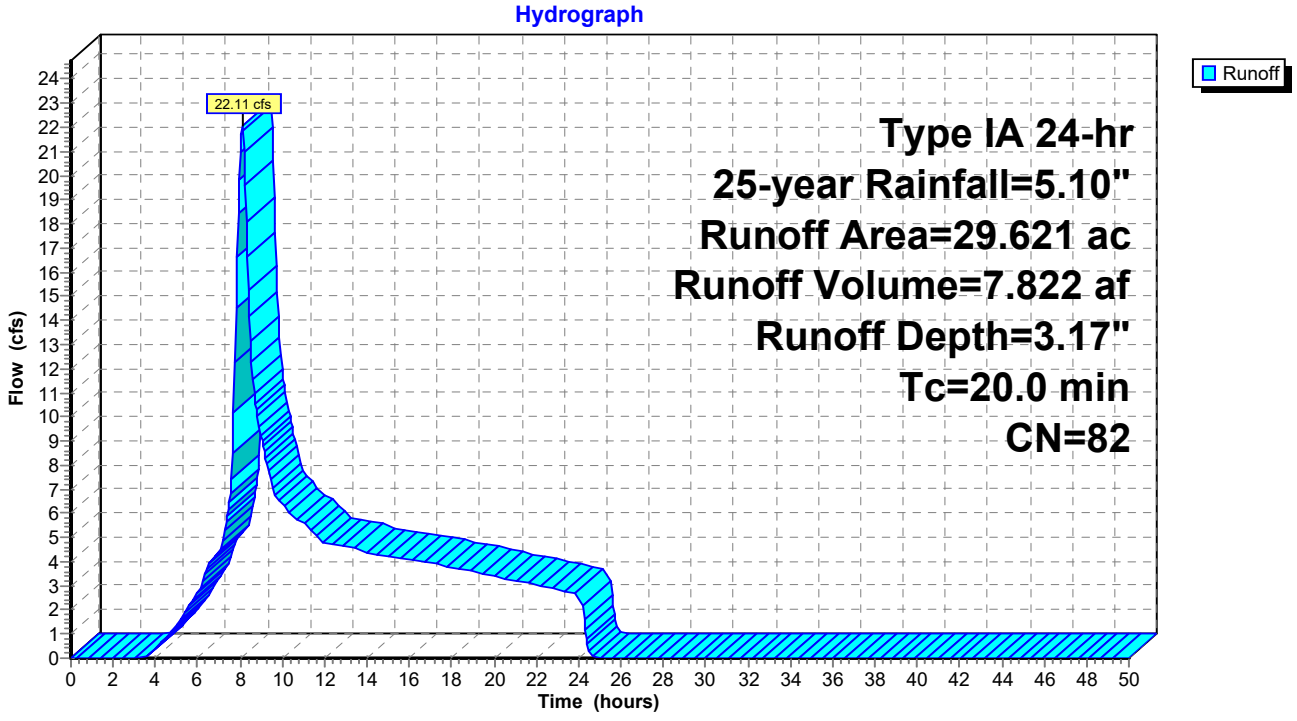
Runoff = 22.11 cfs @ 8.11 hrs, Volume= 7.822 af, Depth= 3.17"
Routed to Pond N1 : Node D

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D5P: Node D - Non-PGIS



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af
Outflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af, Atten= 46%, Lag= 25.9 min
Primary = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 54.62' @ 8.51 hrs Surf.Area= 1.674 ac Storage= 2.845 af

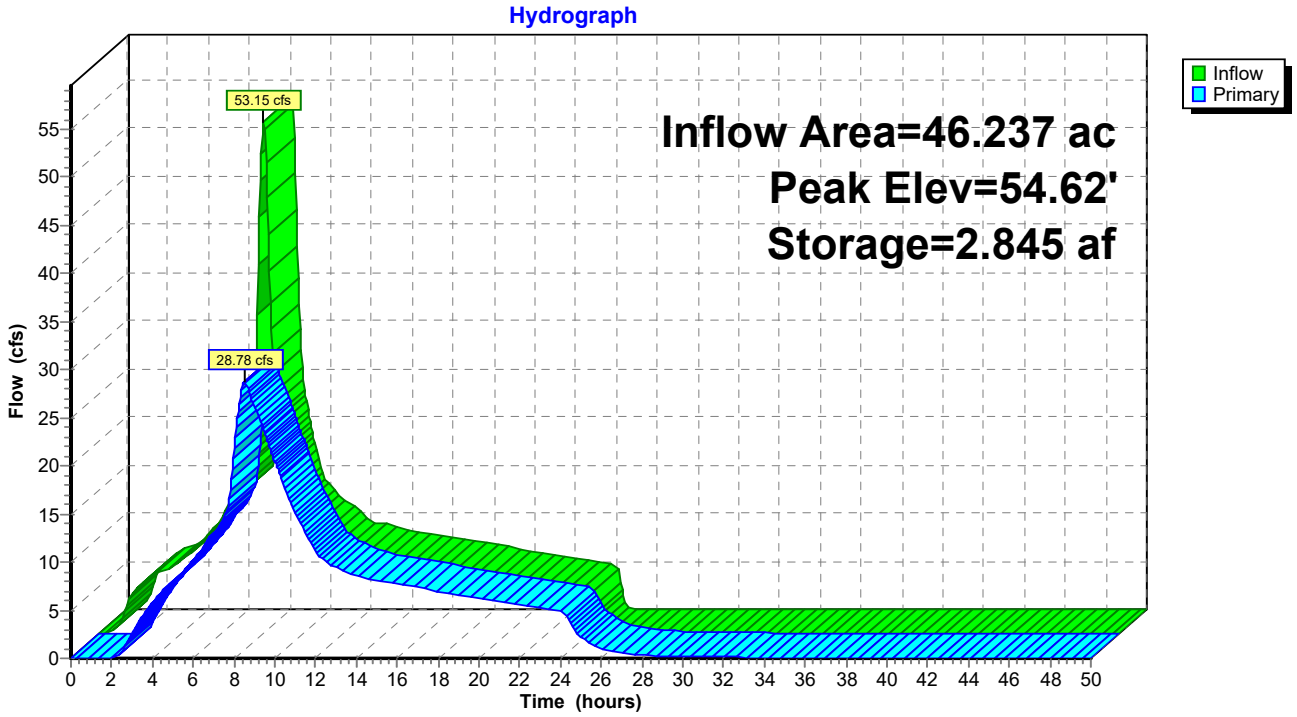
Plug-Flow detention time= 90.8 min calculated for 18.424 af (98% of inflow)
Center-of-Mass det. time= 77.7 min (745.3 - 667.6)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	**270.00'W x 270.00'L x 6.50'H Prismatoid** 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	**270.00'W x 270.00'L x 2.00'H Prismatoid** Inside #1
#3	50.50'	0.019 af	**24.0" Round Pipe Storage** Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	**60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=28.76 cfs @ 8.51 hrs HW=54.62' (Free Discharge)
1=Orifice/Grate (Weir Controls 2.05 cfs @ 1.12 fps)
2=Orifice/Grate (Orifice Controls 26.71 cfs @ 8.50 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af
Outflow = 1.93 cfs @ 8.11 hrs, Volume= 0.682 af, Atten= 0%, Lag= 1.7 min
Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.277 af
Secondary = 1.78 cfs @ 8.11 hrs, Volume= 0.406 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.73' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.037 af

Plug-Flow detention time= 65.8 min calculated for 0.682 af (100% of inflow)
Center-of-Mass det. time= 65.7 min (733.3 - 667.6)

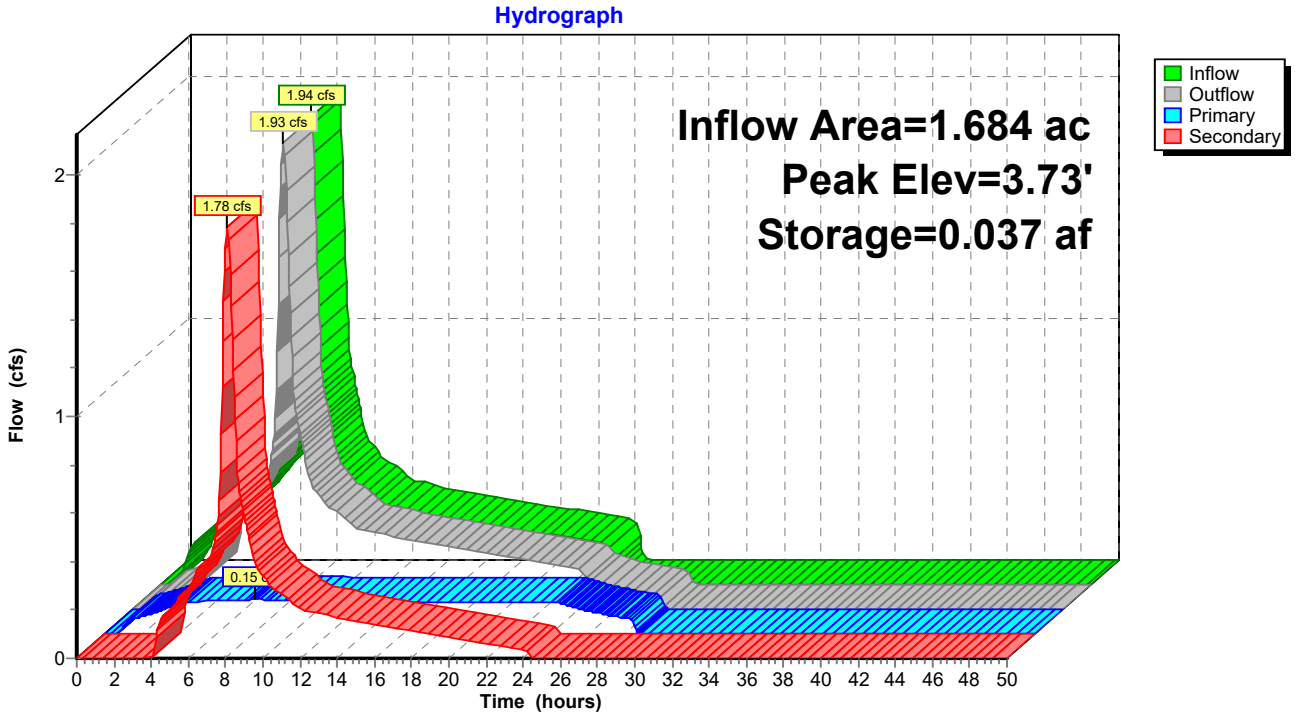
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	**5.00'W x 250.00'L x 5.00'H Bioretention** 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=1.78 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.78 cfs @ 2.90 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

Inflow Area = 7.516 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af
Outflow = 8.62 cfs @ 8.10 hrs, Volume= 3.046 af, Atten= 0%, Lag= 1.2 min
Primary = 0.36 cfs @ 8.10 hrs, Volume= 0.882 af
Secondary = 8.26 cfs @ 8.10 hrs, Volume= 2.164 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.97' @ 8.10 hrs Surf.Area= 0.138 ac Storage= 0.240 af

Plug-Flow detention time= 109.9 min calculated for 3.046 af (100% of inflow)
Center-of-Mass det. time= 109.8 min (777.4 - 667.6)

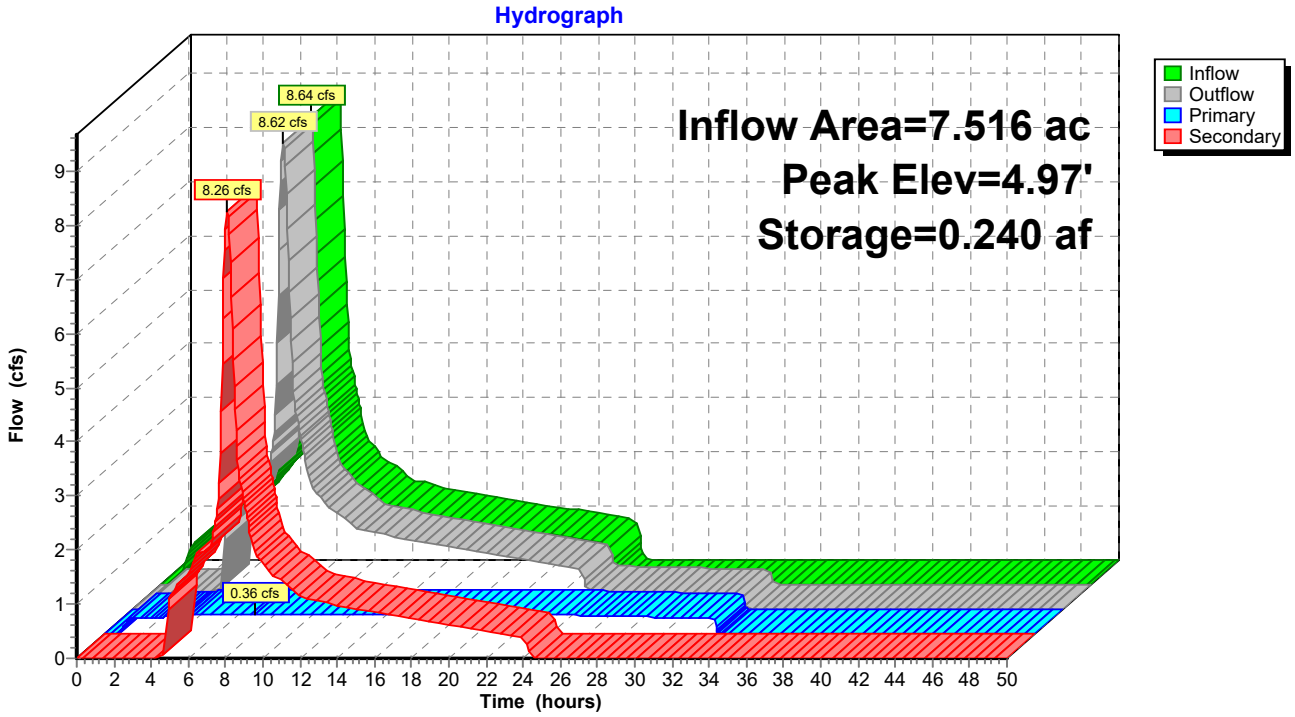
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	**50.00'W x 120.00'L x 5.00'H Infiltration Trench** 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.50'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=8.25 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 8.25 cfs @ 2.24 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 7P: Node B

[57] Hint: Peaked at 48.56' (Flood elevation advised)
[81] Warning: Exceeded Pond 10P by 45.31' @ 8.10 hrs
[81] Warning: Exceeded Pond 11P by 44.32' @ 33.00 hrs
[79] Warning: Submerged Pond N3 Primary device # 1 INLET by 7.12'

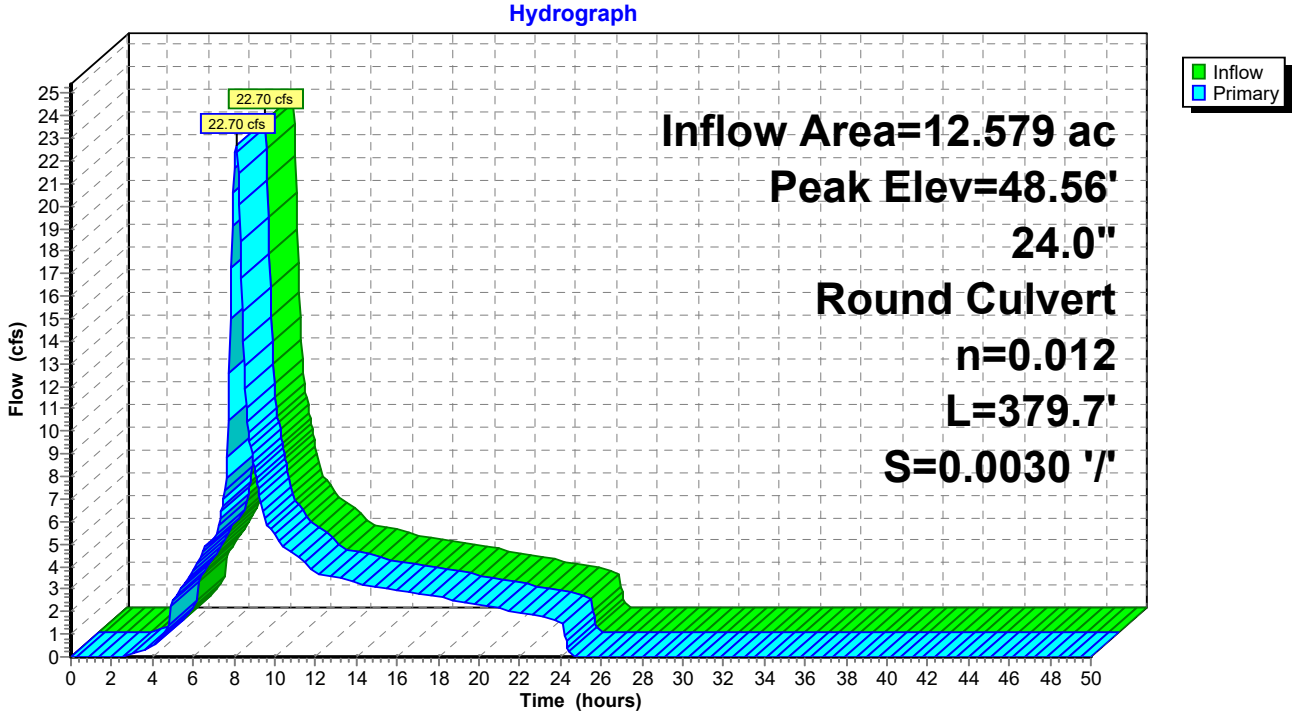
Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 6.37" for 25-year event
Inflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
Outflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af, Atten= 0%, Lag= 0.0 min
Primary = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 48.56' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	**24.0" Round Culvert** L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=22.70 cfs @ 8.10 hrs HW=48.56' TW=44.32' (Fixed TW Elev= 44.32')
1=Culvert (Outlet Controls 22.70 cfs @ 7.22 fps)

Pond 7P: Node B



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af
Outflow = 0.29 cfs @ 8.09 hrs, Volume= 0.101 af, Atten= 0%, Lag= 0.5 min
Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.045 af
Secondary = 0.26 cfs @ 8.09 hrs, Volume= 0.056 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.25' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 67.0 min calculated for 0.101 af (100% of inflow)
Center-of-Mass det. time= 67.1 min (734.7 - 667.6)

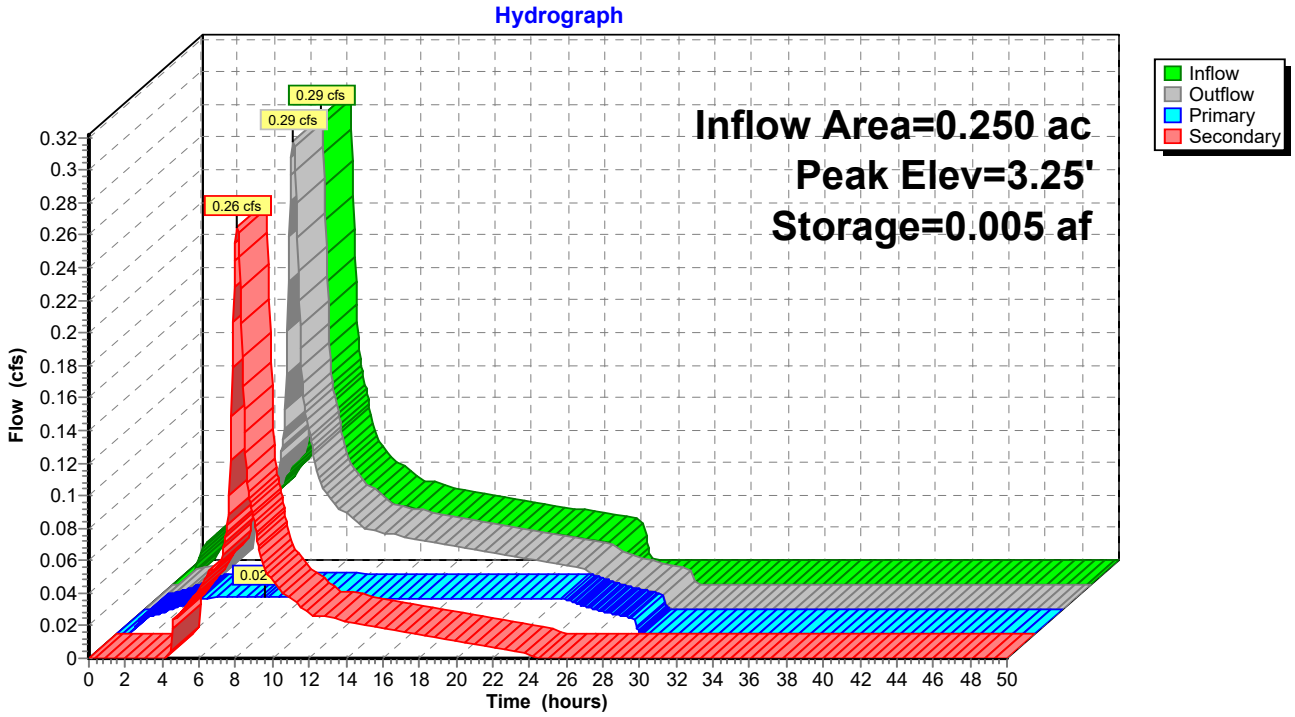
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	**5.00'W x 40.00'L x 5.00'H Bioretention** 0.023 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.26 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 0.26 cfs @ 1.71 fps)

Pond 10P: Bioretention



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af
Outflow = 2.48 cfs @ 8.11 hrs, Volume= 0.882 af, Atten= 1%, Lag= 2.0 min
Primary = 0.19 cfs @ 8.11 hrs, Volume= 0.356 af
Secondary = 2.30 cfs @ 8.11 hrs, Volume= 0.526 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.87' @ 8.11 hrs Surf.Area= 0.031 ac Storage= 0.053 af

Plug-Flow detention time= 73.2 min calculated for 0.881 af (100% of inflow)
Center-of-Mass det. time= 73.4 min (741.0 - 667.6)

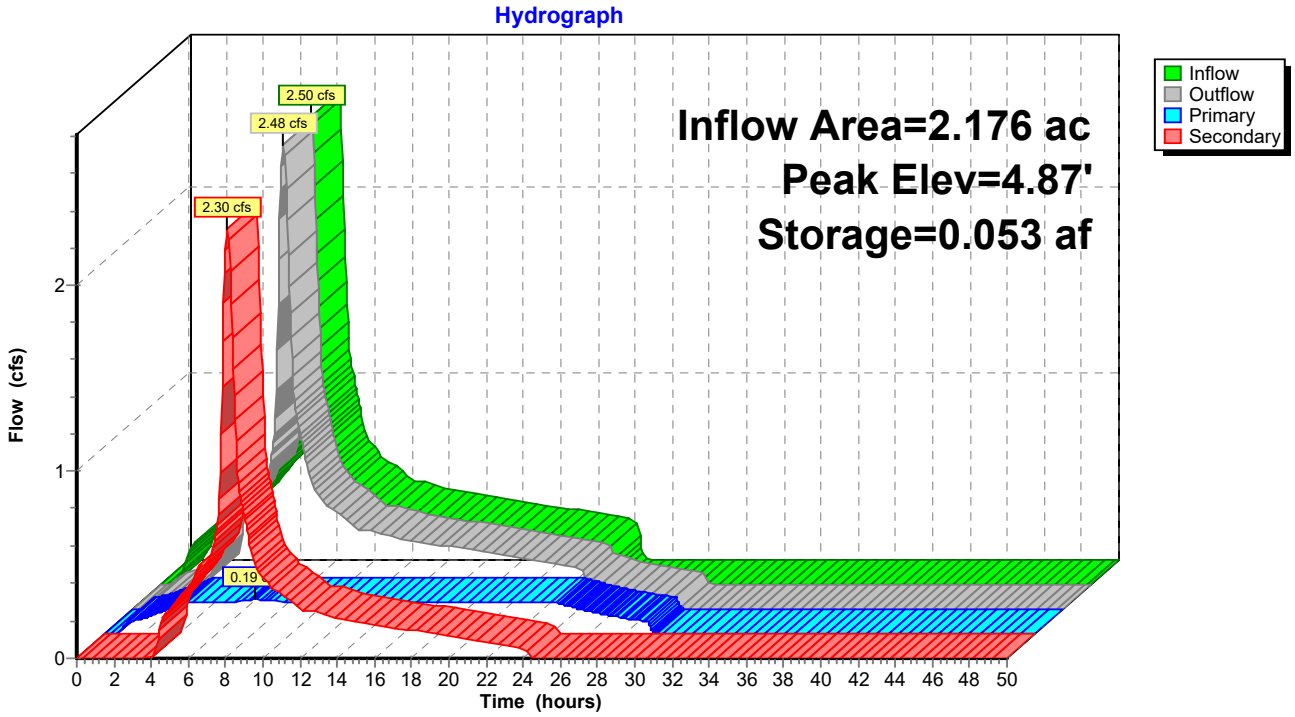
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	**5.00'W x 270.00'L x 6.00'H Bioretention** 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.30 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 2.30 cfs @ 3.17 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 1.95" for 25-year event
Inflow = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af
Outflow = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af, Atten= 59%, Lag= 79.6 min
Primary = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 0.73' @ 9.47 hrs Surf.Area= 0.014 ac Storage= 0.004 af

Plug-Flow detention time= 31.1 min calculated for 0.039 af (100% of inflow)
Center-of-Mass det. time= 31.1 min (884.7 - 853.6)

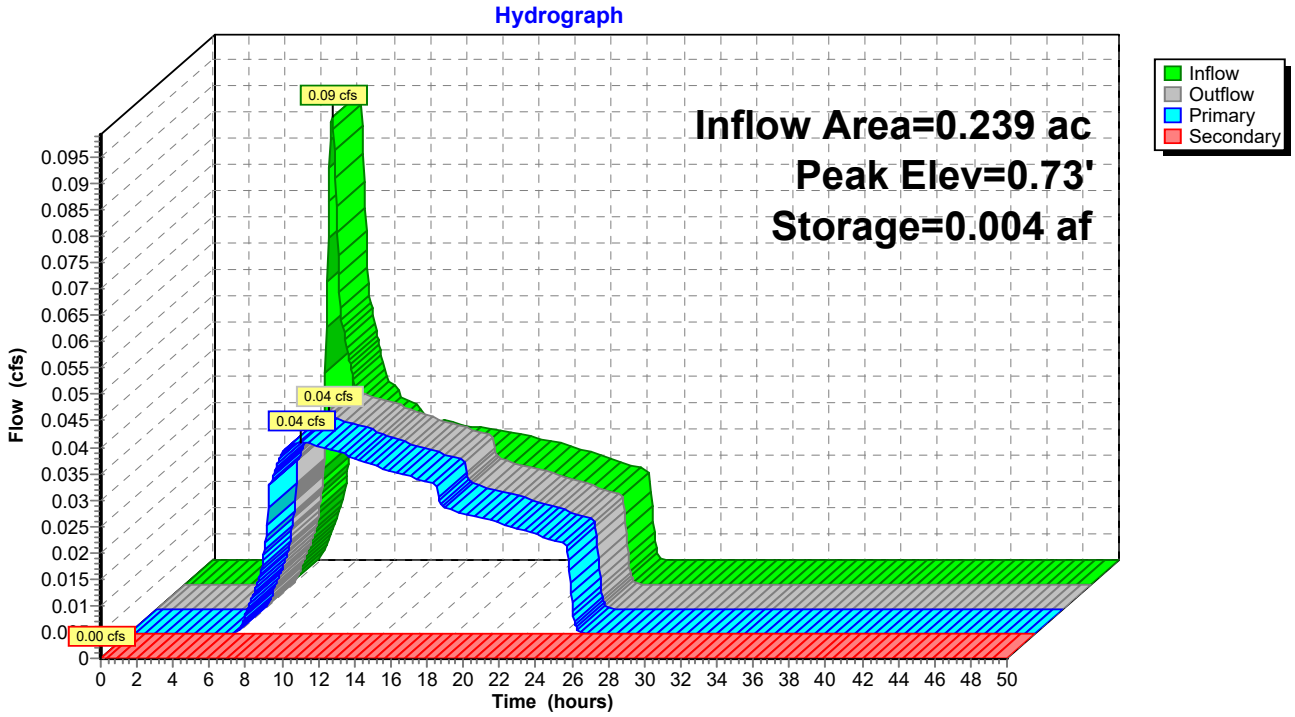
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	**5.00'W x 120.00'L x 5.00'H Bioretention** 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.04 cfs @ 9.47 hrs HW=0.73' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 4.19" for 25-year event
Inflow = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af
Outflow = 1.41 cfs @ 8.12 hrs, Volume= 0.481 af, Atten= 1%, Lag= 1.8 min
Primary = 0.09 cfs @ 8.12 hrs, Volume= 0.189 af
Secondary = 1.32 cfs @ 8.12 hrs, Volume= 0.292 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.61' @ 8.12 hrs Surf.Area= 0.028 ac Storage= 0.044 af

Plug-Flow detention time= 110.7 min calculated for 0.480 af (100% of inflow)
Center-of-Mass det. time= 111.0 min (827.2 - 716.3)

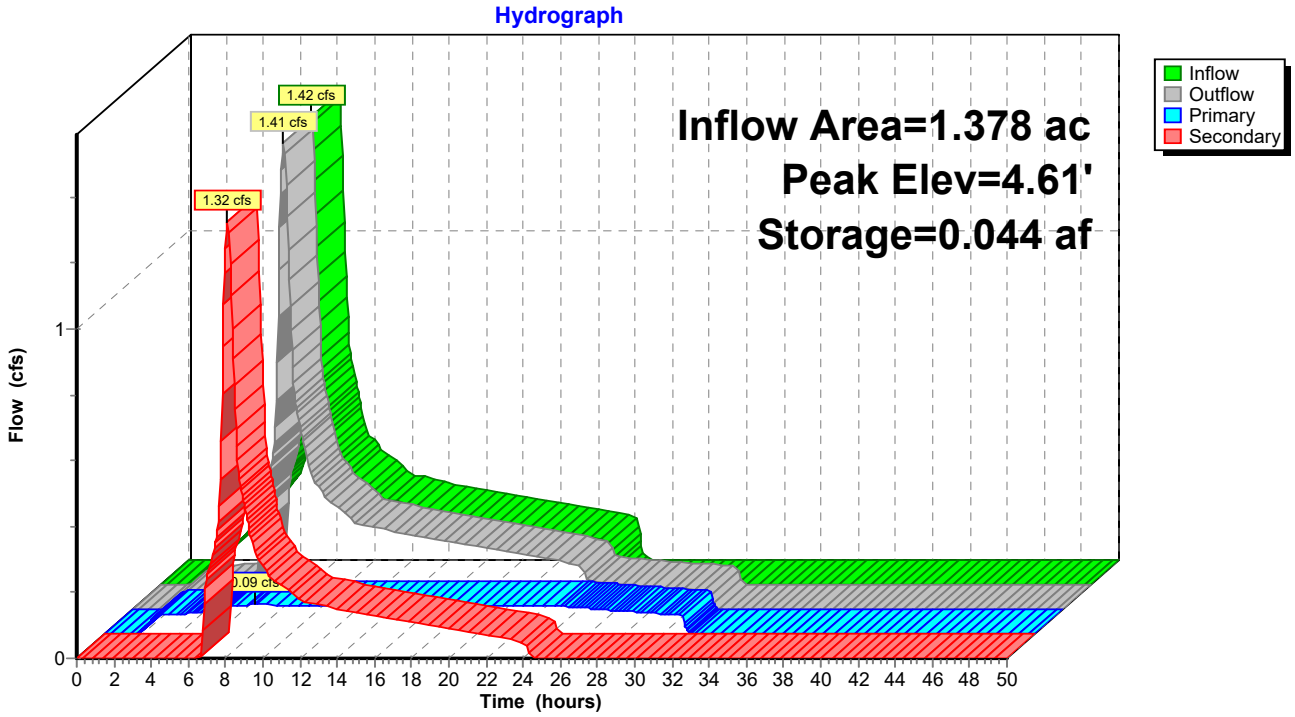
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	**20.00'W x 60.00'L x 6.00'H Infiltration Trench** 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.32 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.32 cfs @ 2.65 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth > 4.78" for 25-year event
Inflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
Outflow = 27.97 cfs @ 8.70 hrs, Volume= 18.424 af, Atten= 3%, Lag= 11.7 min
Primary = 3.57 cfs @ 8.70 hrs, Volume= 8.564 af
Secondary = 24.41 cfs @ 8.70 hrs, Volume= 9.860 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.86' @ 8.70 hrs Surf.Area= 1.674 ac Storage= 2.259 af

Plug-Flow detention time= 143.4 min calculated for 18.424 af (100% of inflow)
Center-of-Mass det. time= 143.3 min (888.6 - 745.3)

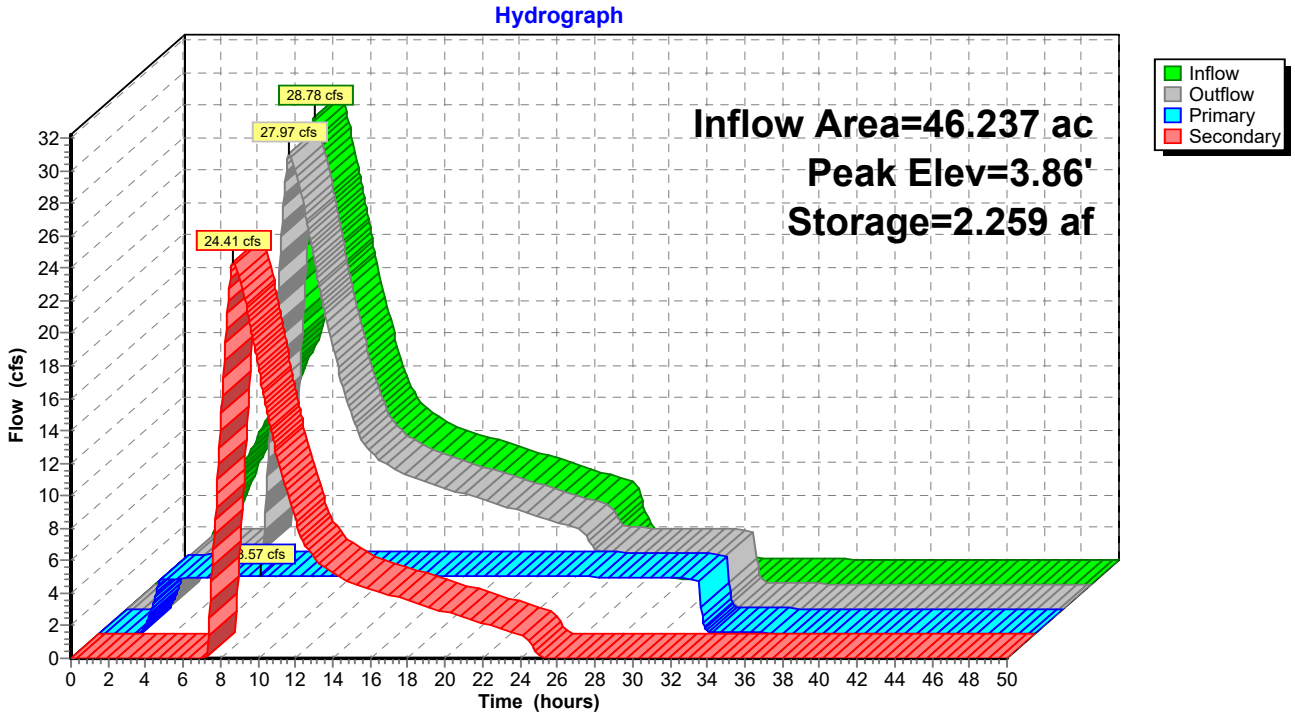
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	**270.00'W x 270.00'L x 5.00'H Infiltration Trench** 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.57 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 3.57 cfs)

Secondary OutFlow Max=24.40 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 24.40 cfs @ 3.03 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=13)
[81] Warning: Exceeded Pond 19P by 38.51' @ 8.25 hrs
[79] Warning: Submerged Pond N2 Primary device # 1 INLET by 3.08'

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 6.90" for 25-year event
Inflow = 65.60 cfs @ 8.14 hrs, Volume= 25.625 af
Outflow = 57.61 cfs @ 8.35 hrs, Volume= 25.625 af, Atten= 12%, Lag= 12.5 min
Primary = 57.61 cfs @ 8.35 hrs, Volume= 25.625 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 42.27' @ 8.35 hrs Surf.Area= 34,718 sf Storage= 9,485 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.3 min (742.9 - 742.5)

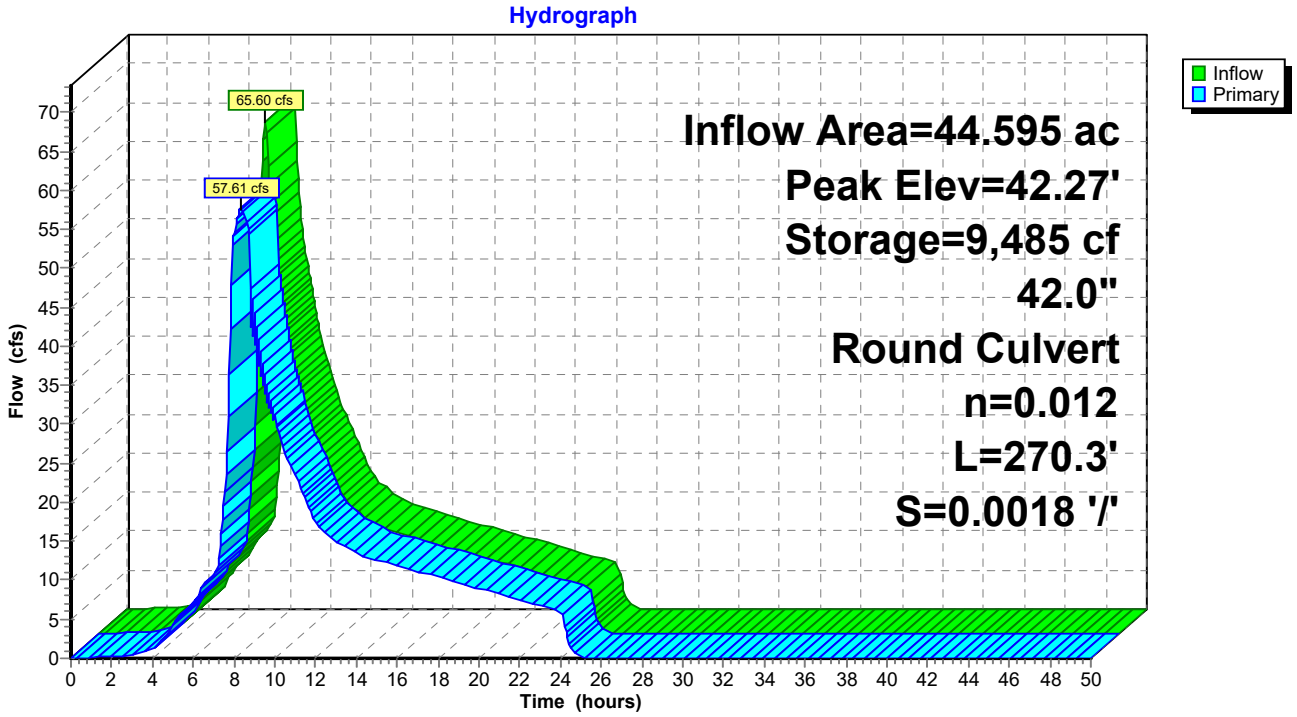
Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

Device	Routing	Invert	Outlet Devices
#1	Primary	38.00'	**42.0" Round Culvert** L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 9.62 sf

Primary OutFlow Max=57.64 cfs @ 8.35 hrs HW=42.27' (Free Discharge)
1=Culvert (Barrel Controls 57.64 cfs @ 6.24 fps)

Pond N1: Node D



Summary for Pond N2: Node C

[57] Hint: Peaked at 44.32' (Flood elevation advised)
[81] Warning: Exceeded Pond 7P by 1.94' @ 2.10 hrs
[81] Warning: Exceeded Pond 15P by 44.04' @ 8.10 hrs
[81] Warning: Exceeded Pond 16P by 42.27' @ 1.60 hrs

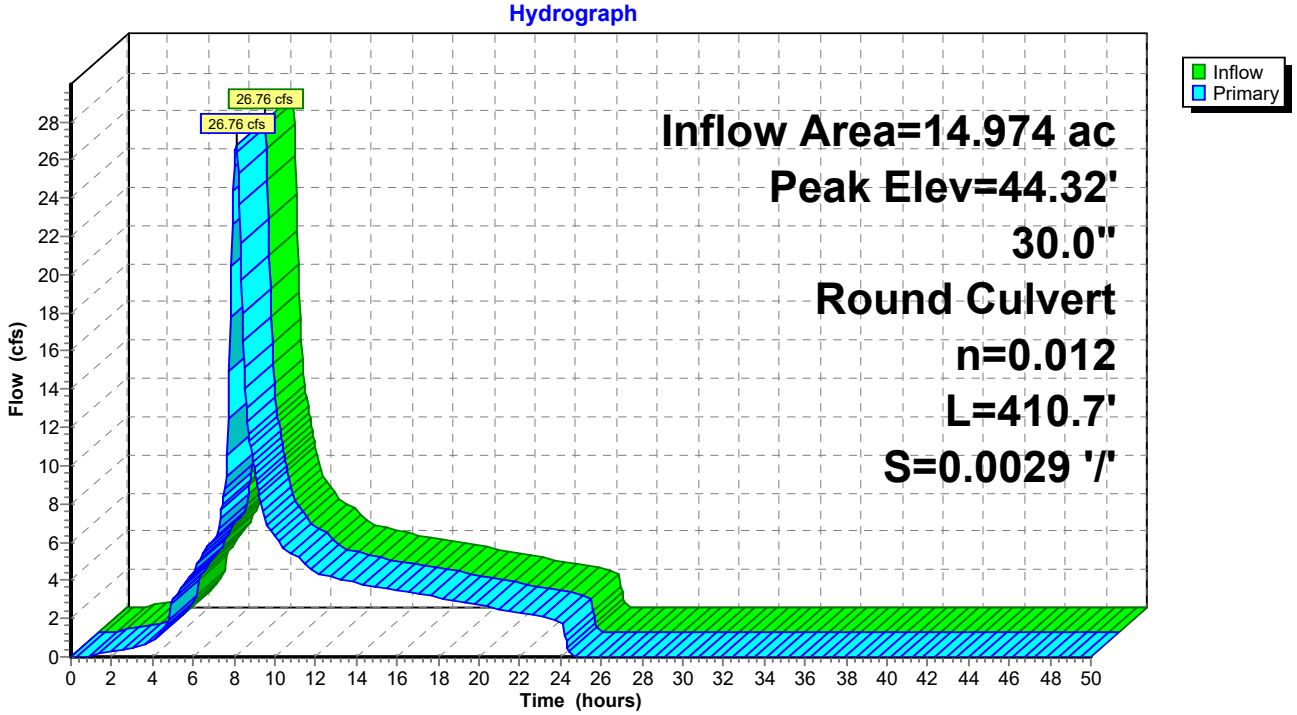
Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 6.37" for 25-year event
Inflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
Outflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af, Atten= 0%, Lag= 0.0 min
Primary = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 44.32' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	**30.0" Round Culvert** L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=26.76 cfs @ 8.10 hrs HW=44.32' TW=42.27' (Fixed TW Elev= 42.27')
1=Culvert (Outlet Controls 26.76 cfs @ 5.45 fps)

Pond N2: Node C



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.24' (Flood elevation advised)
[81] Warning: Exceeded Pond 4P by 48.49' @ 31.50 hrs
[81] Warning: Exceeded Pond 5P by 48.49' @ 35.90 hrs

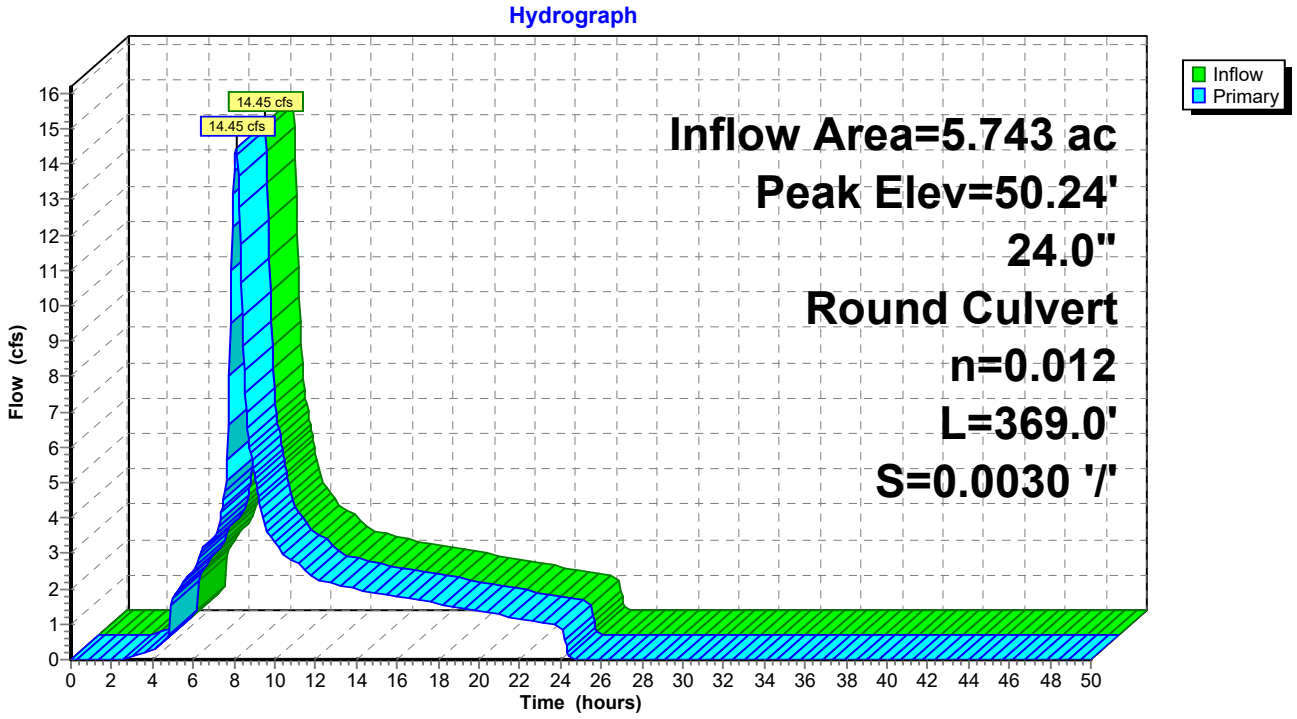
Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 8.63" for 25-year event
Inflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
Outflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af, Atten= 0%, Lag= 0.0 min
Primary = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
Routed to Pond 7P : Node B

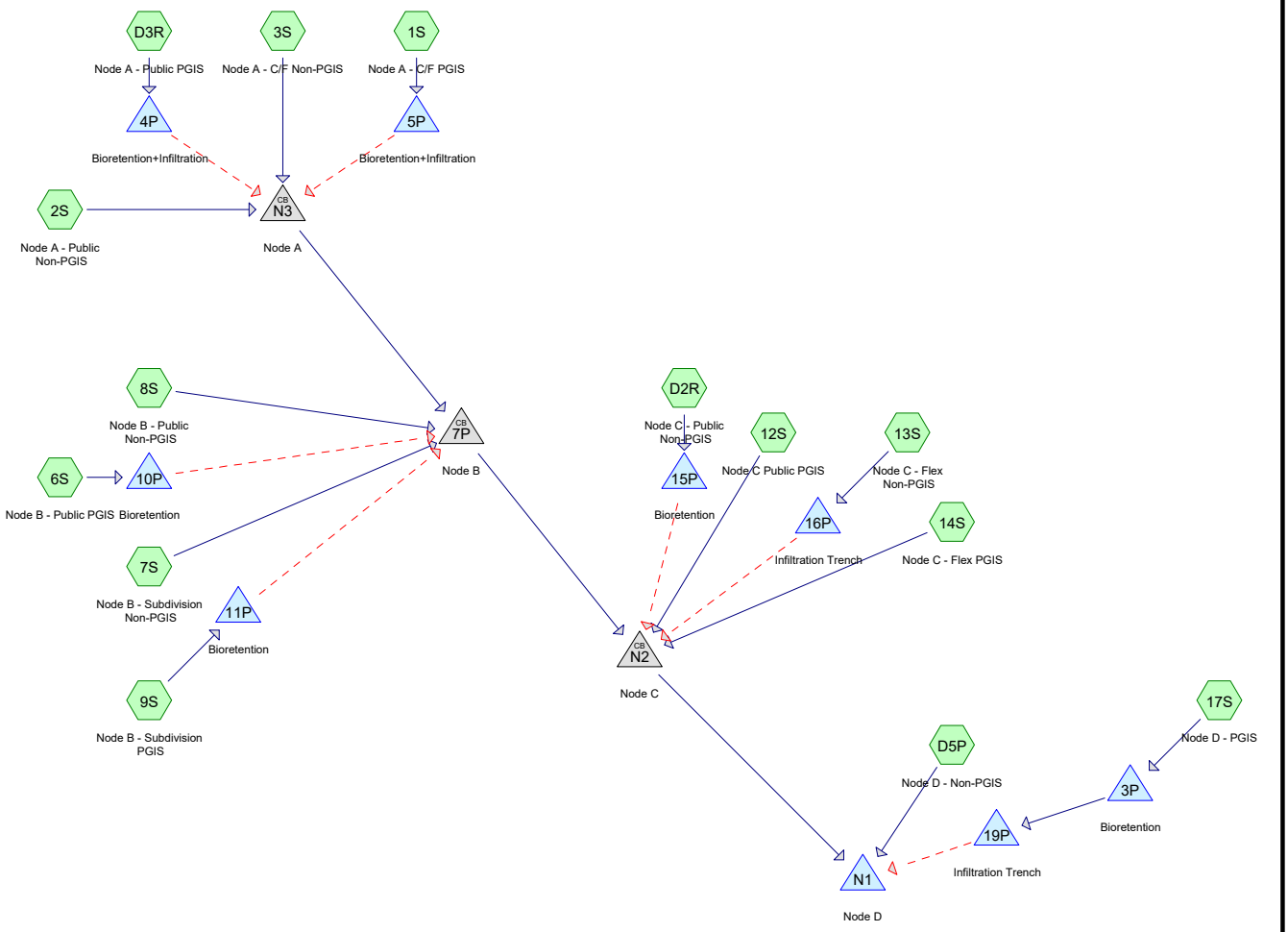
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 50.24' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	**24.0" Round Culvert** L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=14.45 cfs @ 8.10 hrs HW=50.24' TW=48.56' (Fixed TW Elev= 48.56')
1=Culvert (Outlet Controls 14.45 cfs @ 4.60 fps)

Pond N3: Node A





Subcat Reach Pond Link

Routing Diagram for ALTERNATE _Onsite 100-Year Storm - Water @ OHWM or Below

Prepared by MacKay & Sposito, Inc, Printed 3/10/2025

HydroCAD® 10.20-5c s/n 01662 © 2023 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	**38.896**	**0.000**	**0.000**	**0.000**	**104.075**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=10.54 cfs 3.734 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.97"
Tc=20.0 min CN=59 Runoff=0.38 cfs 0.190 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=4.82"
Tc=20.0 min CN=88 Runoff=5.43 cfs 1.840 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=0.35 cfs 0.124 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=4.49"
Tc=20.0 min CN=85 Runoff=7.39 cfs 2.525 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=3.86"
Tc=20.0 min CN=79 Runoff=0.08 cfs 0.029 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=3.05 cfs 1.081 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=1.00 cfs 0.353 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=5.27"
Tc=20.0 min CN=92 Runoff=1.78 cfs 0.605 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=64.81 cfs 22.971 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=2.78"
Tc=20.0 min CN=68 Runoff=0.14 cfs 0.055 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=4.17"
Tc=20.0 min CN=82 Runoff=29.72 cfs 10.297 af

Pond 3P: Bioretention Peak Elev=54.89' Storage=3.301 af Inflow=64.81 cfs 22.971 af
Outflow=40.37 cfs 22.657 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.84' Storage=0.039 af Inflow=2.36 cfs 0.837 af
Primary=0.15 cfs 0.283 af Secondary=2.20 cfs 0.554 af Outflow=2.35 cfs 0.837 af

Pond 5P: Bioretention+Infiltration Peak Elev=5.04' Storage=0.241 af Inflow=10.54 cfs 3.734 af
Primary=0.36 cfs 0.890 af Secondary=10.21 cfs 2.844 af Outflow=10.57 cfs 3.734 af

Pond 7P: Node B Peak Elev=49.68' Inflow=28.83 cfs 8.778 af
Outflow=28.83 cfs 8.778 af

Pond 10P: Bioretention Peak Elev=3.28' Storage=0.005 af Inflow=0.35 cfs 0.124 af
Primary=0.02 cfs 0.046 af Secondary=0.33 cfs 0.078 af Outflow=0.35 cfs 0.124 af

Pond 11P: Bioretention Peak Elev=5.06' Storage=0.055 af Inflow=3.05 cfs 1.081 af
Primary=0.19 cfs 0.364 af Secondary=2.82 cfs 0.717 af Outflow=3.02 cfs 1.081 af

Pond 15P: Bioretention Peak Elev=1.52' Storage=0.007 af Inflow=0.14 cfs 0.055 af
Primary=0.05 cfs 0.055 af Secondary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.055 af

Pond 16P: Infiltration Trench Peak Elev=4.70' Storage=0.045 af Inflow=1.78 cfs 0.605 af
Primary=0.09 cfs 0.193 af Secondary=1.68 cfs 0.411 af Outflow=1.77 cfs 0.605 af

Pond 19P: Infiltration Trench Peak Elev=4.09' Storage=2.393 af Inflow=40.37 cfs 22.657 af
Primary=3.58 cfs 8.734 af Secondary=34.89 cfs 13.923 af Outflow=38.47 cfs 22.657 af

Pond N1: Node D Peak Elev=43.12' Storage=42,363 cf Inflow=84.32 cfs 34.599 af
Primary=66.43 cfs 34.599 af Secondary=0.00 cfs 0.000 af Outflow=66.43 cfs 34.599 af

Pond N2: Node C Peak Elev=46.40' Inflow=33.86 cfs 10.379 af
Outflow=33.86 cfs 10.379 af

Pond N3: Node A Peak Elev=50.56' Inflow=18.21 cfs 5.428 af
Outflow=18.21 cfs 5.428 af

Total Runoff Area = 104.075 ac Runoff Volume = 45.478 af Average Runoff Depth = 5.24"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

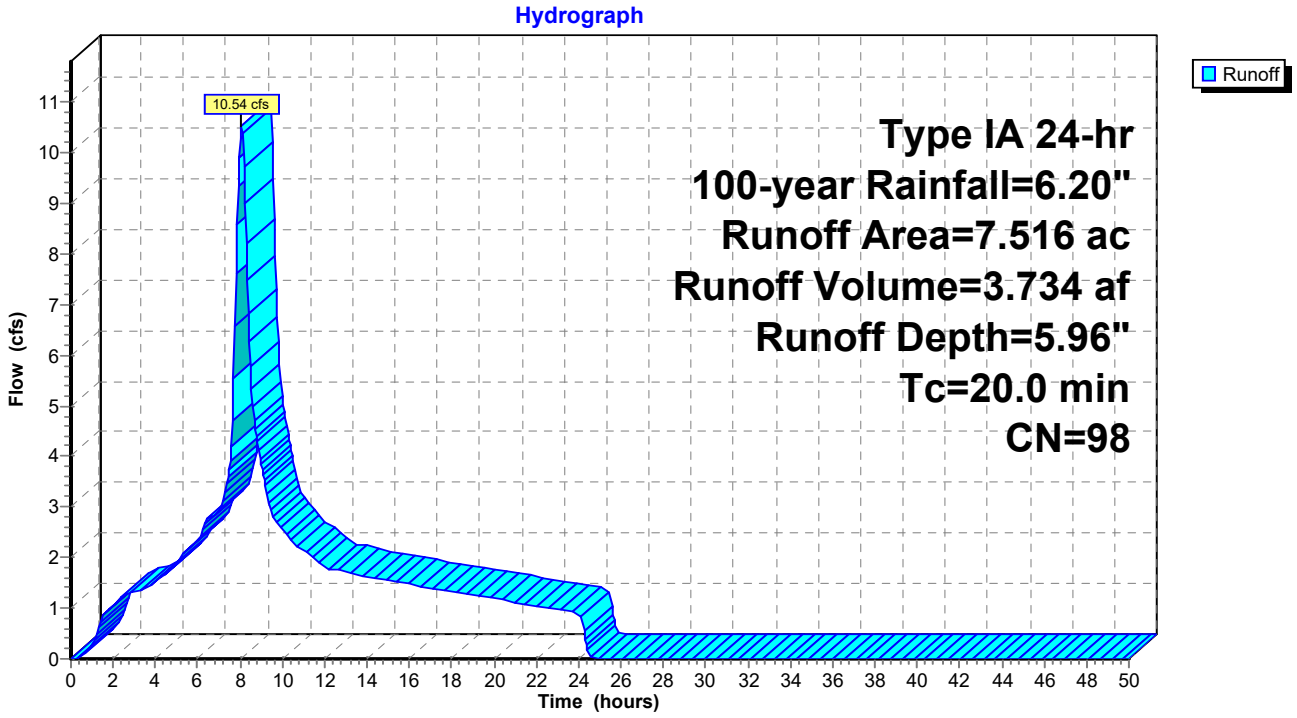
Runoff = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af, Depth= 5.96"
Routed to Pond 5P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 1S: Node A - C/F PGIS



Summary for Subcatchment 2S: Node A - Public Non-PGIS

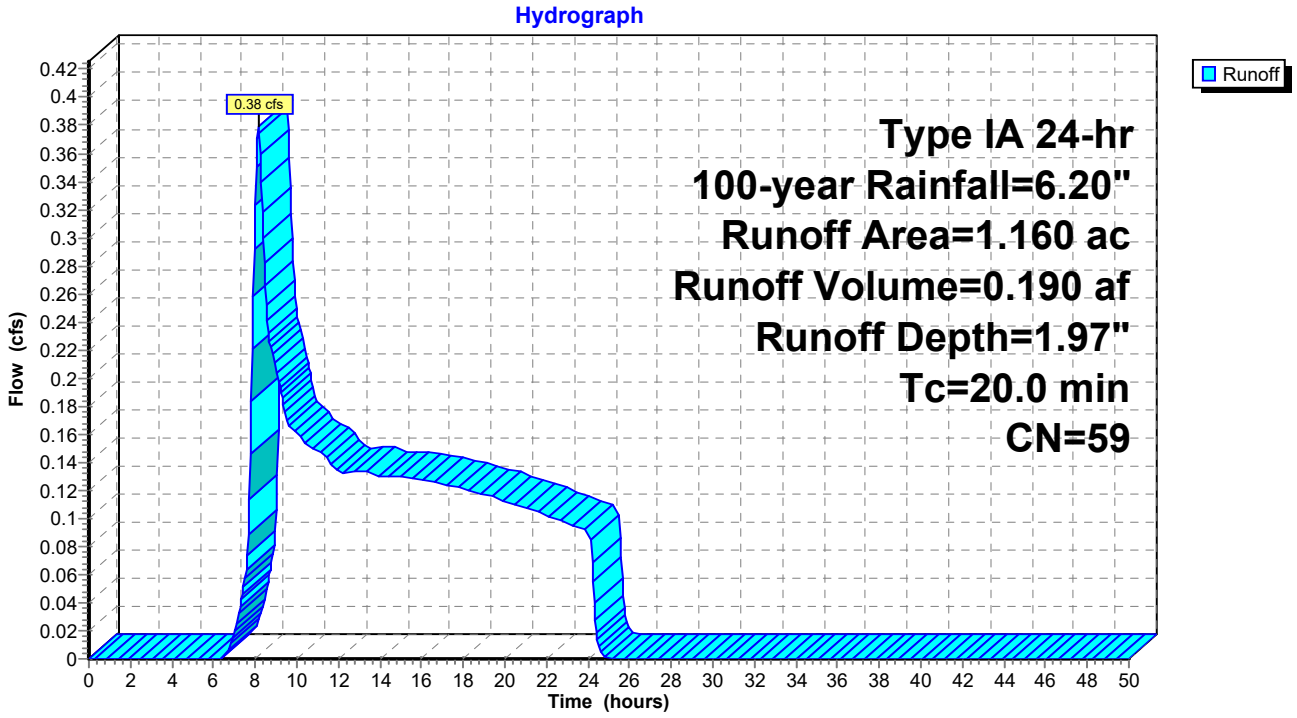
Runoff = 0.38 cfs @ 8.16 hrs, Volume= 0.190 af, Depth= 1.97"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
	1.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 2S: Node A - Public Non-PGIS



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

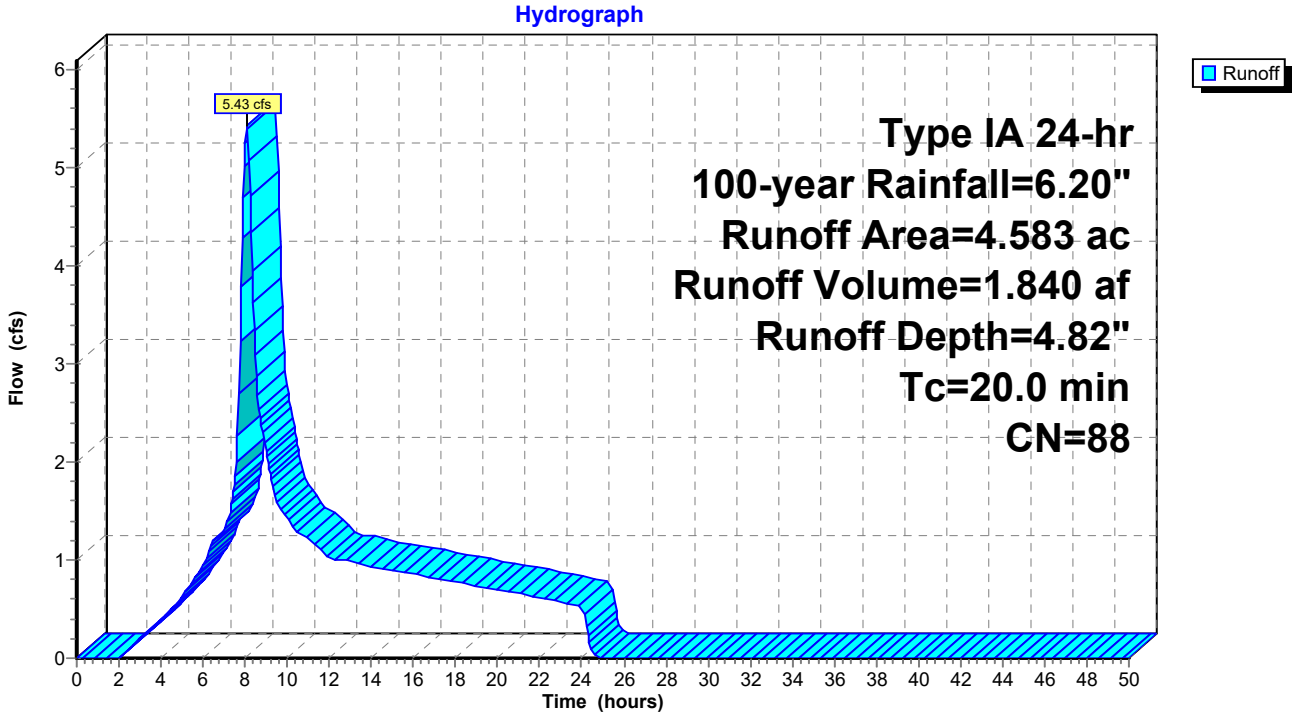
Runoff = 5.43 cfs @ 8.09 hrs, Volume= 1.840 af, Depth= 4.82"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
	3.373	98	Roofs, HSG A
	4.583	88	Weighted Average
	1.210		26.40% Pervious Area
	3.373		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 3S: Node A - C/F Non-PGIS



Summary for Subcatchment 6S: Node B - Public PGIS

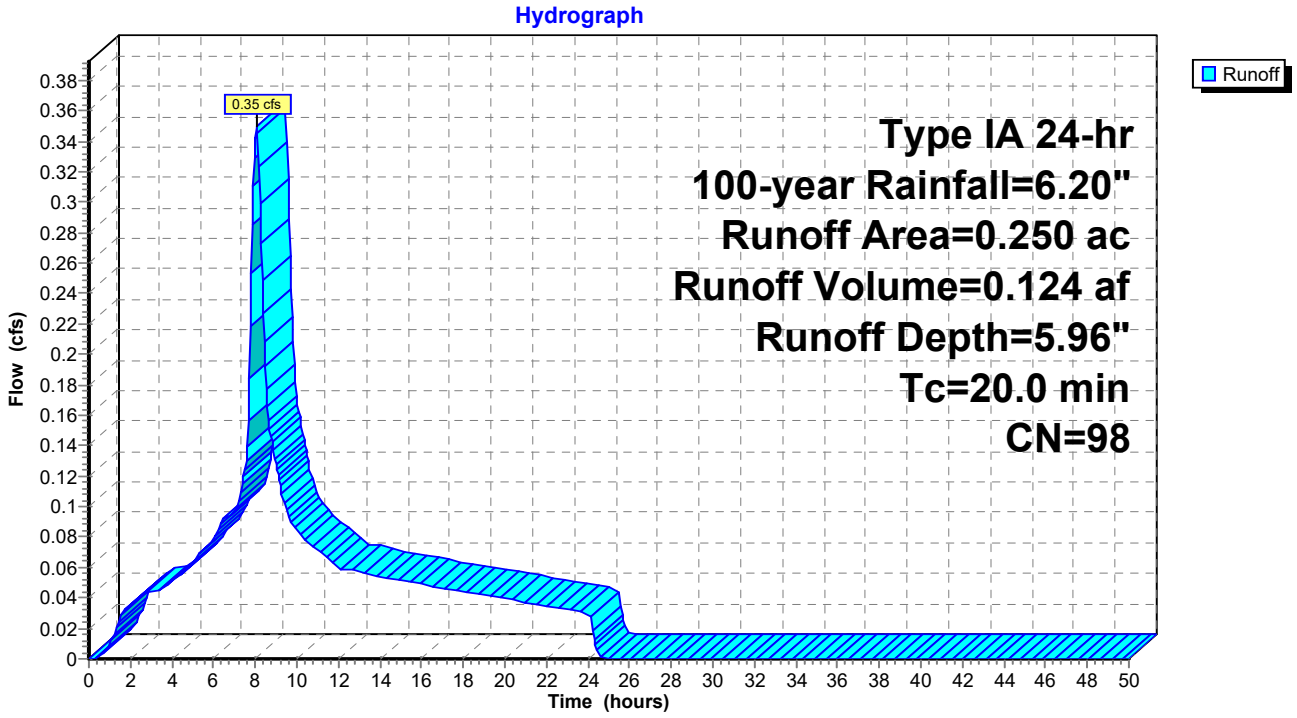
Runoff = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af, Depth= 5.96"
Routed to Pond 10P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 6S: Node B - Public PGIS



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

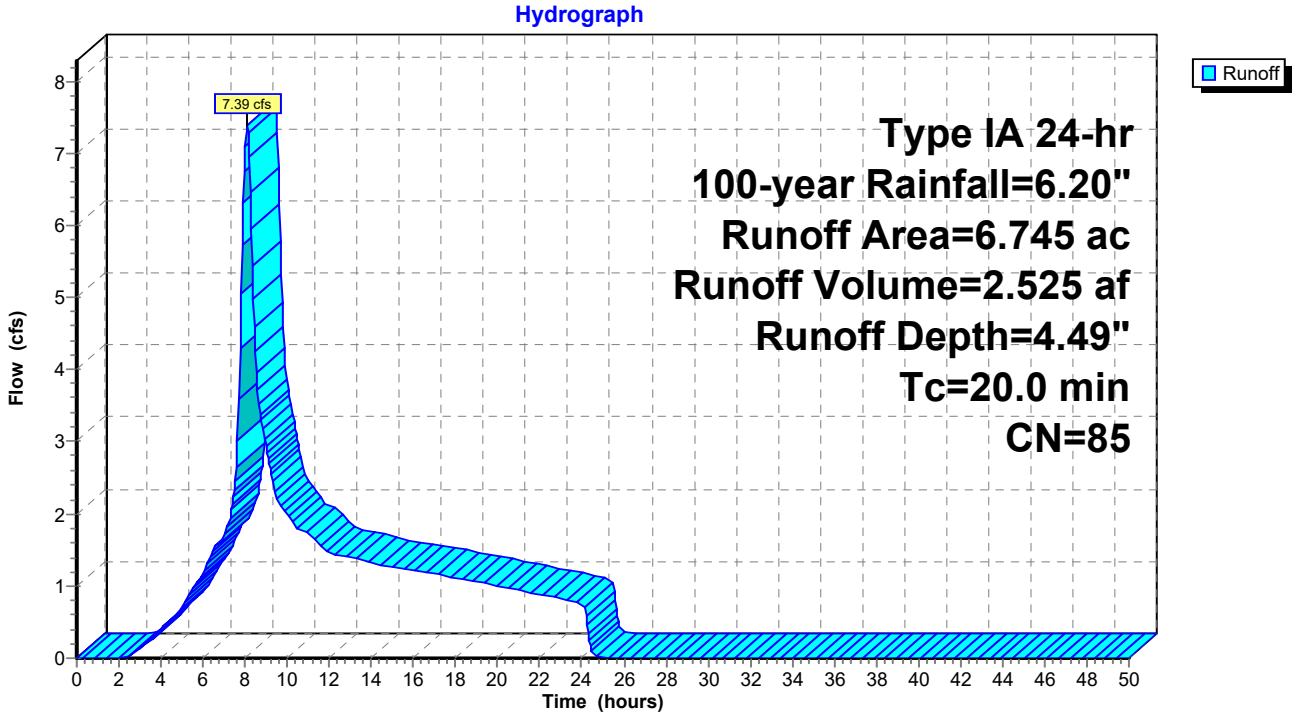
Runoff = 7.39 cfs @ 8.09 hrs, Volume= 2.525 af, Depth= 4.49"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 7S: Node B - Subdivision Non-PGIS



Summary for Subcatchment 8S: Node B - Public Non-PGIS

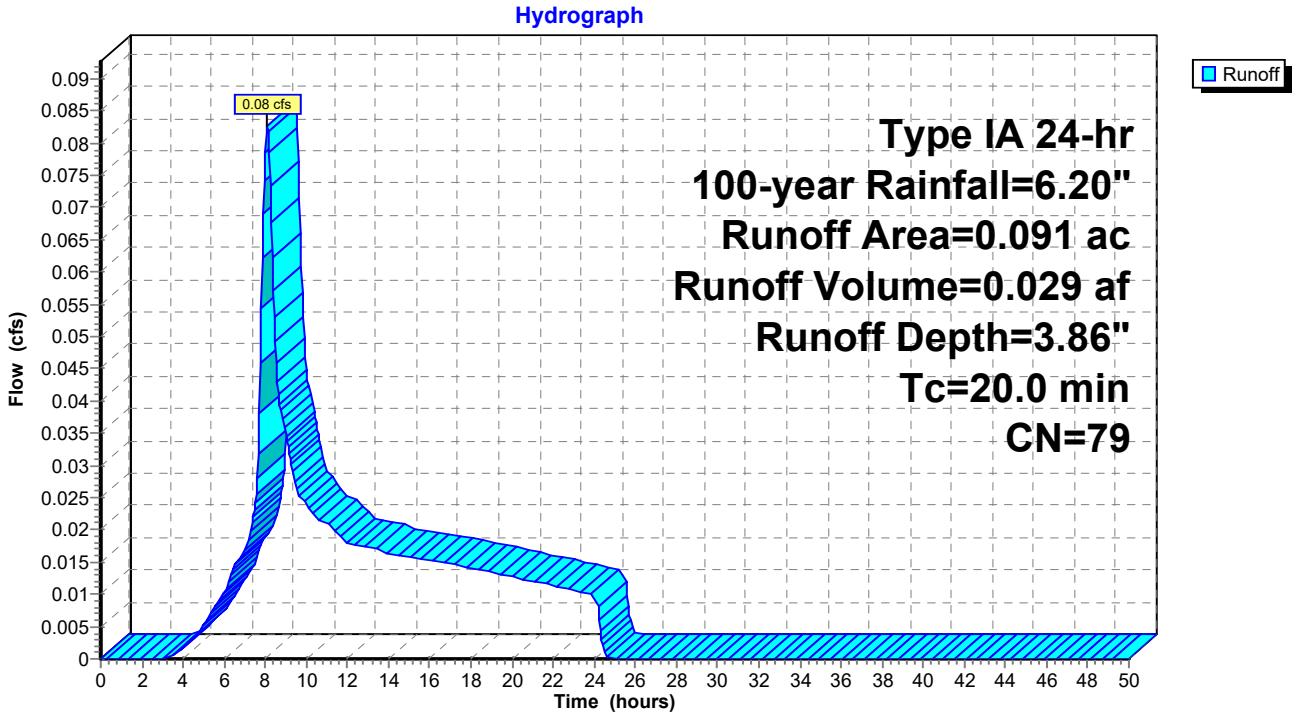
Runoff = 0.08 cfs @ 8.11 hrs, Volume= 0.029 af, Depth= 3.86"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 8S: Node B - Public Non-PGIS



Summary for Subcatchment 9S: Node B - Subdivision PGIS

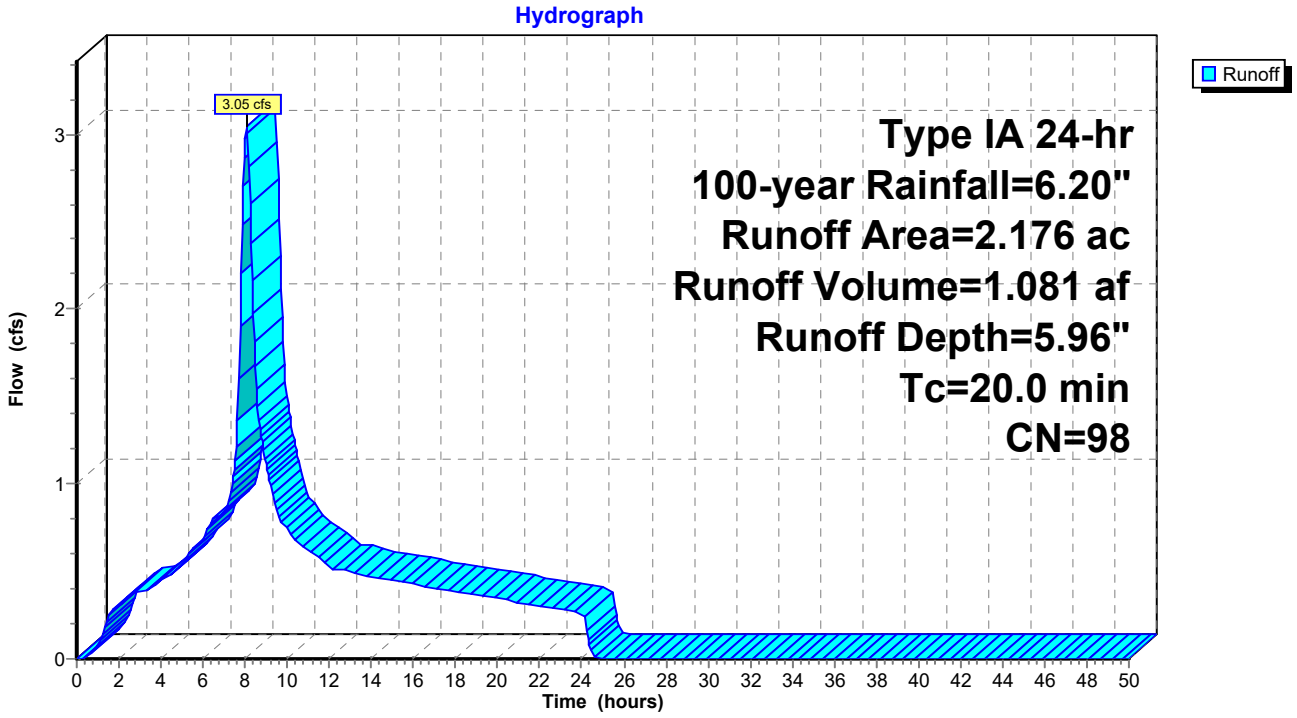
Runoff = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af, Depth= 5.96"
Routed to Pond 11P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 9S: Node B - Subdivision PGIS



Summary for Subcatchment 12S: Node C Public PGIS

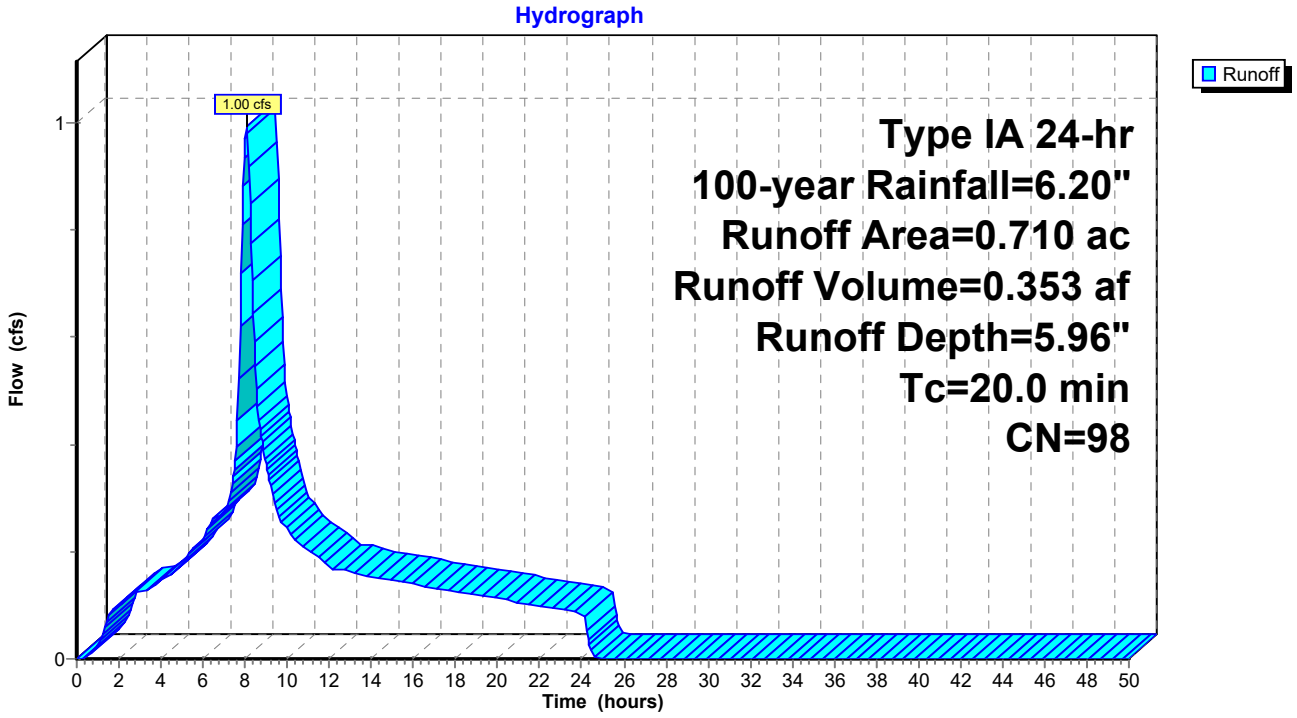
Runoff = 1.00 cfs @ 8.08 hrs, Volume= 0.353 af, Depth= 5.96"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 12S: Node C Public PGIS



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

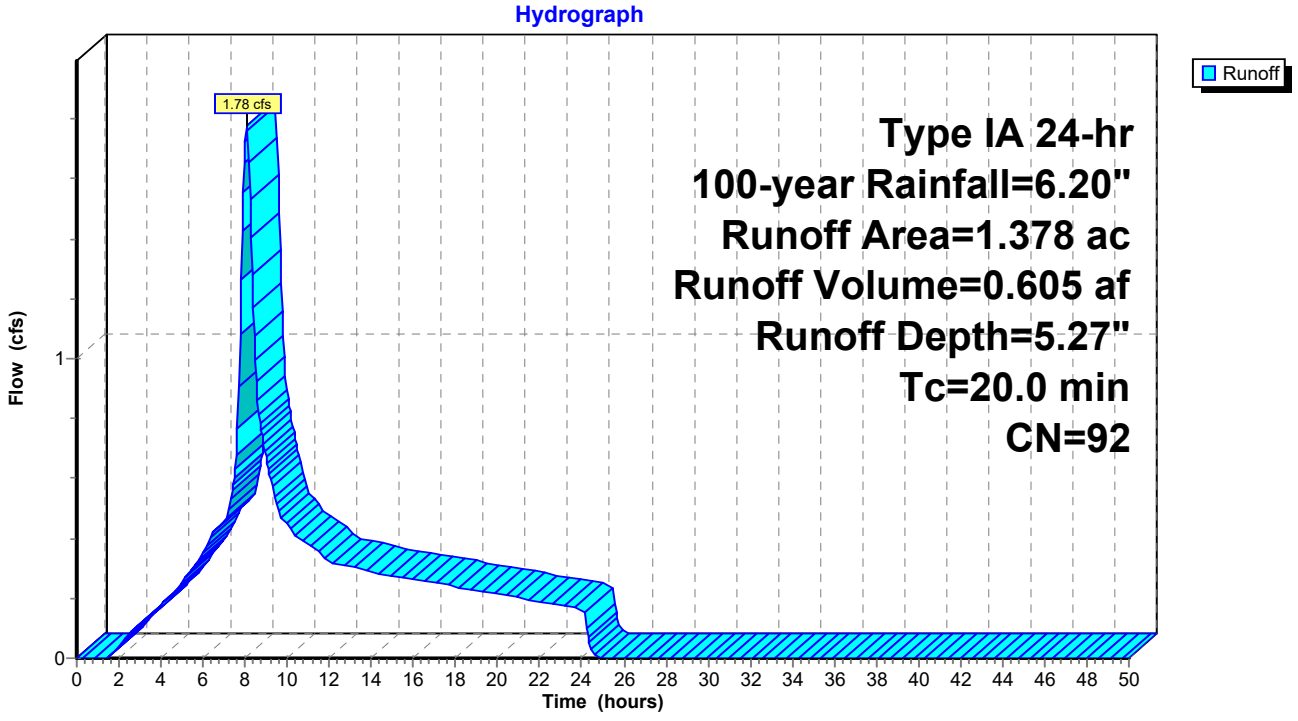
Runoff = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af, Depth= 5.27"
Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

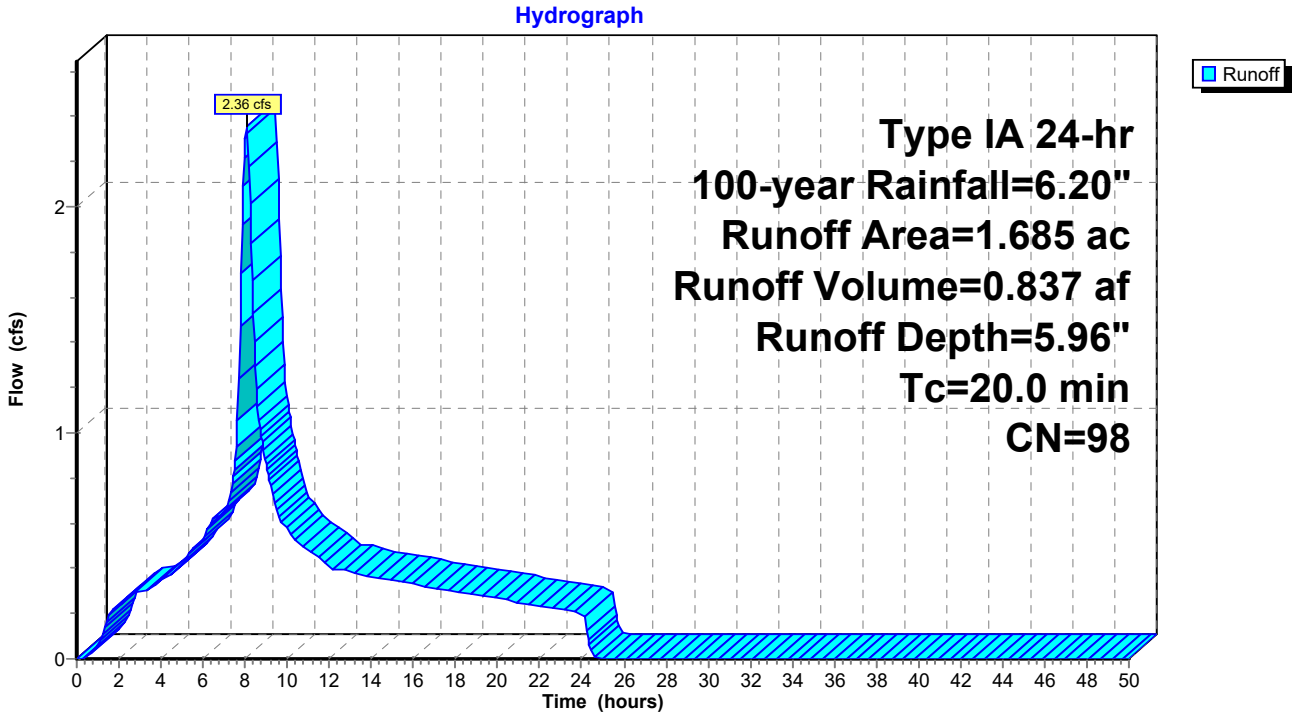
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 14S: Node C - Flex PGIS



Summary for Subcatchment 17S: Node D - PGIS

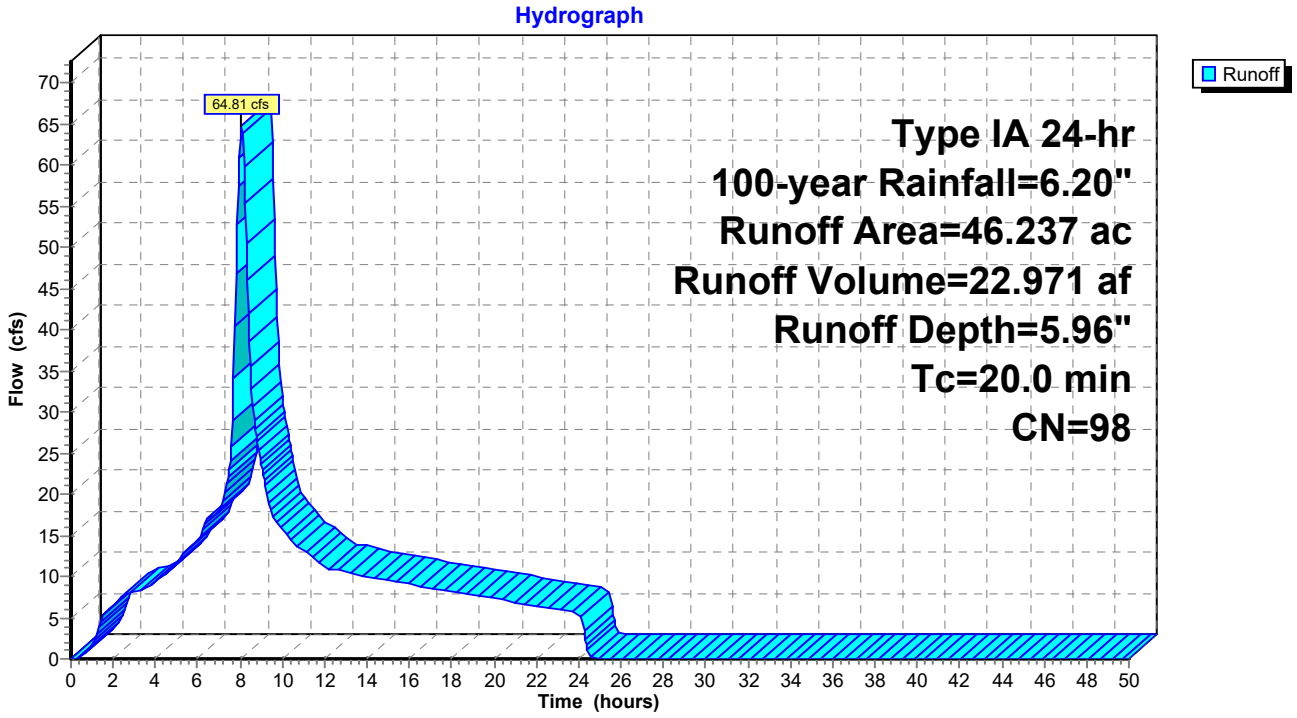
Runoff = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af, Depth= 5.96"
Routed to Pond 3P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 17S: Node D - PGIS



Summary for Subcatchment D2R: Node C - Public Non-PGIS

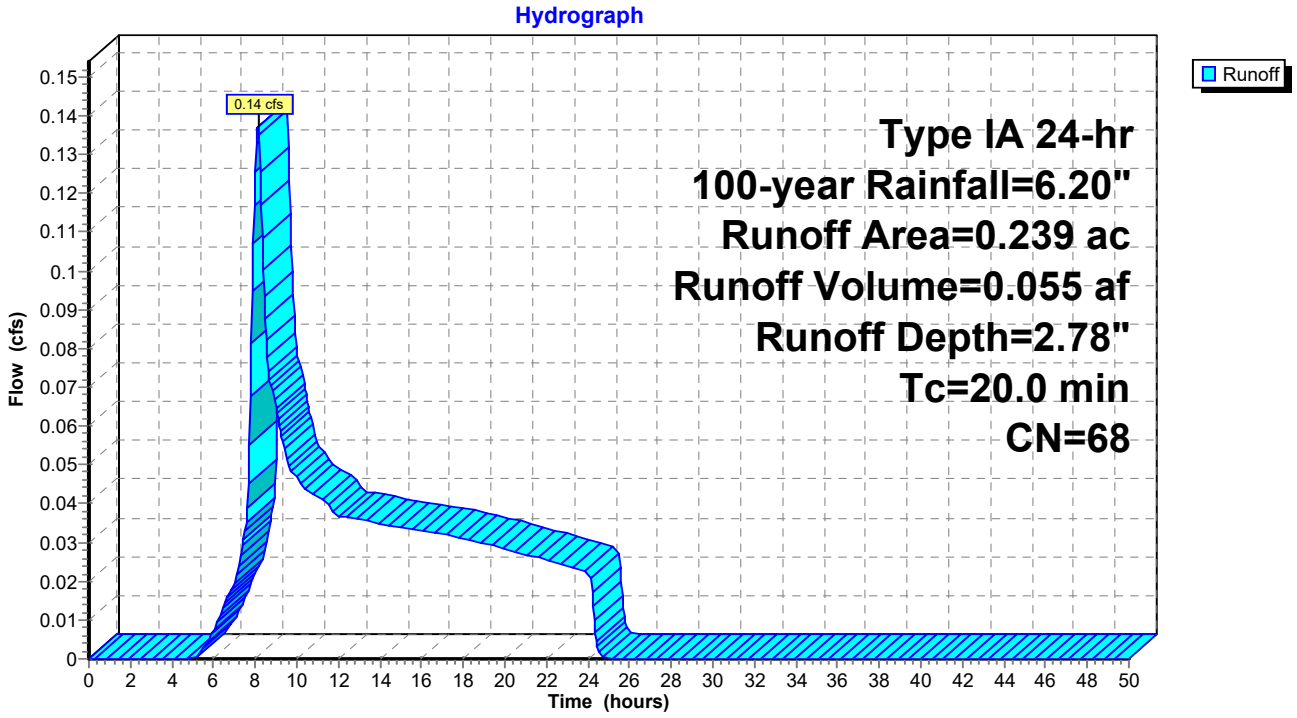
Runoff = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af, Depth= 2.78"
Routed to Pond 15P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D2R: Node C - Public Non-PGIS



Summary for Subcatchment D3R: Node A - Public PGIS

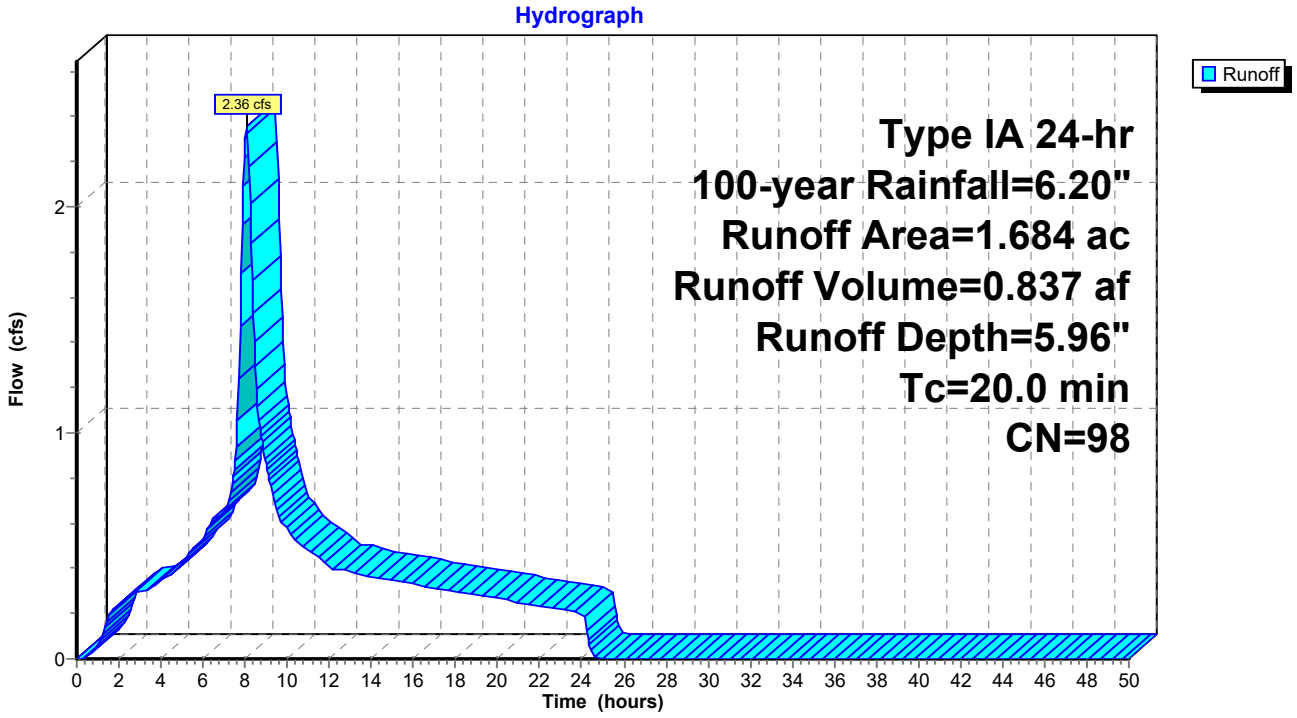
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

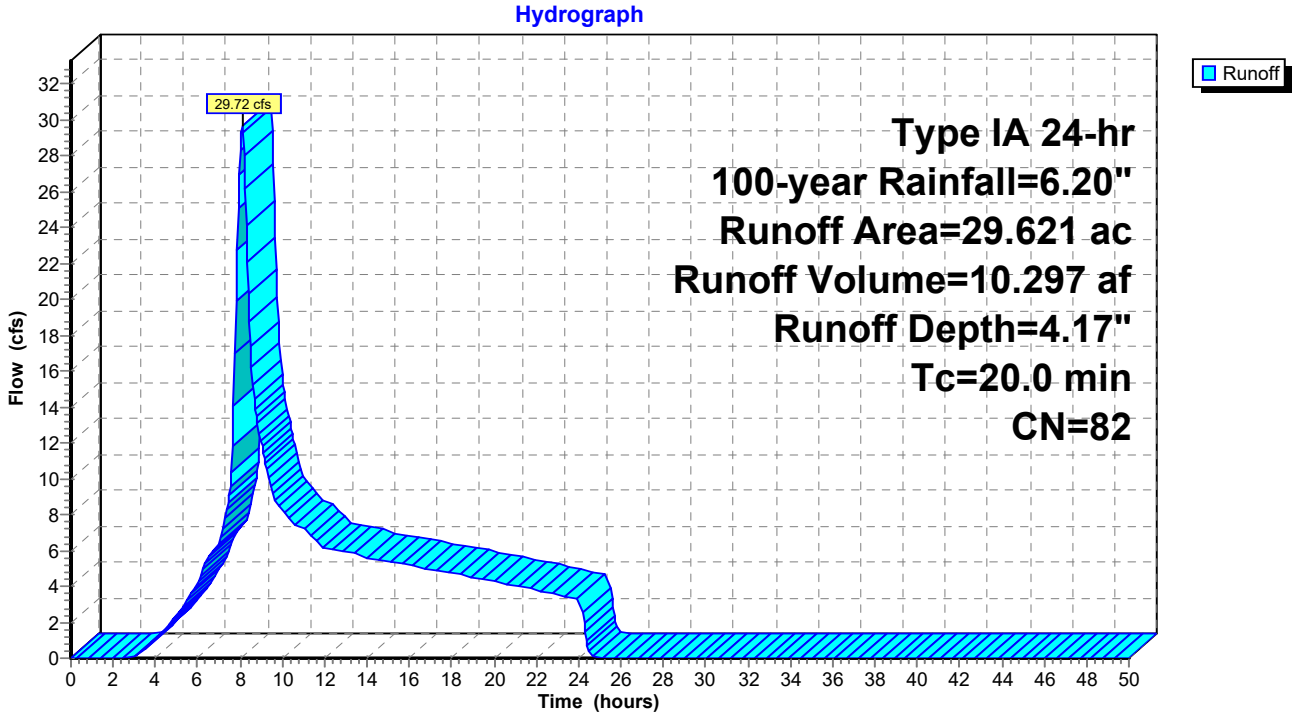
Runoff = 29.72 cfs @ 8.10 hrs, Volume= 10.297 af, Depth= 4.17"
Routed to Pond N1 : Node D

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D5P: Node D - Non-PGIS



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af
Outflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af, Atten= 38%, Lag= 20.8 min
Primary = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 54.89' @ 8.42 hrs Surf.Area= 1.674 ac Storage= 3.301 af

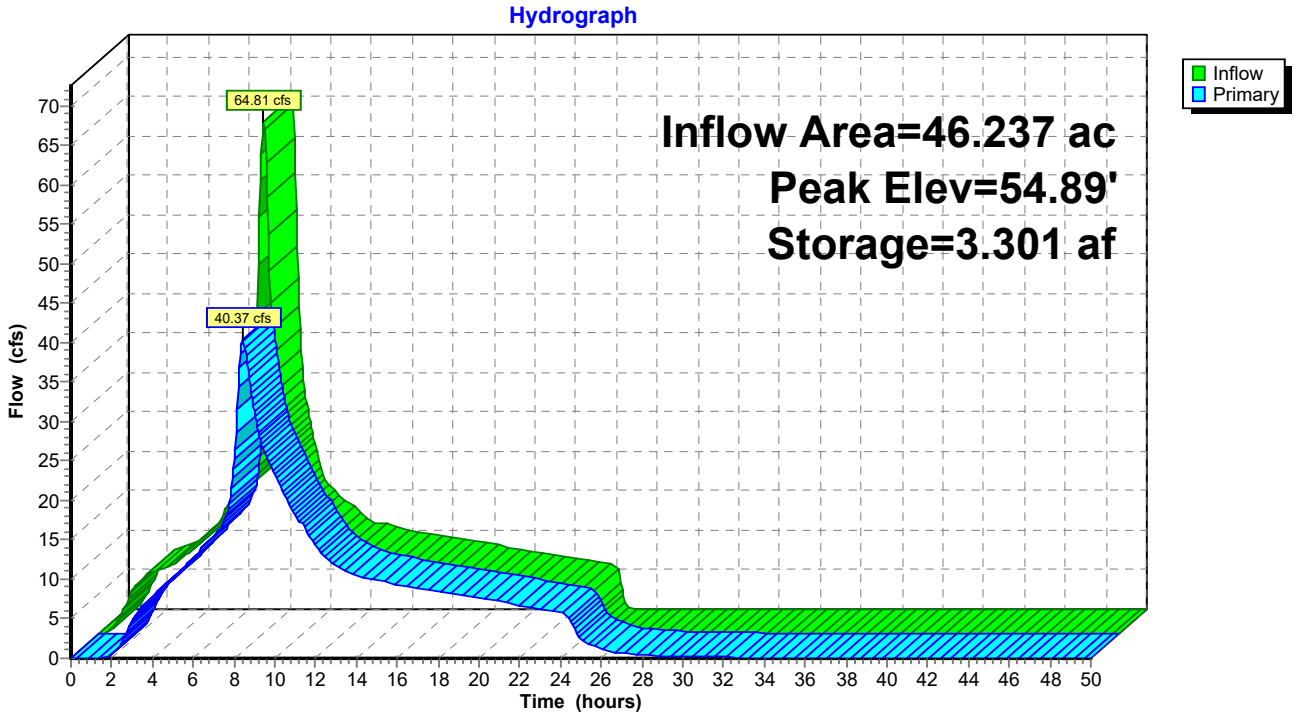
Plug-Flow detention time= 83.2 min calculated for 22.657 af (99% of inflow)
Center-of-Mass det. time= 72.4 min (736.4 - 664.0)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	**270.00'W x 270.00'L x 6.50'H Prismatoid** 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	**270.00'W x 270.00'L x 2.00'H Prismatoid** Inside #1
#3	50.50'	0.019 af	**24.0" Round Pipe Storage** Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	**60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=40.28 cfs @ 8.42 hrs HW=54.89' (Free Discharge)
└**1=Orifice/Grate** (Weir Controls 12.44 cfs @ 2.04 fps)
└**2=Orifice/Grate** (Orifice Controls 27.85 cfs @ 8.86 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af
Outflow = 2.35 cfs @ 8.11 hrs, Volume= 0.837 af, Atten= 1%, Lag= 1.8 min
Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.283 af
Secondary = 2.20 cfs @ 8.11 hrs, Volume= 0.554 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.84' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.039 af

Plug-Flow detention time= 55.2 min calculated for 0.836 af (100% of inflow)
Center-of-Mass det. time= 55.4 min (719.4 - 664.0)

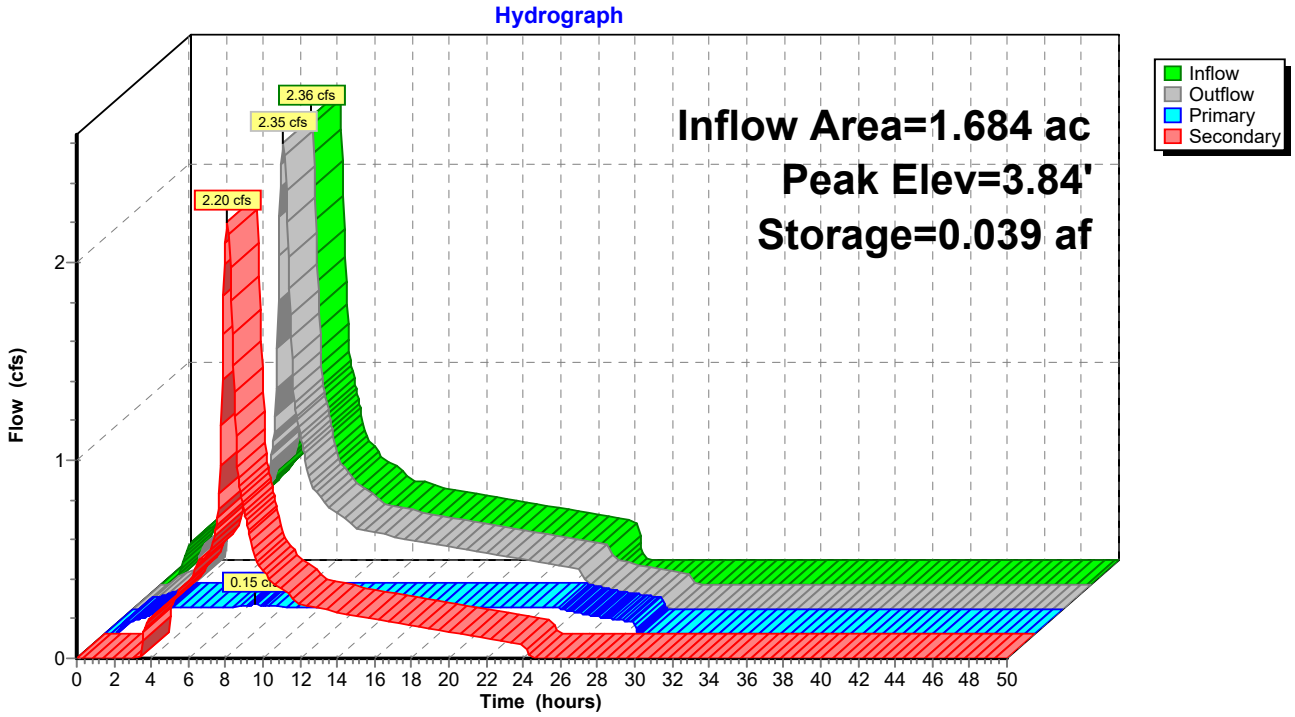
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	**5.00'W x 250.00'L x 5.00'H Bioretention** 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=2.20 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
2=Orifice/Grate (Orifice Controls 2.20 cfs @ 3.12 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

[93] Warning: Storage range exceeded by 0.04'
[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 7.516 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af
Outflow = 10.57 cfs @ 8.09 hrs, Volume= 3.734 af, Atten= 0%, Lag= 0.5 min
Primary = 0.36 cfs @ 7.95 hrs, Volume= 0.890 af
Secondary = 10.21 cfs @ 8.09 hrs, Volume= 2.844 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 5.04' @ 8.09 hrs Surf.Area= 0.138 ac Storage= 0.241 af

Plug-Flow detention time= 91.6 min calculated for 3.730 af (100% of inflow)
Center-of-Mass det. time= 92.0 min (756.0 - 664.0)

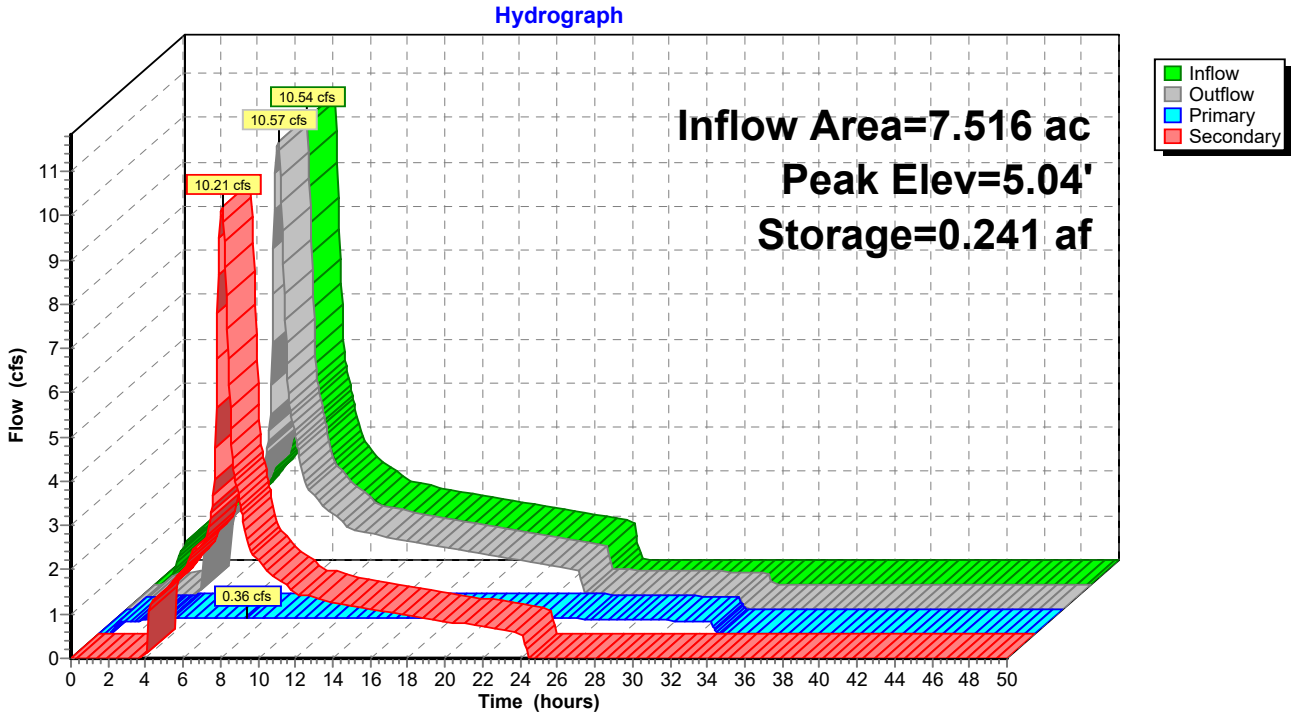
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	**50.00'W x 120.00'L x 5.00'H Infiltration Trench** 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.50'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 7.95 hrs HW=5.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=10.16 cfs @ 8.09 hrs HW=5.04' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 10.16 cfs @ 2.40 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 7P: Node B

[57] Hint: Peaked at 49.68' (Flood elevation advised)
[81] Warning: Exceeded Pond 10P by 46.40' @ 31.35 hrs
[81] Warning: Exceeded Pond 11P by 46.40' @ 33.05 hrs

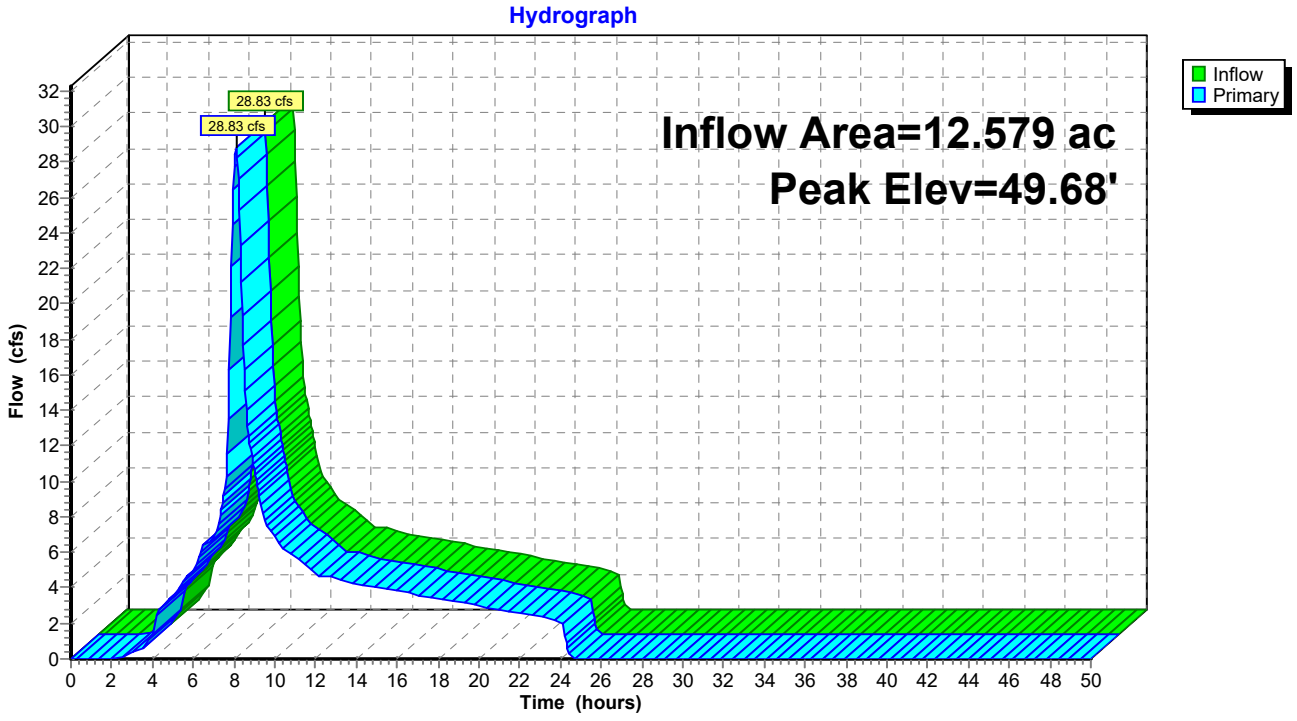
Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 8.37" for 100-year event
Inflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
Outflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af, Atten= 0%, Lag= 0.0 min
Primary = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 49.68' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	**24.0" Round Culvert** L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	49.50'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=28.67 cfs @ 8.09 hrs HW=49.68' TW=46.40' (Fixed TW Elev= 46.40')
1=Culvert (Outlet Controls 19.95 cfs @ 6.35 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 8.72 cfs @ 1.37 fps)

Pond 7P: Node B



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af
Outflow = 0.35 cfs @ 8.09 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.5 min
Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.046 af
Secondary = 0.33 cfs @ 8.09 hrs, Volume= 0.078 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.28' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 56.2 min calculated for 0.124 af (100% of inflow)
Center-of-Mass det. time= 56.3 min (720.4 - 664.0)

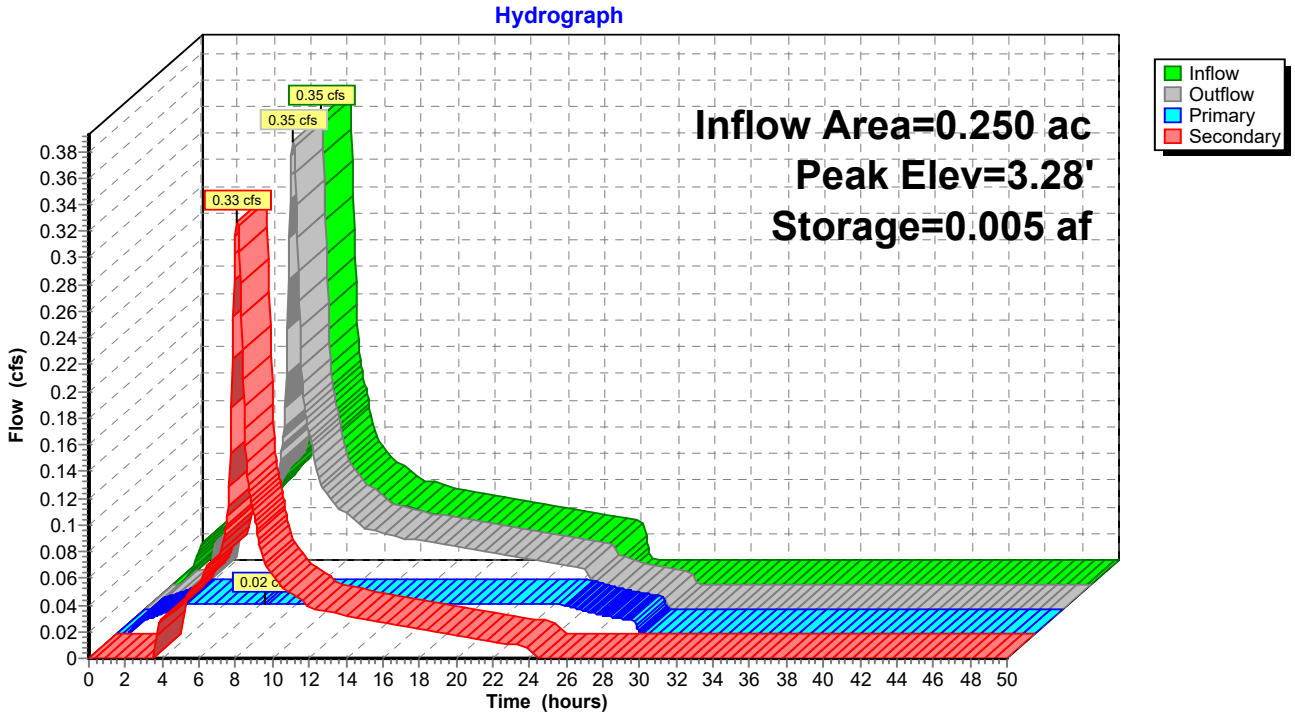
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	**5.00'W x 40.00'L x 5.00'H Bioretention** 0.023 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.32 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 0.32 cfs @ 1.80 fps)

Pond 10P: Bioretention



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af
Outflow = 3.02 cfs @ 8.12 hrs, Volume= 1.081 af, Atten= 1%, Lag= 2.8 min
Primary = 0.19 cfs @ 8.12 hrs, Volume= 0.364 af
Secondary = 2.82 cfs @ 8.12 hrs, Volume= 0.717 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 5.06' @ 8.12 hrs Surf.Area= 0.031 ac Storage= 0.055 af

Plug-Flow detention time= 61.6 min calculated for 1.080 af (100% of inflow)
Center-of-Mass det. time= 61.8 min (725.8 - 664.0)

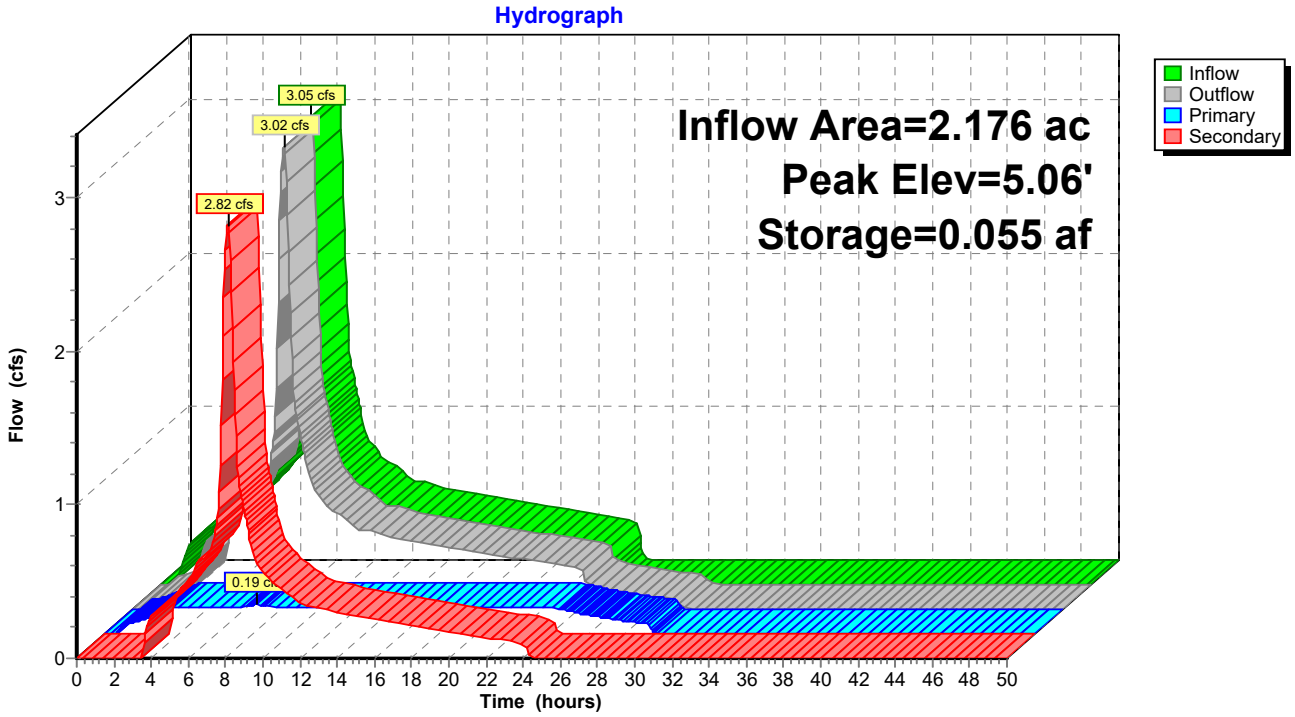
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	**5.00'W x 270.00'L x 6.00'H Bioretention** 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.82 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 2.82 cfs @ 3.59 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 2.78" for 100-year event
Inflow = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af
Outflow = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af, Atten= 67%, Lag= 125.5 min
Primary = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 1.52' @ 10.22 hrs Surf.Area= 0.014 ac Storage= 0.007 af

Plug-Flow detention time= 77.6 min calculated for 0.055 af (100% of inflow)
Center-of-Mass det. time= 77.5 min (908.4 - 830.8)

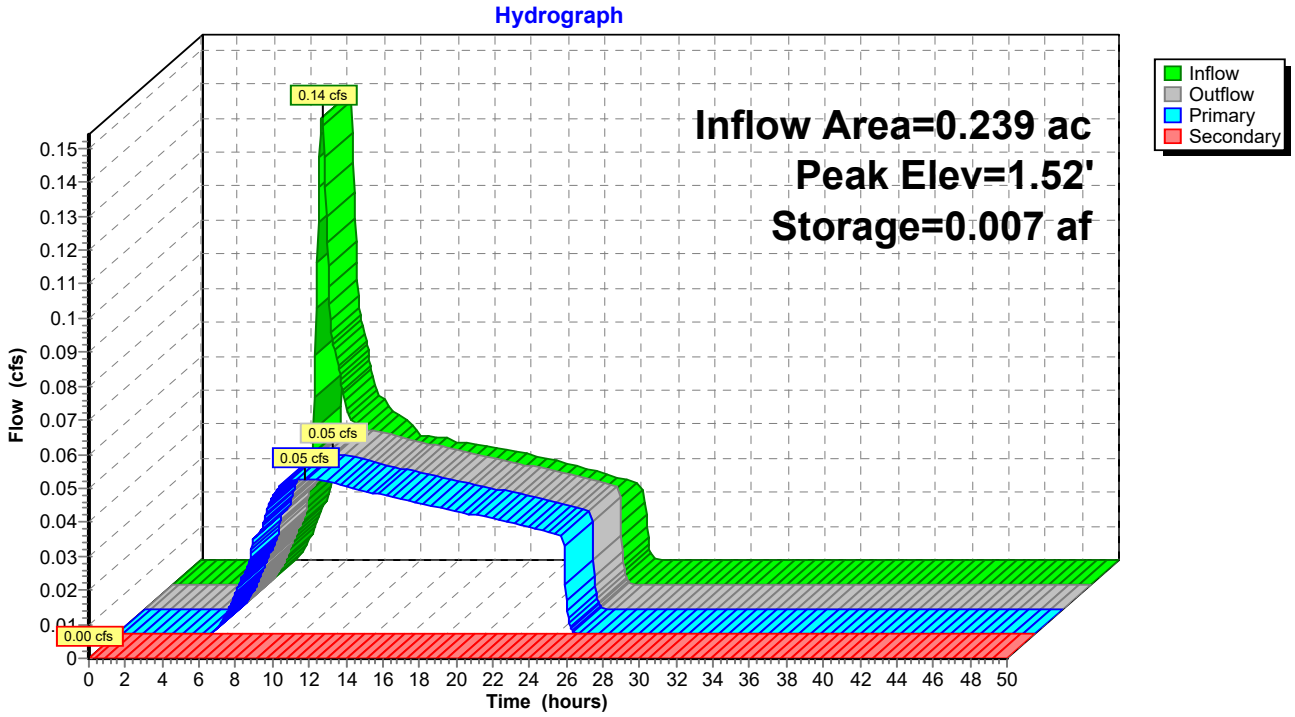
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	**5.00'W x 120.00'L x 5.00'H Bioretention** 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.05 cfs @ 10.22 hrs HW=1.52' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 5.27" for 100-year event
Inflow = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af
Outflow = 1.77 cfs @ 8.11 hrs, Volume= 0.605 af, Atten= 0%, Lag= 1.7 min
Primary = 0.09 cfs @ 8.11 hrs, Volume= 0.193 af
Secondary = 1.68 cfs @ 8.11 hrs, Volume= 0.411 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.70' @ 8.11 hrs Surf.Area= 0.028 ac Storage= 0.045 af

Plug-Flow detention time= 91.8 min calculated for 0.604 af (100% of inflow)
Center-of-Mass det. time= 92.1 min (798.9 - 706.8)

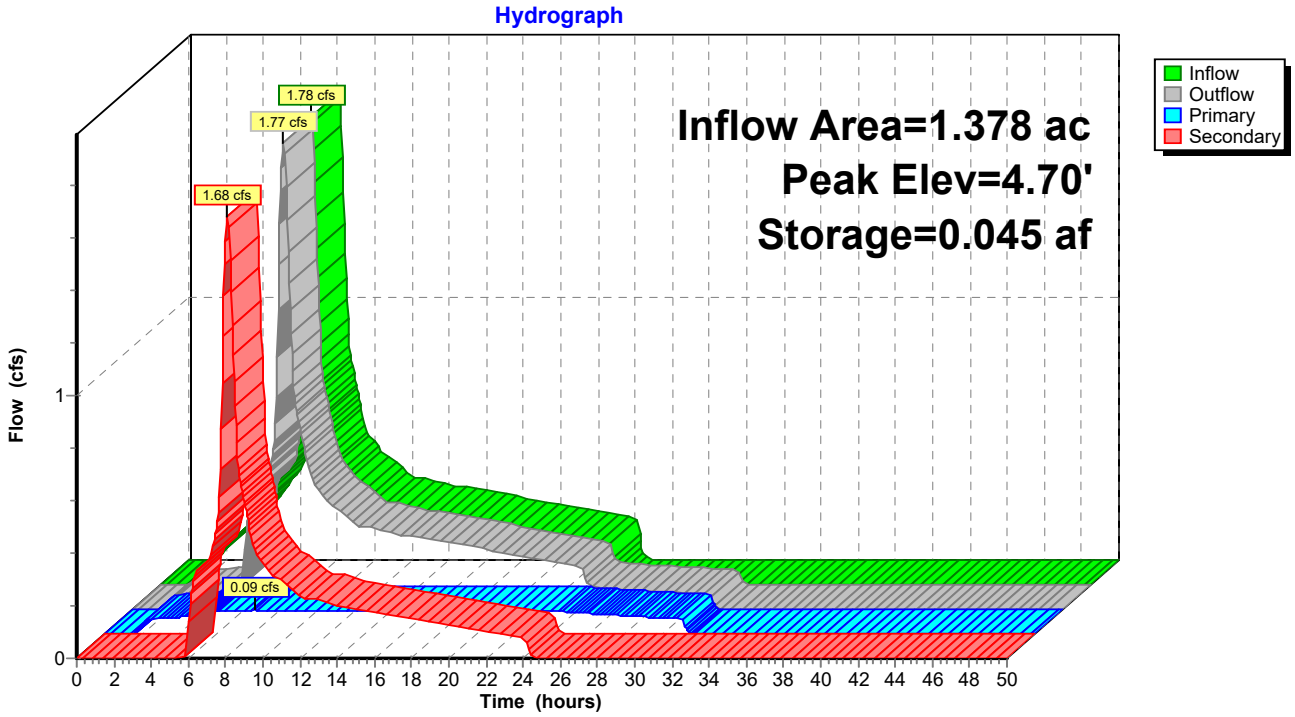
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	**20.00'W x 60.00'L x 6.00'H Infiltration Trench** 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.68 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.68 cfs @ 2.85 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth > 5.88" for 100-year event
Inflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
Outflow = 38.47 cfs @ 8.60 hrs, Volume= 22.657 af, Atten= 5%, Lag= 10.4 min
Primary = 3.58 cfs @ 8.60 hrs, Volume= 8.734 af
Secondary = 34.89 cfs @ 8.60 hrs, Volume= 13.923 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.09' @ 8.60 hrs Surf.Area= 1.674 ac Storage= 2.393 af

Plug-Flow detention time= 123.7 min calculated for 22.657 af (100% of inflow)
Center-of-Mass det. time= 123.7 min (860.1 - 736.4)

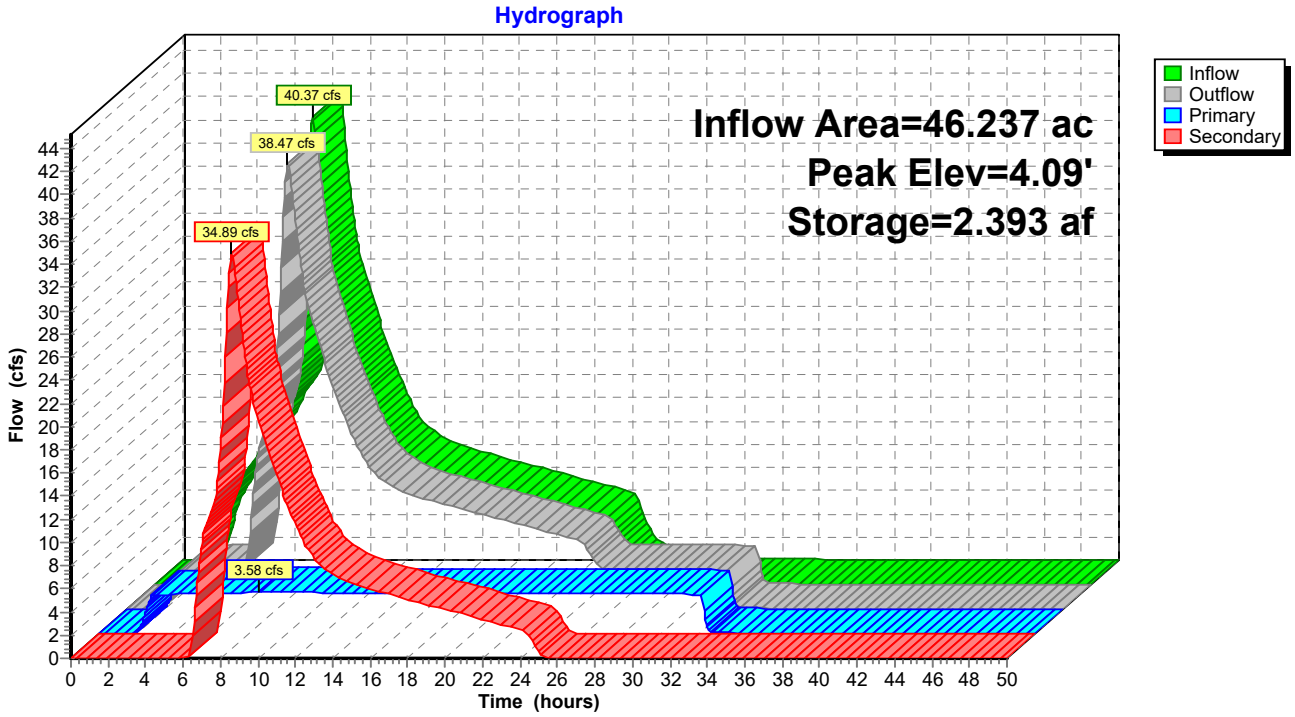
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	**270.00'W x 270.00'L x 5.00'H Infiltration Trench** 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.58 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 3.58 cfs)

Secondary OutFlow Max=34.87 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 34.87 cfs @ 3.41 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=14)
[81] Warning: Exceeded Pond 19P by 39.03' @ 8.60 hrs

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 9.31" for 100-year event
Inflow = 84.32 cfs @ 8.14 hrs, Volume= 34.599 af
Outflow = 66.43 cfs @ 8.60 hrs, Volume= 34.599 af, Atten= 21%, Lag= 27.5 min
Primary = 66.43 cfs @ 8.60 hrs, Volume= 34.599 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 43.12' @ 8.60 hrs Surf.Area= 43,113 sf Storage= 42,363 cf

Plug-Flow detention time= 2.0 min calculated for 34.599 af (100% of inflow)
Center-of-Mass det. time= 2.0 min (737.6 - 735.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

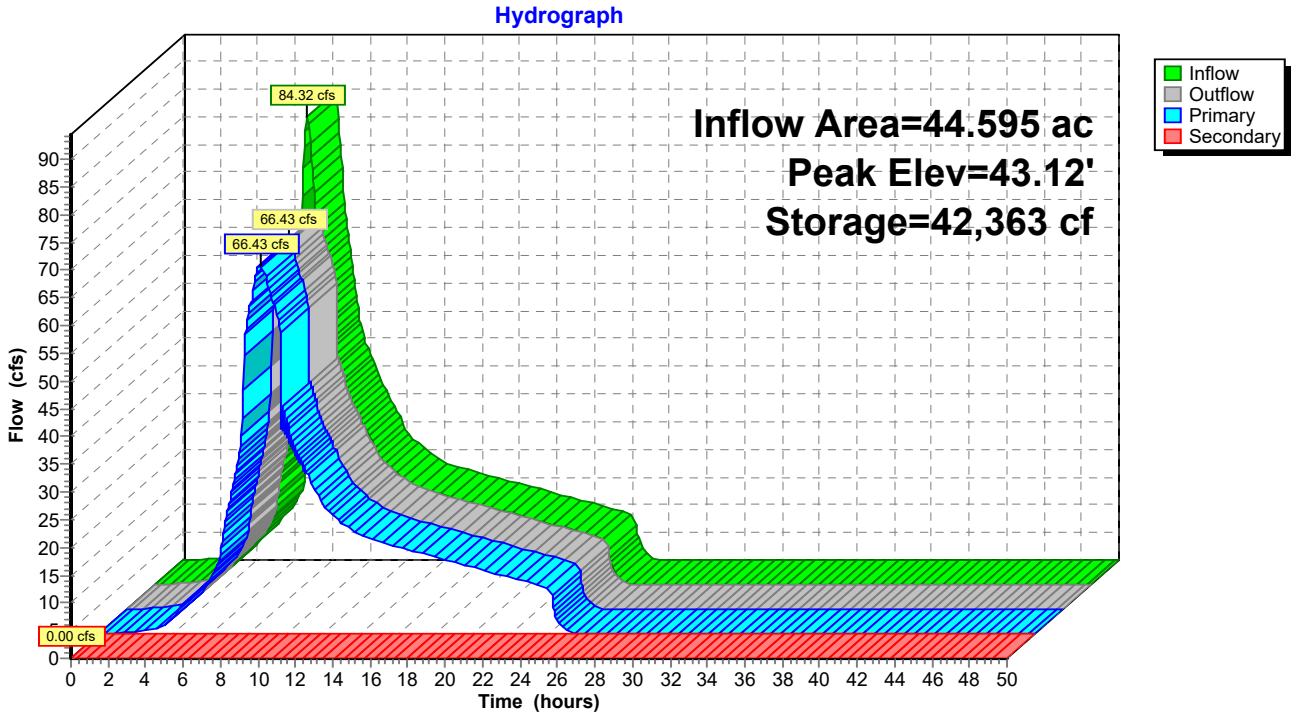
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

Device	Routing	Invert	Outlet Devices
#1	Secondary	48.00'	**30.0' long + 1.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Primary	38.00'	**42.0" Round Culvert** L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 9.62 sf

Primary OutFlow Max=66.43 cfs @ 8.60 hrs HW=43.12' (Free Discharge)
└**2=Culvert** (Barrel Controls 66.43 cfs @ 6.90 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond N1: Node D



Summary for Pond N2: Node C

[57] Hint: Peaked at 46.40' (Flood elevation advised)
[81] Warning: Exceeded Pond 7P by 2.80' @ 1.75 hrs
[81] Warning: Exceeded Pond 15P by 45.83' @ 8.05 hrs
[81] Warning: Exceeded Pond 16P by 43.12' @ 1.45 hrs

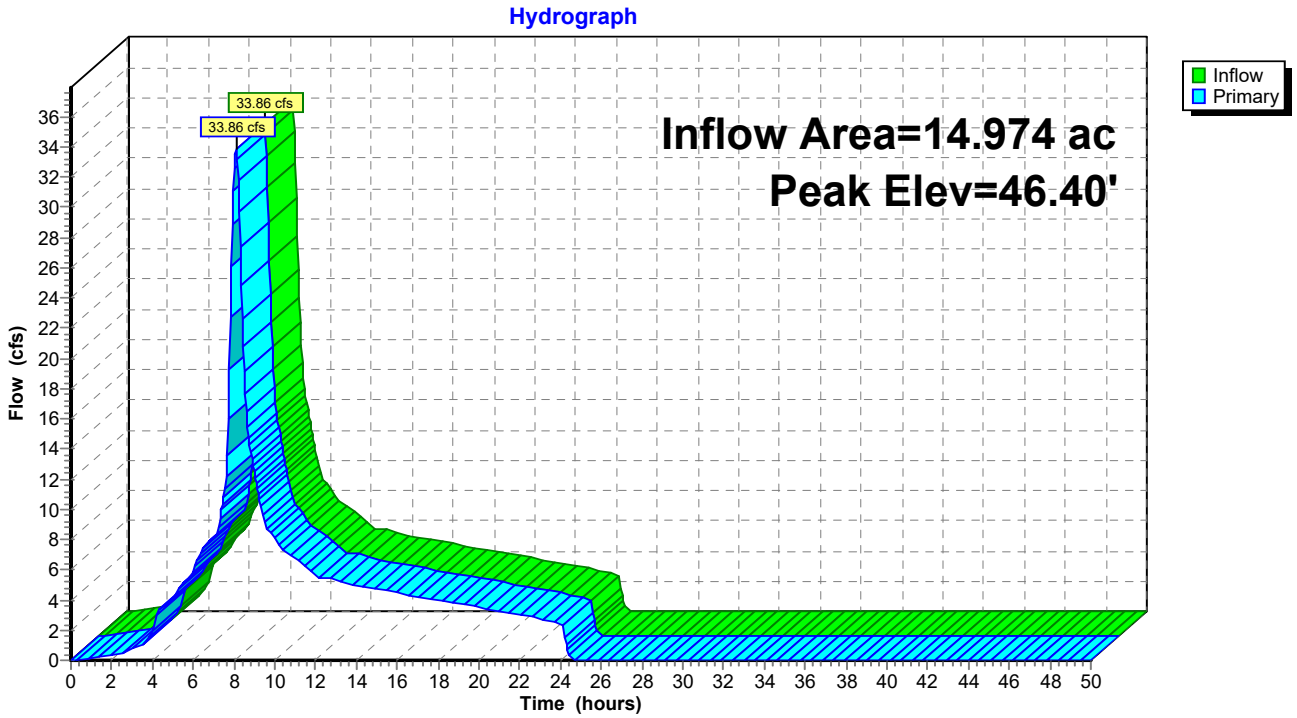
Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 8.32" for 100-year event
Inflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
Outflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af, Atten= 0%, Lag= 0.0 min
Primary = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 46.40' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	**30.0" Round Culvert** L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf
#2	Primary	48.80'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=33.80 cfs @ 8.09 hrs HW=46.39' TW=43.12' (Fixed TW Elev= 43.12')
1=Culvert (Outlet Controls 33.80 cfs @ 6.88 fps)
2=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

Pond N2: Node C



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.56' (Flood elevation advised)
[81] Warning: Exceeded Pond 4P by 49.68' @ 31.55 hrs
[81] Warning: Exceeded Pond 5P by 49.68' @ 35.95 hrs

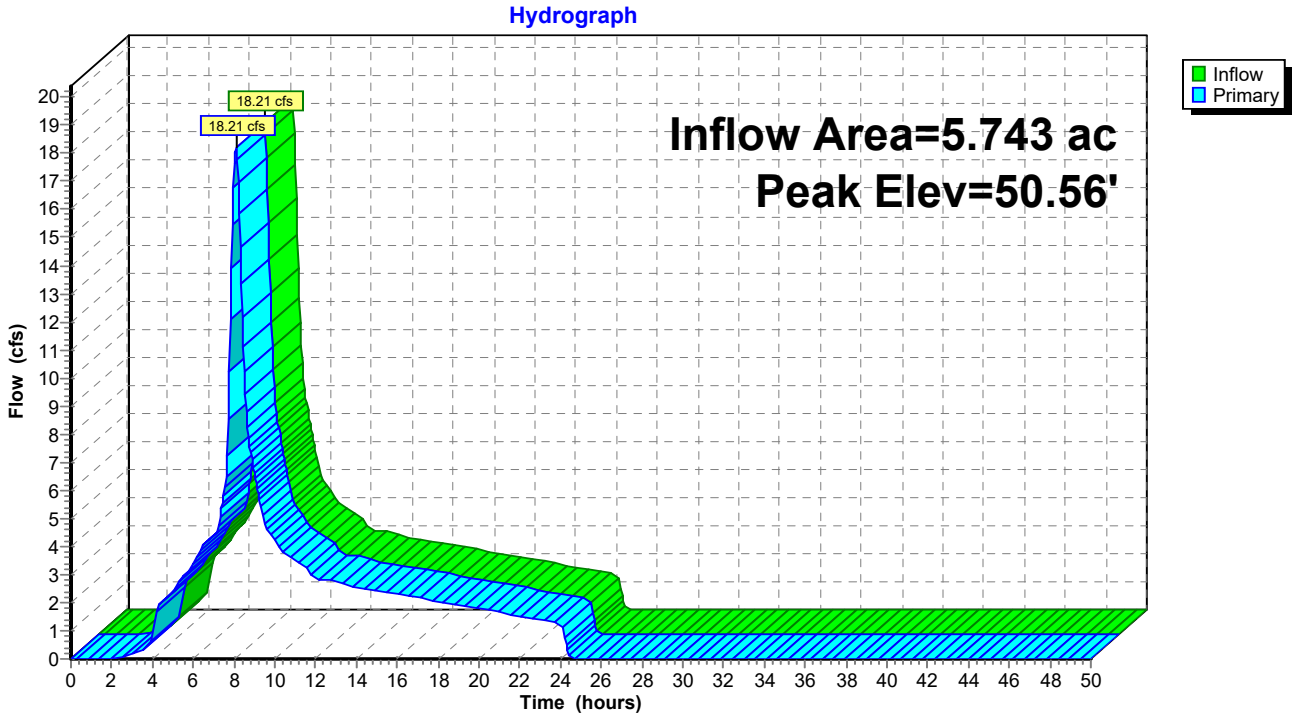
Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 11.34" for 100-year event
Inflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
Outflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af, Atten= 0%, Lag= 0.0 min
Primary = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
Routed to Pond 7P : Node B

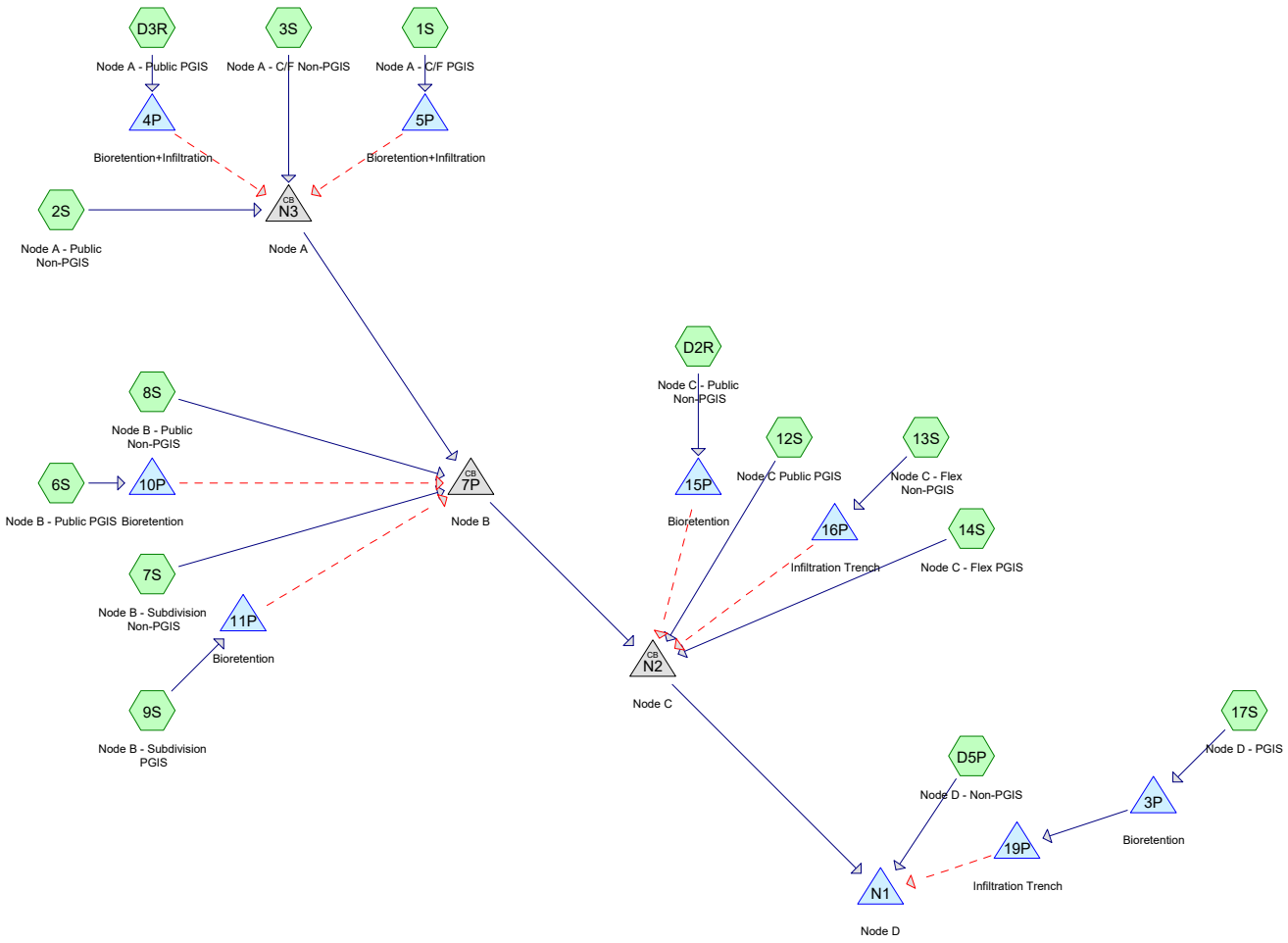
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 50.56' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	**24.0" Round Culvert** L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	50.40'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=17.89 cfs @ 8.09 hrs HW=50.56' TW=49.68' (Fixed TW Elev= 49.68')
1=Culvert (Outlet Controls 10.45 cfs @ 3.33 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 7.44 cfs @ 1.30 fps)

Pond N3: Node A





Subcat Reach Pond Link

Routing Diagram for ALTERNATE _Onsite 25-Year Storm - Minor Flood
Prepared by MacKay & Sposito, Inc, Printed 3/10/2025
HydroCAD® 10.20-5c s/n 01662 © 2023 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	**38.896**	**0.000**	**0.000**	**0.000**	**104.075**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=8.64 cfs 3.046 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.29"
Tc=20.0 min CN=59 Runoff=0.20 cfs 0.125 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=3.76"
Tc=20.0 min CN=88 Runoff=4.22 cfs 1.438 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=0.29 cfs 0.101 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=3.46"
Tc=20.0 min CN=85 Runoff=5.62 cfs 1.945 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=2.89"
Tc=20.0 min CN=79 Runoff=0.06 cfs 0.022 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=2.50 cfs 0.882 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=0.82 cfs 0.288 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=4.19"
Tc=20.0 min CN=92 Runoff=1.42 cfs 0.481 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=1.94 cfs 0.683 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=53.15 cfs 18.738 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=1.95"
Tc=20.0 min CN=68 Runoff=0.09 cfs 0.039 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=1.94 cfs 0.682 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=3.17"
Tc=20.0 min CN=82 Runoff=22.11 cfs 7.822 af

Pond 3P: Bioretention Peak Elev=54.62' Storage=2.845 af Inflow=53.15 cfs 18.738 af
Outflow=28.78 cfs 18.424 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.73' Storage=0.037 af Inflow=1.94 cfs 0.682 af
Primary=0.15 cfs 0.277 af Secondary=1.78 cfs 0.406 af Outflow=1.93 cfs 0.682 af

Pond 5P: Bioretention+Infiltration Peak Elev=4.97' Storage=0.240 af Inflow=8.64 cfs 3.046 af
Primary=0.36 cfs 0.882 af Secondary=8.26 cfs 2.164 af Outflow=8.62 cfs 3.046 af

Pond 7P: Node B Peak Elev=48.77' Inflow=22.70 cfs 6.681 af
24.0" Round Culvert n=0.012 L=379.7' S=0.0030 '/' Outflow=22.70 cfs 6.681 af

Pond 10P: Bioretention Peak Elev=3.25' Storage=0.005 af Inflow=0.29 cfs 0.101 af
Primary=0.02 cfs 0.045 af Secondary=0.26 cfs 0.056 af Outflow=0.29 cfs 0.101 af

Pond 11P: Bioretention Peak Elev=4.87' Storage=0.053 af Inflow=2.50 cfs 0.882 af
Primary=0.19 cfs 0.356 af Secondary=2.30 cfs 0.526 af Outflow=2.48 cfs 0.882 af

Pond 15P: Bioretention Peak Elev=0.73' Storage=0.004 af Inflow=0.09 cfs 0.039 af
Primary=0.04 cfs 0.039 af Secondary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.039 af

Pond 16P: Infiltration Trench Peak Elev=4.61' Storage=0.044 af Inflow=1.42 cfs 0.481 af
Primary=0.09 cfs 0.189 af Secondary=1.32 cfs 0.292 af Outflow=1.41 cfs 0.481 af

Pond 19P: Infiltration Trench Peak Elev=3.86' Storage=2.259 af Inflow=28.78 cfs 18.424 af
Primary=3.57 cfs 8.564 af Secondary=24.41 cfs 9.860 af Outflow=27.97 cfs 18.424 af

Pond N1: Node D Peak Elev=42.48' Storage=16,980 cf Inflow=65.60 cfs 25.625 af
42.0" Round Culvert n=0.012 L=270.3' S=0.0018 '/' Outflow=56.41 cfs 25.621 af

Pond N2: Node C Peak Elev=44.53' Inflow=26.76 cfs 7.943 af
30.0" Round Culvert n=0.012 L=410.7' S=0.0029 '/' Outflow=26.76 cfs 7.943 af

Pond N3: Node A Peak Elev=50.45' Inflow=14.45 cfs 4.132 af
24.0" Round Culvert n=0.012 L=369.0' S=0.0030 '/' Outflow=14.45 cfs 4.132 af

Total Runoff Area = 104.075 ac Runoff Volume = 36.290 af Average Runoff Depth = 4.18"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

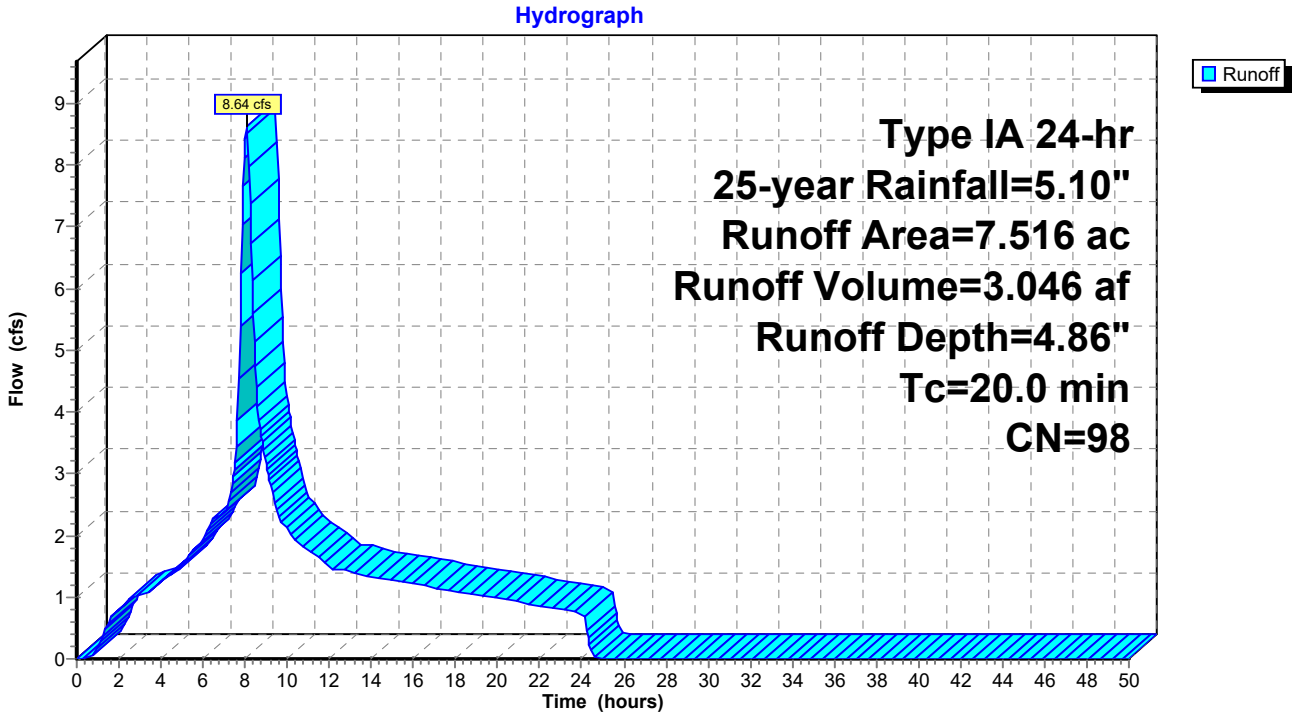
Runoff = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af, Depth= 4.86"
Routed to Pond 5P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 1S: Node A - C/F PGIS



Summary for Subcatchment 2S: Node A - Public Non-PGIS

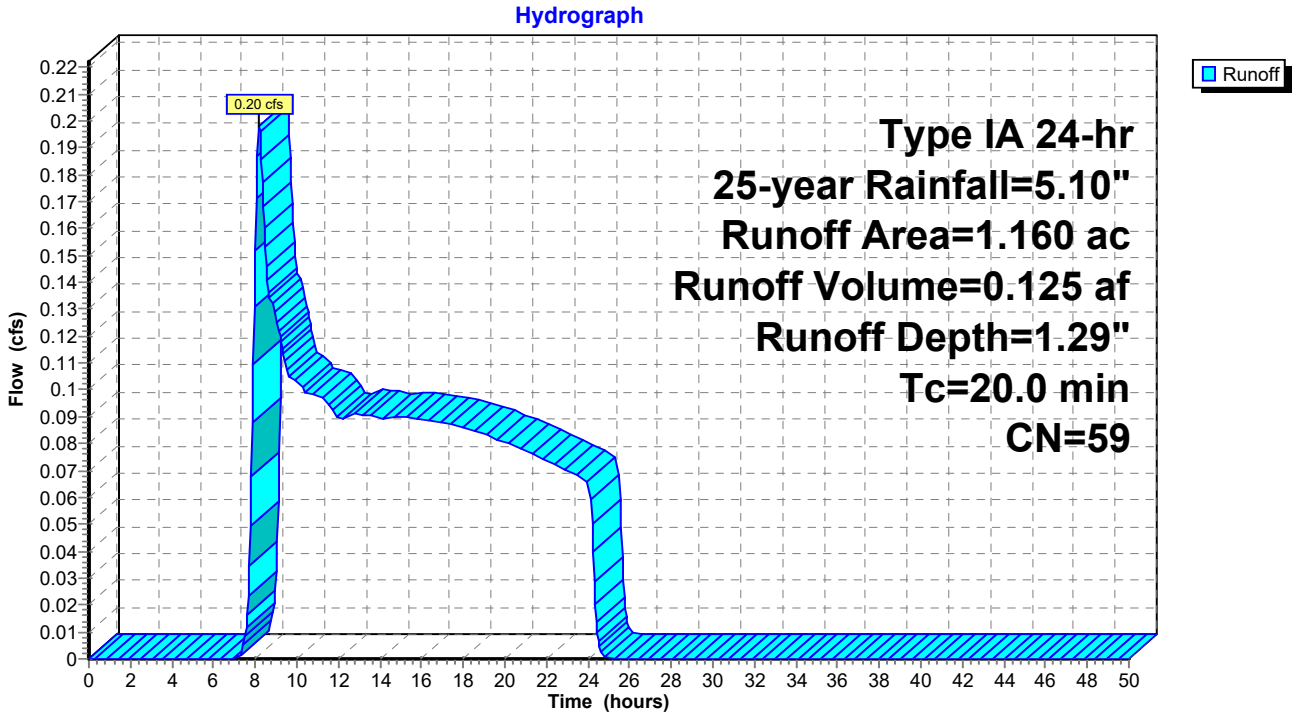
Runoff = 0.20 cfs @ 8.19 hrs, Volume= 0.125 af, Depth= 1.29"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

	Area (ac)	CN	Description
*	1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
	1.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 2S: Node A - Public Non-PGIS



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

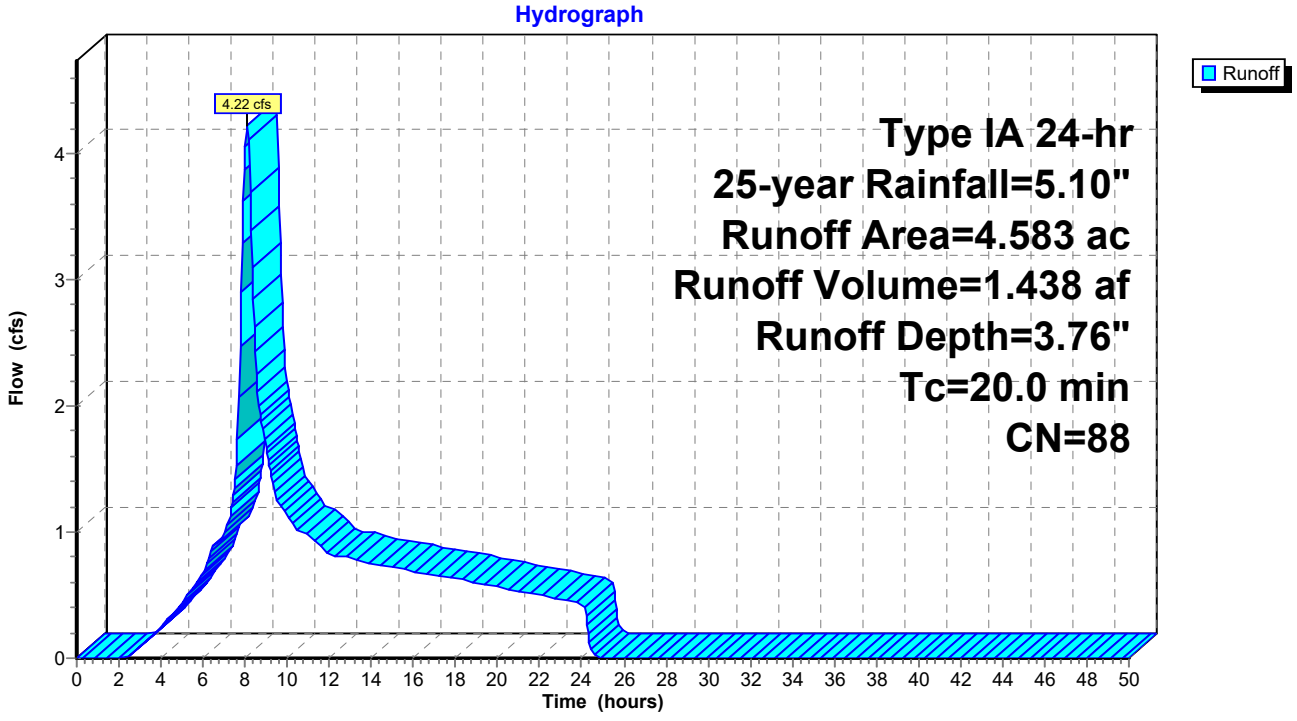
Runoff = 4.22 cfs @ 8.09 hrs, Volume= 1.438 af, Depth= 3.76"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

	Area (ac)	CN	Description
*	1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
	3.373	98	Roofs, HSG A
	4.583	88	Weighted Average
	1.210		26.40% Pervious Area
	3.373		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 3S: Node A - C/F Non-PGIS



Summary for Subcatchment 6S: Node B - Public PGIS

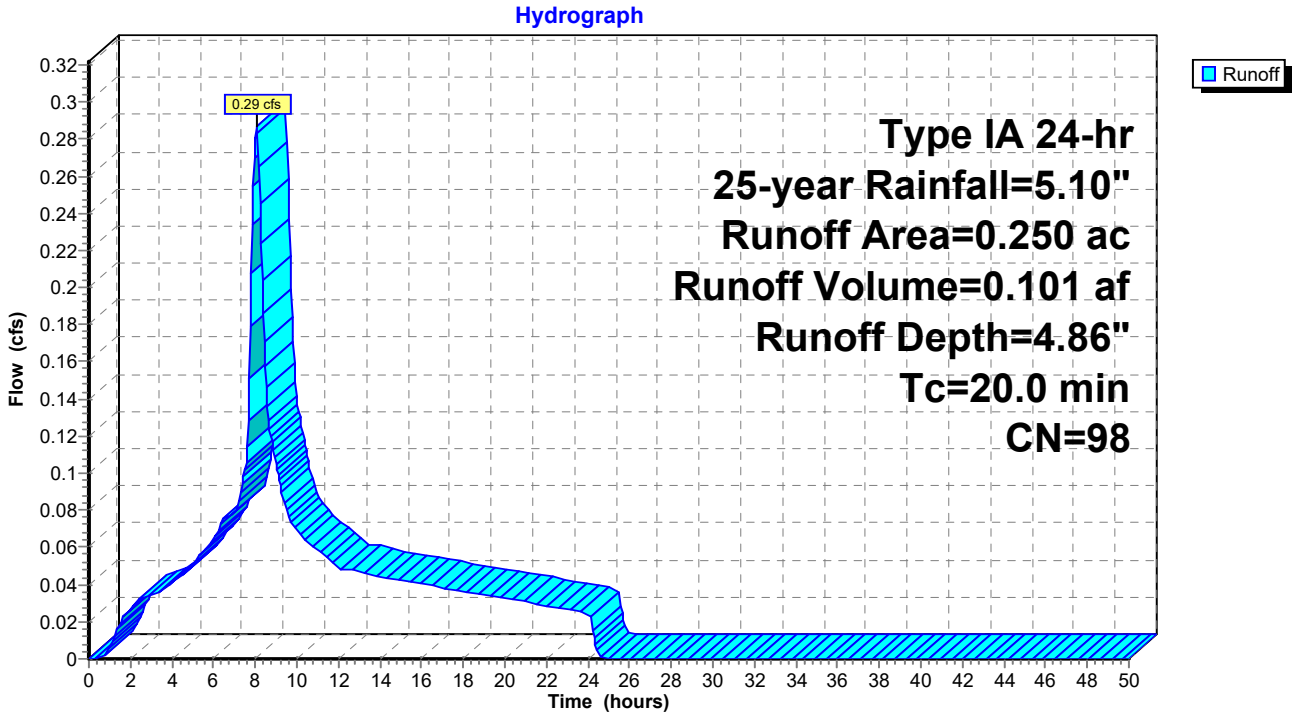
Runoff = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af, Depth= 4.86"
Routed to Pond 10P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 6S: Node B - Public PGIS



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

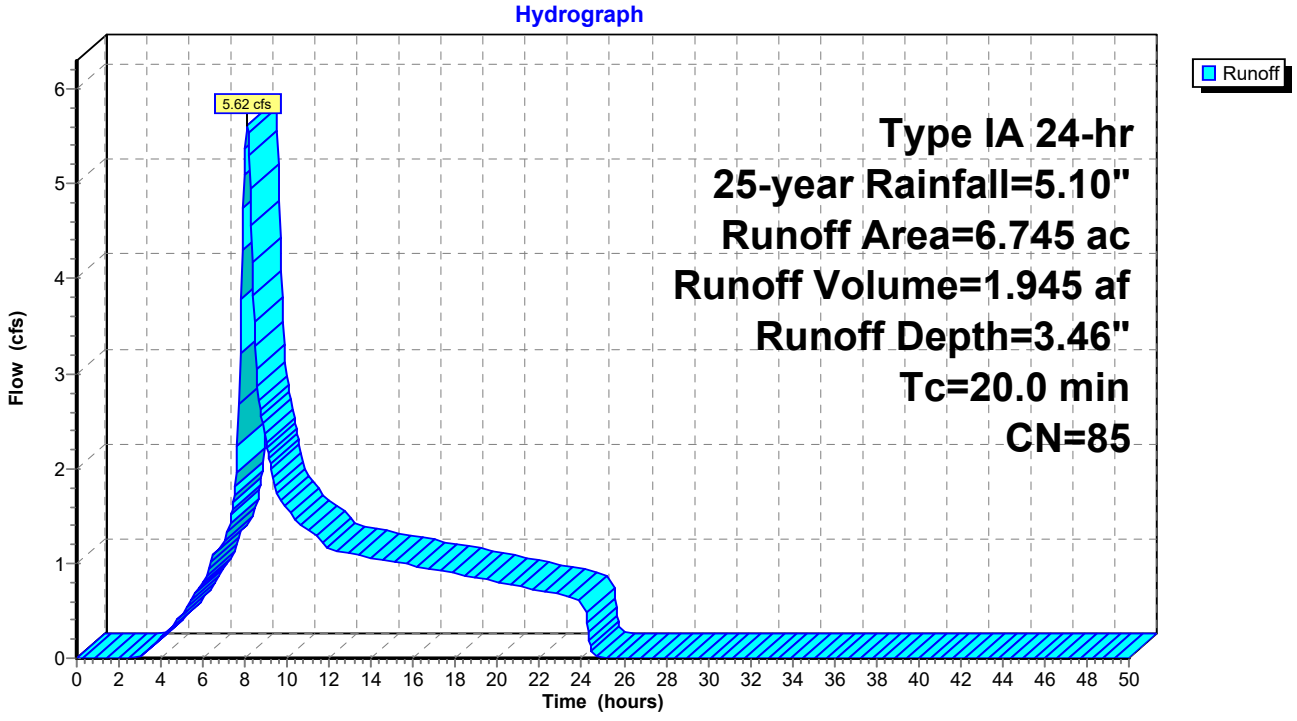
Runoff = 5.62 cfs @ 8.10 hrs, Volume= 1.945 af, Depth= 3.46"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 7S: Node B - Subdivision Non-PGIS



Summary for Subcatchment 8S: Node B - Public Non-PGIS

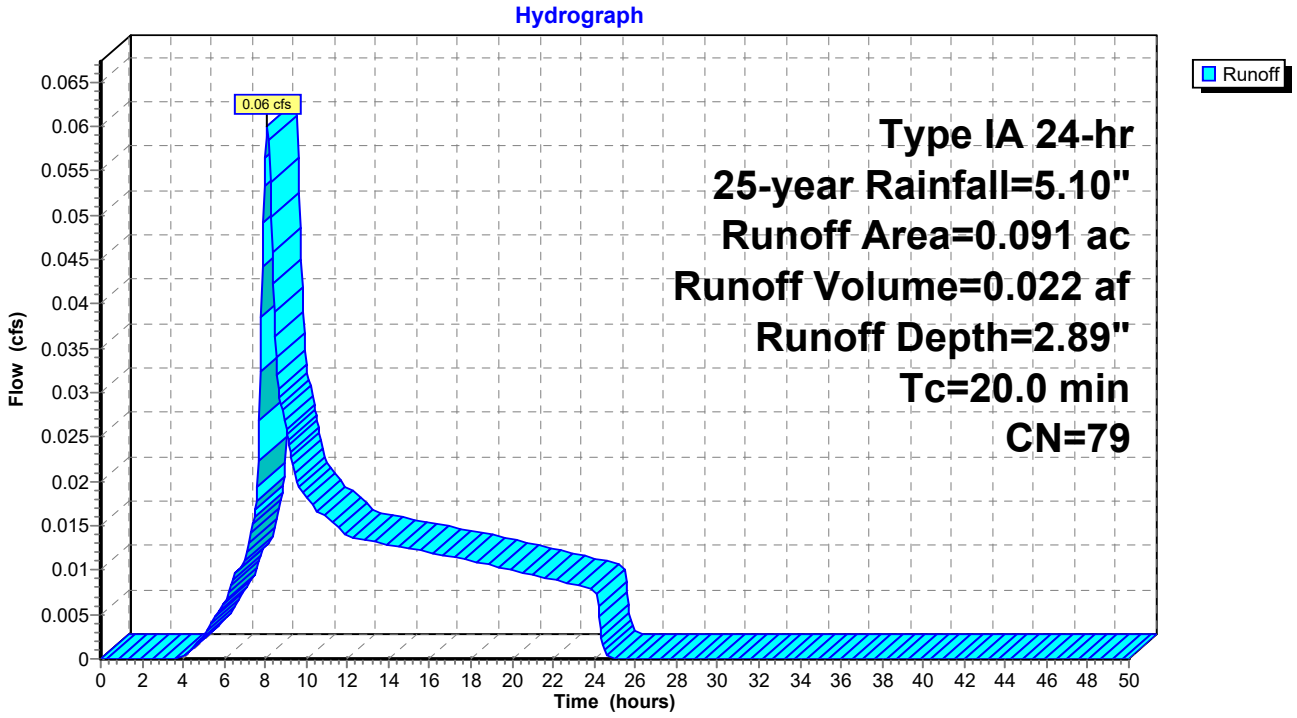
Runoff = 0.06 cfs @ 8.11 hrs, Volume= 0.022 af, Depth= 2.89"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 8S: Node B - Public Non-PGIS



Summary for Subcatchment 9S: Node B - Subdivision PGIS

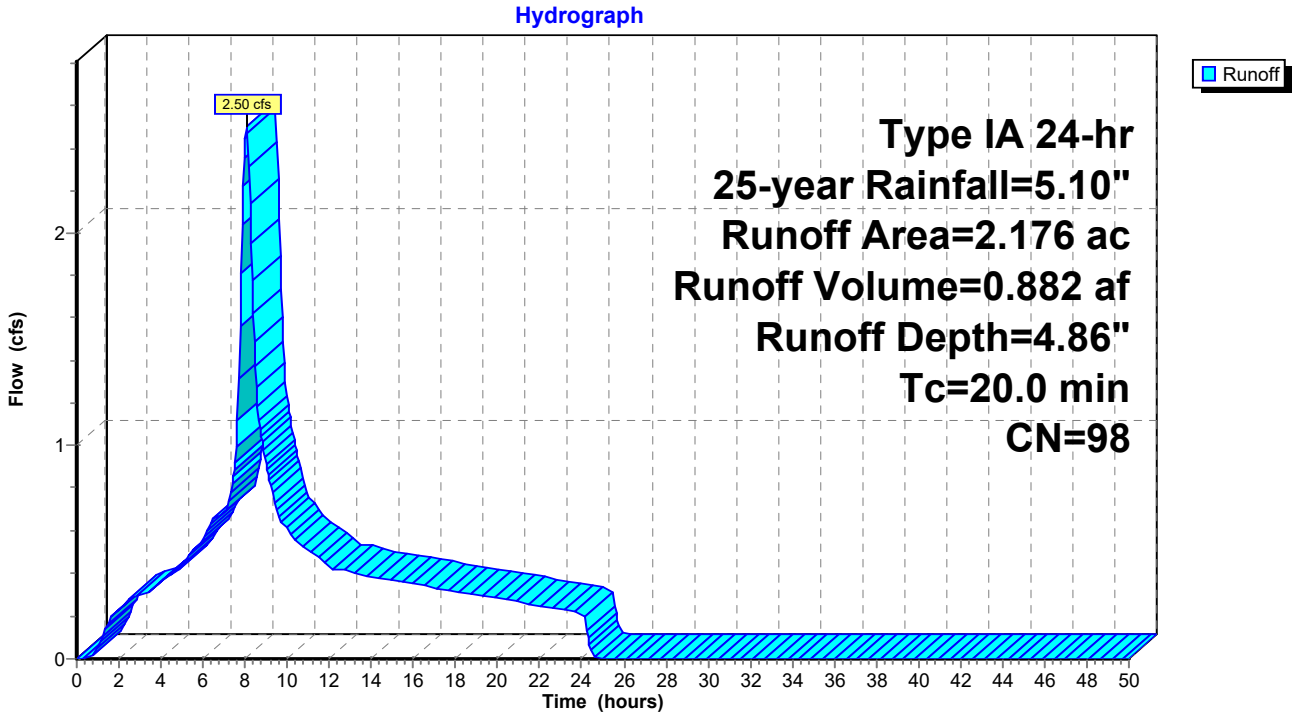
Runoff = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af, Depth= 4.86"
Routed to Pond 11P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 9S: Node B - Subdivision PGIS



Summary for Subcatchment 12S: Node C Public PGIS

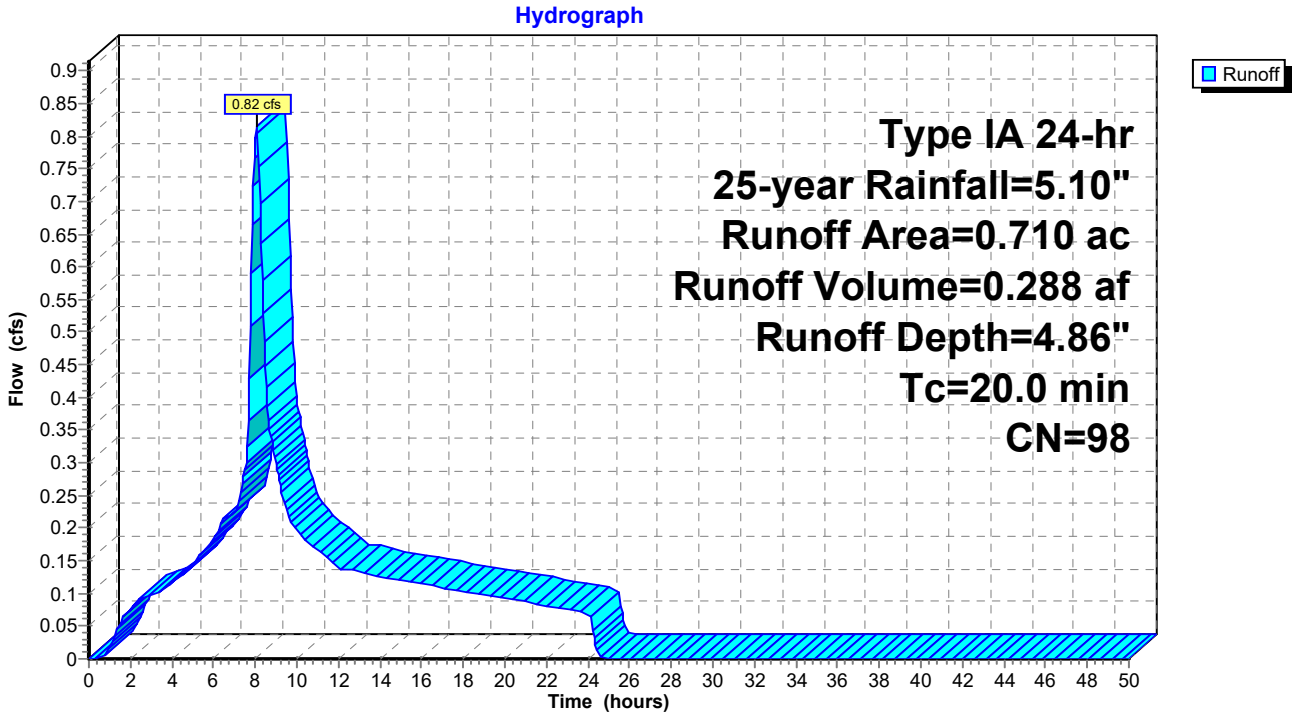
Runoff = 0.82 cfs @ 8.08 hrs, Volume= 0.288 af, Depth= 4.86"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 12S: Node C Public PGIS



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

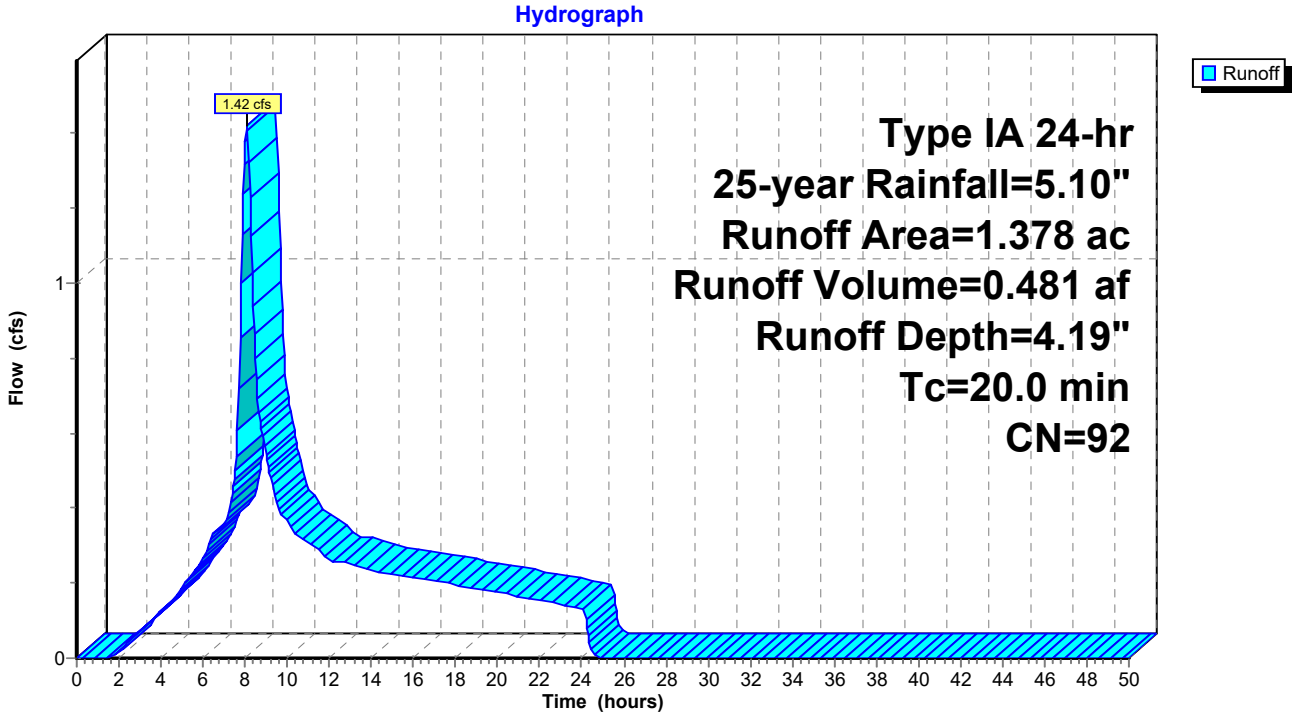
Runoff = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af, Depth= 4.19"
Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

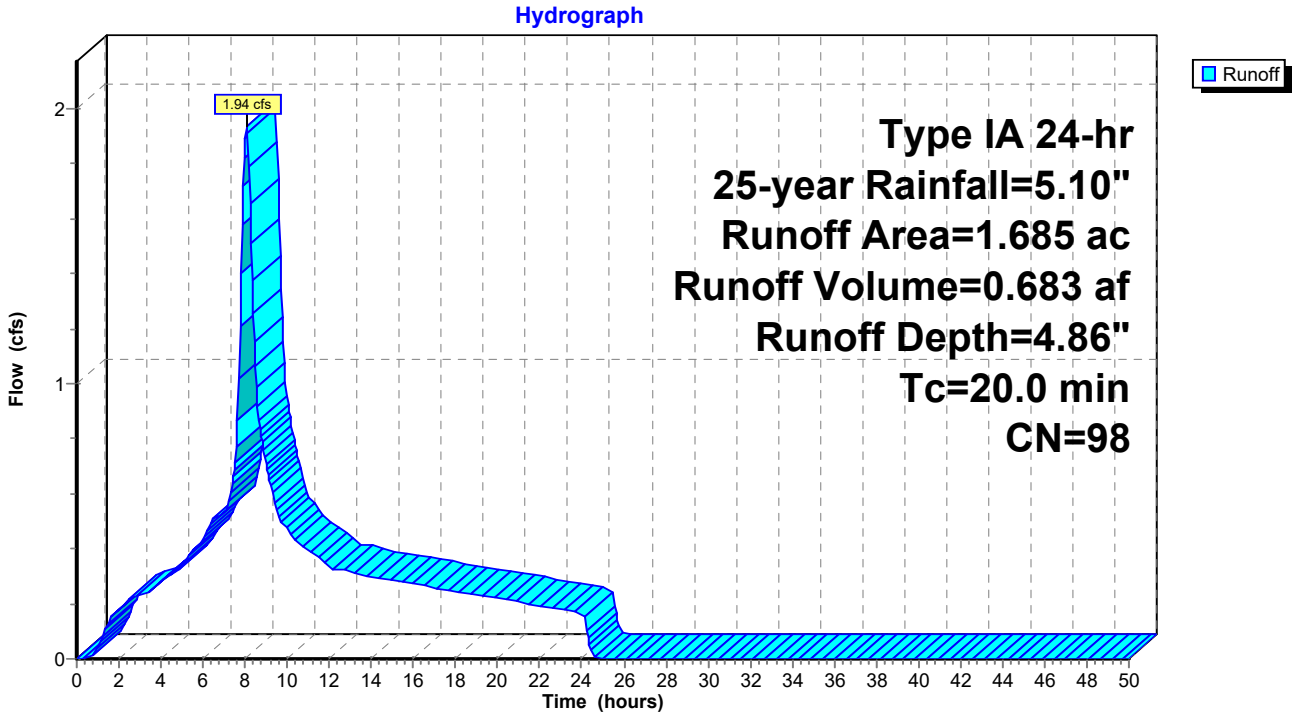
Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.683 af, Depth= 4.86"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 14S: Node C - Flex PGIS



Summary for Subcatchment 17S: Node D - PGIS

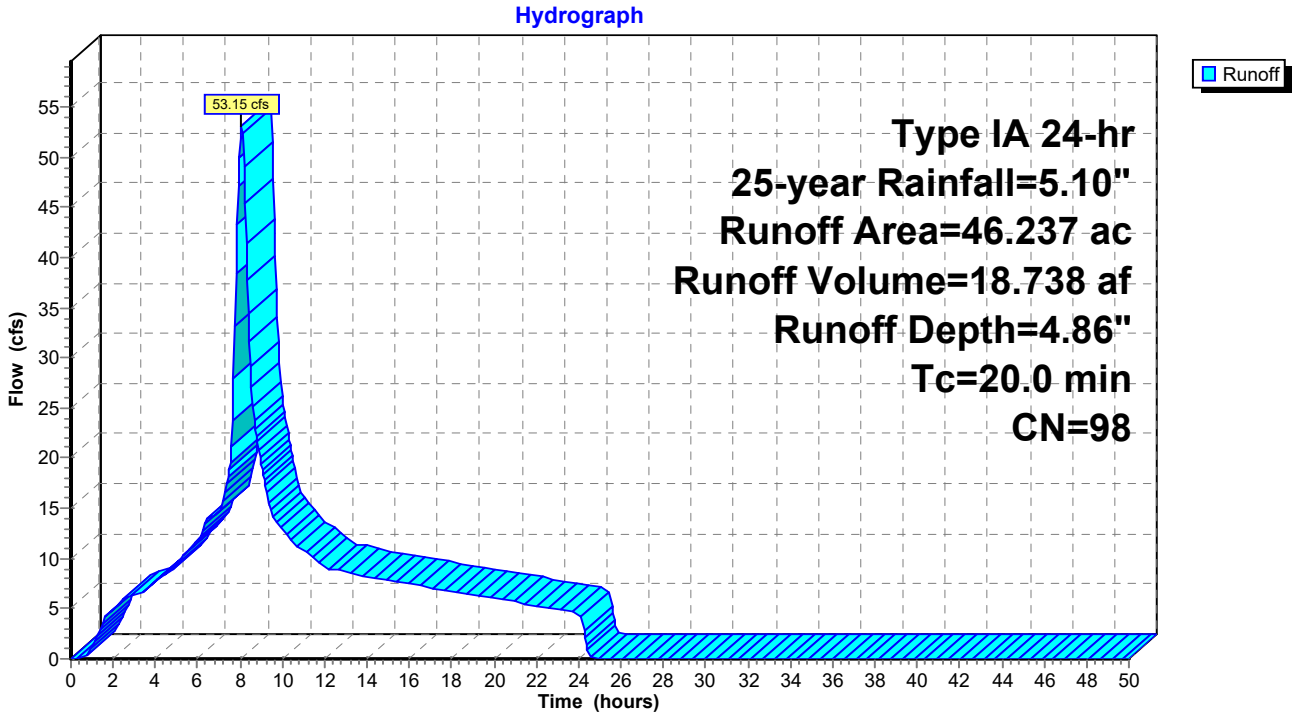
Runoff = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af, Depth= 4.86"
Routed to Pond 3P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 17S: Node D - PGIS



Summary for Subcatchment D2R: Node C - Public Non-PGIS

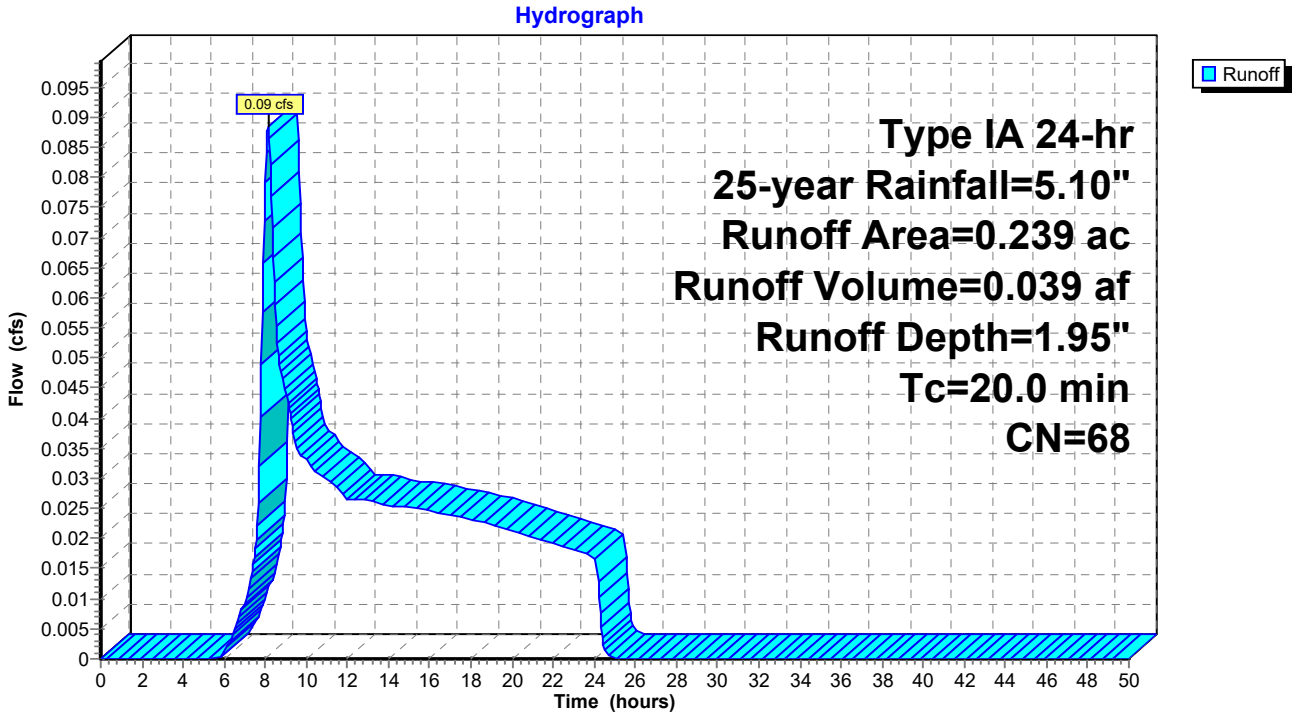
Runoff = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af, Depth= 1.95"
Routed to Pond 15P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D2R: Node C - Public Non-PGIS



Summary for Subcatchment D3R: Node A - Public PGIS

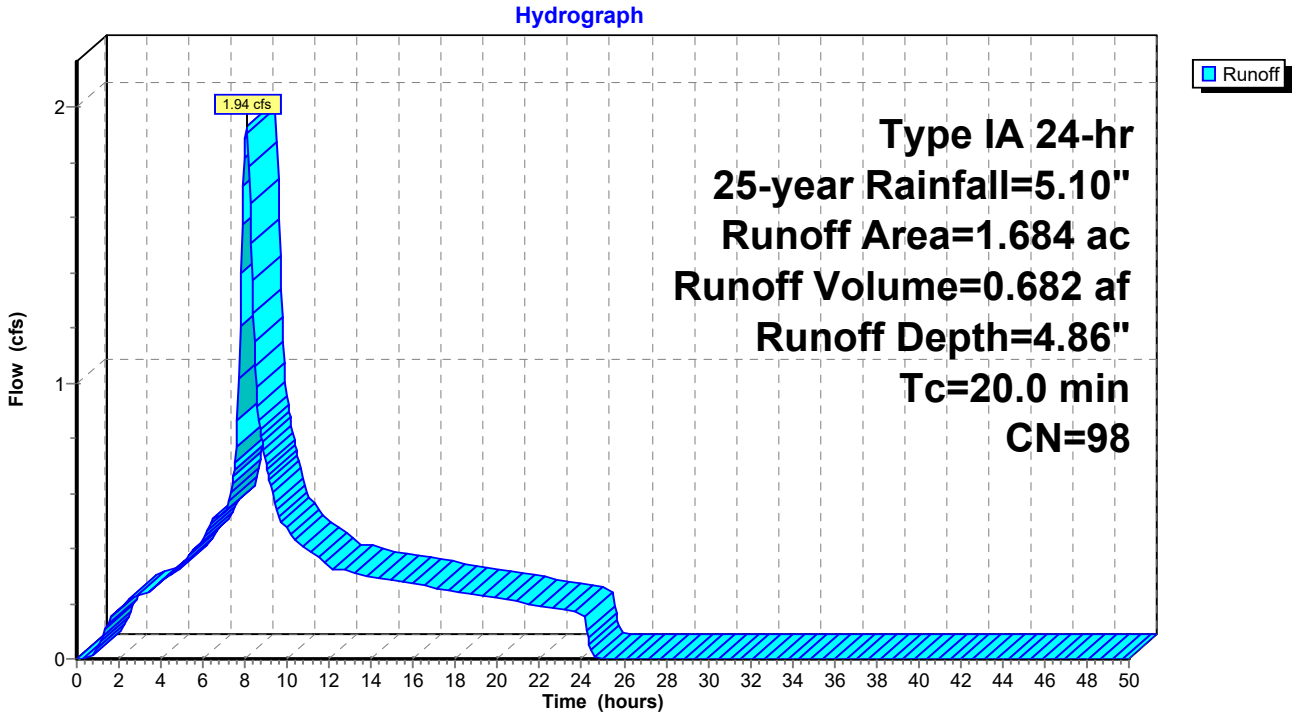
Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af, Depth= 4.86"
Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

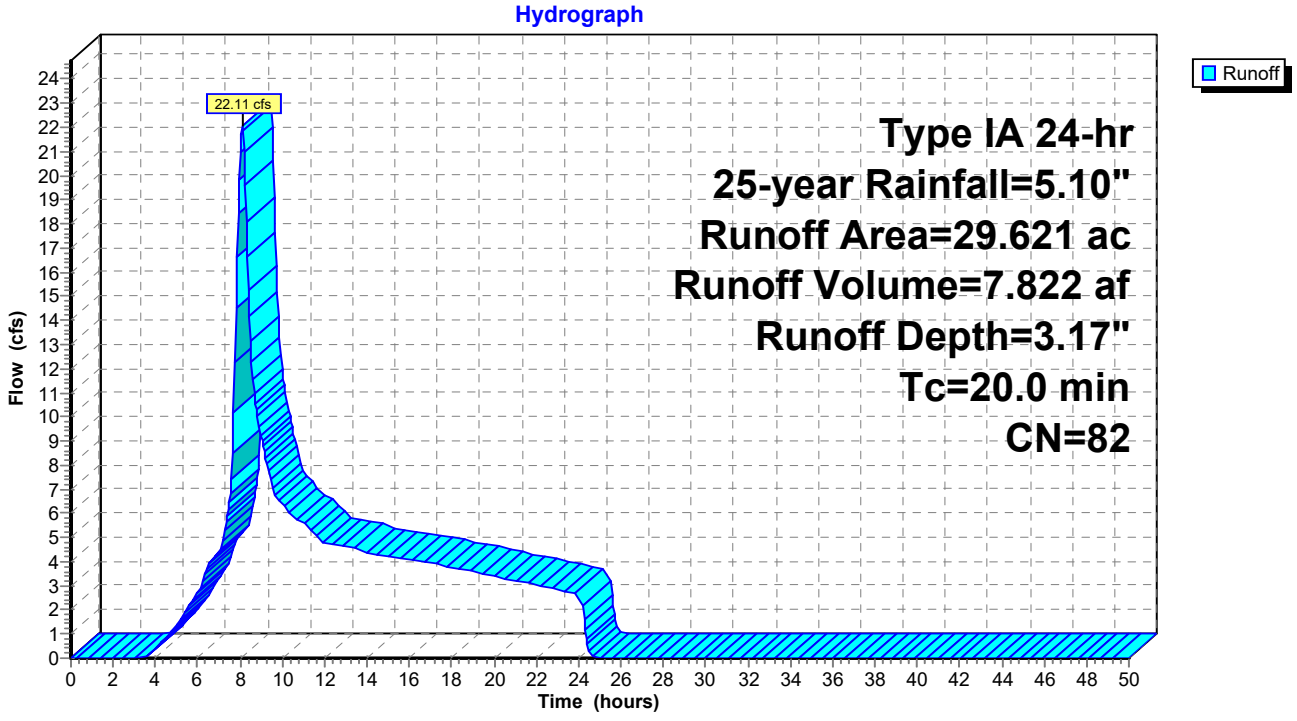
Runoff = 22.11 cfs @ 8.11 hrs, Volume= 7.822 af, Depth= 3.17"
Routed to Pond N1 : Node D

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D5P: Node D - Non-PGIS



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af
Outflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af, Atten= 46%, Lag= 25.9 min
Primary = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 54.62' @ 8.51 hrs Surf.Area= 1.674 ac Storage= 2.845 af

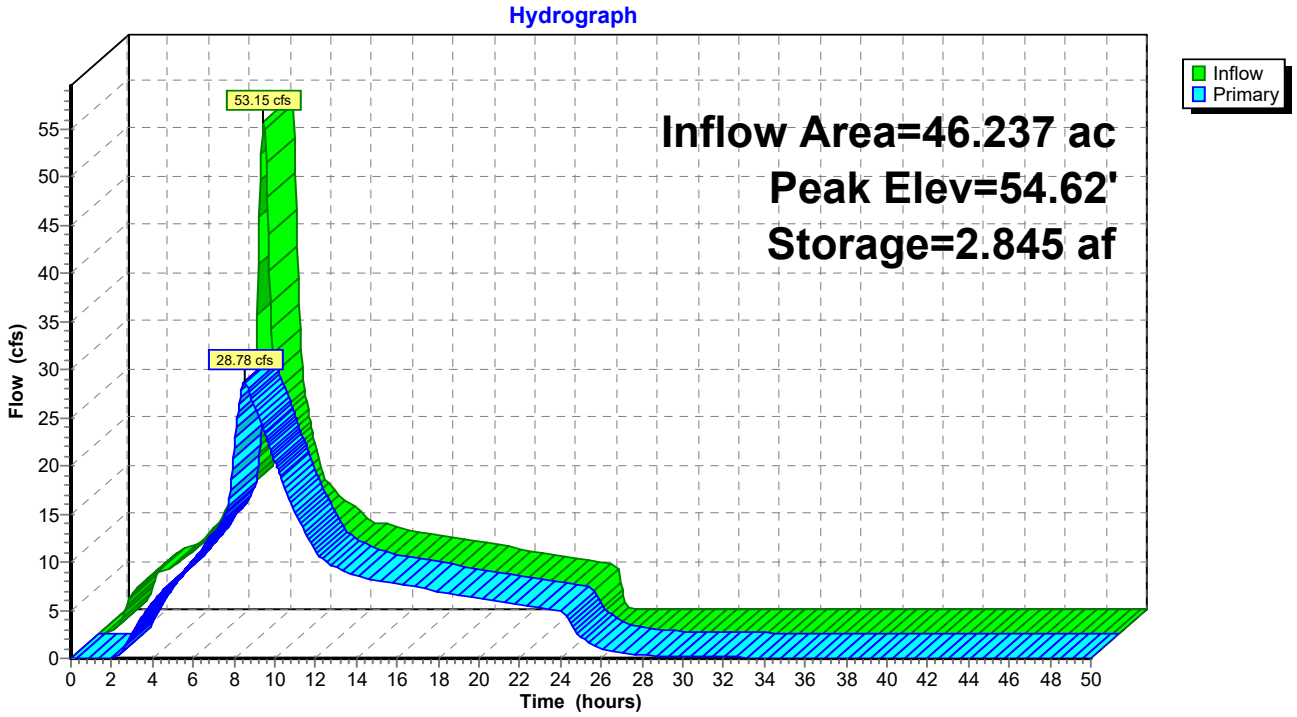
Plug-Flow detention time= 90.8 min calculated for 18.424 af (98% of inflow)
Center-of-Mass det. time= 77.7 min (745.3 - 667.6)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	**270.00'W x 270.00'L x 6.50'H Prismatoid** 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	**270.00'W x 270.00'L x 2.00'H Prismatoid** Inside #1
#3	50.50'	0.019 af	**24.0" Round Pipe Storage** Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	**60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=28.76 cfs @ 8.51 hrs HW=54.62' (Free Discharge)
1=Orifice/Grate (Weir Controls 2.05 cfs @ 1.12 fps)
2=Orifice/Grate (Orifice Controls 26.71 cfs @ 8.50 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af
Outflow = 1.93 cfs @ 8.11 hrs, Volume= 0.682 af, Atten= 0%, Lag= 1.7 min
Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.277 af
Secondary = 1.78 cfs @ 8.11 hrs, Volume= 0.406 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.73' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.037 af

Plug-Flow detention time= 65.8 min calculated for 0.682 af (100% of inflow)
Center-of-Mass det. time= 65.7 min (733.3 - 667.6)

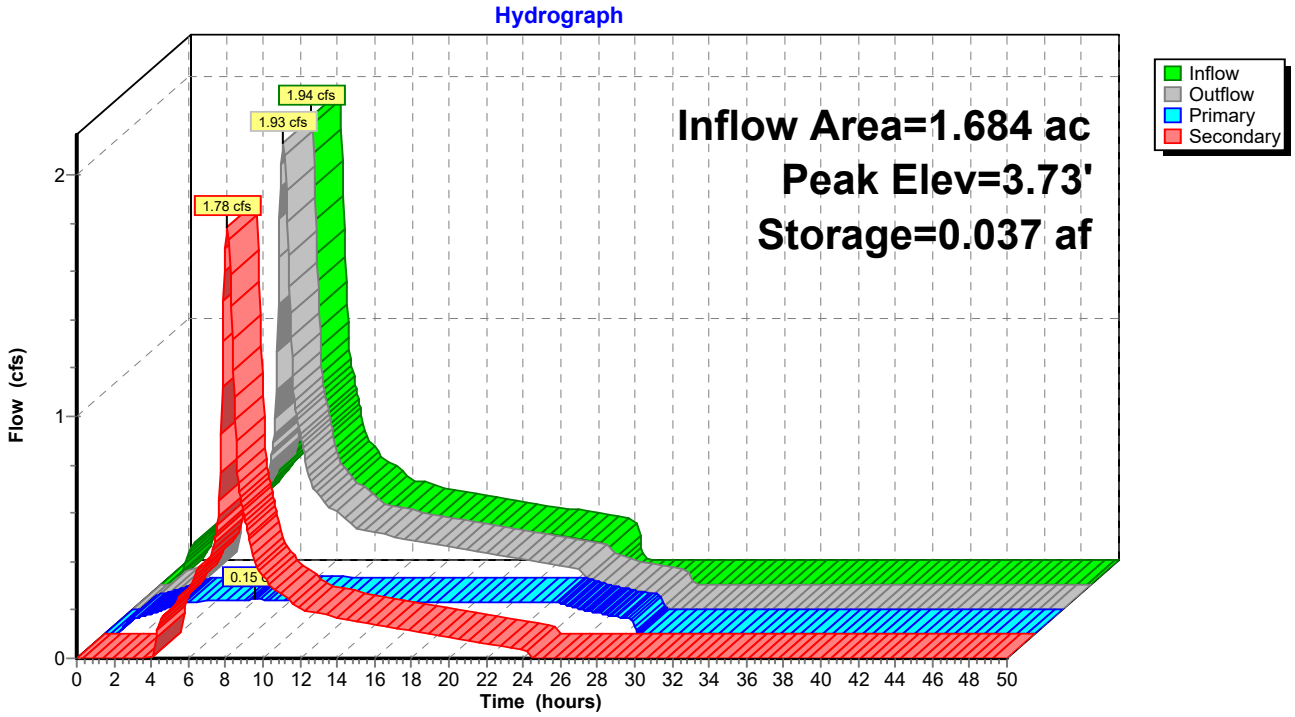
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	**5.00'W x 250.00'L x 5.00'H Bioretention** 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=1.78 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
2=Orifice/Grate (Orifice Controls 1.78 cfs @ 2.90 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

Inflow Area = 7.516 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af
Outflow = 8.62 cfs @ 8.10 hrs, Volume= 3.046 af, Atten= 0%, Lag= 1.2 min
Primary = 0.36 cfs @ 8.10 hrs, Volume= 0.882 af
Secondary = 8.26 cfs @ 8.10 hrs, Volume= 2.164 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.97' @ 8.10 hrs Surf.Area= 0.138 ac Storage= 0.240 af

Plug-Flow detention time= 109.9 min calculated for 3.046 af (100% of inflow)
Center-of-Mass det. time= 109.8 min (777.4 - 667.6)

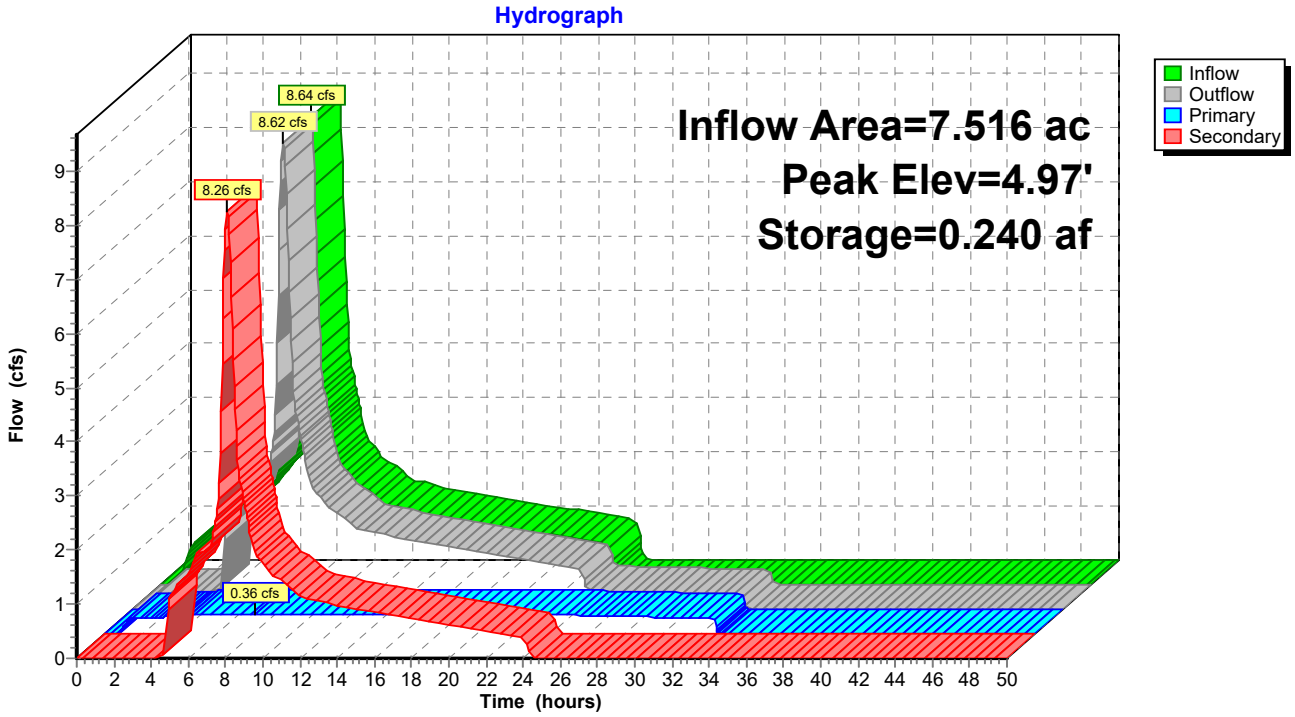
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	**50.00'W x 120.00'L x 5.00'H Infiltration Trench** 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.50'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=8.25 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
↑**2=Orifice/Grate** (Weir Controls 8.25 cfs @ 2.24 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 7P: Node B

[57] Hint: Peaked at 48.77' (Flood elevation advised)
[81] Warning: Exceeded Pond 10P by 45.52' @ 8.10 hrs
[81] Warning: Exceeded Pond 11P by 44.53' @ 33.00 hrs
[79] Warning: Submerged Pond N3 Primary device # 1 INLET by 7.33'

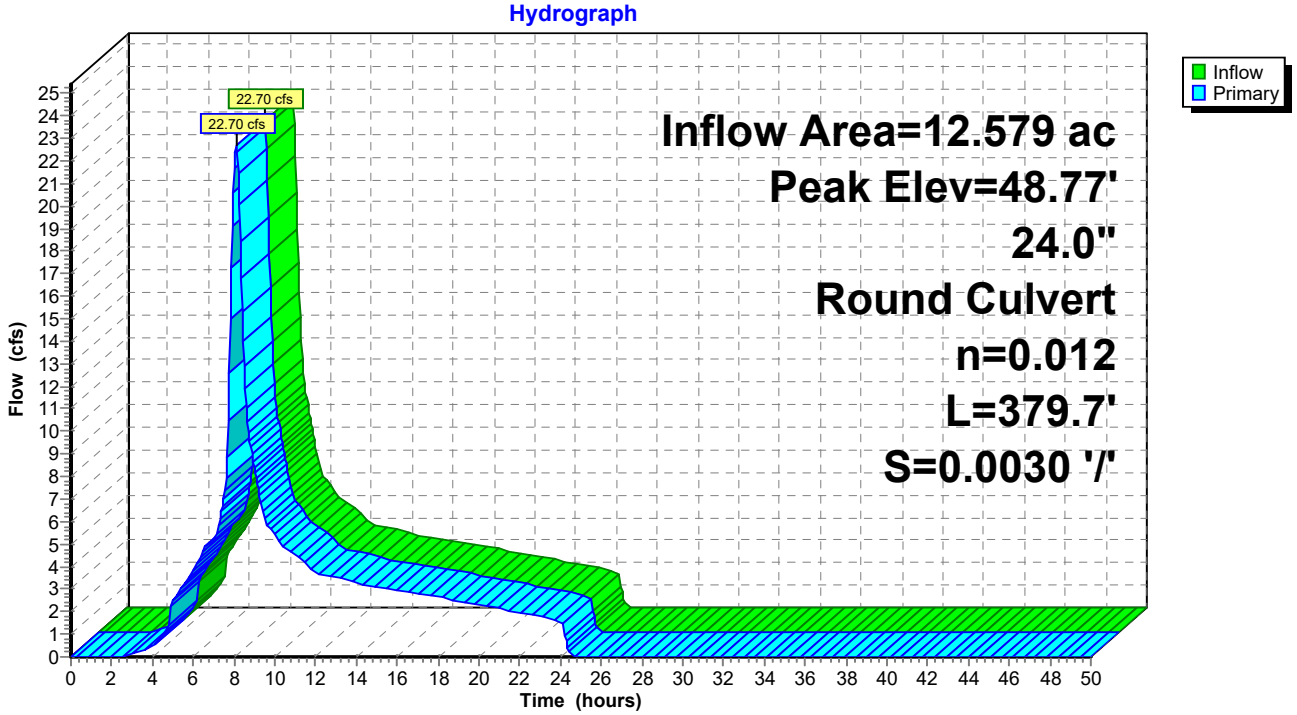
Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 6.37" for 25-year event
Inflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
Outflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af, Atten= 0%, Lag= 0.0 min
Primary = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 48.77' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	**24.0" Round Culvert** L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=22.70 cfs @ 8.10 hrs HW=48.77' TW=44.53' (Fixed TW Elev= 44.53')
└─**1=Culvert** (Outlet Controls 22.70 cfs @ 7.22 fps)

Pond 7P: Node B



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af
Outflow = 0.29 cfs @ 8.09 hrs, Volume= 0.101 af, Atten= 0%, Lag= 0.5 min
Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.045 af
Secondary = 0.26 cfs @ 8.09 hrs, Volume= 0.056 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.25' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 67.0 min calculated for 0.101 af (100% of inflow)
Center-of-Mass det. time= 67.1 min (734.7 - 667.6)

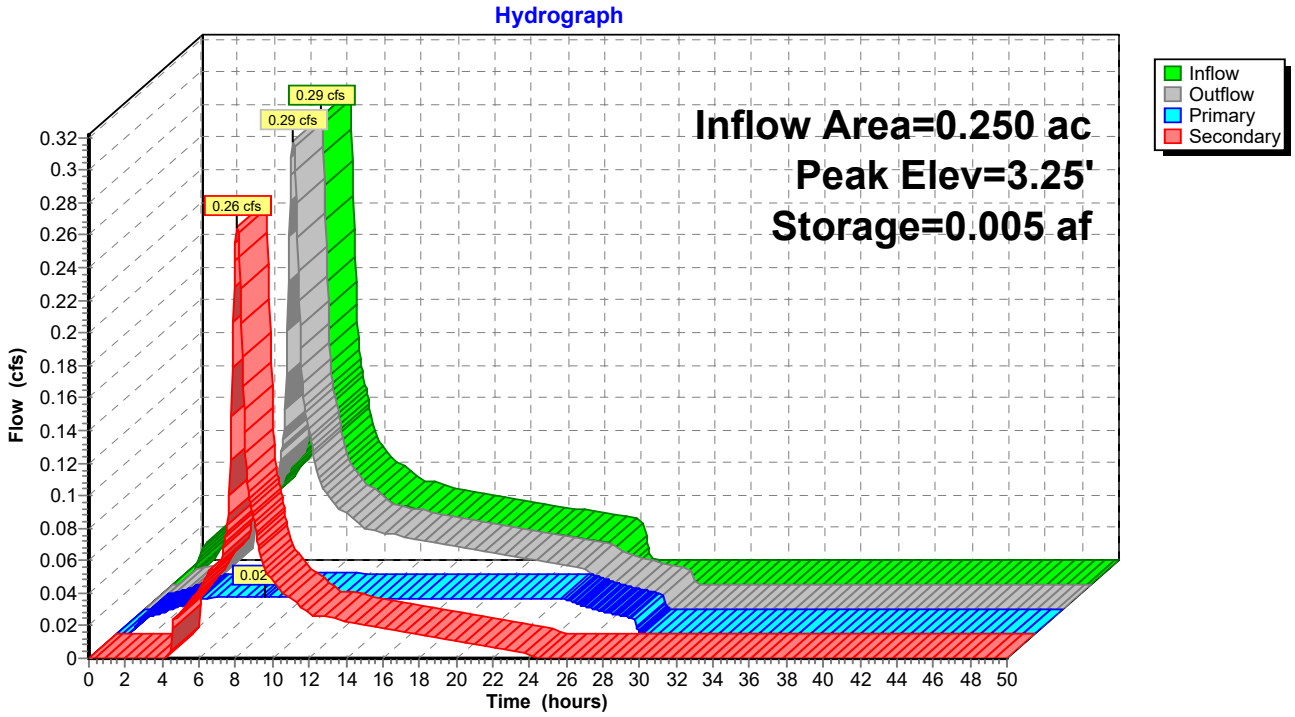
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	**5.00'W x 40.00'L x 5.00'H Bioretention** 0.023 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.26 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 0.26 cfs @ 1.71 fps)

Pond 10P: Bioretention



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af
Outflow = 2.48 cfs @ 8.11 hrs, Volume= 0.882 af, Atten= 1%, Lag= 2.0 min
Primary = 0.19 cfs @ 8.11 hrs, Volume= 0.356 af
Secondary = 2.30 cfs @ 8.11 hrs, Volume= 0.526 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.87' @ 8.11 hrs Surf.Area= 0.031 ac Storage= 0.053 af

Plug-Flow detention time= 73.2 min calculated for 0.881 af (100% of inflow)
Center-of-Mass det. time= 73.4 min (741.0 - 667.6)

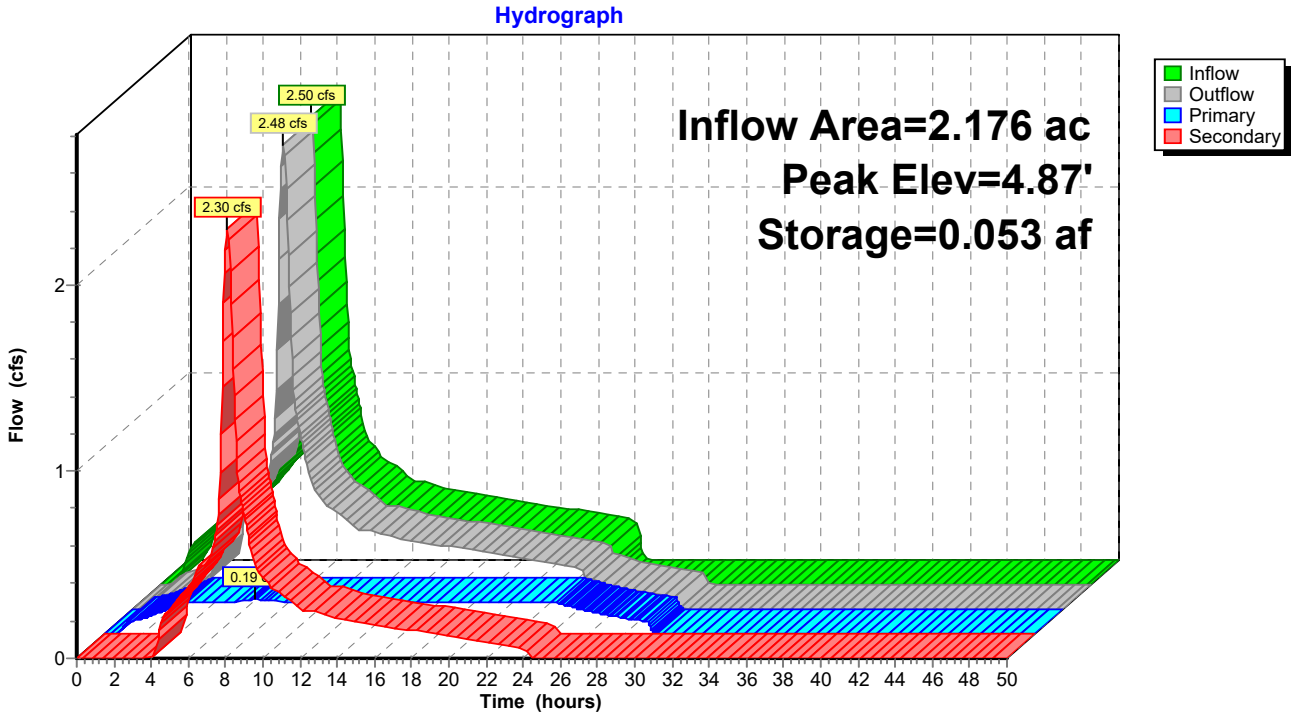
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	**5.00'W x 270.00'L x 6.00'H Bioretention** 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.30 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 2.30 cfs @ 3.17 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 1.95" for 25-year event
Inflow = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af
Outflow = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af, Atten= 59%, Lag= 79.6 min
Primary = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 0.73' @ 9.47 hrs Surf.Area= 0.014 ac Storage= 0.004 af

Plug-Flow detention time= 31.1 min calculated for 0.039 af (100% of inflow)
Center-of-Mass det. time= 31.1 min (884.7 - 853.6)

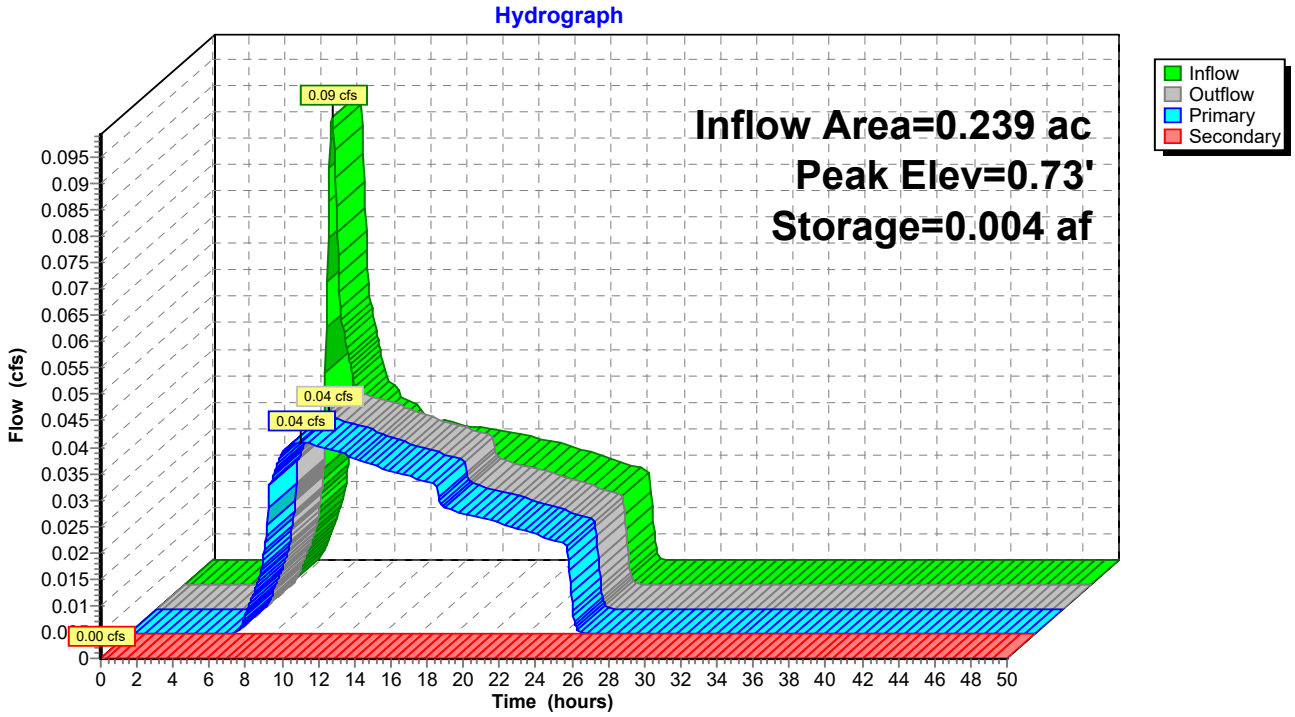
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	**5.00'W x 120.00'L x 5.00'H Bioretention** 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.04 cfs @ 9.47 hrs HW=0.73' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 4.19" for 25-year event
Inflow = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af
Outflow = 1.41 cfs @ 8.12 hrs, Volume= 0.481 af, Atten= 1%, Lag= 1.8 min
Primary = 0.09 cfs @ 8.12 hrs, Volume= 0.189 af
Secondary = 1.32 cfs @ 8.12 hrs, Volume= 0.292 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.61' @ 8.12 hrs Surf.Area= 0.028 ac Storage= 0.044 af

Plug-Flow detention time= 110.7 min calculated for 0.480 af (100% of inflow)
Center-of-Mass det. time= 111.0 min (827.2 - 716.3)

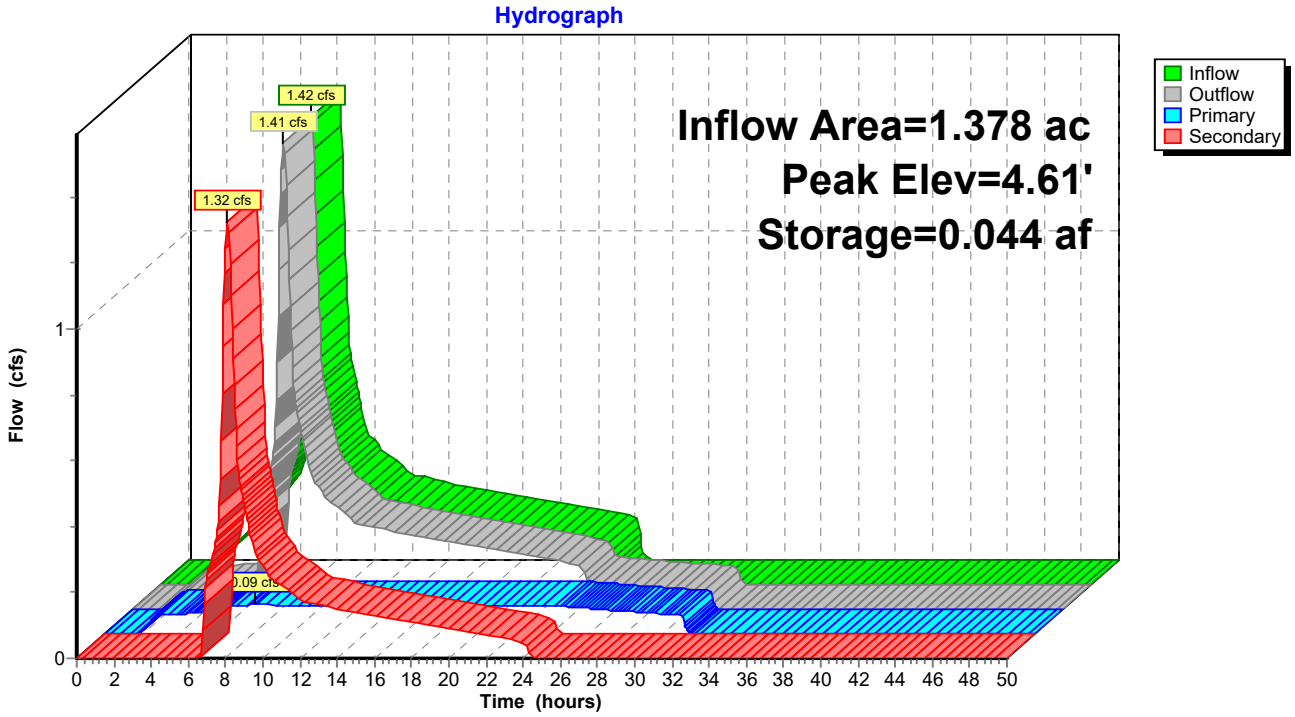
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	**20.00'W x 60.00'L x 6.00'H Infiltration Trench** 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.32 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.32 cfs @ 2.65 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth > 4.78" for 25-year event
Inflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
Outflow = 27.97 cfs @ 8.70 hrs, Volume= 18.424 af, Atten= 3%, Lag= 11.7 min
Primary = 3.57 cfs @ 8.70 hrs, Volume= 8.564 af
Secondary = 24.41 cfs @ 8.70 hrs, Volume= 9.860 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.86' @ 8.70 hrs Surf.Area= 1.674 ac Storage= 2.259 af

Plug-Flow detention time= 143.4 min calculated for 18.424 af (100% of inflow)
Center-of-Mass det. time= 143.3 min (888.6 - 745.3)

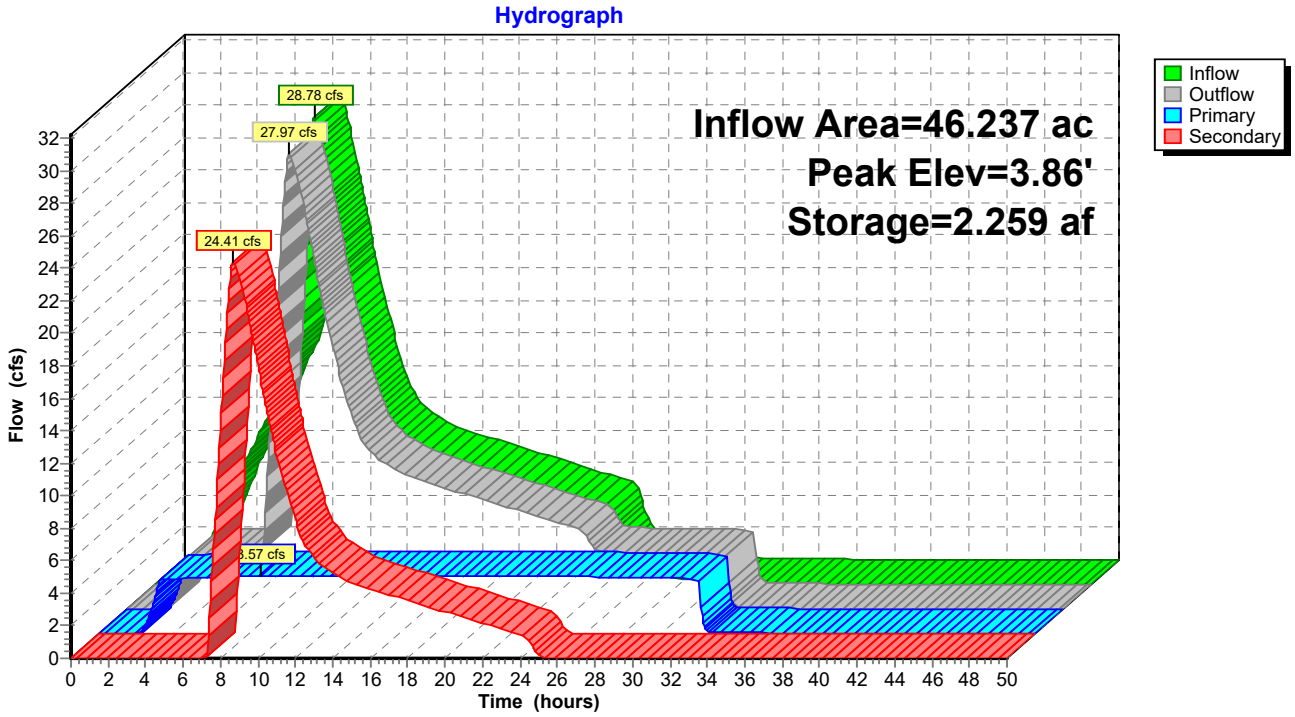
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	**270.00'W x 270.00'L x 5.00'H Infiltration Trench** 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.57 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 3.57 cfs)

Secondary OutFlow Max=24.40 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 24.40 cfs @ 3.03 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=58)
[81] Warning: Exceeded Pond 19P by 41.00' @ 2.00 hrs
[79] Warning: Submerged Pond N2 Primary device # 1 INLET by 3.29'

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 6.90" for 25-year event
Inflow = 65.60 cfs @ 8.14 hrs, Volume= 25.625 af
Outflow = 56.41 cfs @ 8.38 hrs, Volume= 25.621 af, Atten= 14%, Lag= 14.0 min
Primary = 56.41 cfs @ 8.38 hrs, Volume= 25.621 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 42.48' @ 8.38 hrs Surf.Area= 36,800 sf Storage= 16,980 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.8 min (743.3 - 742.5)

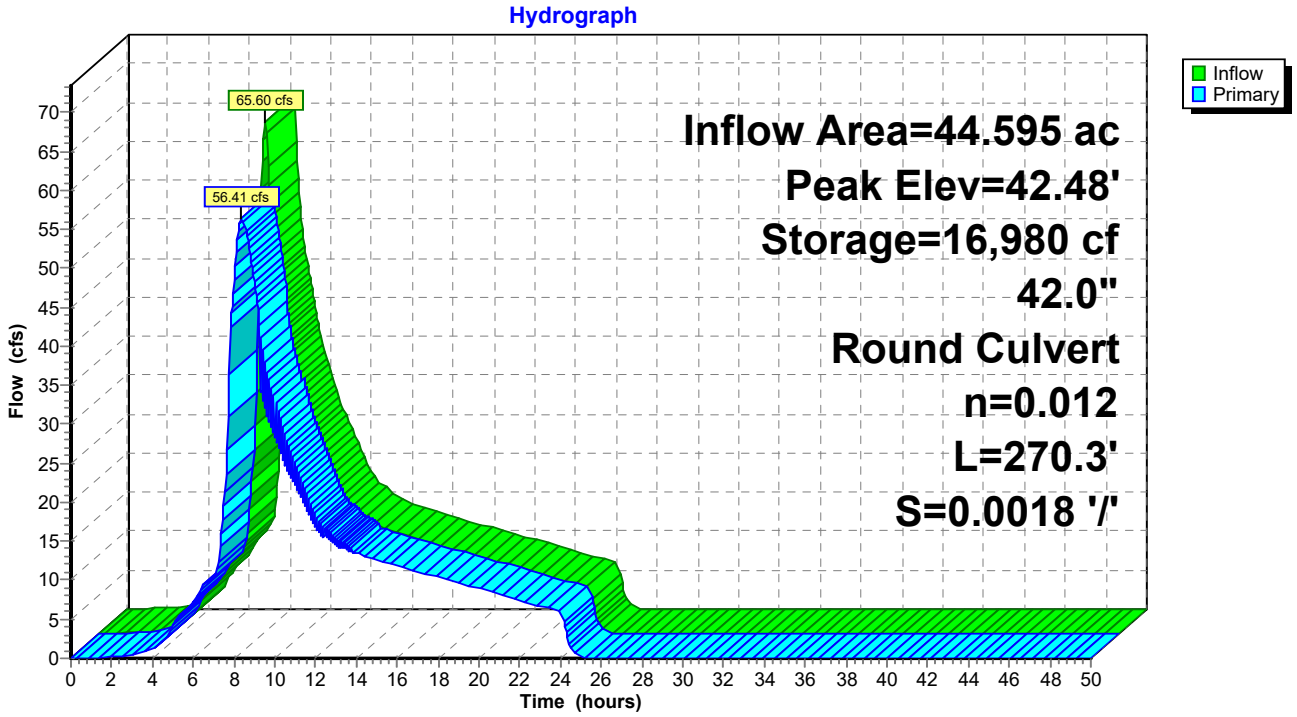
Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

Device	Routing	Invert	Outlet Devices
#1	Primary	38.00'	**42.0" Round Culvert** L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 9.62 sf

Primary OutFlow Max=56.39 cfs @ 8.38 hrs HW=42.48' TW=41.00' (Fixed TW Elev= 41.00')
↑—**1=Culvert** (Inlet Controls 56.39 cfs @ 5.86 fps)

Pond N1: Node D



Summary for Pond N2: Node C

[57] Hint: Peaked at 44.53' (Flood elevation advised)
[81] Warning: Exceeded Pond 7P by 2.15' @ 2.10 hrs
[81] Warning: Exceeded Pond 15P by 44.25' @ 8.05 hrs
[81] Warning: Exceeded Pond 16P by 42.48' @ 1.60 hrs

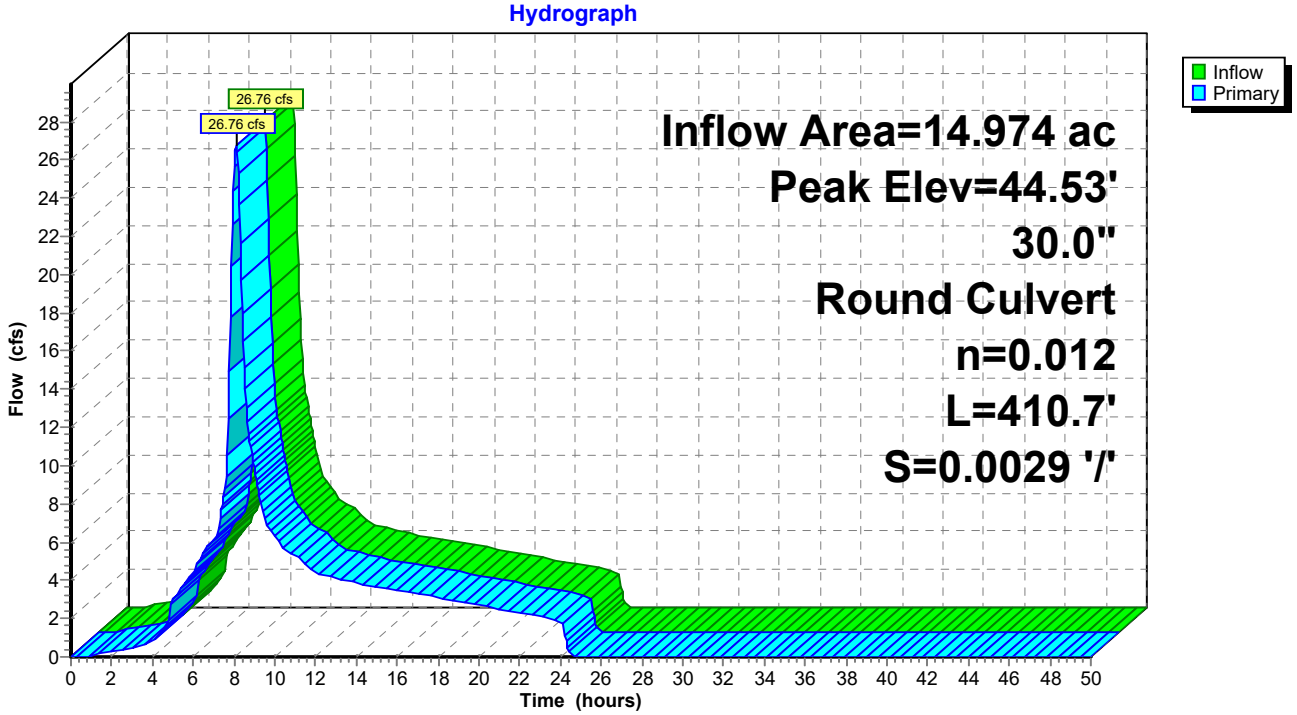
Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 6.37" for 25-year event
Inflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
Outflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af, Atten= 0%, Lag= 0.0 min
Primary = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 44.53' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	**30.0" Round Culvert** L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=26.76 cfs @ 8.10 hrs HW=44.53' TW=42.48' (Fixed TW Elev= 42.48')
└**1=Culvert** (Outlet Controls 26.76 cfs @ 5.45 fps)

Pond N2: Node C



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.45' (Flood elevation advised)
[81] Warning: Exceeded Pond 4P by 48.70' @ 31.50 hrs
[81] Warning: Exceeded Pond 5P by 48.70' @ 35.90 hrs

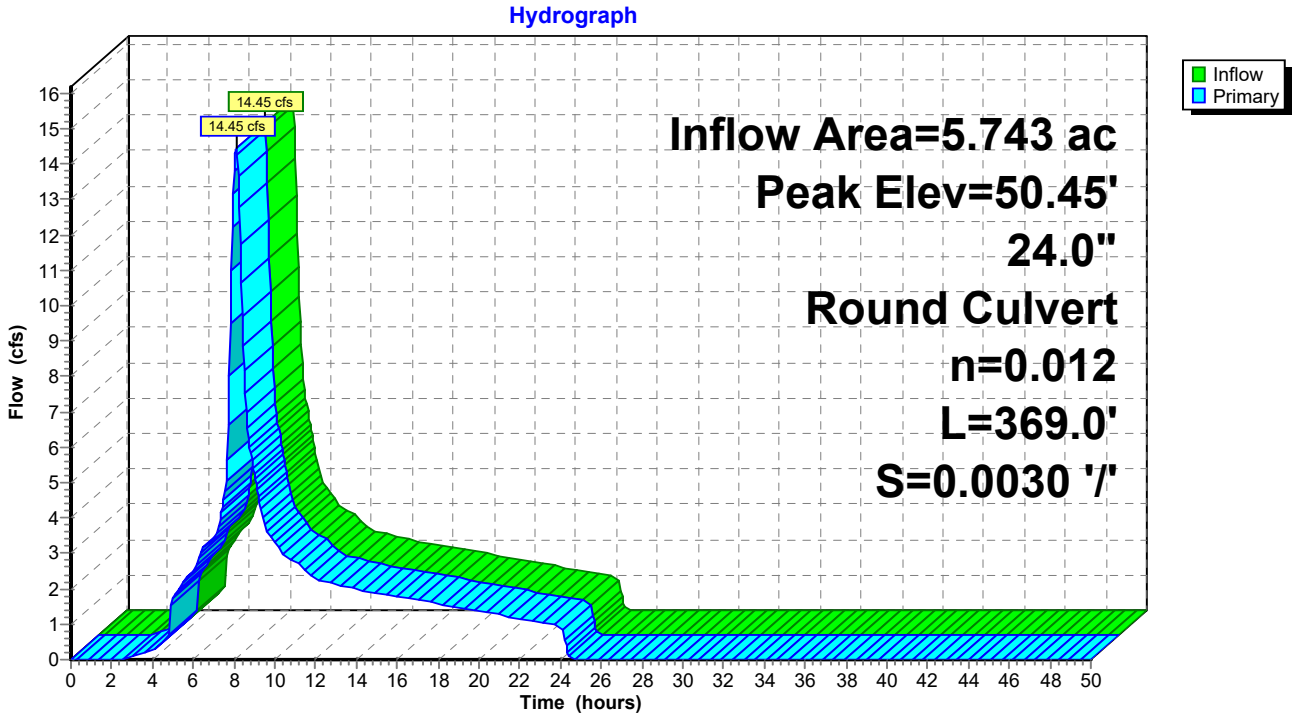
Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 8.63" for 25-year event
Inflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
Outflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af, Atten= 0%, Lag= 0.0 min
Primary = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
Routed to Pond 7P : Node B

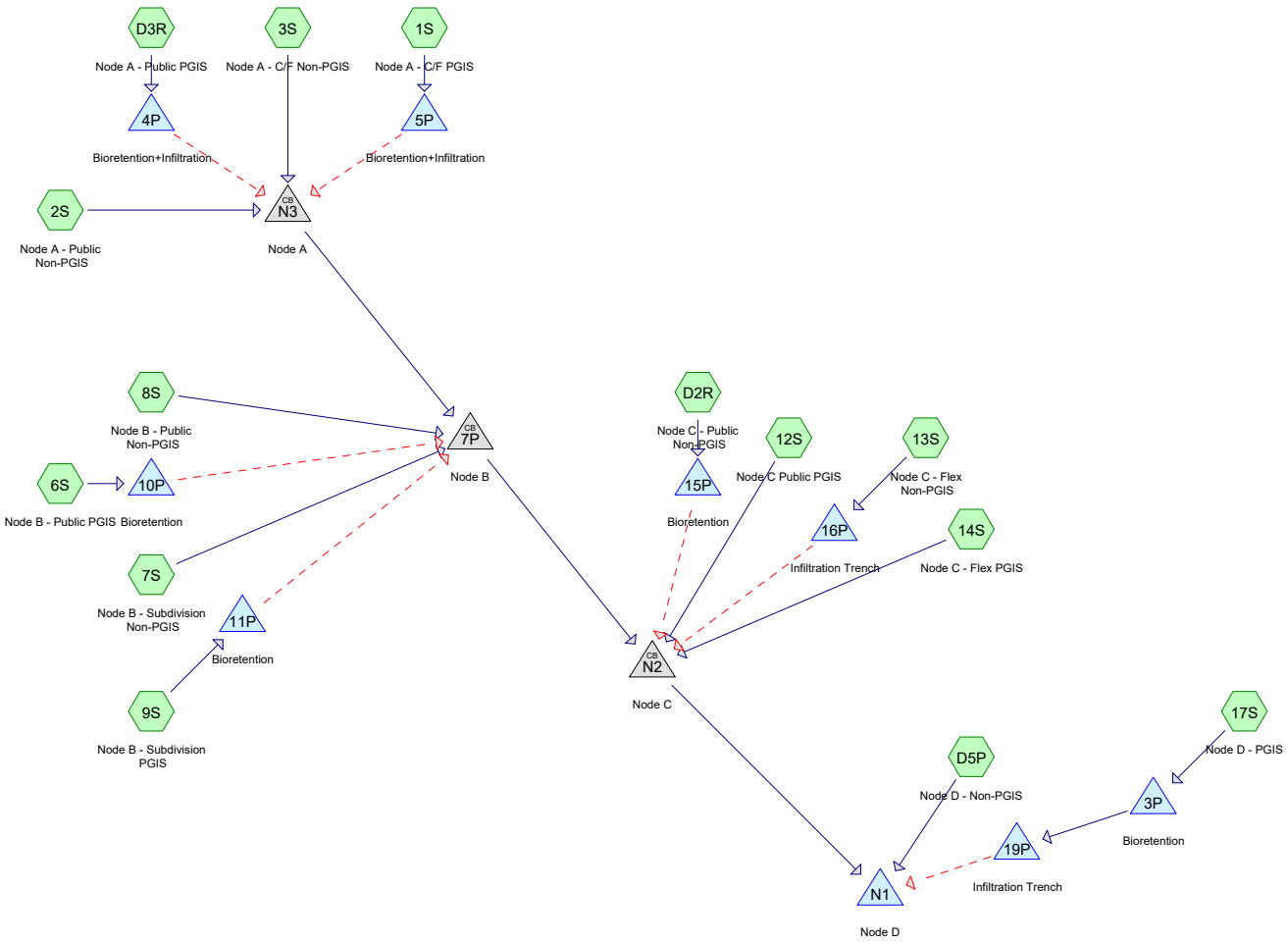
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 50.45' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	**24.0" Round Culvert** L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=14.45 cfs @ 8.10 hrs HW=50.45' TW=48.77' (Fixed TW Elev= 48.77')
1=Culvert (Outlet Controls 14.45 cfs @ 4.60 fps)

Pond N3: Node A





Subcat Reach Pond Link

Routing Diagram for ALTERNATE _Onsite 100-Year Storm - Minor Flood
Prepared by MacKay & Sposito, Inc, Printed 3/10/2025
HydroCAD® 10.20-5c s/n 01662 © 2023 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	**38.896**	**0.000**	**0.000**	**0.000**	**104.075**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=10.54 cfs 3.734 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.97"
Tc=20.0 min CN=59 Runoff=0.38 cfs 0.190 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=4.82"
Tc=20.0 min CN=88 Runoff=5.43 cfs 1.840 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=0.35 cfs 0.124 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=4.49"
Tc=20.0 min CN=85 Runoff=7.39 cfs 2.525 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=3.86"
Tc=20.0 min CN=79 Runoff=0.08 cfs 0.029 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=3.05 cfs 1.081 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=1.00 cfs 0.353 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=5.27"
Tc=20.0 min CN=92 Runoff=1.78 cfs 0.605 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=64.81 cfs 22.971 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=2.78"
Tc=20.0 min CN=68 Runoff=0.14 cfs 0.055 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=4.17"
Tc=20.0 min CN=82 Runoff=29.72 cfs 10.297 af

Pond 3P: Bioretention Peak Elev=54.89' Storage=3.301 af Inflow=64.81 cfs 22.971 af
Outflow=40.37 cfs 22.657 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.84' Storage=0.039 af Inflow=2.36 cfs 0.837 af
Primary=0.15 cfs 0.283 af Secondary=2.20 cfs 0.554 af Outflow=2.35 cfs 0.837 af

Pond 5P: Bioretention+Infiltration Peak Elev=5.04' Storage=0.241 af Inflow=10.54 cfs 3.734 af
Primary=0.36 cfs 0.890 af Secondary=10.21 cfs 2.844 af Outflow=10.57 cfs 3.734 af

Pond 7P: Node B Peak Elev=49.68' Inflow=28.83 cfs 8.778 af
Outflow=28.83 cfs 8.778 af

Pond 10P: Bioretention Peak Elev=3.28' Storage=0.005 af Inflow=0.35 cfs 0.124 af
Primary=0.02 cfs 0.046 af Secondary=0.33 cfs 0.078 af Outflow=0.35 cfs 0.124 af

Pond 11P: Bioretention Peak Elev=5.06' Storage=0.055 af Inflow=3.05 cfs 1.081 af
Primary=0.19 cfs 0.364 af Secondary=2.82 cfs 0.717 af Outflow=3.02 cfs 1.081 af

Pond 15P: Bioretention Peak Elev=1.52' Storage=0.007 af Inflow=0.14 cfs 0.055 af
Primary=0.05 cfs 0.055 af Secondary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.055 af

Pond 16P: Infiltration Trench Peak Elev=4.70' Storage=0.045 af Inflow=1.78 cfs 0.605 af
Primary=0.09 cfs 0.193 af Secondary=1.68 cfs 0.411 af Outflow=1.77 cfs 0.605 af

Pond 19P: Infiltration Trench Peak Elev=4.09' Storage=2.393 af Inflow=40.37 cfs 22.657 af
Primary=3.58 cfs 8.734 af Secondary=34.89 cfs 13.923 af Outflow=38.47 cfs 22.657 af

Pond N1: Node D Peak Elev=43.19' Storage=45,518 cf Inflow=84.32 cfs 34.599 af
Primary=67.56 cfs 34.595 af Secondary=0.00 cfs 0.000 af Outflow=67.56 cfs 34.595 af

Pond N2: Node C Peak Elev=46.47' Inflow=33.86 cfs 10.379 af
Outflow=33.86 cfs 10.379 af

Pond N3: Node A Peak Elev=50.56' Inflow=18.21 cfs 5.428 af
Outflow=18.21 cfs 5.428 af

Total Runoff Area = 104.075 ac Runoff Volume = 45.478 af Average Runoff Depth = 5.24"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

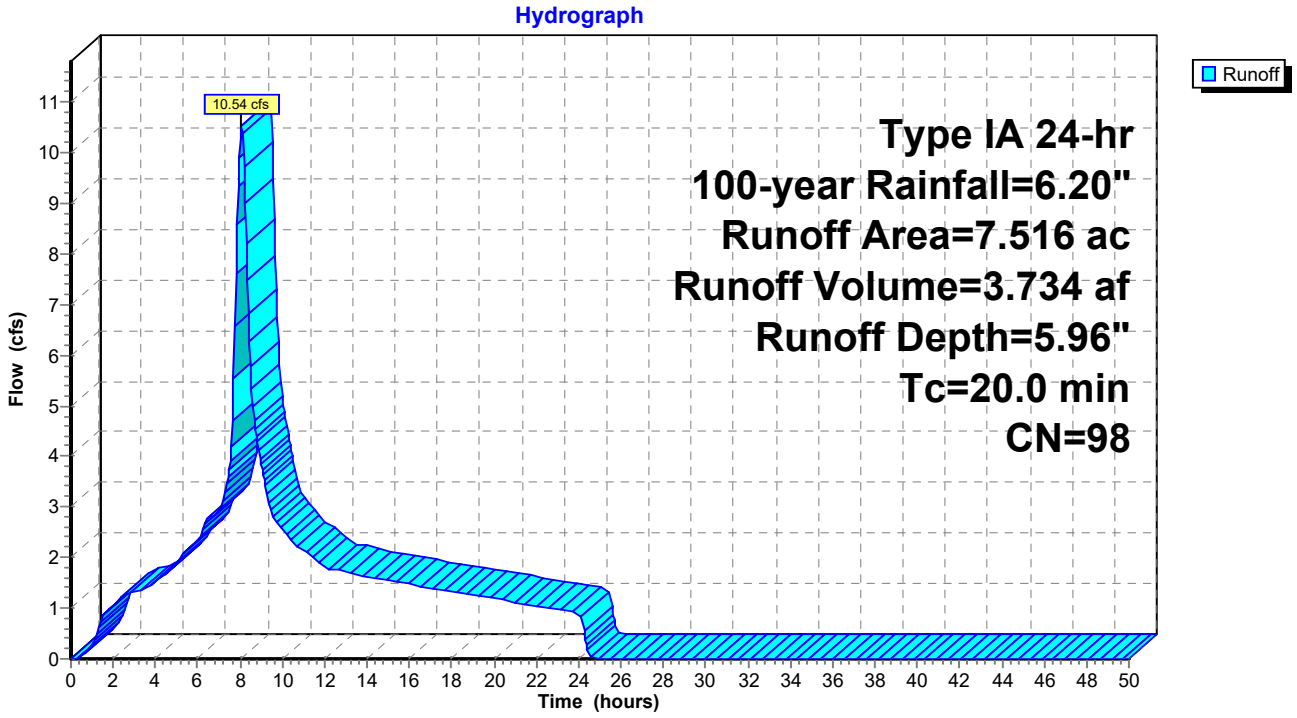
Runoff = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af, Depth= 5.96"
Routed to Pond 5P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 1S: Node A - C/F PGIS



Summary for Subcatchment 2S: Node A - Public Non-PGIS

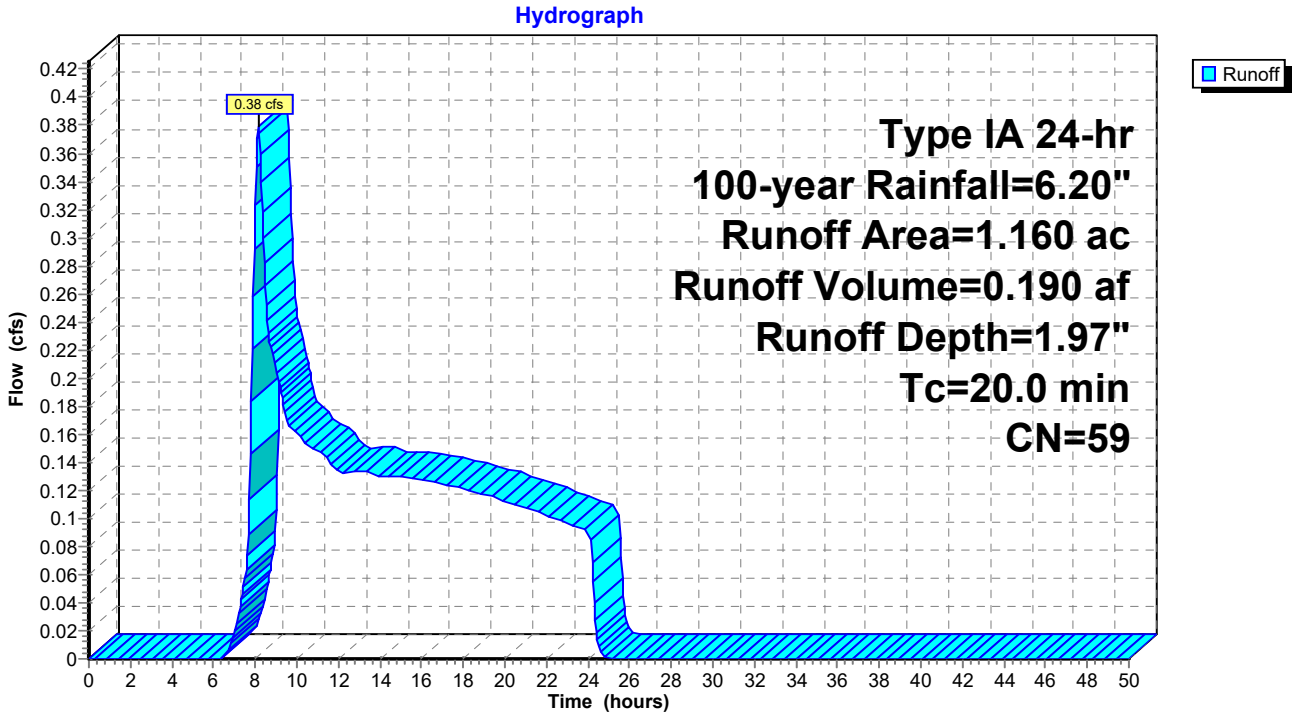
Runoff = 0.38 cfs @ 8.16 hrs, Volume= 0.190 af, Depth= 1.97"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
	1.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 2S: Node A - Public Non-PGIS



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

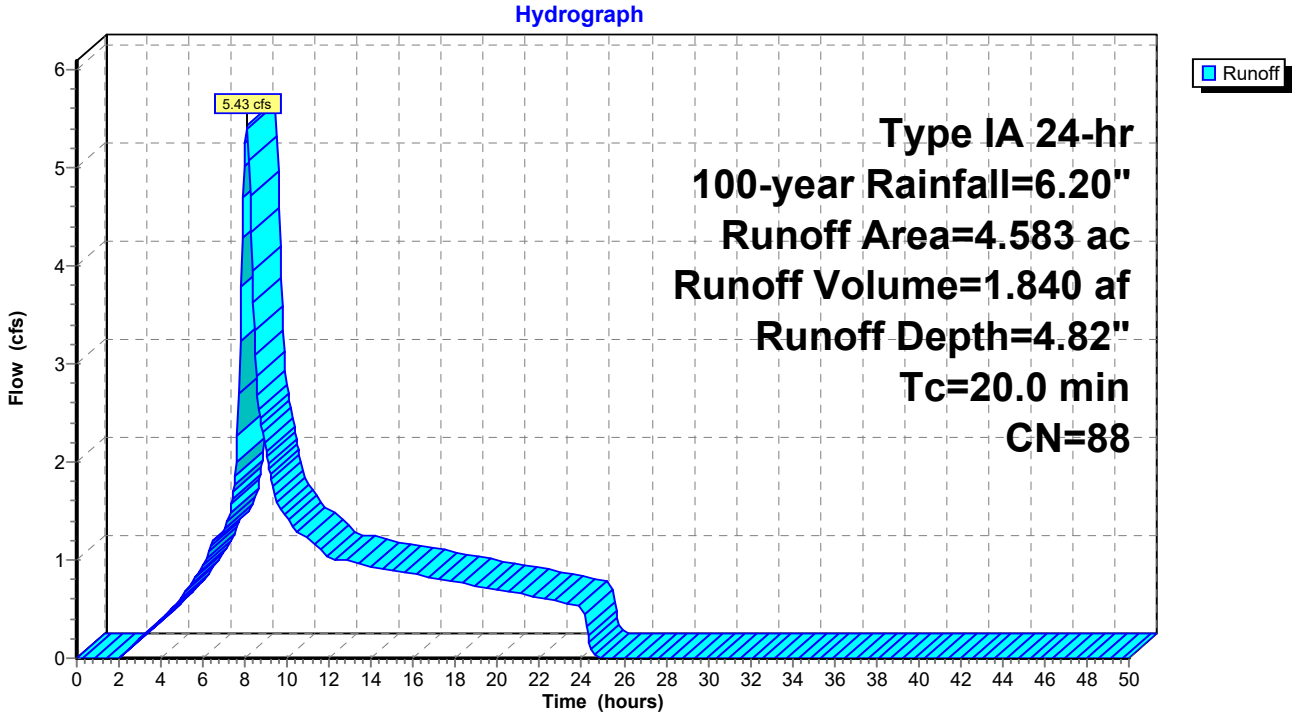
Runoff = 5.43 cfs @ 8.09 hrs, Volume= 1.840 af, Depth= 4.82"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
	3.373	98	Roofs, HSG A
	4.583	88	Weighted Average
	1.210		26.40% Pervious Area
	3.373		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 3S: Node A - C/F Non-PGIS



Summary for Subcatchment 6S: Node B - Public PGIS

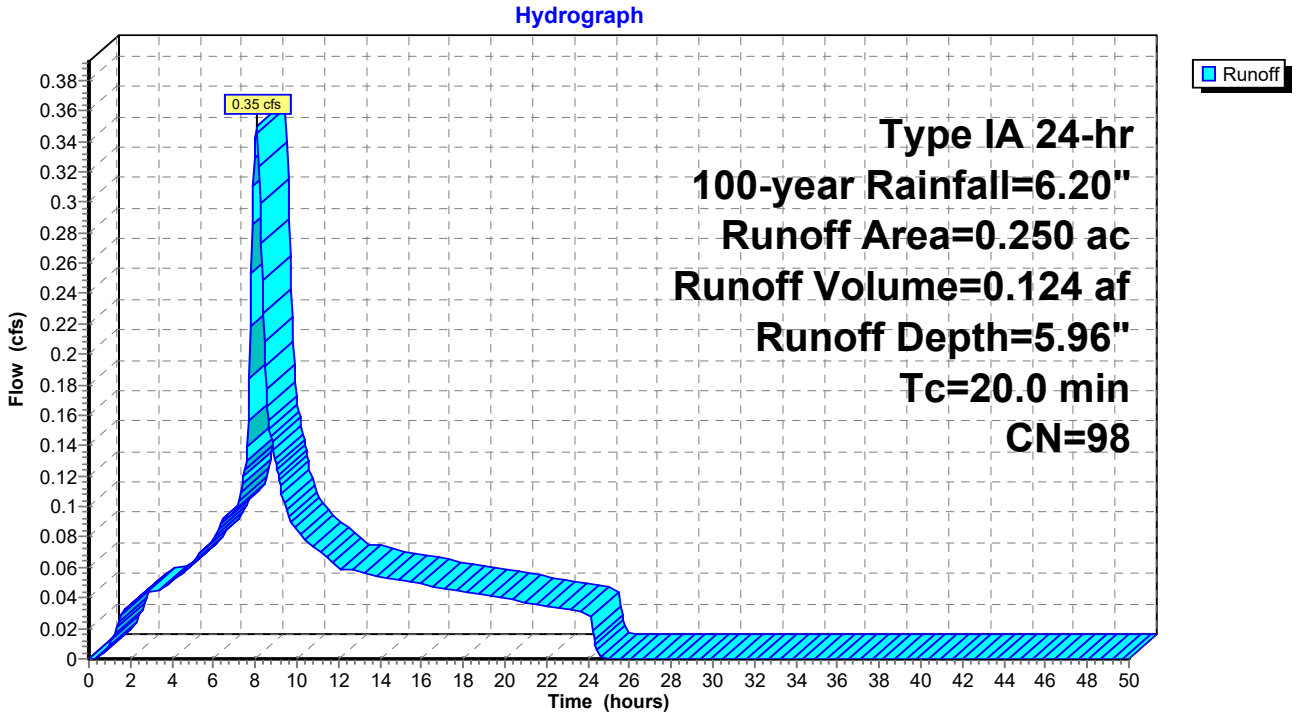
Runoff = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af, Depth= 5.96"
Routed to Pond 10P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 6S: Node B - Public PGIS



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

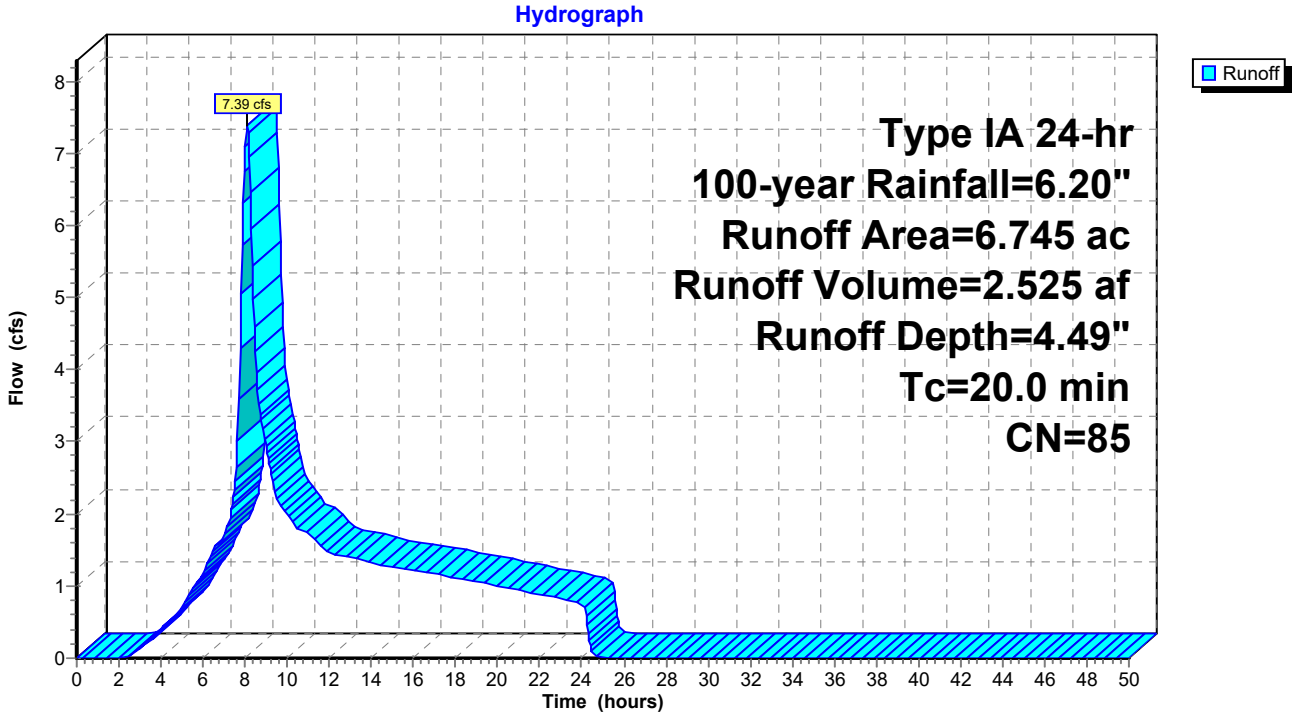
Runoff = 7.39 cfs @ 8.09 hrs, Volume= 2.525 af, Depth= 4.49"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 7S: Node B - Subdivision Non-PGIS



Summary for Subcatchment 8S: Node B - Public Non-PGIS

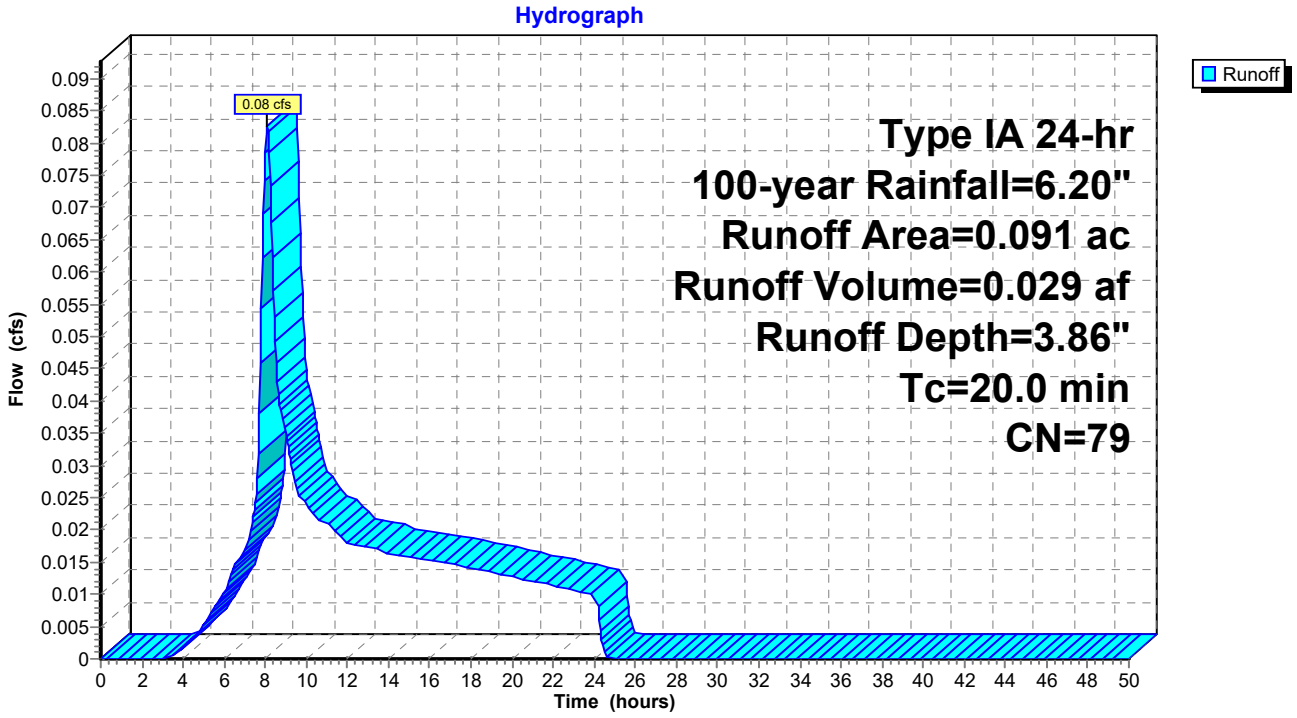
Runoff = 0.08 cfs @ 8.11 hrs, Volume= 0.029 af, Depth= 3.86"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 8S: Node B - Public Non-PGIS



Summary for Subcatchment 9S: Node B - Subdivision PGIS

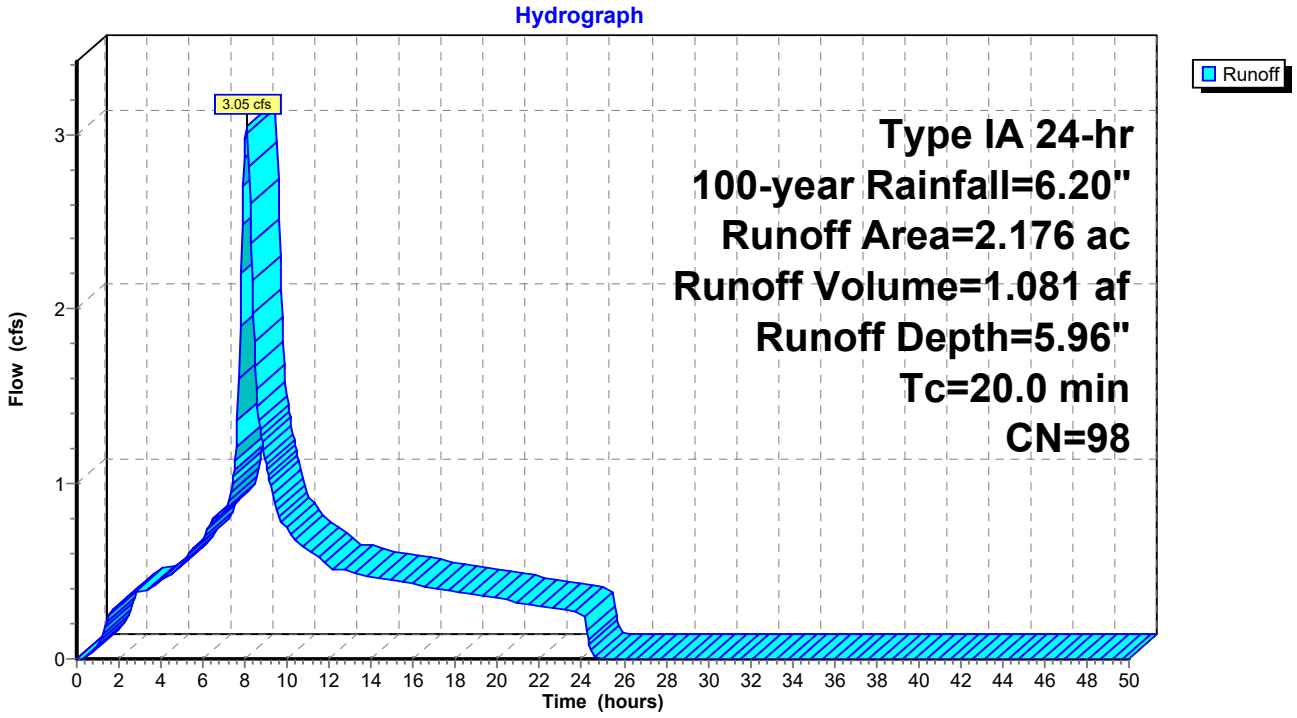
Runoff = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af, Depth= 5.96"
Routed to Pond 11P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 9S: Node B - Subdivision PGIS



Summary for Subcatchment 12S: Node C Public PGIS

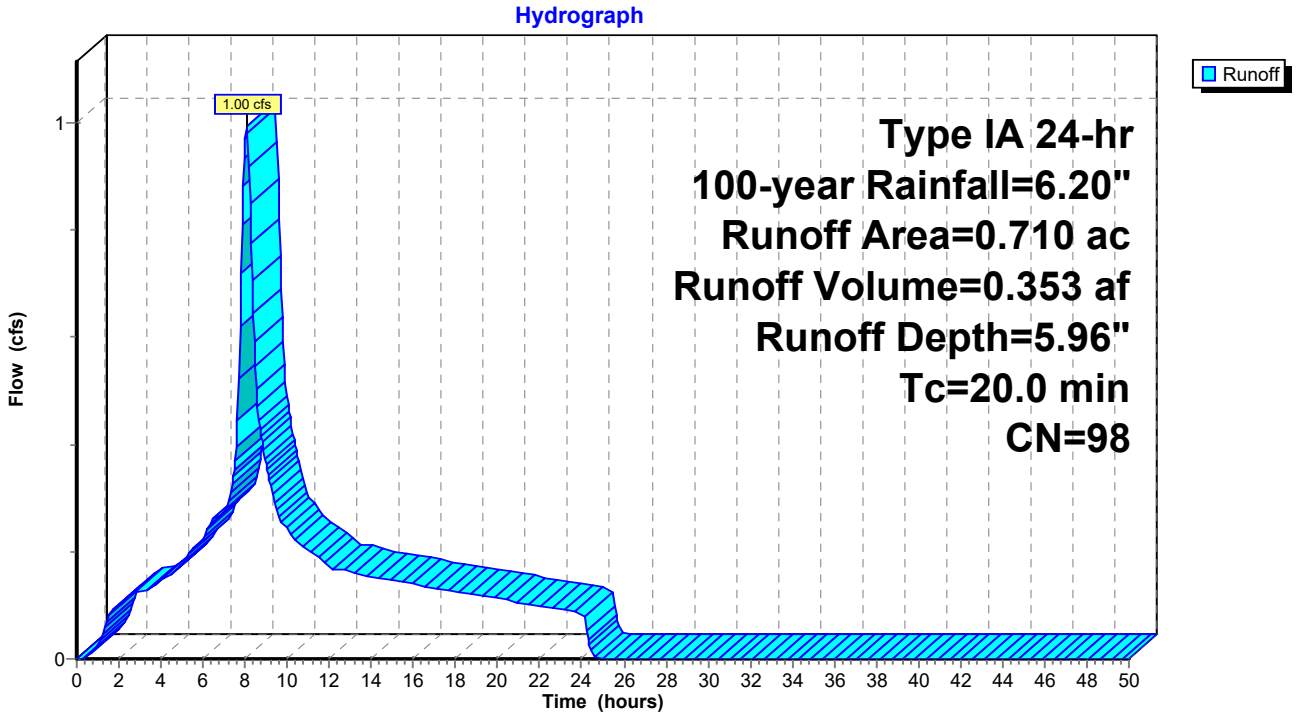
Runoff = 1.00 cfs @ 8.08 hrs, Volume= 0.353 af, Depth= 5.96"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 12S: Node C Public PGIS



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

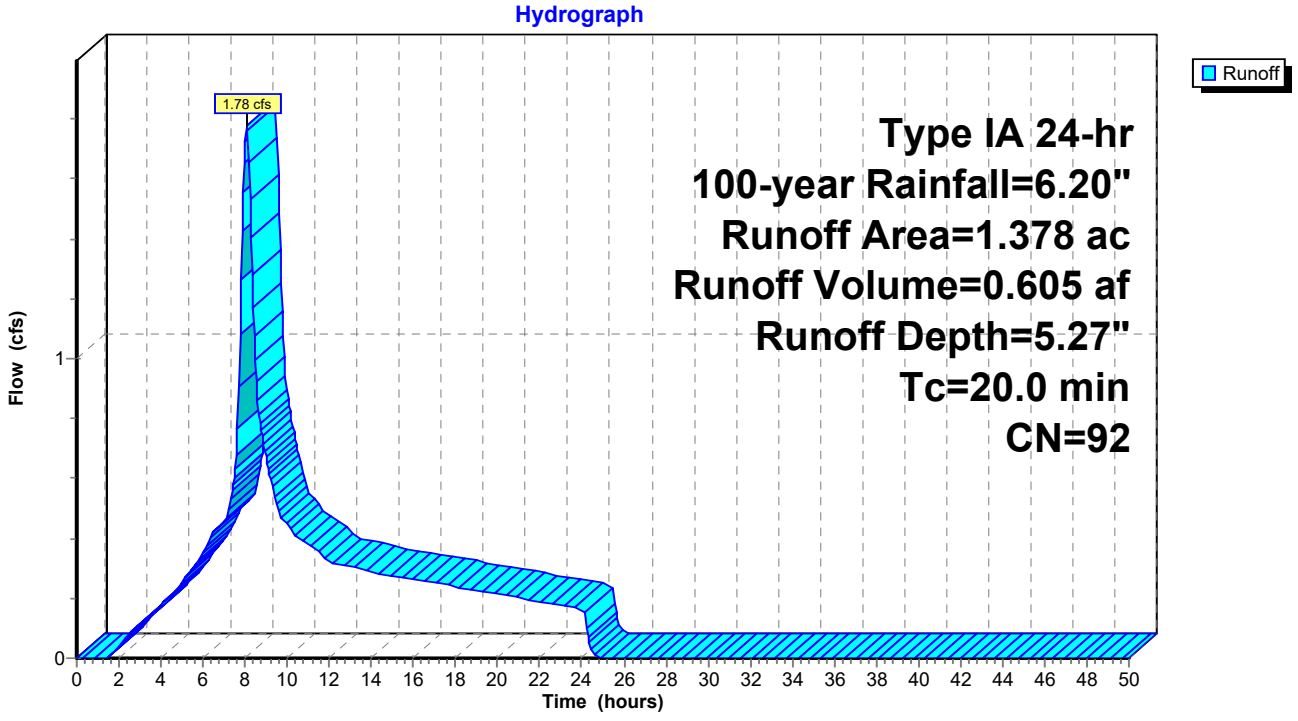
Runoff = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af, Depth= 5.27"
Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

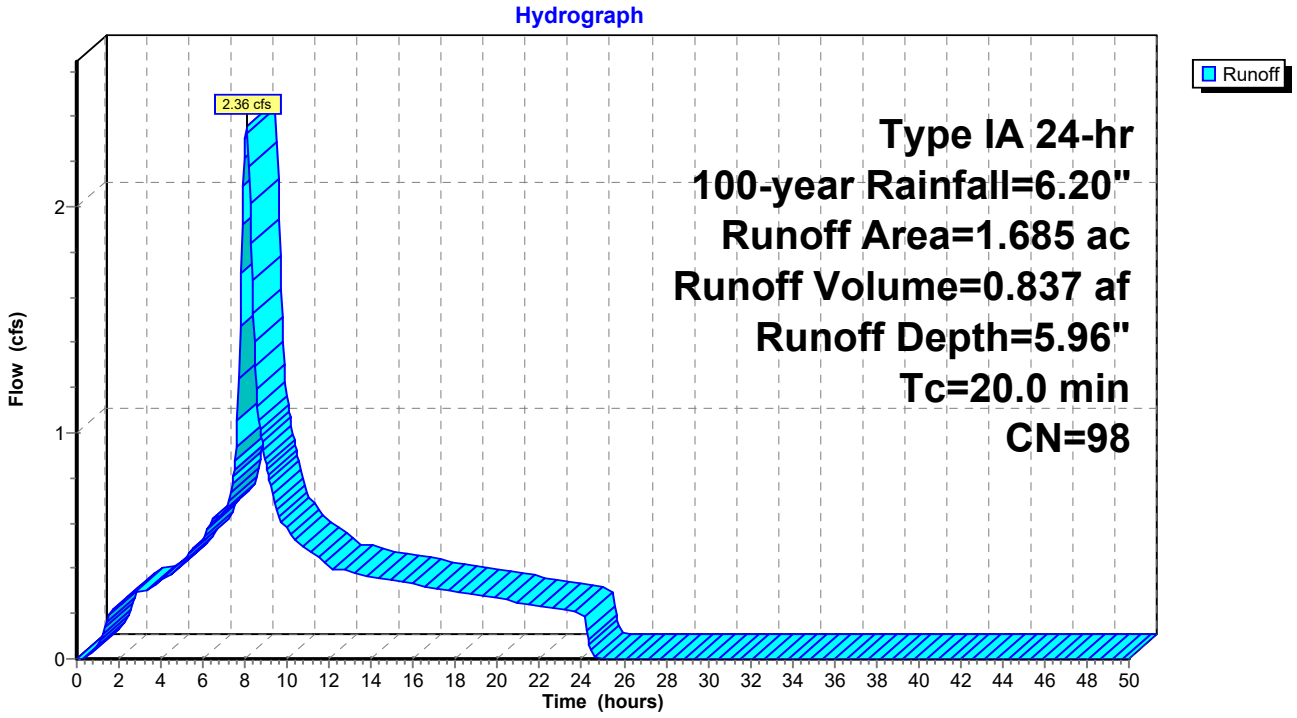
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 14S: Node C - Flex PGIS



Summary for Subcatchment 17S: Node D - PGIS

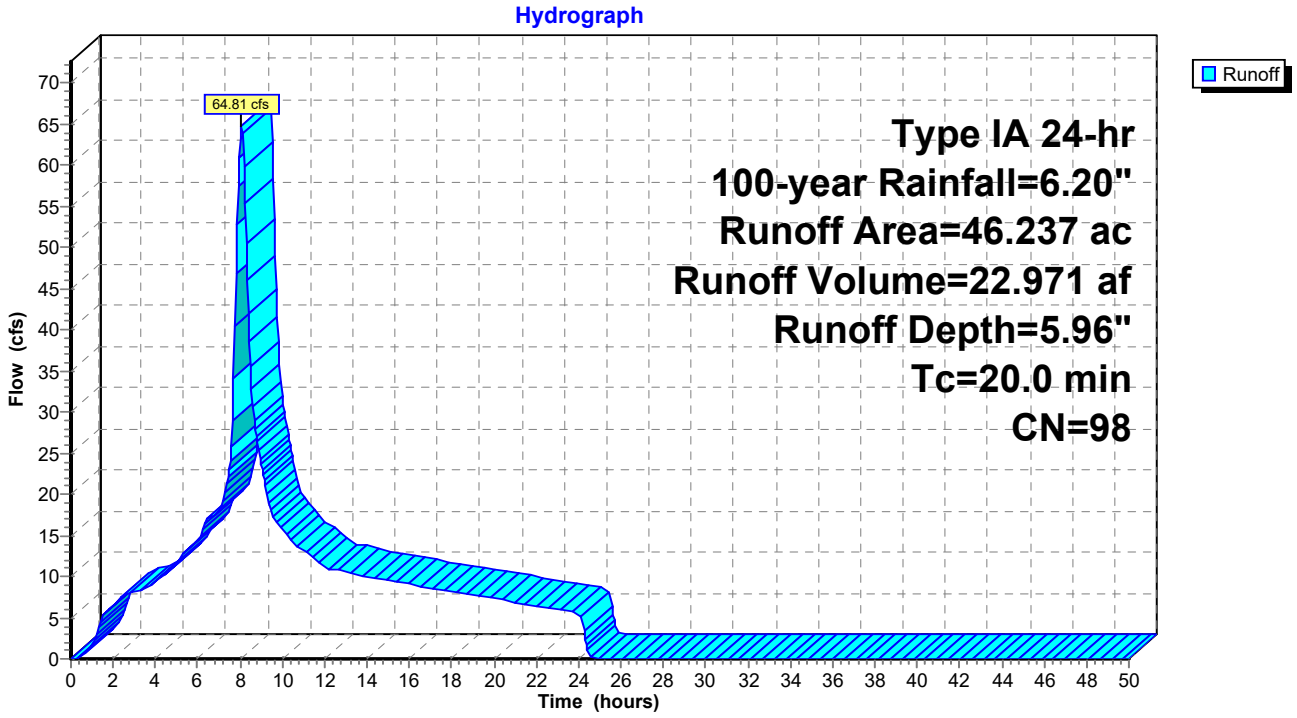
Runoff = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af, Depth= 5.96"
Routed to Pond 3P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 17S: Node D - PGIS



Summary for Subcatchment D2R: Node C - Public Non-PGIS

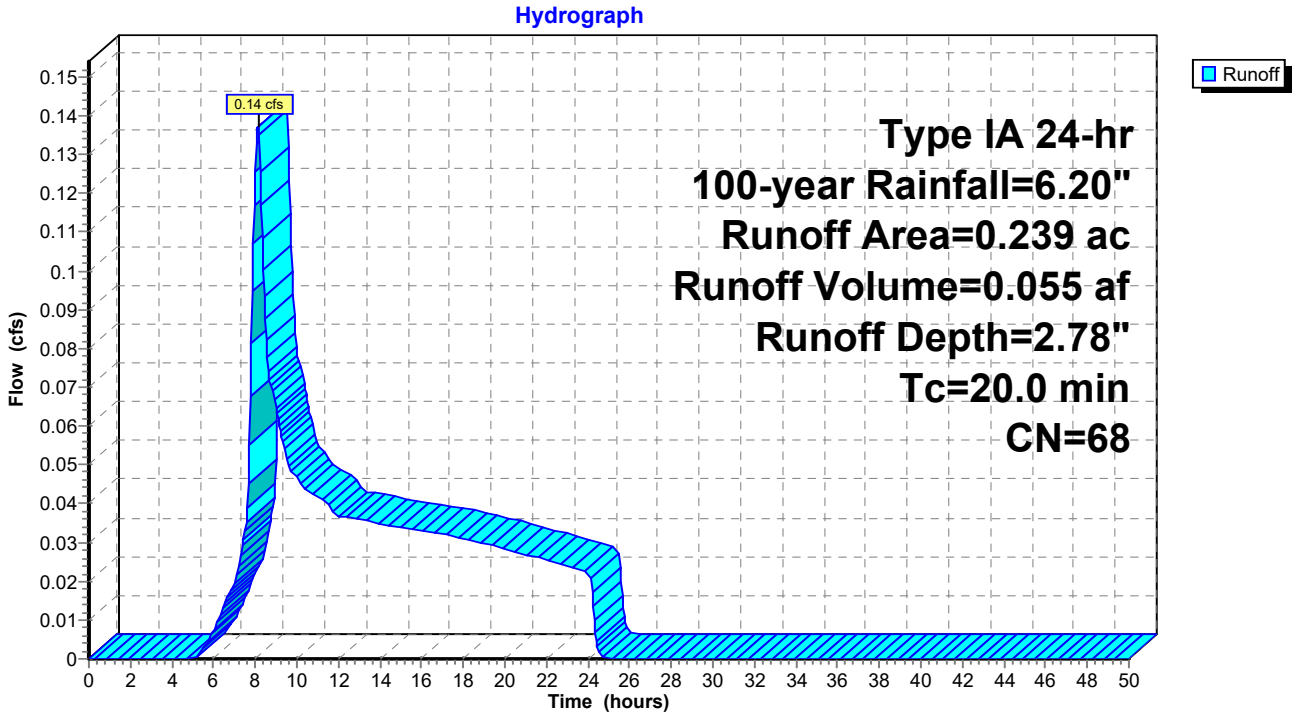
Runoff = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af, Depth= 2.78"
Routed to Pond 15P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D2R: Node C - Public Non-PGIS



Summary for Subcatchment D3R: Node A - Public PGIS

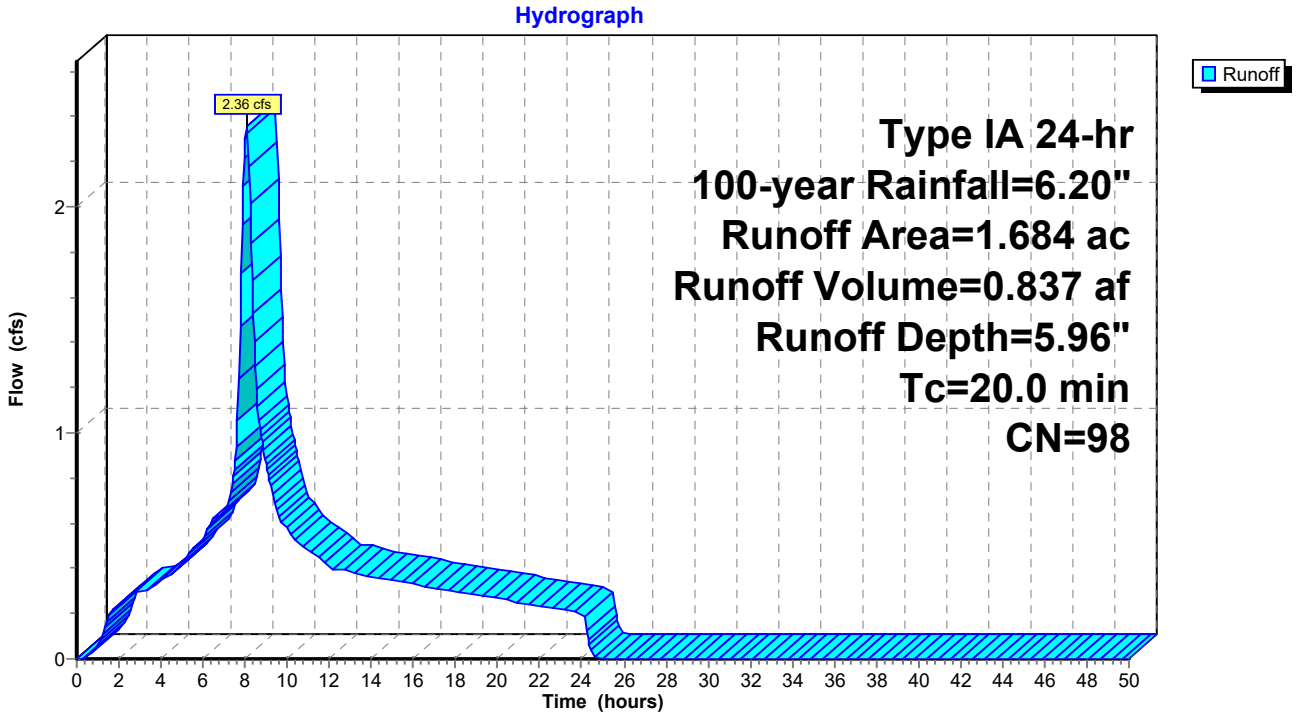
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

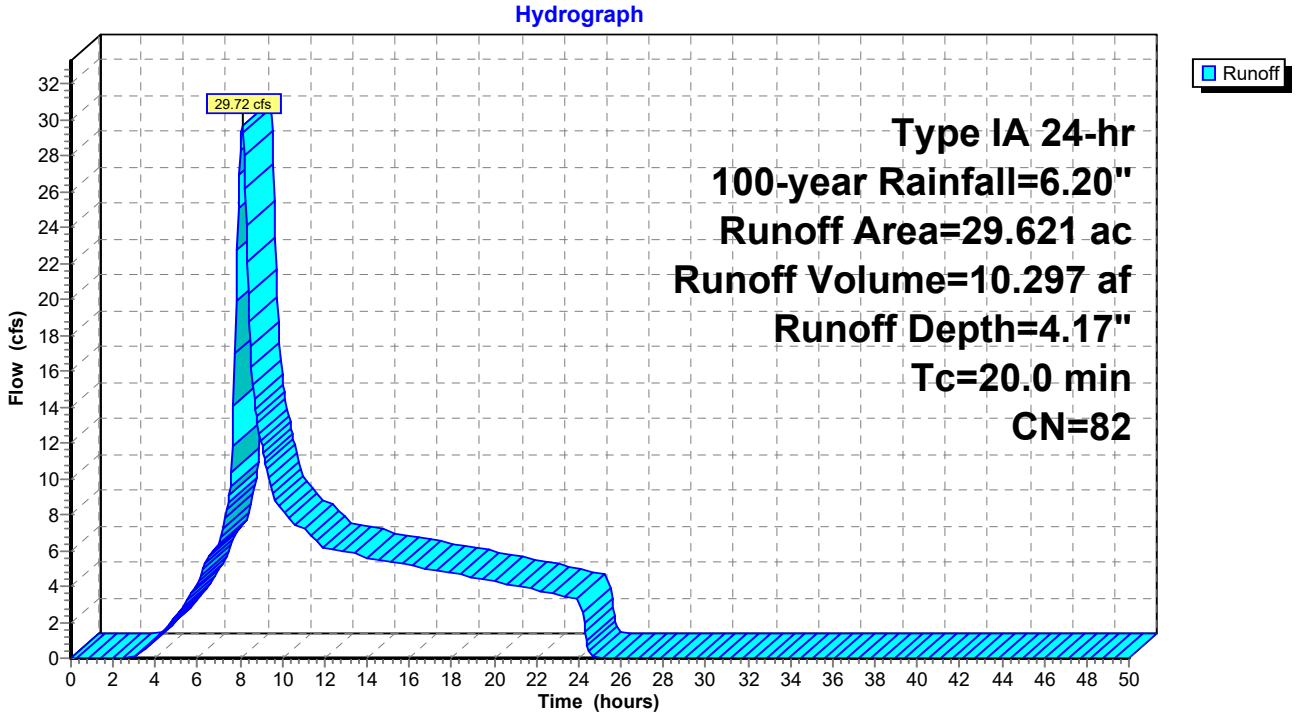
Runoff = 29.72 cfs @ 8.10 hrs, Volume= 10.297 af, Depth= 4.17"
Routed to Pond N1 : Node D

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D5P: Node D - Non-PGIS



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af
Outflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af, Atten= 38%, Lag= 20.8 min
Primary = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 54.89' @ 8.42 hrs Surf.Area= 1.674 ac Storage= 3.301 af

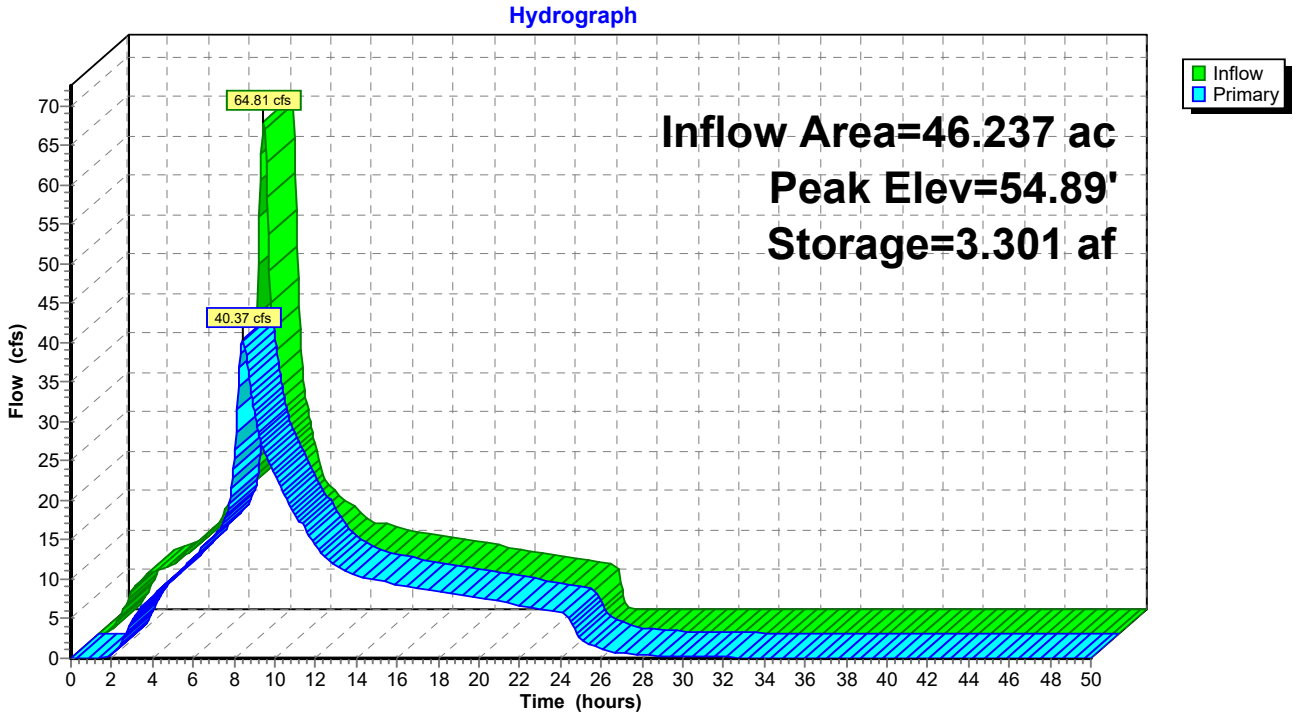
Plug-Flow detention time= 83.2 min calculated for 22.657 af (99% of inflow)
Center-of-Mass det. time= 72.4 min (736.4 - 664.0)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	**270.00'W x 270.00'L x 6.50'H Prismatoid** 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	**270.00'W x 270.00'L x 2.00'H Prismatoid** Inside #1
#3	50.50'	0.019 af	**24.0" Round Pipe Storage** Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	**60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=40.28 cfs @ 8.42 hrs HW=54.89' (Free Discharge)
1=Orifice/Grate (Weir Controls 12.44 cfs @ 2.04 fps)
2=Orifice/Grate (Orifice Controls 27.85 cfs @ 8.86 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af
Outflow = 2.35 cfs @ 8.11 hrs, Volume= 0.837 af, Atten= 1%, Lag= 1.8 min
Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.283 af
Secondary = 2.20 cfs @ 8.11 hrs, Volume= 0.554 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.84' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.039 af

Plug-Flow detention time= 55.2 min calculated for 0.836 af (100% of inflow)
Center-of-Mass det. time= 55.4 min (719.4 - 664.0)

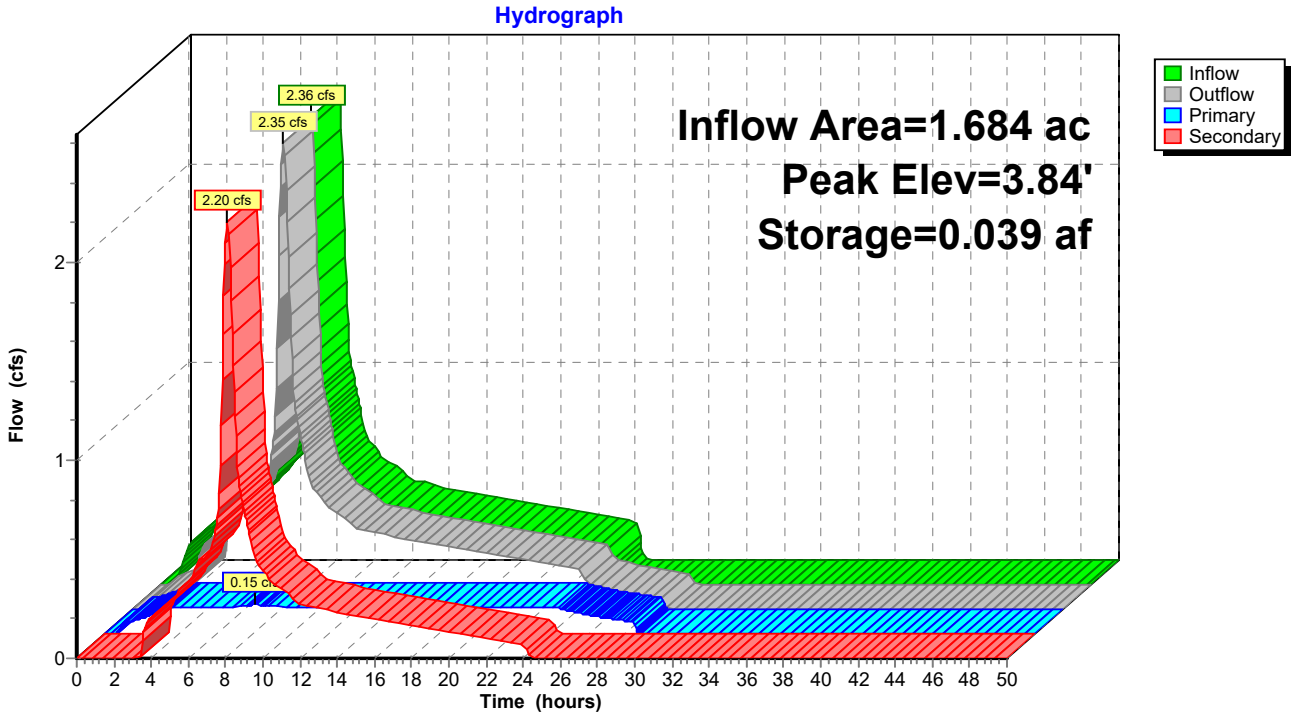
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	**5.00'W x 250.00'L x 5.00'H Bioretention** 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=2.20 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
2=Orifice/Grate (Orifice Controls 2.20 cfs @ 3.12 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

[93] Warning: Storage range exceeded by 0.04'
[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 7.516 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af
Outflow = 10.57 cfs @ 8.09 hrs, Volume= 3.734 af, Atten= 0%, Lag= 0.5 min
Primary = 0.36 cfs @ 7.95 hrs, Volume= 0.890 af
Secondary = 10.21 cfs @ 8.09 hrs, Volume= 2.844 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 5.04' @ 8.09 hrs Surf.Area= 0.138 ac Storage= 0.241 af

Plug-Flow detention time= 91.6 min calculated for 3.730 af (100% of inflow)
Center-of-Mass det. time= 92.0 min (756.0 - 664.0)

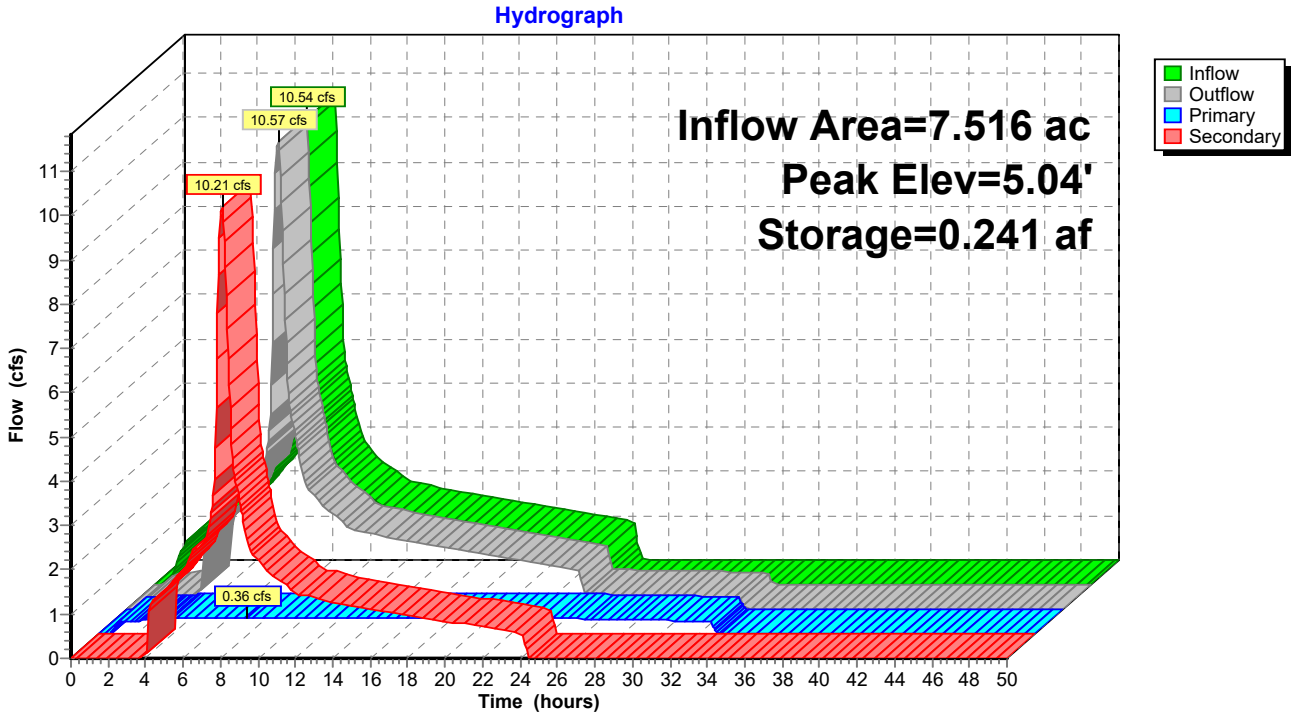
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	**50.00'W x 120.00'L x 5.00'H Infiltration Trench** 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.50'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 7.95 hrs HW=5.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=10.16 cfs @ 8.09 hrs HW=5.04' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 10.16 cfs @ 2.40 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 7P: Node B

[57] Hint: Peaked at 49.68' (Flood elevation advised)
[81] Warning: Exceeded Pond 10P by 46.47' @ 31.35 hrs
[81] Warning: Exceeded Pond 11P by 46.47' @ 33.05 hrs
[79] Warning: Submerged Pond N3 Primary device # 1 INLET by 8.24'

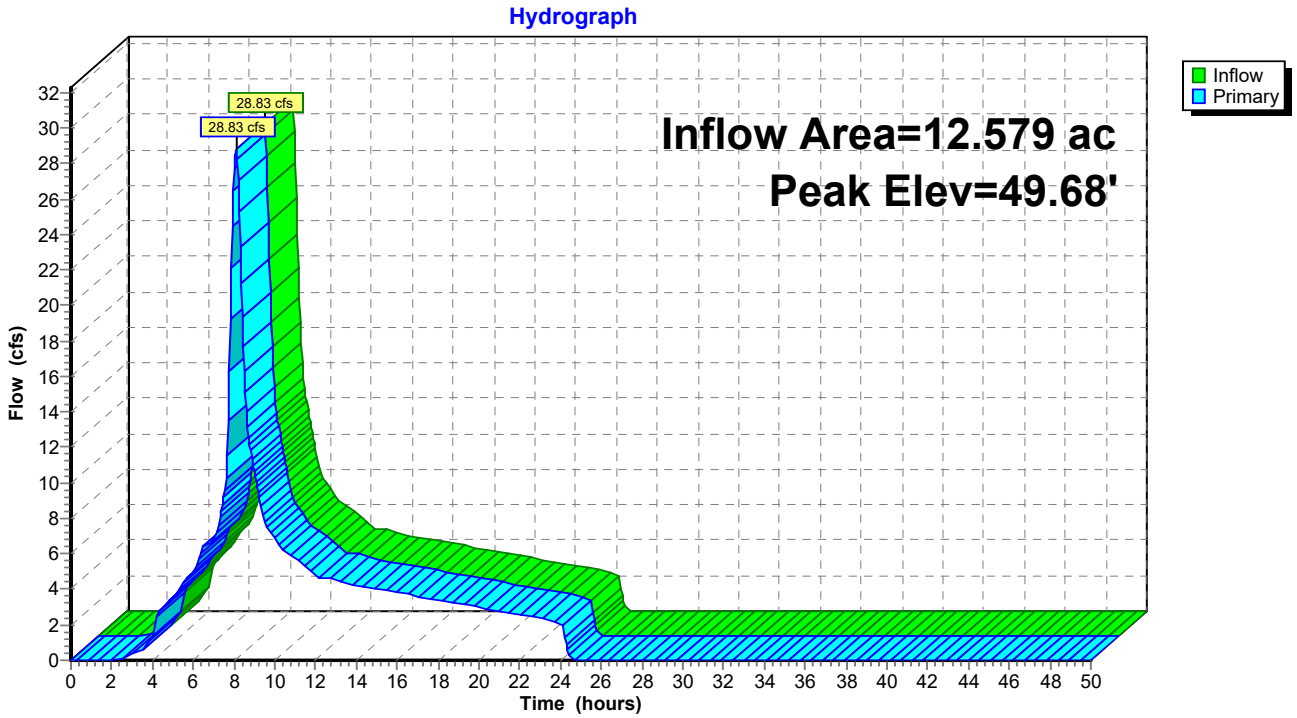
Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 8.37" for 100-year event
Inflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
Outflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af, Atten= 0%, Lag= 0.0 min
Primary = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 49.68' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	**24.0" Round Culvert** L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	49.50'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=28.70 cfs @ 8.09 hrs HW=49.68' TW=46.47' (Fixed TW Elev= 46.47')
1=Culvert (Outlet Controls 19.75 cfs @ 6.29 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 8.95 cfs @ 1.39 fps)

Pond 7P: Node B



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af
Outflow = 0.35 cfs @ 8.09 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.5 min
Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.046 af
Secondary = 0.33 cfs @ 8.09 hrs, Volume= 0.078 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.28' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 56.2 min calculated for 0.124 af (100% of inflow)
Center-of-Mass det. time= 56.3 min (720.4 - 664.0)

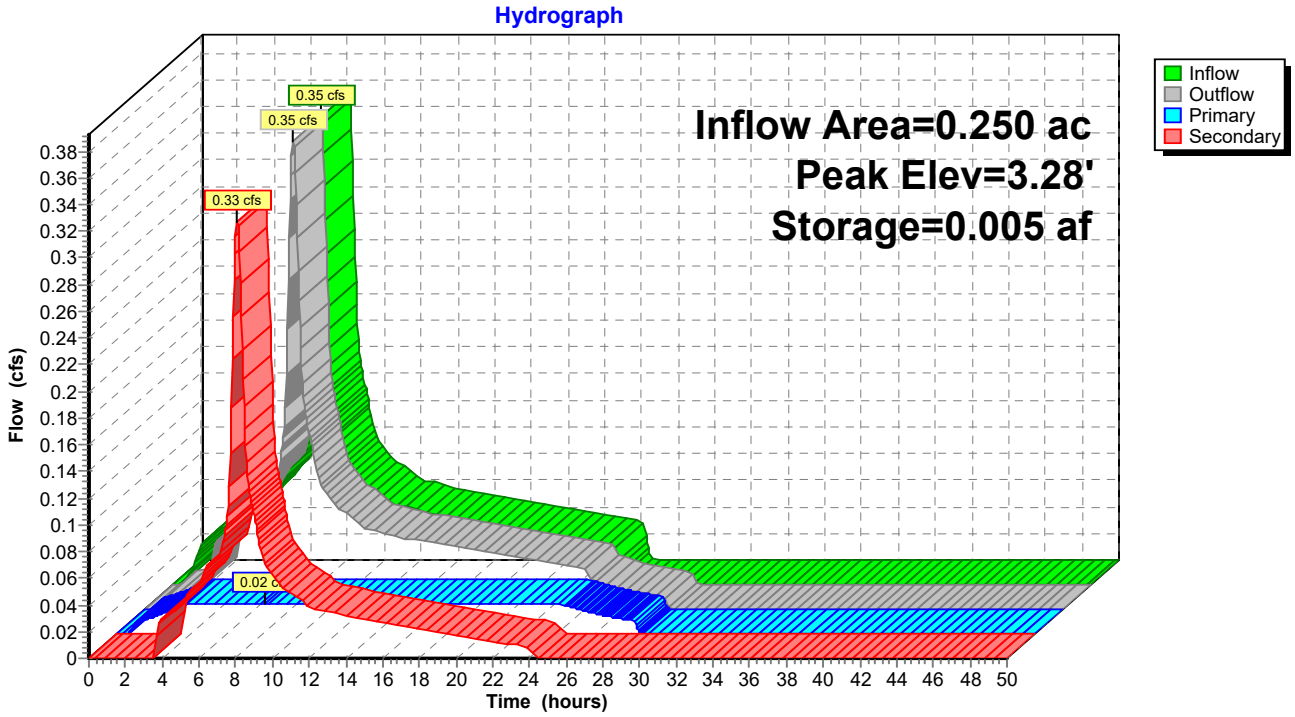
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	**5.00'W x 40.00'L x 5.00'H Bioretention** 0.023 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.32 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 0.32 cfs @ 1.80 fps)

Pond 10P: Bioretention



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af
Outflow = 3.02 cfs @ 8.12 hrs, Volume= 1.081 af, Atten= 1%, Lag= 2.8 min
Primary = 0.19 cfs @ 8.12 hrs, Volume= 0.364 af
Secondary = 2.82 cfs @ 8.12 hrs, Volume= 0.717 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 5.06' @ 8.12 hrs Surf.Area= 0.031 ac Storage= 0.055 af

Plug-Flow detention time= 61.6 min calculated for 1.080 af (100% of inflow)
Center-of-Mass det. time= 61.8 min (725.8 - 664.0)

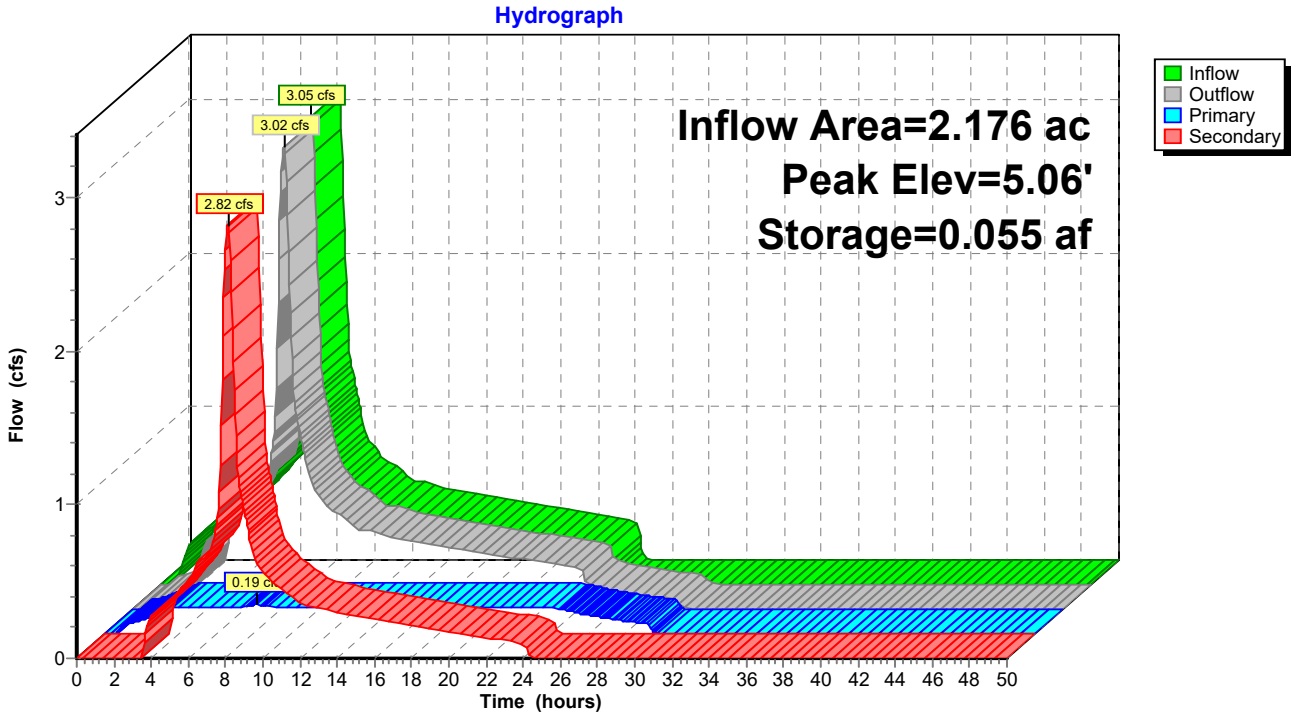
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	**5.00'W x 270.00'L x 6.00'H Bioretention** 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.82 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 2.82 cfs @ 3.59 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 2.78" for 100-year event
Inflow = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af
Outflow = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af, Atten= 67%, Lag= 125.5 min
Primary = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 1.52' @ 10.22 hrs Surf.Area= 0.014 ac Storage= 0.007 af

Plug-Flow detention time= 77.6 min calculated for 0.055 af (100% of inflow)
Center-of-Mass det. time= 77.5 min (908.4 - 830.8)

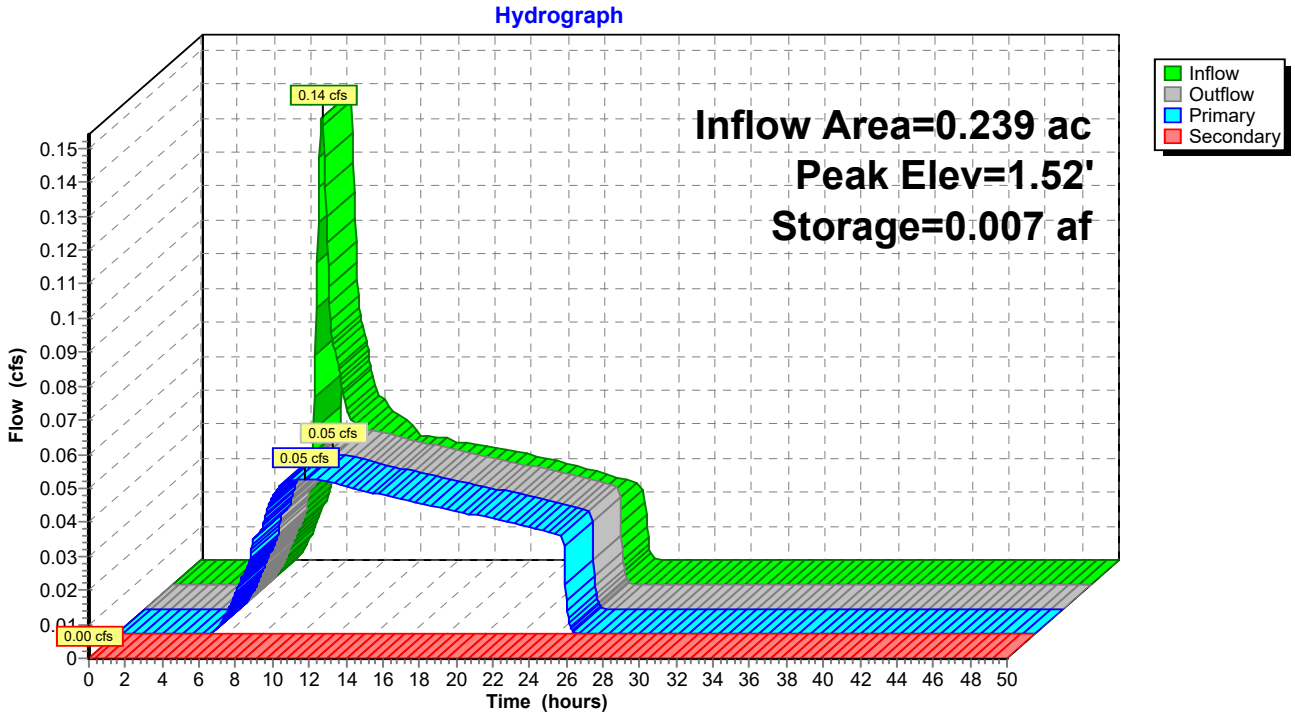
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	**5.00'W x 120.00'L x 5.00'H Bioretention** 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.05 cfs @ 10.22 hrs HW=1.52' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 5.27" for 100-year event
Inflow = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af
Outflow = 1.77 cfs @ 8.11 hrs, Volume= 0.605 af, Atten= 0%, Lag= 1.7 min
Primary = 0.09 cfs @ 8.11 hrs, Volume= 0.193 af
Secondary = 1.68 cfs @ 8.11 hrs, Volume= 0.411 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.70' @ 8.11 hrs Surf.Area= 0.028 ac Storage= 0.045 af

Plug-Flow detention time= 91.8 min calculated for 0.604 af (100% of inflow)
Center-of-Mass det. time= 92.1 min (798.9 - 706.8)

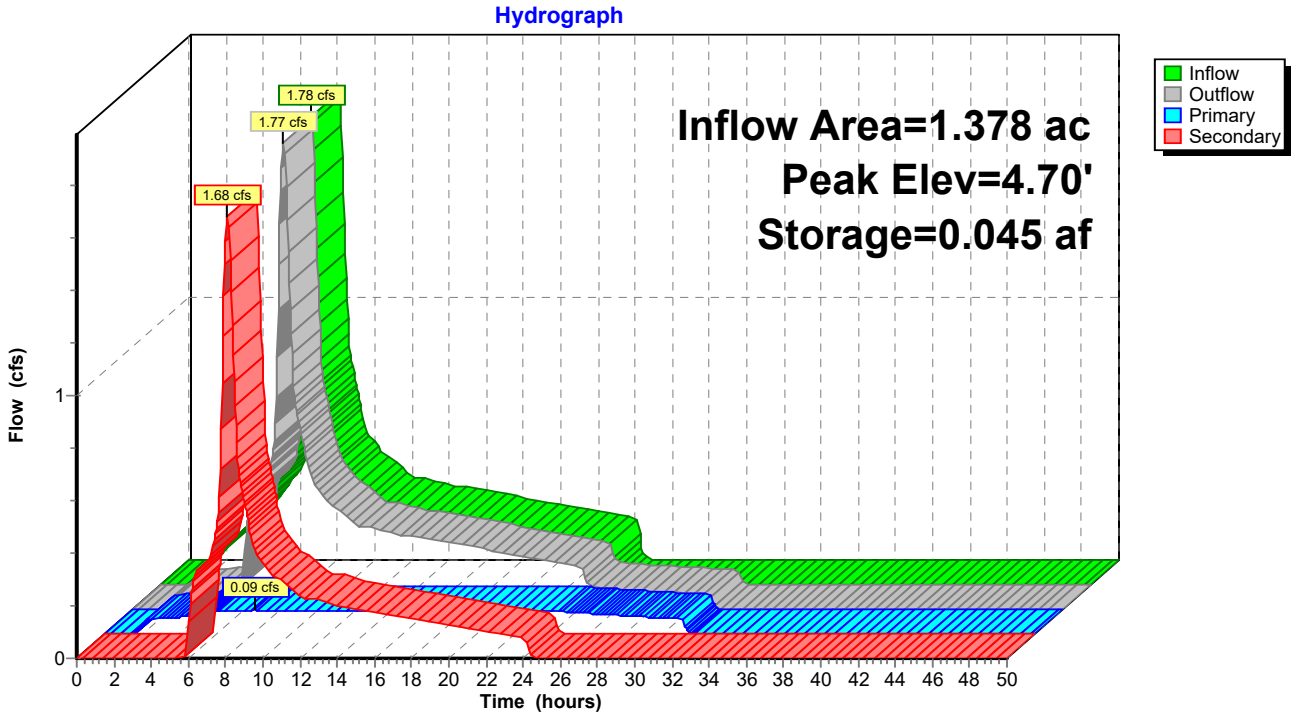
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	**20.00'W x 60.00'L x 6.00'H Infiltration Trench** 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.68 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.68 cfs @ 2.85 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth > 5.88" for 100-year event
Inflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
Outflow = 38.47 cfs @ 8.60 hrs, Volume= 22.657 af, Atten= 5%, Lag= 10.4 min
Primary = 3.58 cfs @ 8.60 hrs, Volume= 8.734 af
Secondary = 34.89 cfs @ 8.60 hrs, Volume= 13.923 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.09' @ 8.60 hrs Surf.Area= 1.674 ac Storage= 2.393 af

Plug-Flow detention time= 123.7 min calculated for 22.657 af (100% of inflow)
Center-of-Mass det. time= 123.7 min (860.1 - 736.4)

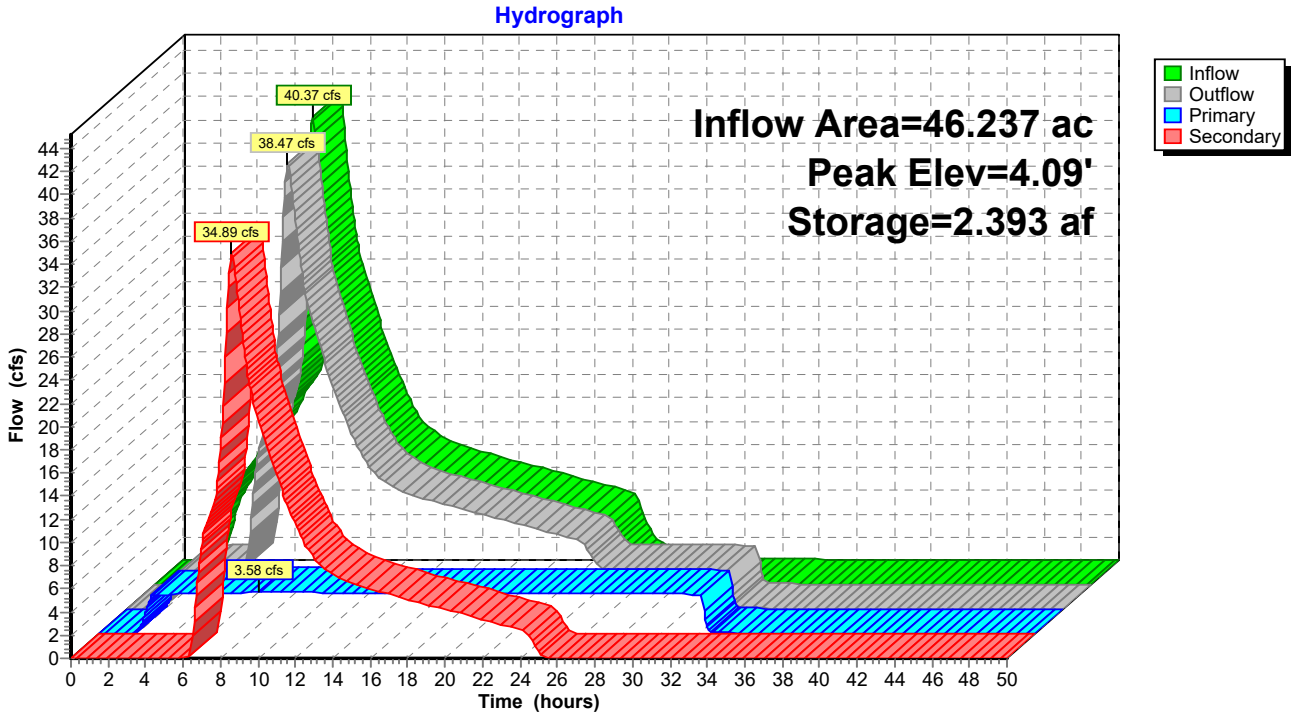
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	**270.00'W x 270.00'L x 5.00'H Infiltration Trench** 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.58 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 3.58 cfs)

Secondary OutFlow Max=34.87 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 34.87 cfs @ 3.41 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=14)
[81] Warning: Exceeded Pond 19P by 41.00' @ 1.75 hrs

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 9.31" for 100-year event
Inflow = 84.32 cfs @ 8.14 hrs, Volume= 34.599 af
Outflow = 67.56 cfs @ 8.57 hrs, Volume= 34.595 af, Atten= 20%, Lag= 25.8 min
Primary = 67.56 cfs @ 8.57 hrs, Volume= 34.595 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 43.19' @ 8.57 hrs Surf.Area= 43,834 sf Storage= 45,518 cf

Plug-Flow detention time= 2.4 min calculated for 34.561 af (100% of inflow)
Center-of-Mass det. time= 2.3 min (737.8 - 735.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

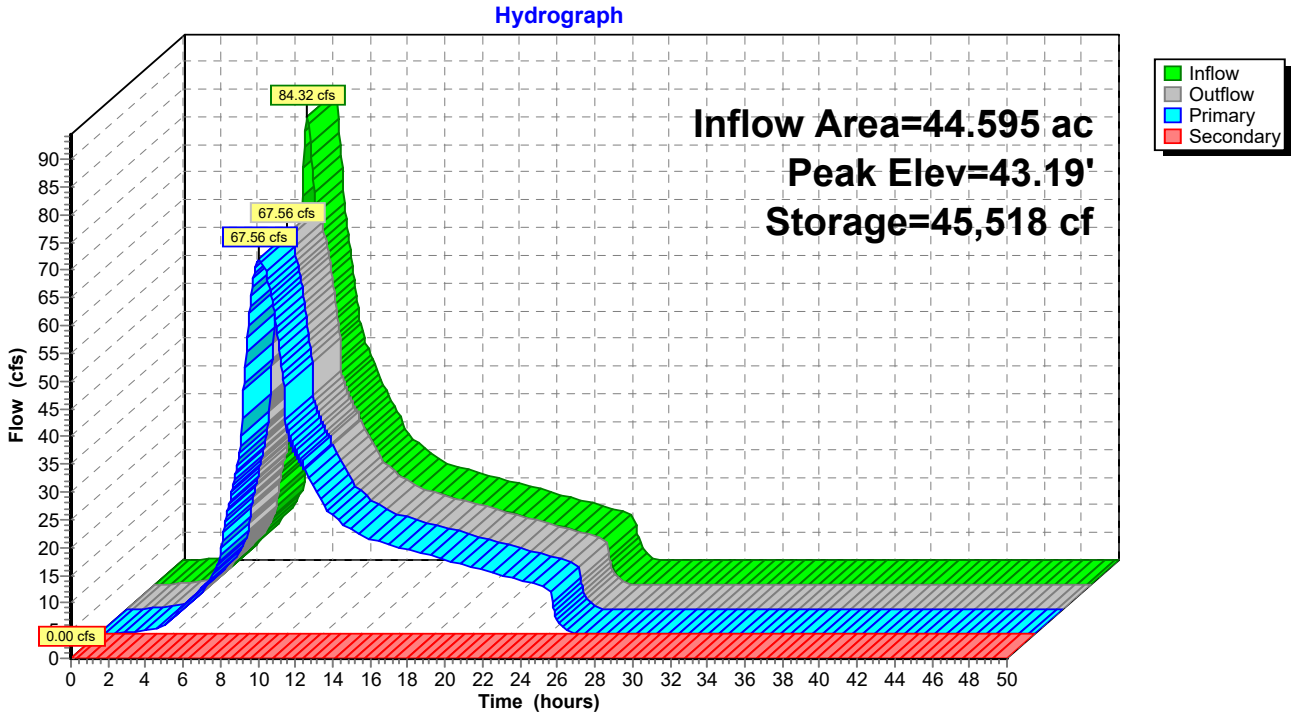
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

Device	Routing	Invert	Outlet Devices
#1	Secondary	48.00'	**30.0' long + 1.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Primary	38.00'	**42.0" Round Culvert** L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 9.62 sf

Primary OutFlow Max=67.54 cfs @ 8.57 hrs HW=43.19' TW=41.00' (Fixed TW Elev= 41.00')
└**2=Culvert** (Barrel Controls 67.54 cfs @ 7.02 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond N1: Node D



Summary for Pond N2: Node C

[57] Hint: Peaked at 46.47' (Flood elevation advised)
[81] Warning: Exceeded Pond 7P by 2.86' @ 1.75 hrs
[81] Warning: Exceeded Pond 15P by 45.90' @ 8.05 hrs
[81] Warning: Exceeded Pond 16P by 43.19' @ 1.45 hrs

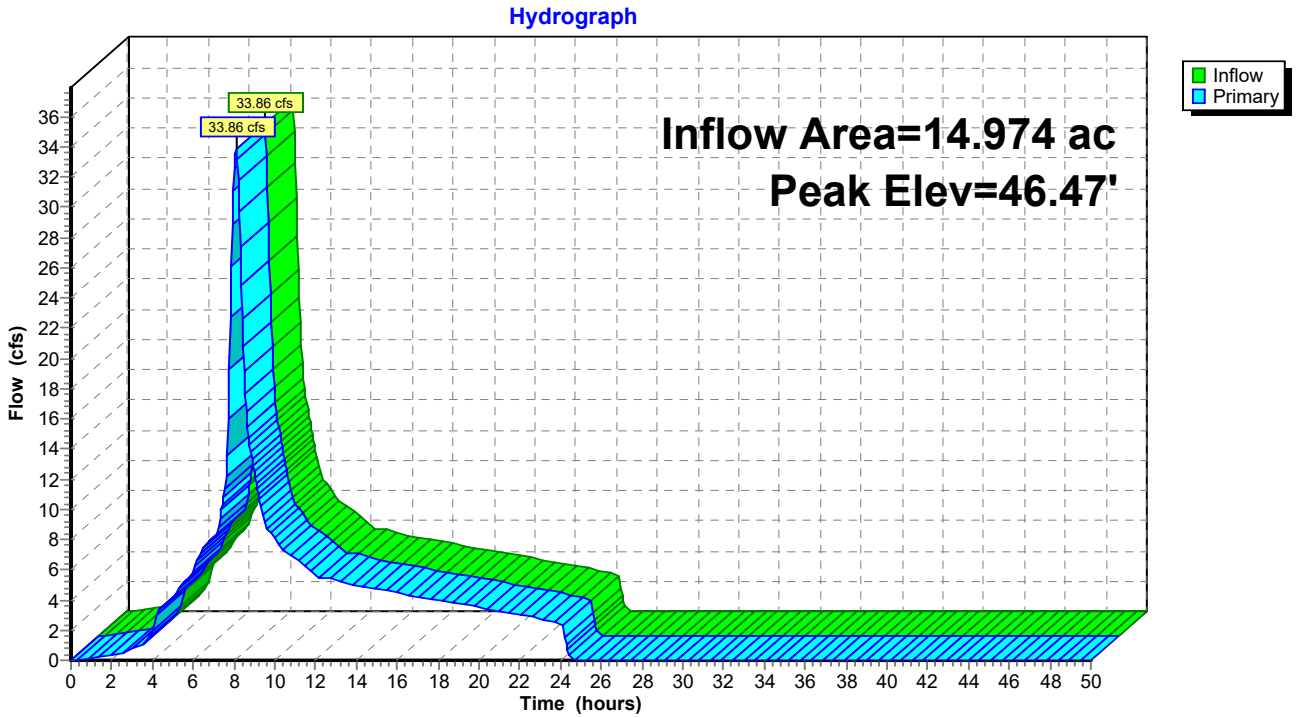
Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 8.32" for 100-year event
Inflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
Outflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af, Atten= 0%, Lag= 0.0 min
Primary = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 46.47' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	**30.0" Round Culvert** L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf
#2	Primary	48.80'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=33.80 cfs @ 8.09 hrs HW=46.46' TW=43.19' (Fixed TW Elev= 43.19')
1=Culvert (Outlet Controls 33.80 cfs @ 6.88 fps)
2=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

Pond N2: Node C



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.56' (Flood elevation advised)
[81] Warning: Exceeded Pond 4P by 49.68' @ 31.55 hrs
[81] Warning: Exceeded Pond 5P by 49.68' @ 35.95 hrs

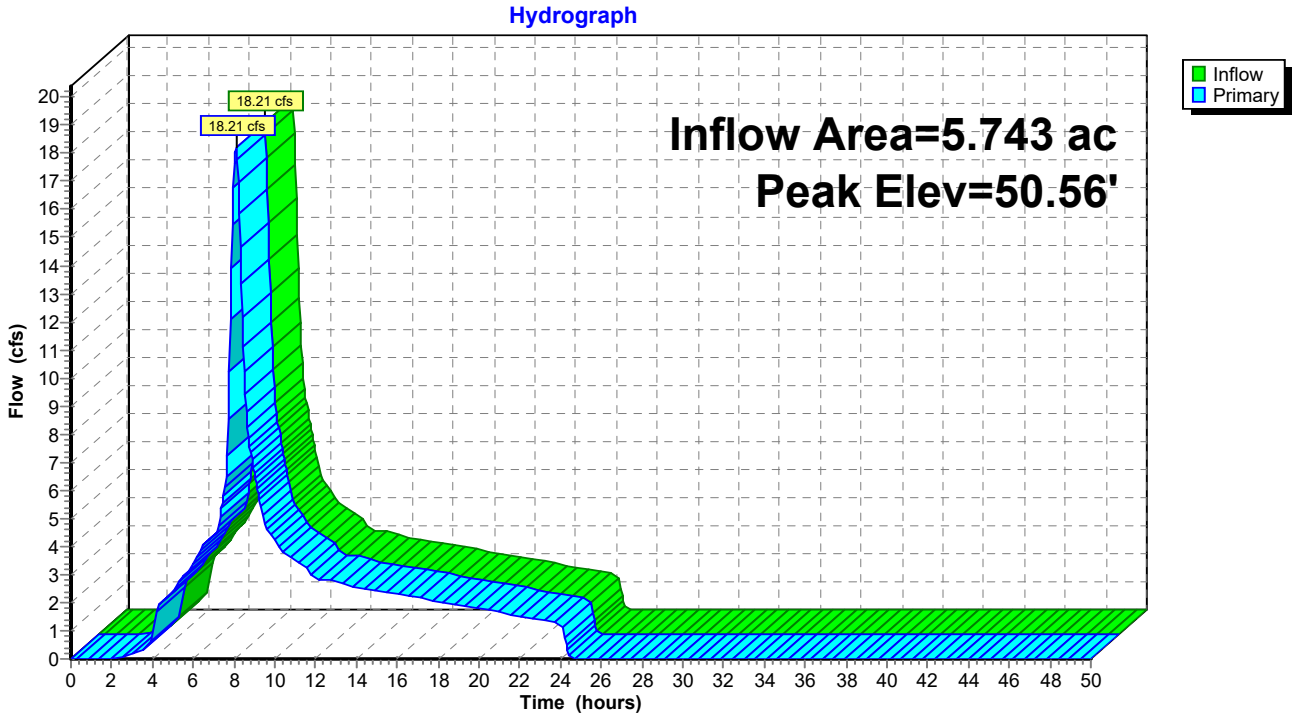
Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 11.34" for 100-year event
Inflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
Outflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af, Atten= 0%, Lag= 0.0 min
Primary = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
Routed to Pond 7P : Node B

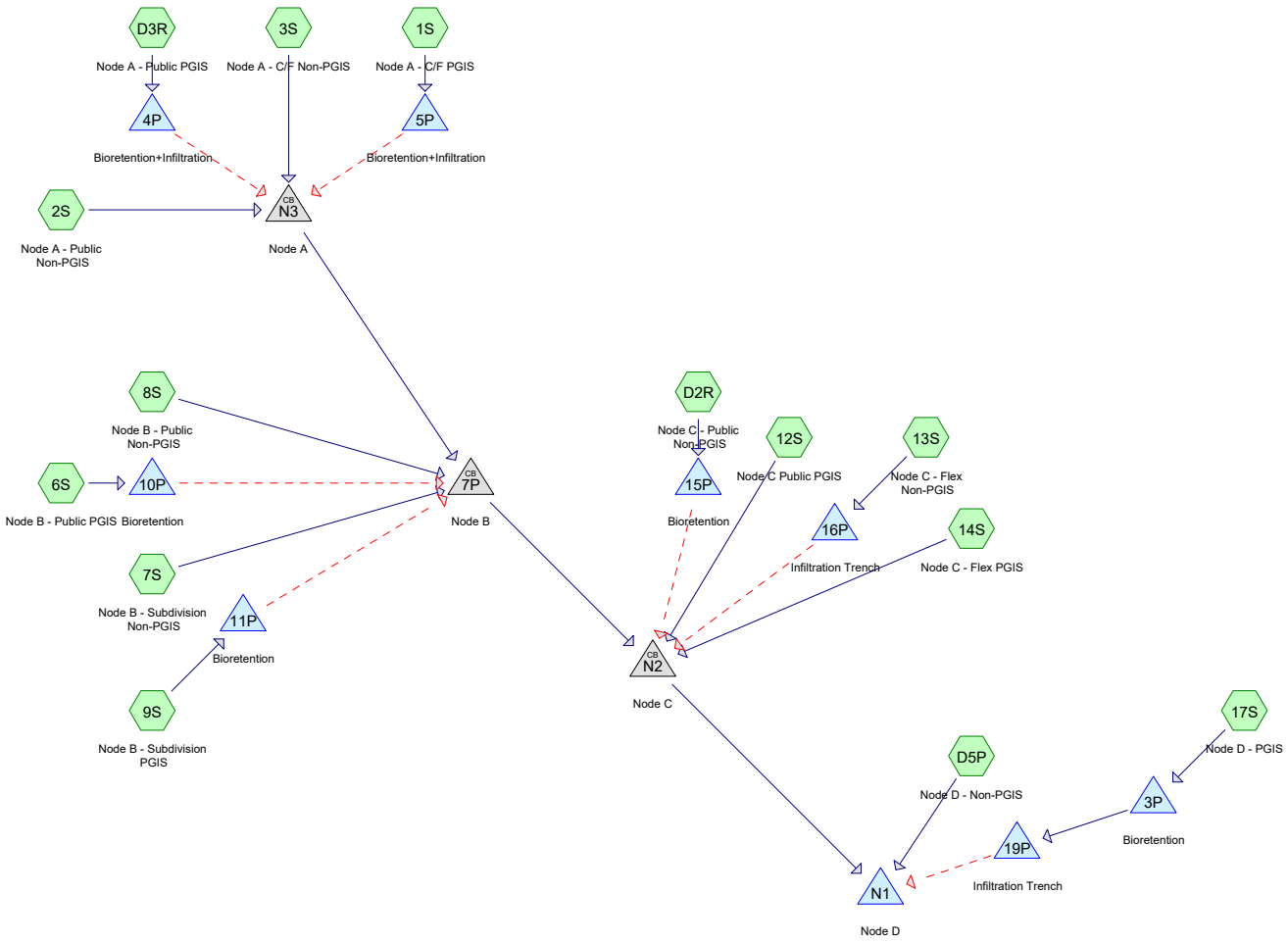
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 50.56' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	**24.0" Round Culvert** L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	50.40'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=17.89 cfs @ 8.09 hrs HW=50.56' TW=49.68' (Fixed TW Elev= 49.68')
1=Culvert (Outlet Controls 10.45 cfs @ 3.33 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 7.44 cfs @ 1.30 fps)

Pond N3: Node A





Subcat Reach Pond Link

Routing Diagram for ALTERNATE _Onsite 25-Year Storm - Moderate Flood Stage

Prepared by MacKay & Sposito, Inc, Printed 3/10/2025

HydroCAD® 10.20-5c s/n 01662 © 2023 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	**38.896**	**0.000**	**0.000**	**0.000**	**104.075**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=8.64 cfs 3.046 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.29"
Tc=20.0 min CN=59 Runoff=0.20 cfs 0.125 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=3.76"
Tc=20.0 min CN=88 Runoff=4.22 cfs 1.438 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=0.29 cfs 0.101 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=3.46"
Tc=20.0 min CN=85 Runoff=5.62 cfs 1.945 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=2.89"
Tc=20.0 min CN=79 Runoff=0.06 cfs 0.022 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=2.50 cfs 0.882 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=0.82 cfs 0.288 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=4.19"
Tc=20.0 min CN=92 Runoff=1.42 cfs 0.481 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=1.94 cfs 0.683 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=53.15 cfs 18.738 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=1.95"
Tc=20.0 min CN=68 Runoff=0.09 cfs 0.039 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=1.94 cfs 0.682 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=3.17"
Tc=20.0 min CN=82 Runoff=22.11 cfs 7.822 af

Pond 3P: Bioretention Peak Elev=54.62' Storage=2.845 af Inflow=53.15 cfs 18.738 af
Outflow=28.78 cfs 18.424 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.73' Storage=0.037 af Inflow=1.94 cfs 0.682 af
Primary=0.15 cfs 0.277 af Secondary=1.78 cfs 0.406 af Outflow=1.93 cfs 0.682 af

Pond 5P: Bioretention+Infiltration Peak Elev=4.97' Storage=0.240 af Inflow=8.64 cfs 3.046 af
Primary=0.36 cfs 0.882 af Secondary=8.26 cfs 2.164 af Outflow=8.62 cfs 3.046 af

Pond 7P: Node B Peak Elev=49.73' Inflow=22.70 cfs 6.681 af
Outflow=22.70 cfs 6.681 af

Pond 10P: Bioretention Peak Elev=3.25' Storage=0.005 af Inflow=0.29 cfs 0.101 af
Primary=0.02 cfs 0.045 af Secondary=0.26 cfs 0.056 af Outflow=0.29 cfs 0.101 af

Pond 11P: Bioretention Peak Elev=4.87' Storage=0.053 af Inflow=2.50 cfs 0.882 af
Primary=0.19 cfs 0.356 af Secondary=2.30 cfs 0.526 af Outflow=2.48 cfs 0.882 af

Pond 15P: Bioretention Peak Elev=0.73' Storage=0.004 af Inflow=0.09 cfs 0.039 af
Primary=0.04 cfs 0.039 af Secondary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.039 af

Pond 16P: Infiltration Trench Peak Elev=4.61' Storage=0.044 af Inflow=1.42 cfs 0.481 af
Primary=0.09 cfs 0.189 af Secondary=1.32 cfs 0.292 af Outflow=1.41 cfs 0.481 af

Pond 19P: Infiltration Trench Peak Elev=3.86' Storage=2.259 af Inflow=28.78 cfs 18.424 af
Primary=3.57 cfs 8.564 af Secondary=24.41 cfs 9.860 af Outflow=27.97 cfs 18.424 af

Pond N1: Node D Peak Elev=47.56' Storage=331,489 cf Inflow=65.60 cfs 25.625 af
Primary=33.98 cfs 19.092 af Secondary=0.00 cfs 0.000 af Outflow=33.98 cfs 19.092 af

Pond N2: Node C Peak Elev=48.92' Inflow=26.76 cfs 7.943 af
Outflow=26.76 cfs 7.943 af

Pond N3: Node A Peak Elev=50.51' Inflow=14.45 cfs 4.132 af
Outflow=14.45 cfs 4.132 af

Total Runoff Area = 104.075 ac Runoff Volume = 36.290 af Average Runoff Depth = 4.18"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

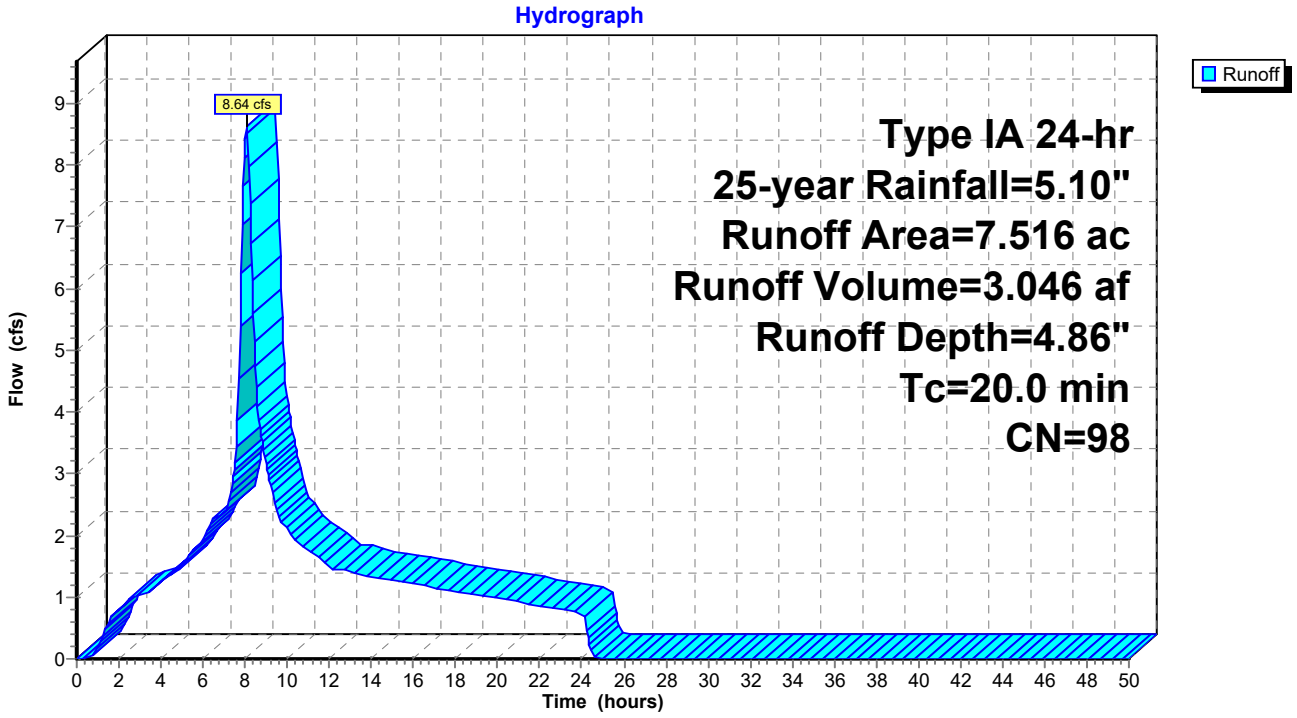
Runoff = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af, Depth= 4.86"
Routed to Pond 5P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 1S: Node A - C/F PGIS



Summary for Subcatchment 2S: Node A - Public Non-PGIS

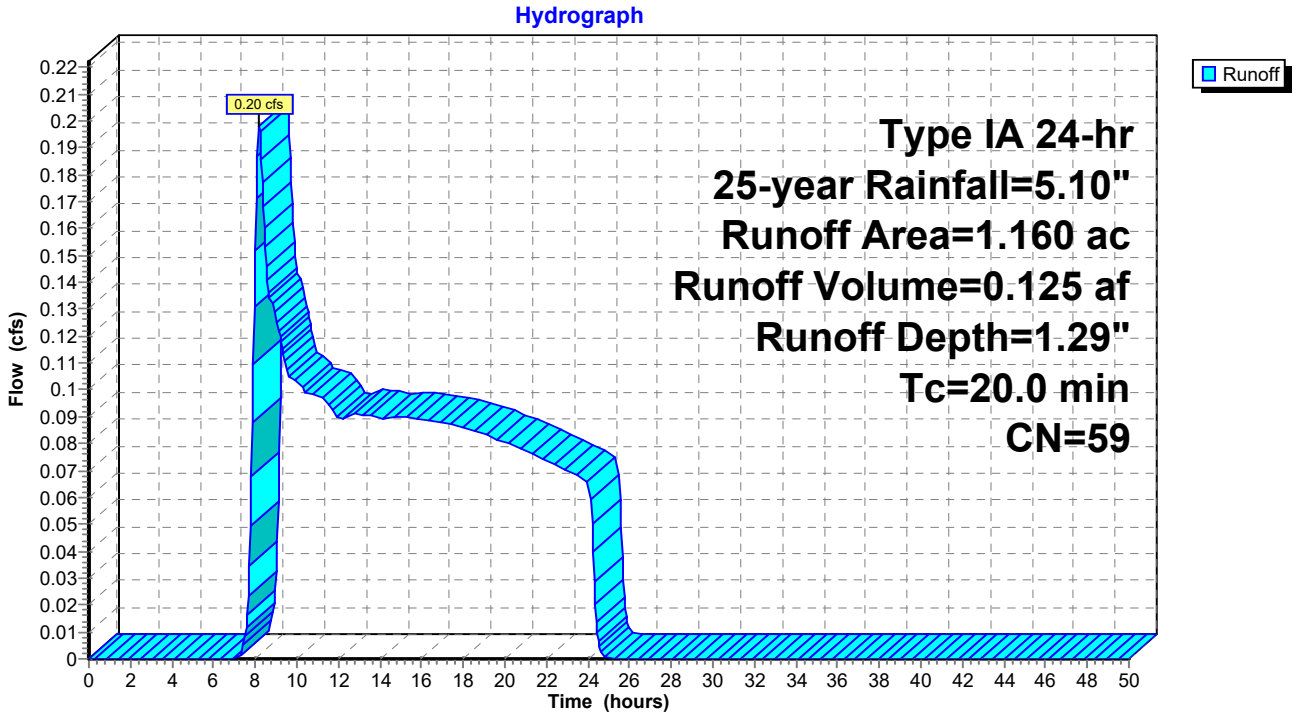
Runoff = 0.20 cfs @ 8.19 hrs, Volume= 0.125 af, Depth= 1.29"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

	Area (ac)	CN	Description
*	1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
	1.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 2S: Node A - Public Non-PGIS



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

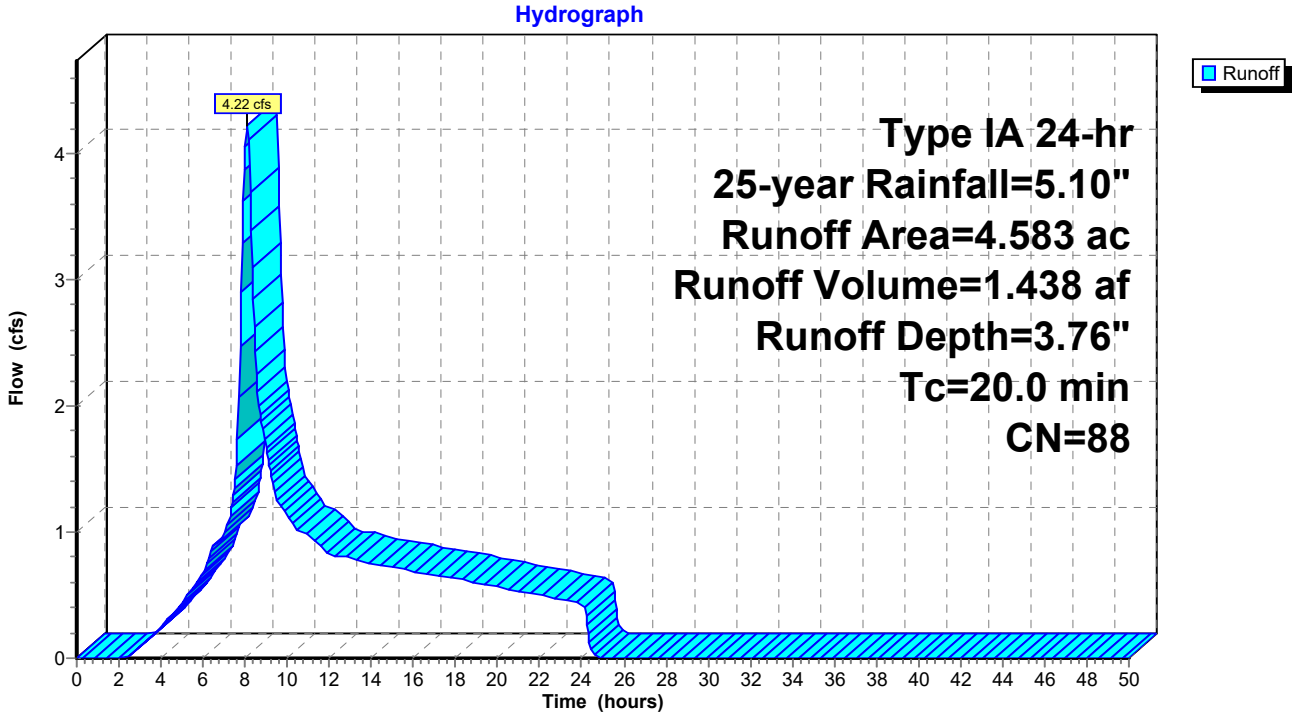
Runoff = 4.22 cfs @ 8.09 hrs, Volume= 1.438 af, Depth= 3.76"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

	Area (ac)	CN	Description
*	1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
	3.373	98	Roofs, HSG A
	4.583	88	Weighted Average
	1.210		26.40% Pervious Area
	3.373		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 3S: Node A - C/F Non-PGIS



Summary for Subcatchment 6S: Node B - Public PGIS

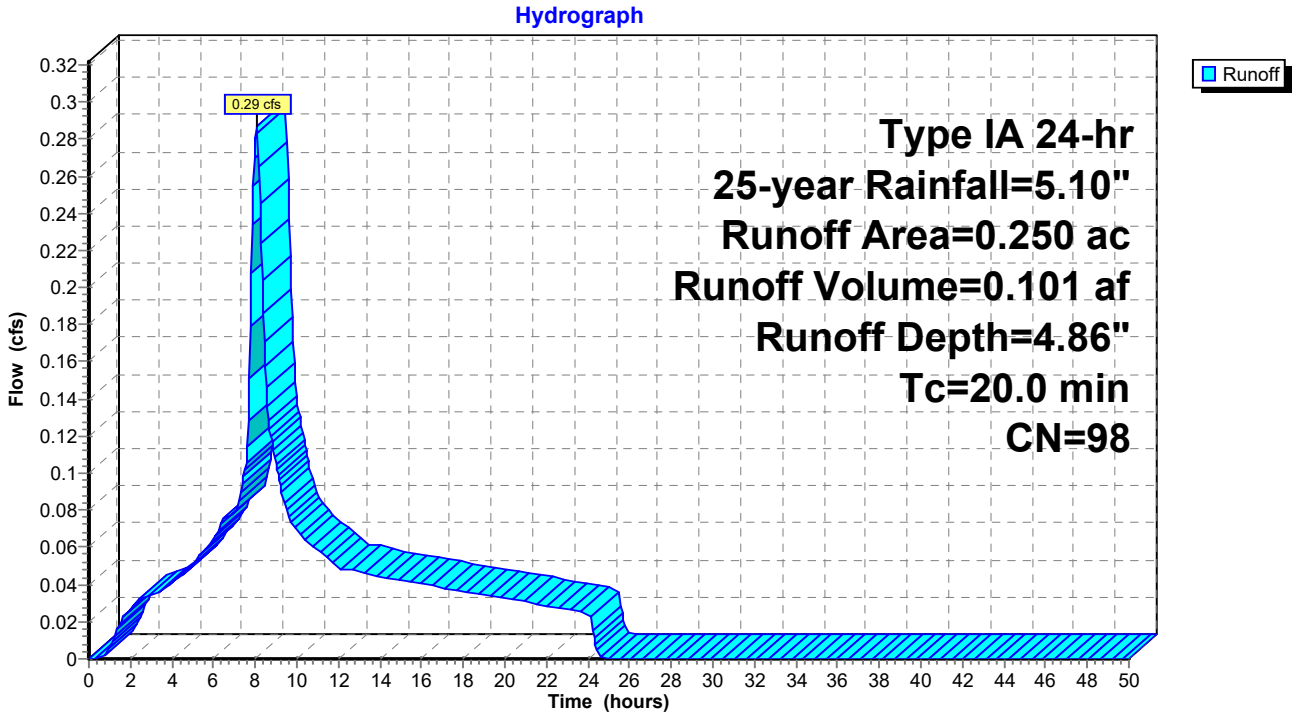
Runoff = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af, Depth= 4.86"
Routed to Pond 10P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 6S: Node B - Public PGIS



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

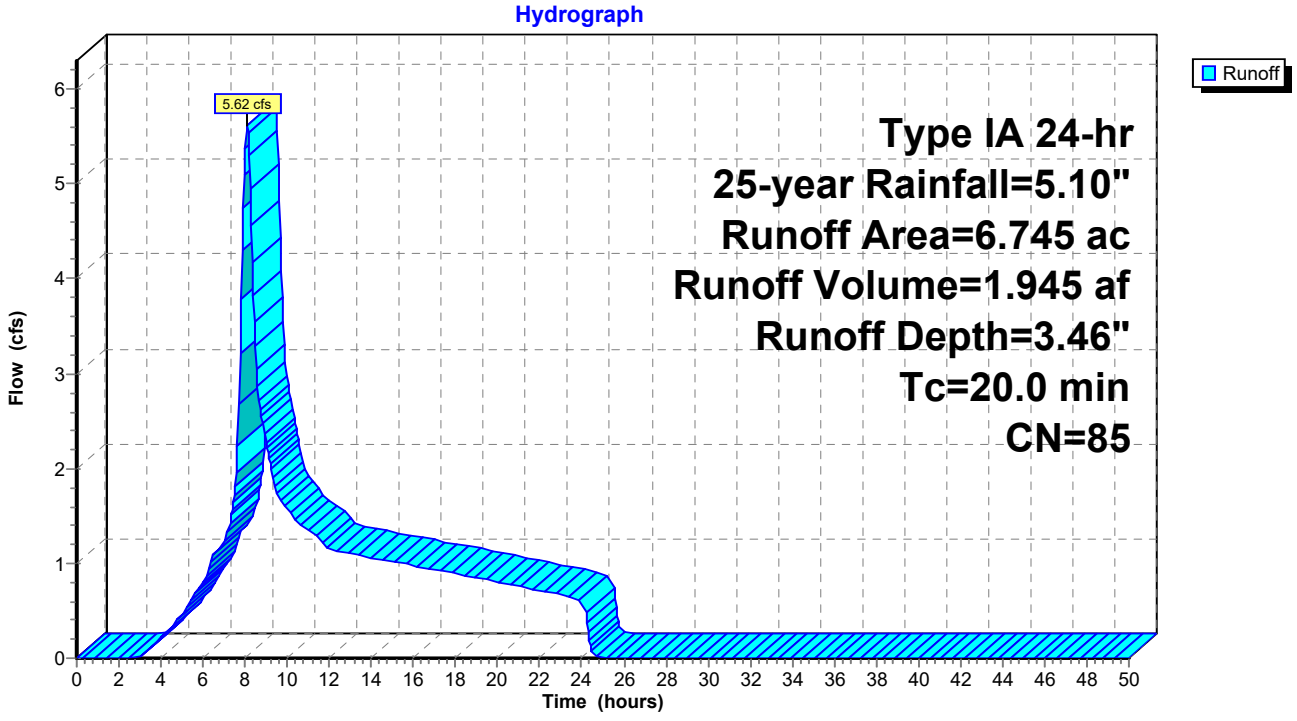
Runoff = 5.62 cfs @ 8.10 hrs, Volume= 1.945 af, Depth= 3.46"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 7S: Node B - Subdivision Non-PGIS



Summary for Subcatchment 8S: Node B - Public Non-PGIS

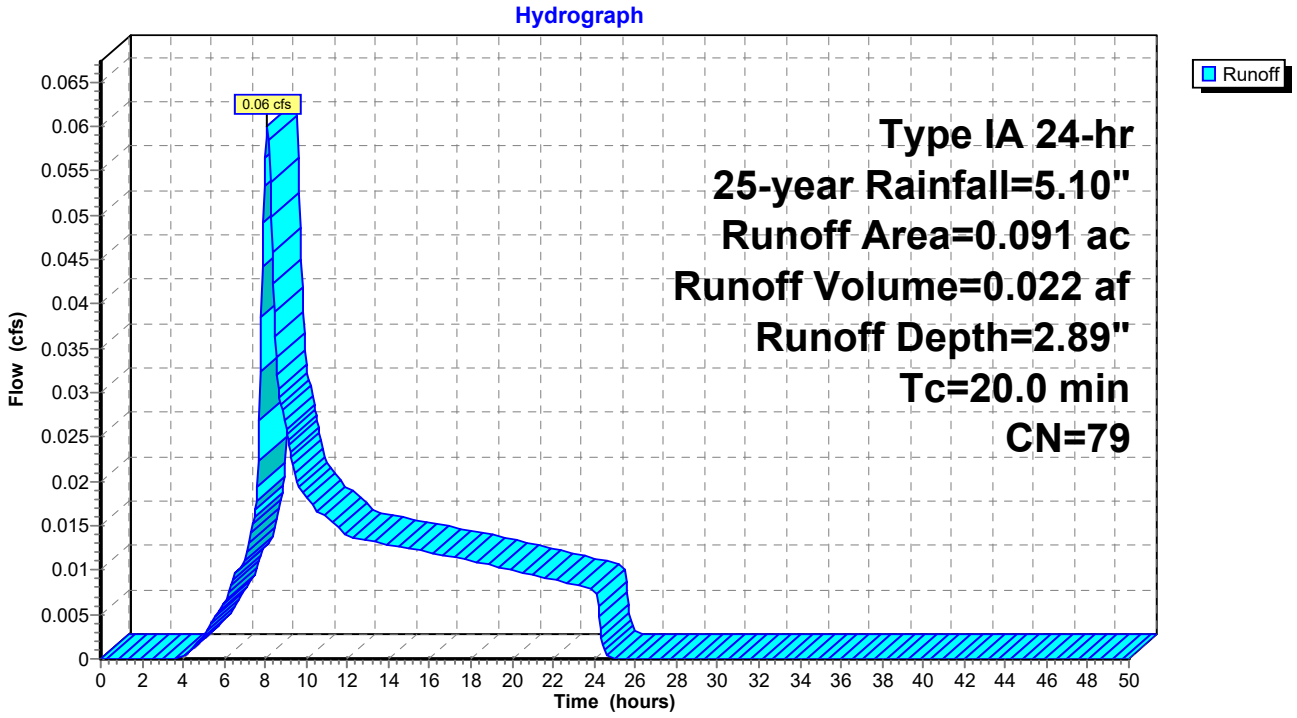
Runoff = 0.06 cfs @ 8.11 hrs, Volume= 0.022 af, Depth= 2.89"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 8S: Node B - Public Non-PGIS



Summary for Subcatchment 9S: Node B - Subdivision PGIS

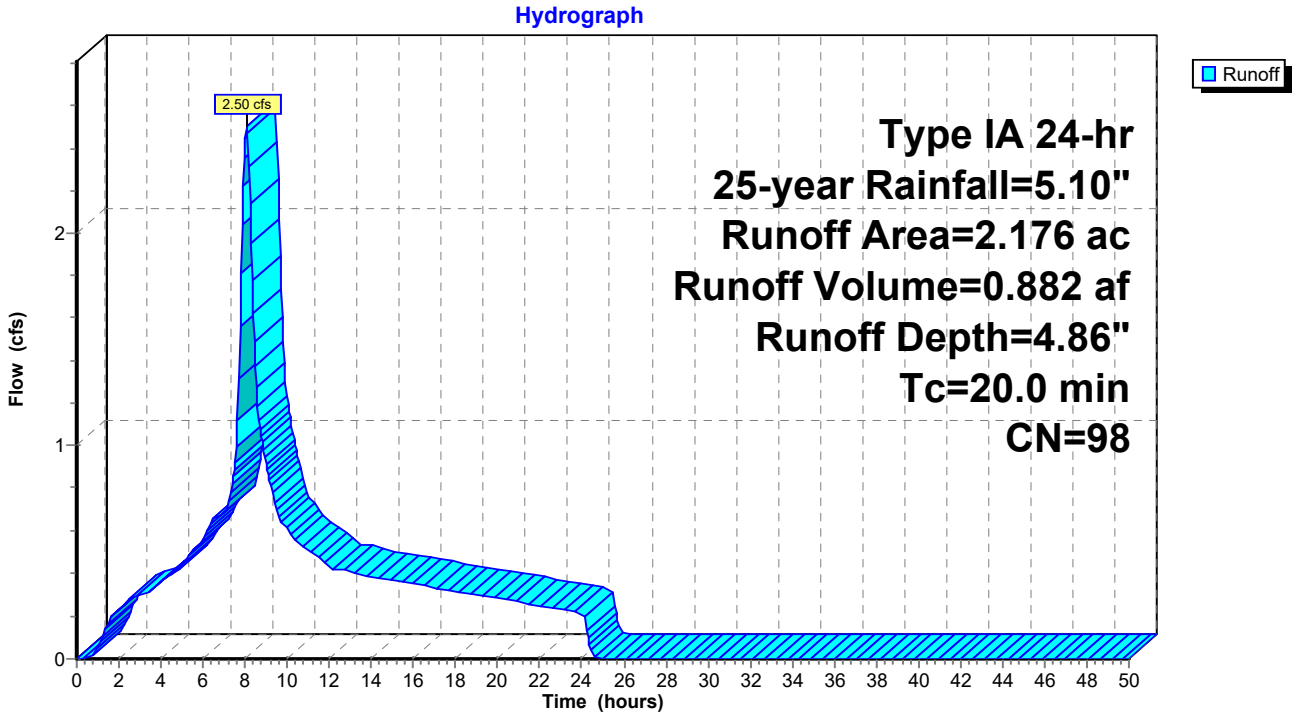
Runoff = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af, Depth= 4.86"
Routed to Pond 11P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 9S: Node B - Subdivision PGIS



Summary for Subcatchment 12S: Node C Public PGIS

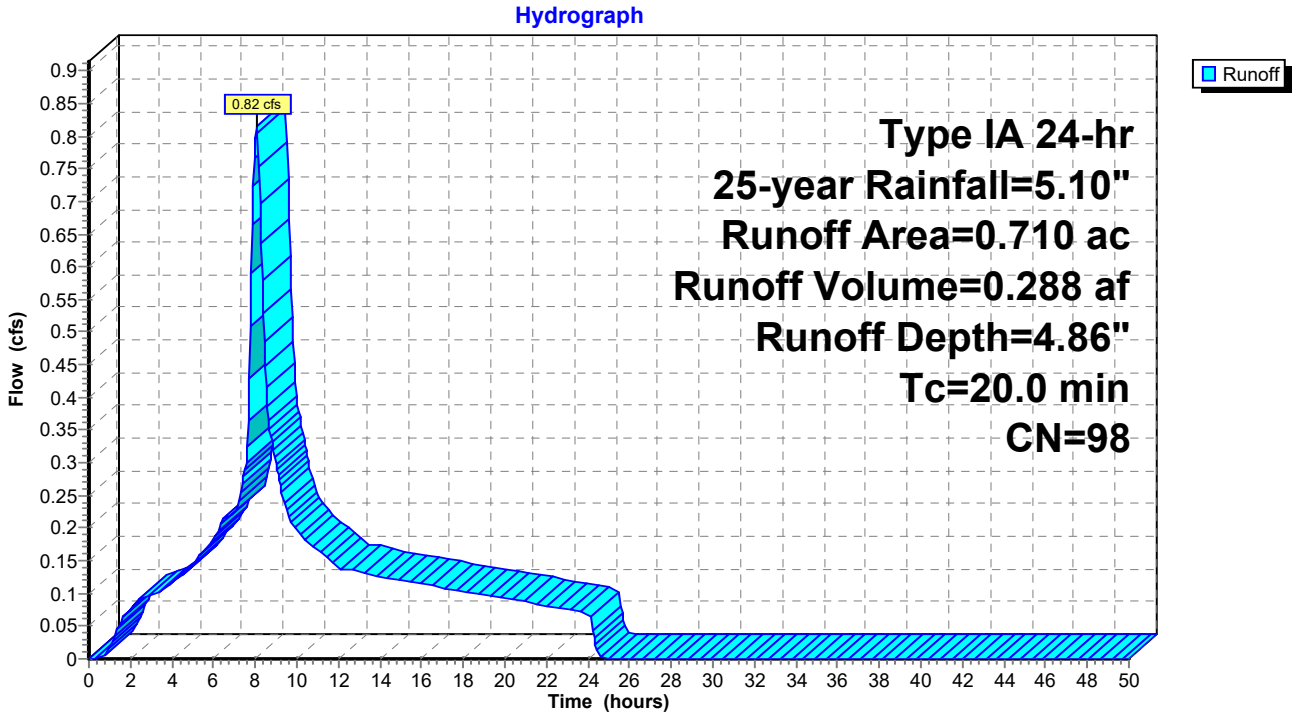
Runoff = 0.82 cfs @ 8.08 hrs, Volume= 0.288 af, Depth= 4.86"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 12S: Node C Public PGIS



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

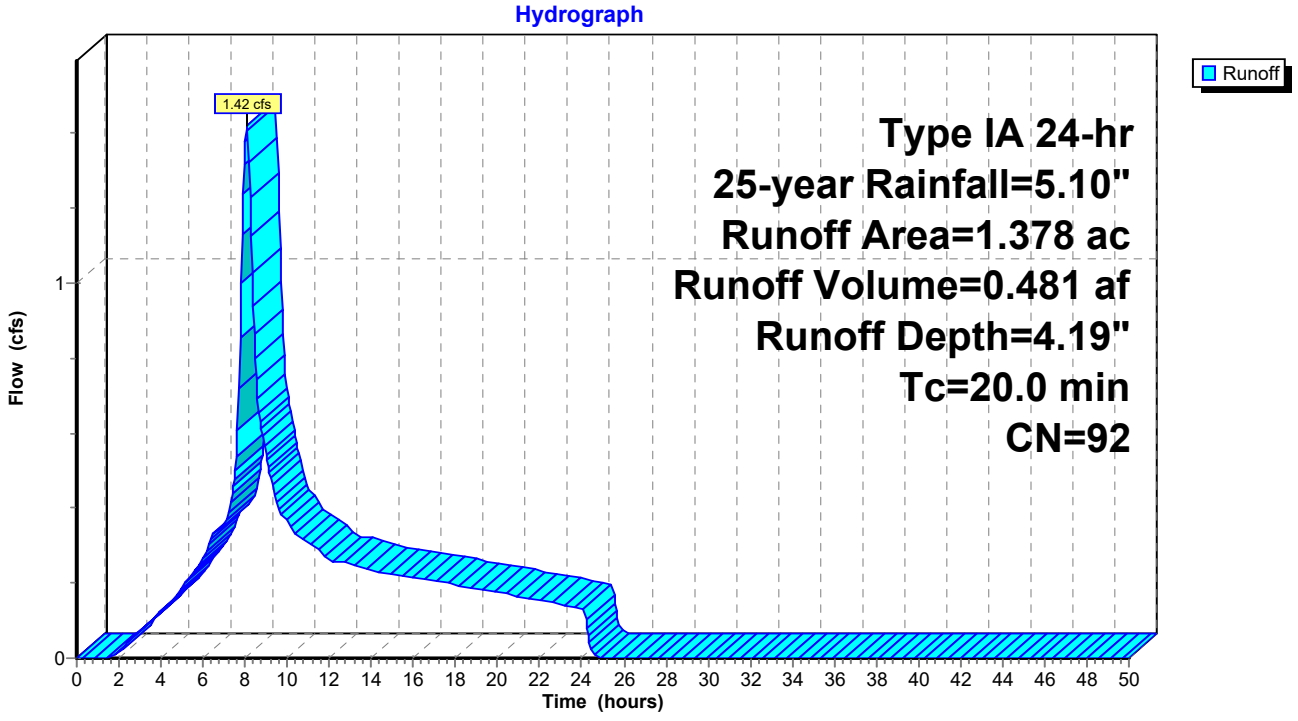
Runoff = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af, Depth= 4.19"
Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

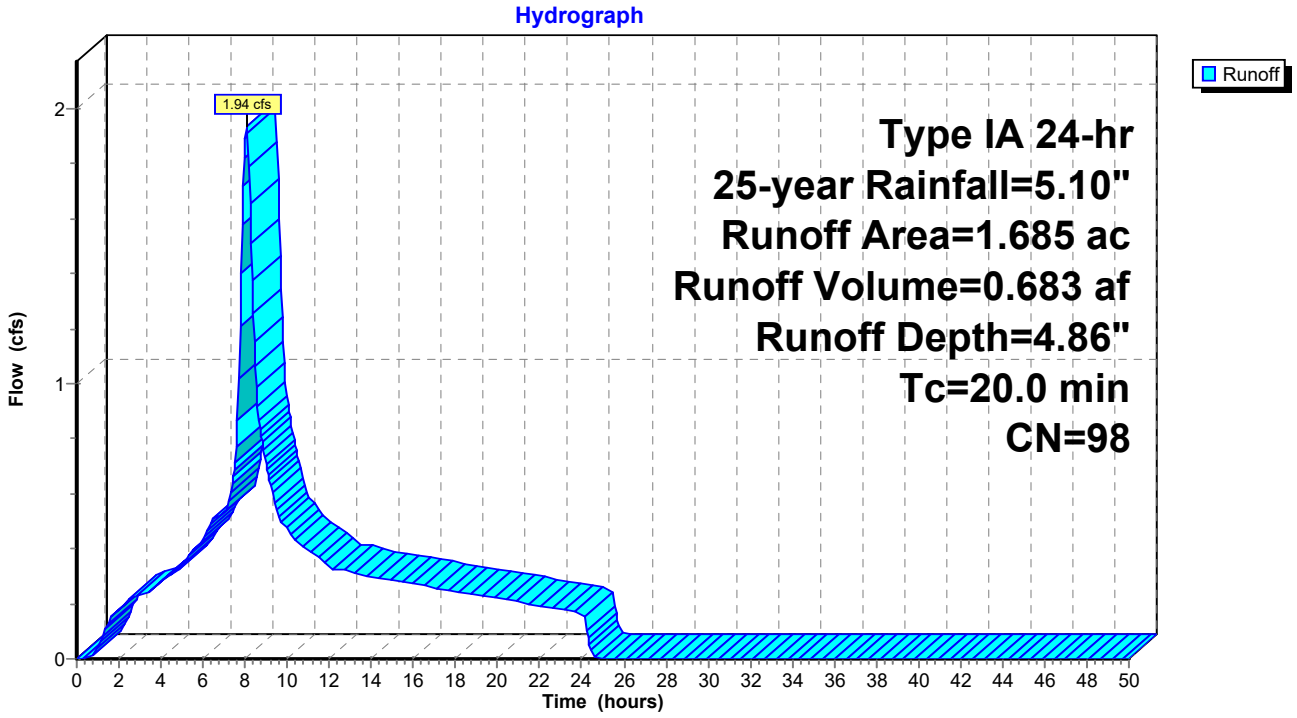
Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.683 af, Depth= 4.86"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 14S: Node C - Flex PGIS



Summary for Subcatchment 17S: Node D - PGIS

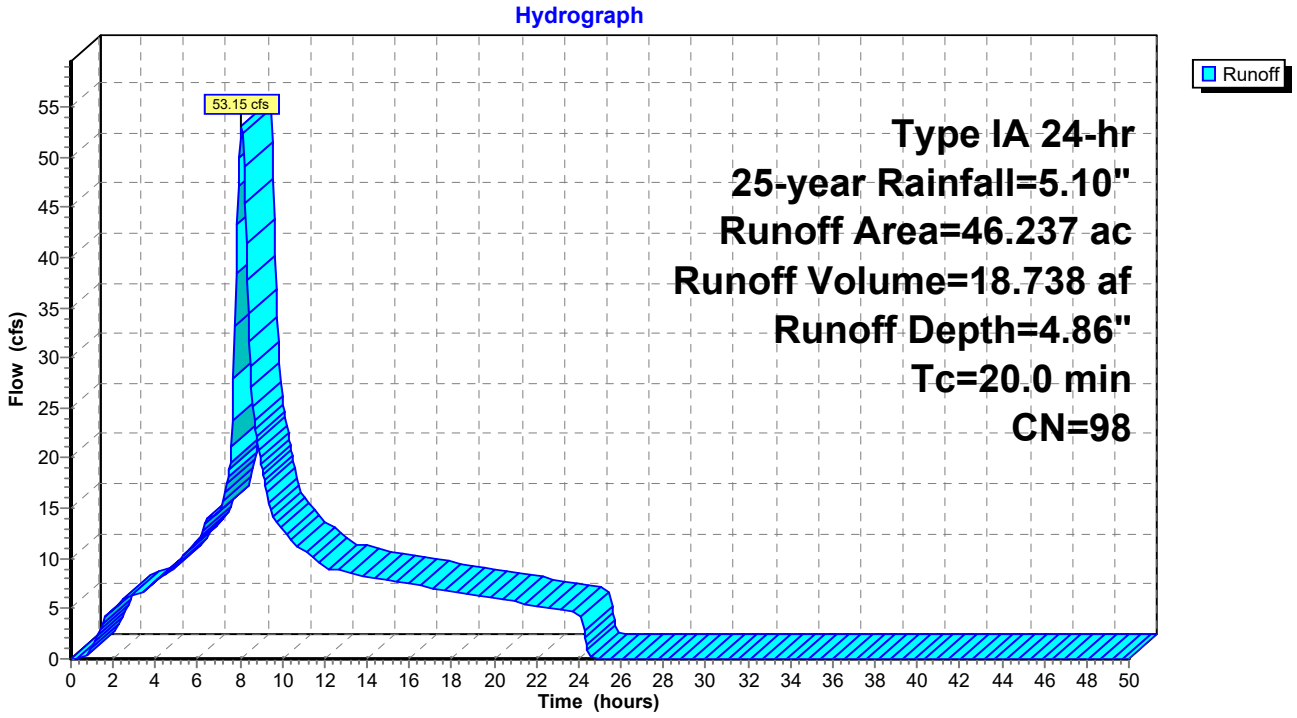
Runoff = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af, Depth= 4.86"
Routed to Pond 3P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 17S: Node D - PGIS



Summary for Subcatchment D2R: Node C - Public Non-PGIS

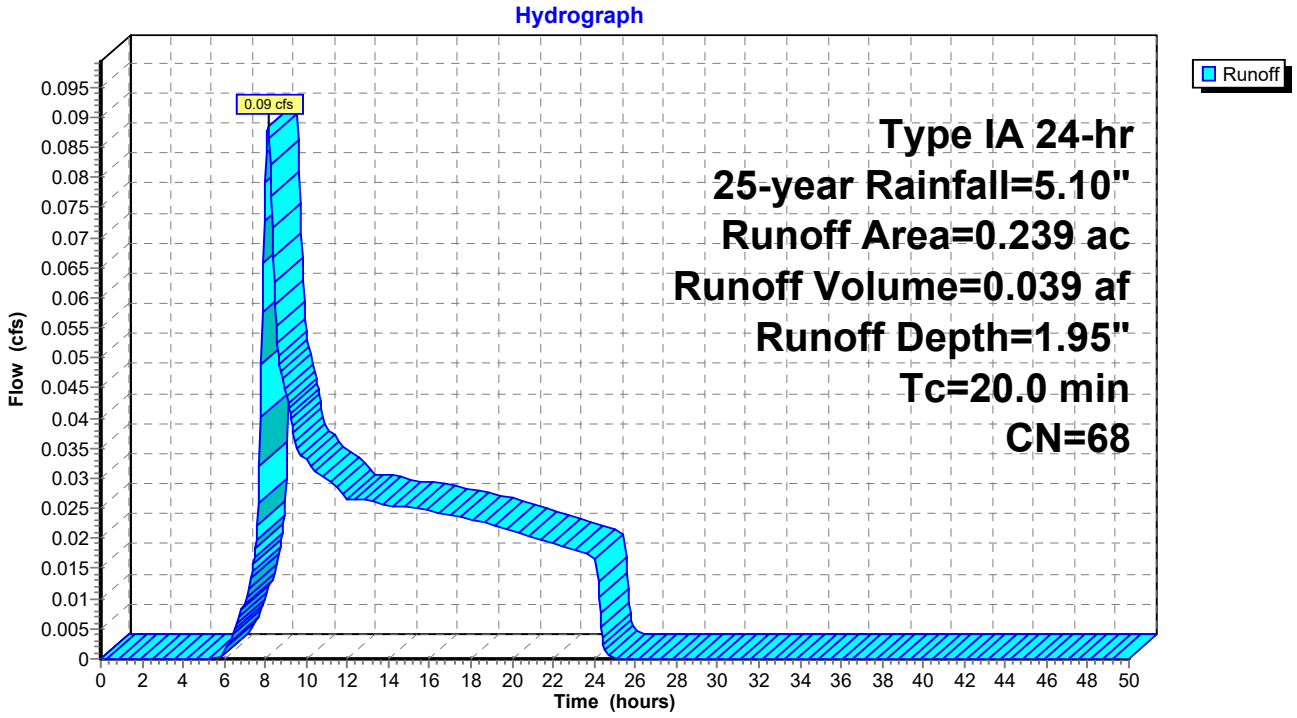
Runoff = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af, Depth= 1.95"
Routed to Pond 15P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D2R: Node C - Public Non-PGIS



Summary for Subcatchment D3R: Node A - Public PGIS

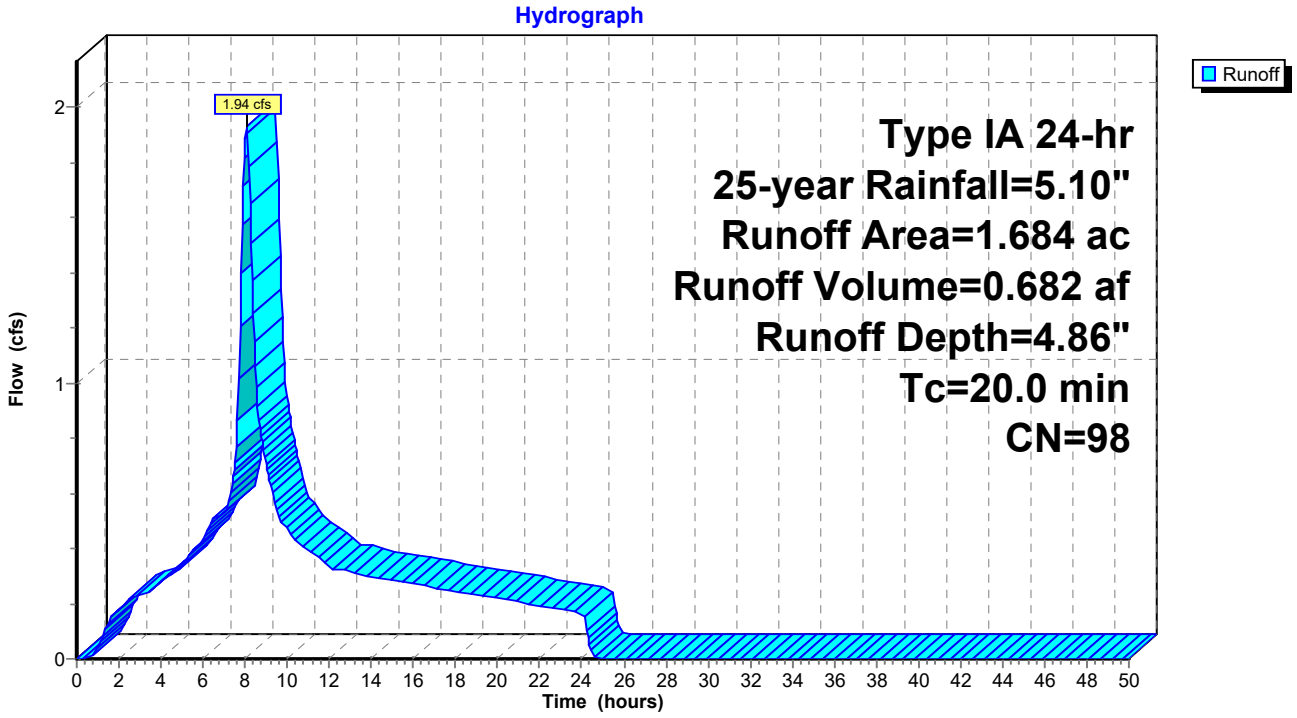
Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af, Depth= 4.86"
Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

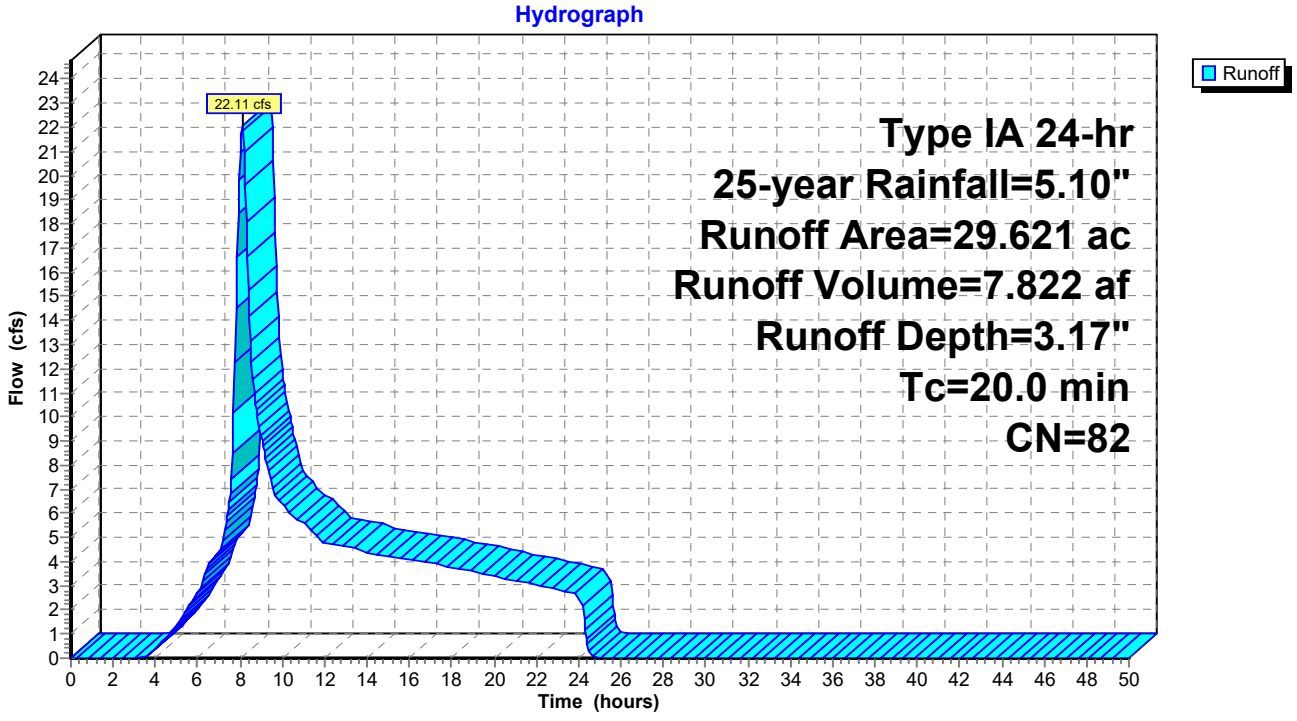
Runoff = 22.11 cfs @ 8.11 hrs, Volume= 7.822 af, Depth= 3.17"
Routed to Pond N1 : Node D

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D5P: Node D - Non-PGIS



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af
Outflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af, Atten= 46%, Lag= 25.9 min
Primary = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 54.62' @ 8.51 hrs Surf.Area= 1.674 ac Storage= 2.845 af

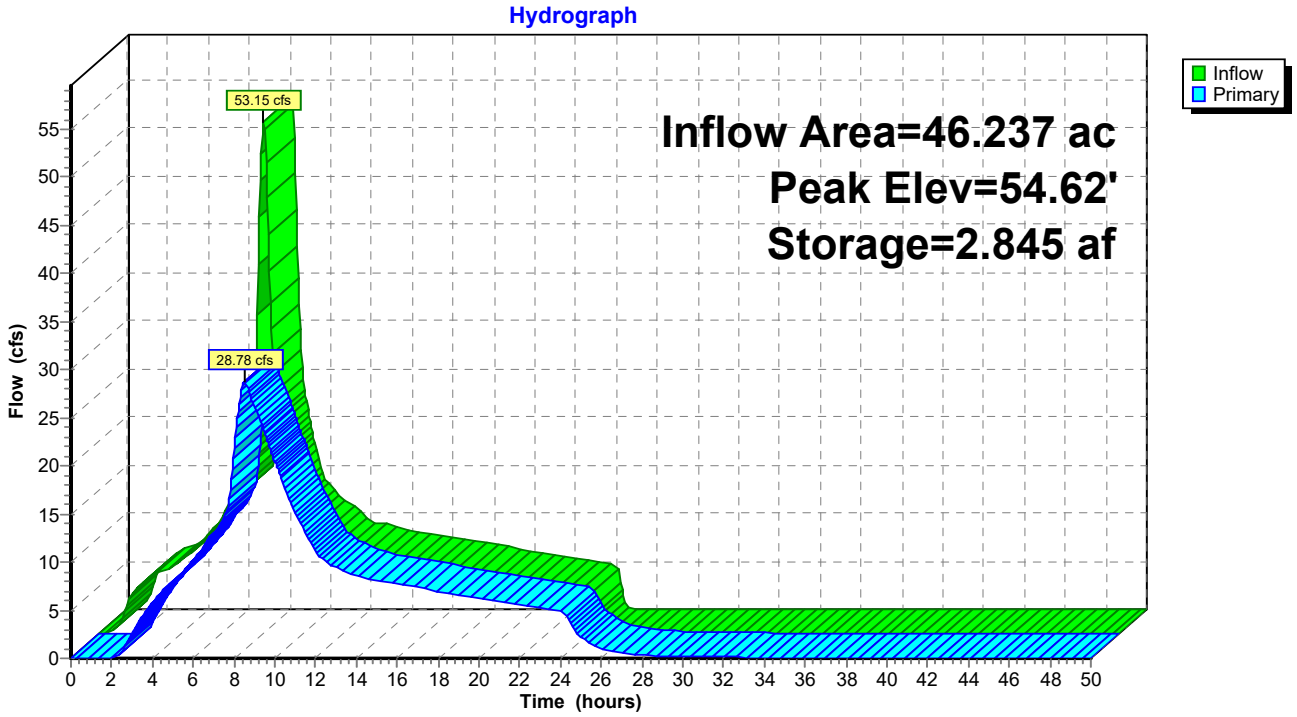
Plug-Flow detention time= 90.8 min calculated for 18.424 af (98% of inflow)
Center-of-Mass det. time= 77.7 min (745.3 - 667.6)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	**270.00'W x 270.00'L x 6.50'H Prismatoid** 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	**270.00'W x 270.00'L x 2.00'H Prismatoid** Inside #1
#3	50.50'	0.019 af	**24.0" Round Pipe Storage** Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	**60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=28.76 cfs @ 8.51 hrs HW=54.62' (Free Discharge)
1=Orifice/Grate (Weir Controls 2.05 cfs @ 1.12 fps)
2=Orifice/Grate (Orifice Controls 26.71 cfs @ 8.50 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af
Outflow = 1.93 cfs @ 8.11 hrs, Volume= 0.682 af, Atten= 0%, Lag= 1.7 min
Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.277 af
Secondary = 1.78 cfs @ 8.11 hrs, Volume= 0.406 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.73' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.037 af

Plug-Flow detention time= 65.8 min calculated for 0.682 af (100% of inflow)
Center-of-Mass det. time= 65.7 min (733.3 - 667.6)

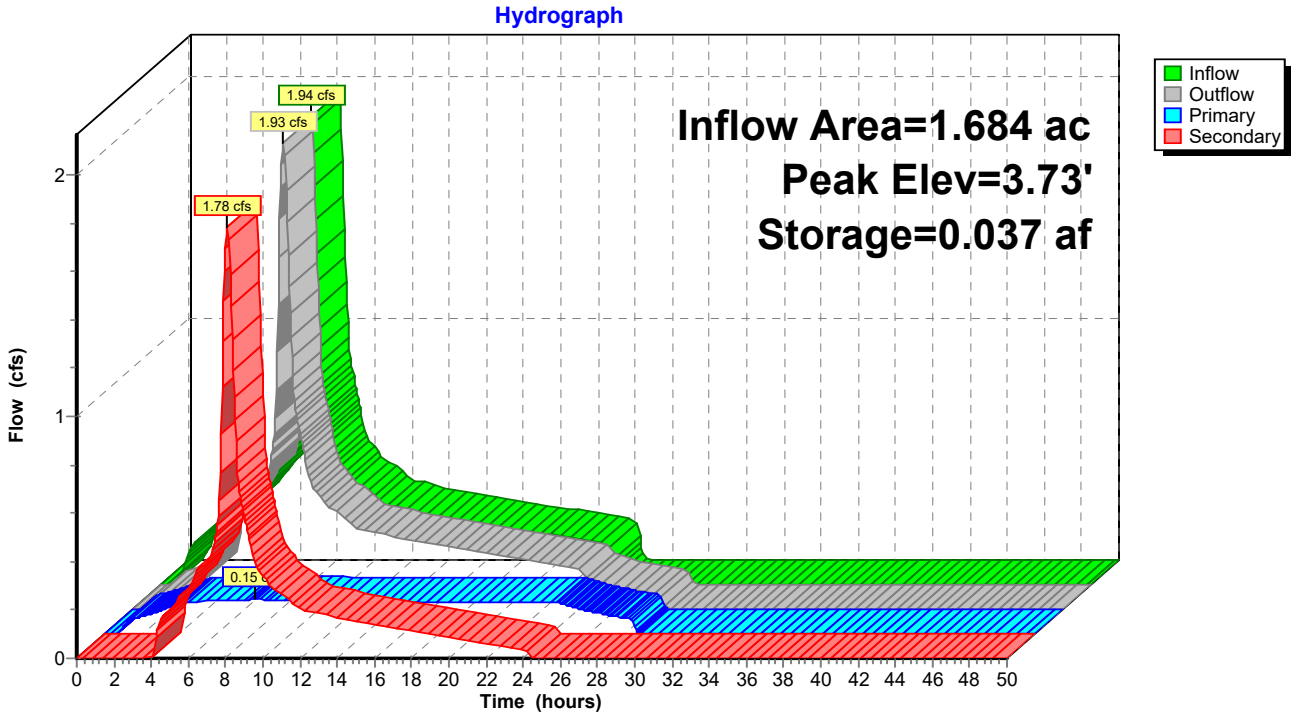
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	**5.00'W x 250.00'L x 5.00'H Bioretention** 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=1.78 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.78 cfs @ 2.90 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

Inflow Area = 7.516 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af
Outflow = 8.62 cfs @ 8.10 hrs, Volume= 3.046 af, Atten= 0%, Lag= 1.2 min
Primary = 0.36 cfs @ 8.10 hrs, Volume= 0.882 af
Secondary = 8.26 cfs @ 8.10 hrs, Volume= 2.164 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.97' @ 8.10 hrs Surf.Area= 0.138 ac Storage= 0.240 af

Plug-Flow detention time= 109.9 min calculated for 3.046 af (100% of inflow)
Center-of-Mass det. time= 109.8 min (777.4 - 667.6)

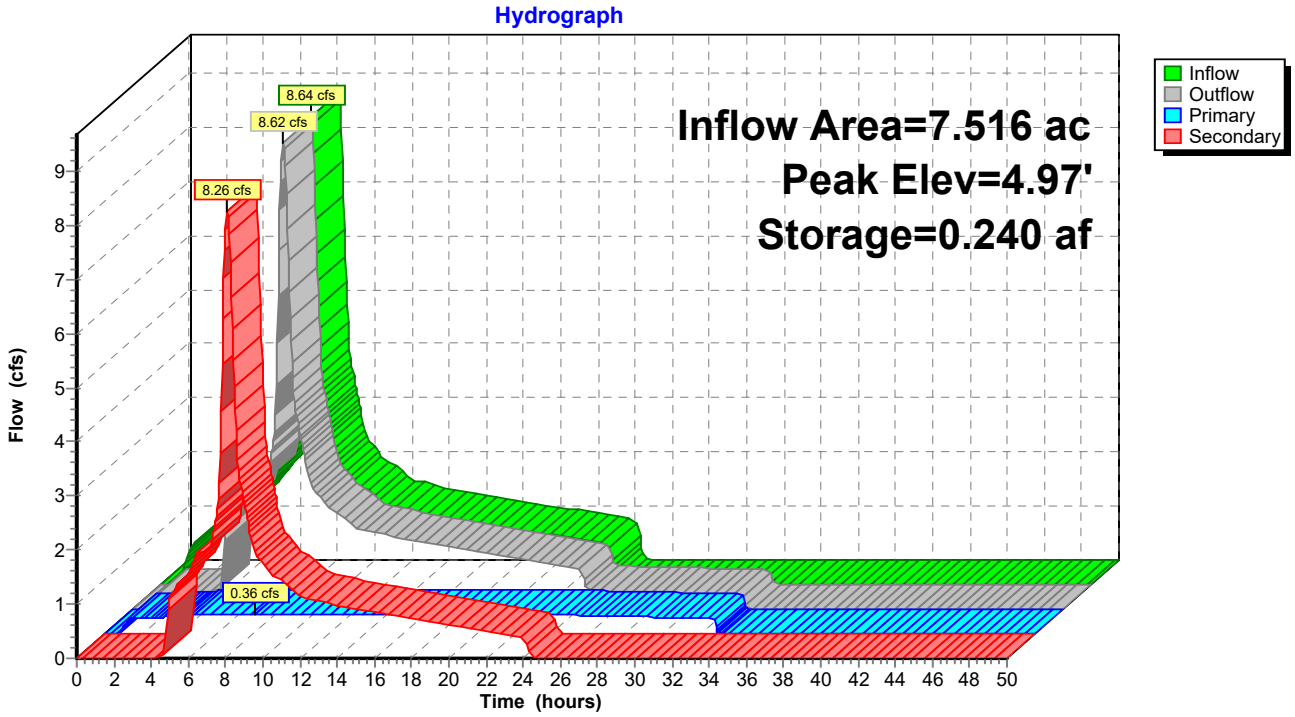
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	**50.00'W x 120.00'L x 5.00'H Infiltration Trench** 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.50'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=8.25 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
↑**2=Orifice/Grate** (Weir Controls 8.25 cfs @ 2.24 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 7P: Node B

[57] Hint: Peaked at 49.73' (Flood elevation advised)
[81] Warning: Exceeded Pond 10P by 48.92' @ 31.30 hrs
[81] Warning: Exceeded Pond 11P by 48.92' @ 33.00 hrs

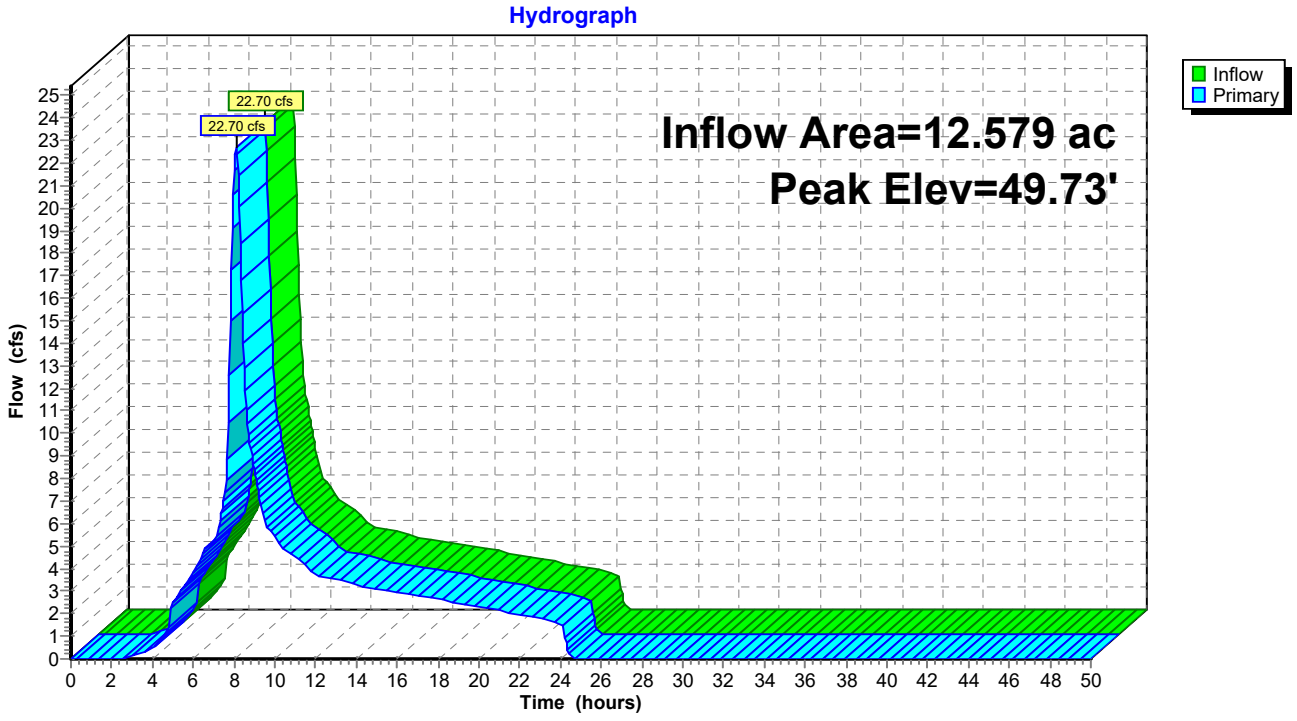
Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 6.37" for 25-year event
Inflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
Outflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af, Atten= 0%, Lag= 0.0 min
Primary = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 49.73' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	**24.0" Round Culvert** L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	49.50'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=22.48 cfs @ 8.10 hrs HW=49.73' TW=48.92' (Fixed TW Elev= 48.92')
1=Culvert (Outlet Controls 9.89 cfs @ 3.15 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 12.59 cfs @ 1.55 fps)

Pond 7P: Node B



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af
Outflow = 0.29 cfs @ 8.09 hrs, Volume= 0.101 af, Atten= 0%, Lag= 0.5 min
Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.045 af
Secondary = 0.26 cfs @ 8.09 hrs, Volume= 0.056 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.25' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 67.0 min calculated for 0.101 af (100% of inflow)
Center-of-Mass det. time= 67.1 min (734.7 - 667.6)

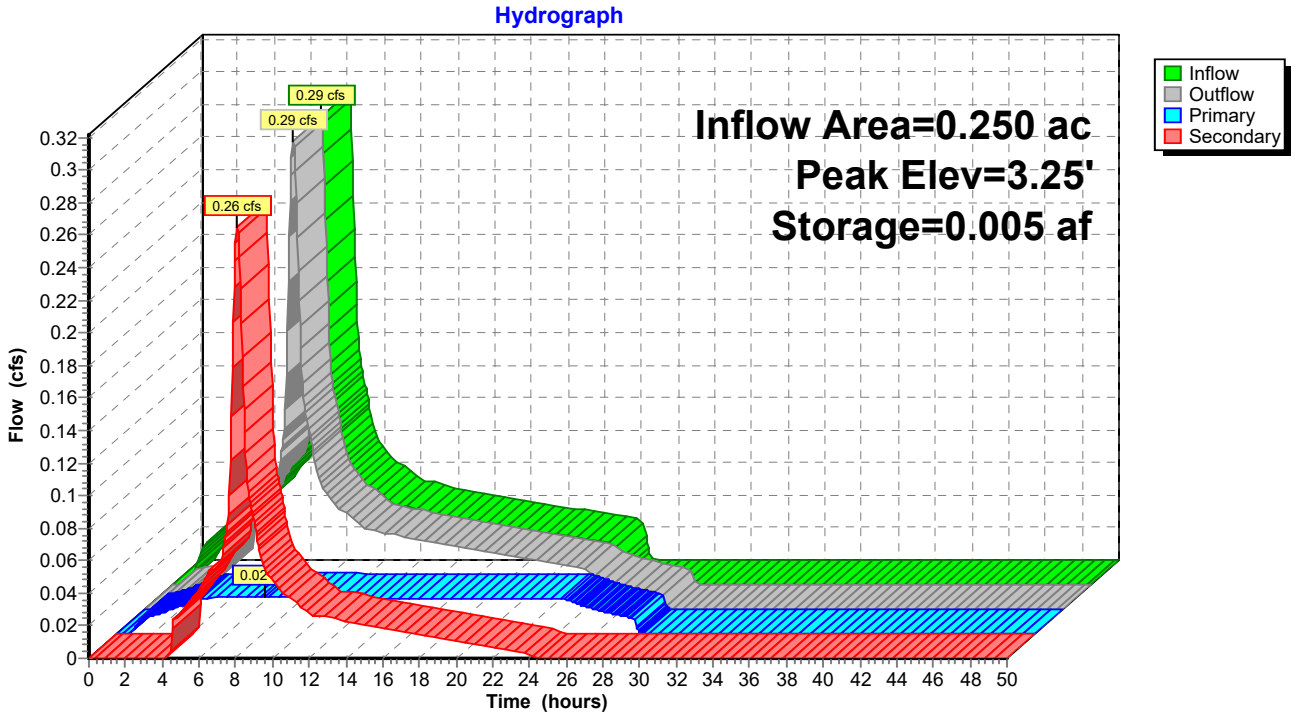
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	**5.00'W x 40.00'L x 5.00'H Bioretention** 0.023 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.26 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
2=Orifice/Grate (Orifice Controls 0.26 cfs @ 1.71 fps)

Pond 10P: Bioretention



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af
Outflow = 2.48 cfs @ 8.11 hrs, Volume= 0.882 af, Atten= 1%, Lag= 2.0 min
Primary = 0.19 cfs @ 8.11 hrs, Volume= 0.356 af
Secondary = 2.30 cfs @ 8.11 hrs, Volume= 0.526 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.87' @ 8.11 hrs Surf.Area= 0.031 ac Storage= 0.053 af

Plug-Flow detention time= 73.2 min calculated for 0.881 af (100% of inflow)
Center-of-Mass det. time= 73.4 min (741.0 - 667.6)

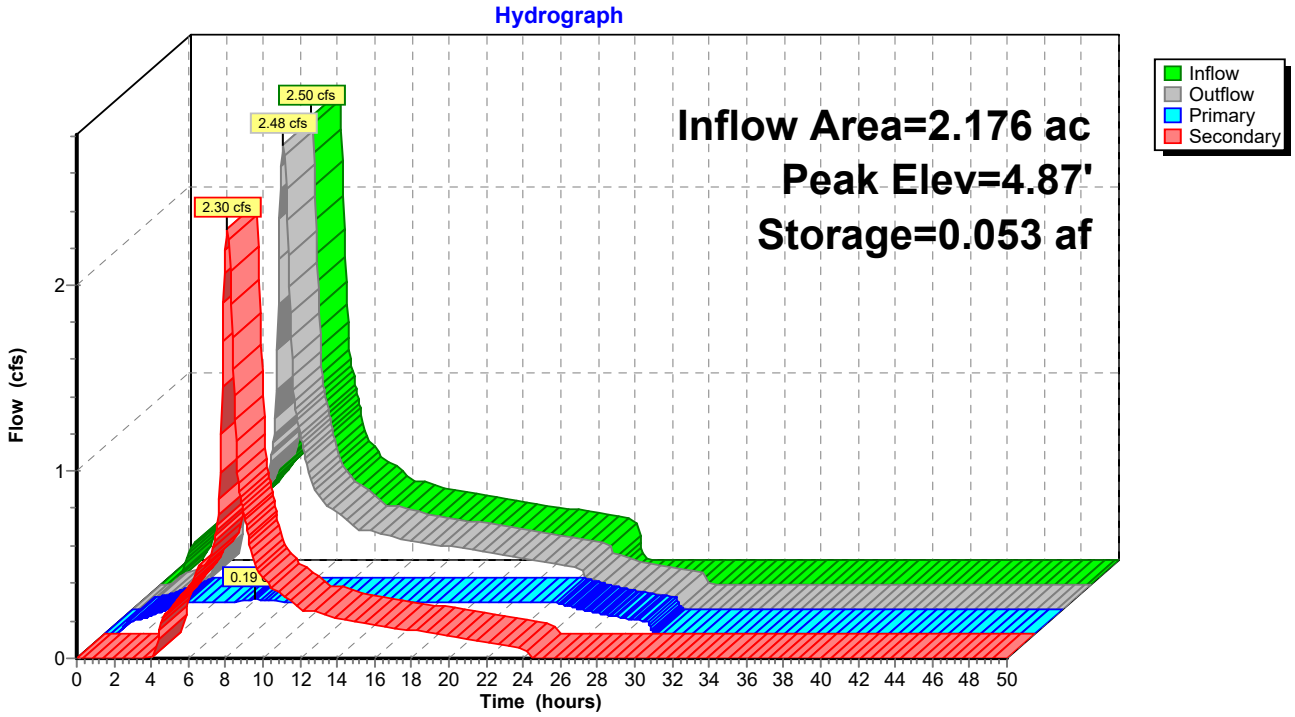
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	**5.00'W x 270.00'L x 6.00'H Bioretention** 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.30 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 2.30 cfs @ 3.17 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 1.95" for 25-year event
Inflow = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af
Outflow = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af, Atten= 59%, Lag= 79.6 min
Primary = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 0.73' @ 9.47 hrs Surf.Area= 0.014 ac Storage= 0.004 af

Plug-Flow detention time= 31.1 min calculated for 0.039 af (100% of inflow)
Center-of-Mass det. time= 31.1 min (884.7 - 853.6)

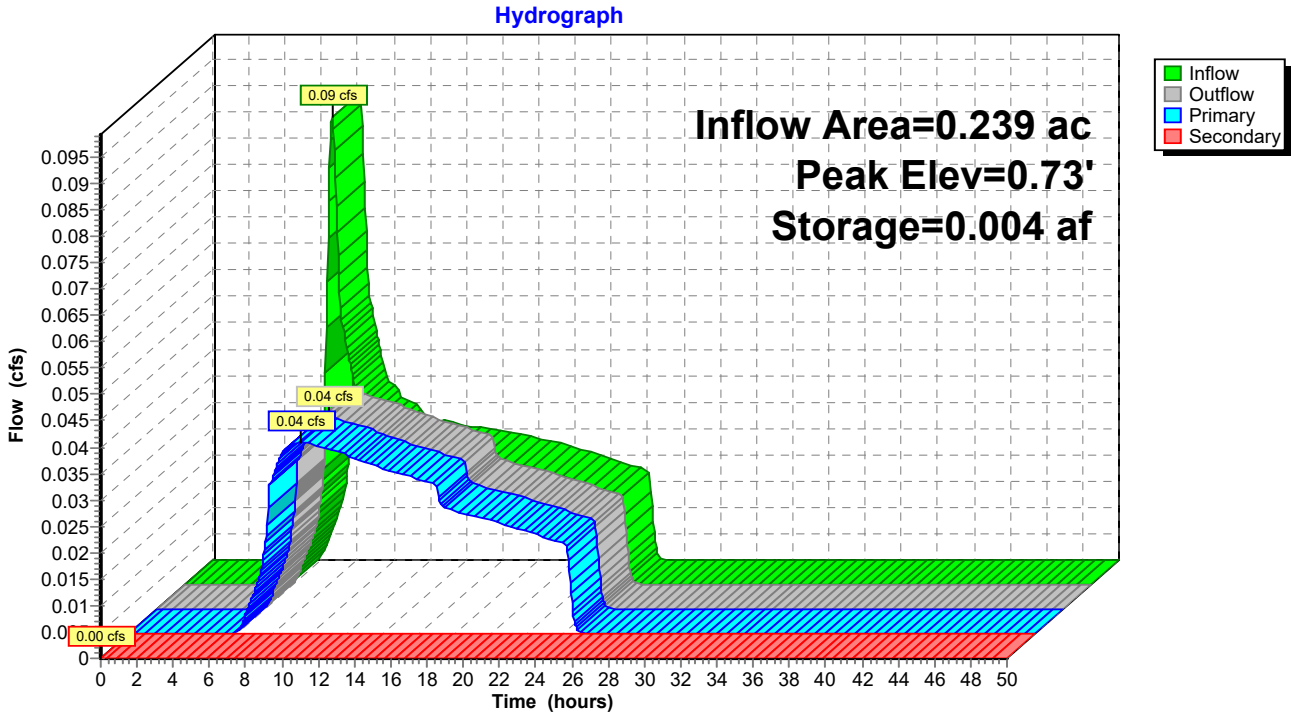
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	**5.00'W x 120.00'L x 5.00'H Bioretention** 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.04 cfs @ 9.47 hrs HW=0.73' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 4.19" for 25-year event
Inflow = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af
Outflow = 1.41 cfs @ 8.12 hrs, Volume= 0.481 af, Atten= 1%, Lag= 1.8 min
Primary = 0.09 cfs @ 8.12 hrs, Volume= 0.189 af
Secondary = 1.32 cfs @ 8.12 hrs, Volume= 0.292 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.61' @ 8.12 hrs Surf.Area= 0.028 ac Storage= 0.044 af

Plug-Flow detention time= 110.7 min calculated for 0.480 af (100% of inflow)
Center-of-Mass det. time= 111.0 min (827.2 - 716.3)

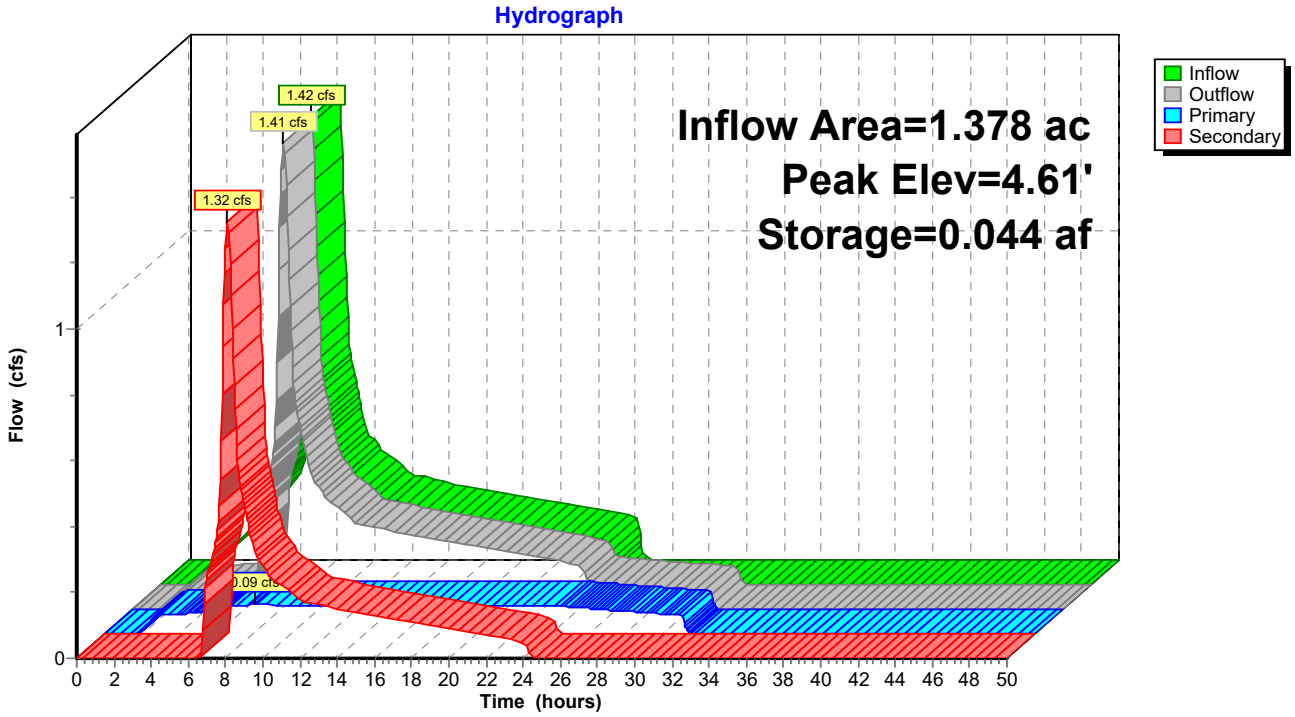
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	**20.00'W x 60.00'L x 6.00'H Infiltration Trench** 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.32 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.32 cfs @ 2.65 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth > 4.78" for 25-year event
Inflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
Outflow = 27.97 cfs @ 8.70 hrs, Volume= 18.424 af, Atten= 3%, Lag= 11.7 min
Primary = 3.57 cfs @ 8.70 hrs, Volume= 8.564 af
Secondary = 24.41 cfs @ 8.70 hrs, Volume= 9.860 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.86' @ 8.70 hrs Surf.Area= 1.674 ac Storage= 2.259 af

Plug-Flow detention time= 143.4 min calculated for 18.424 af (100% of inflow)
Center-of-Mass det. time= 143.3 min (888.6 - 745.3)

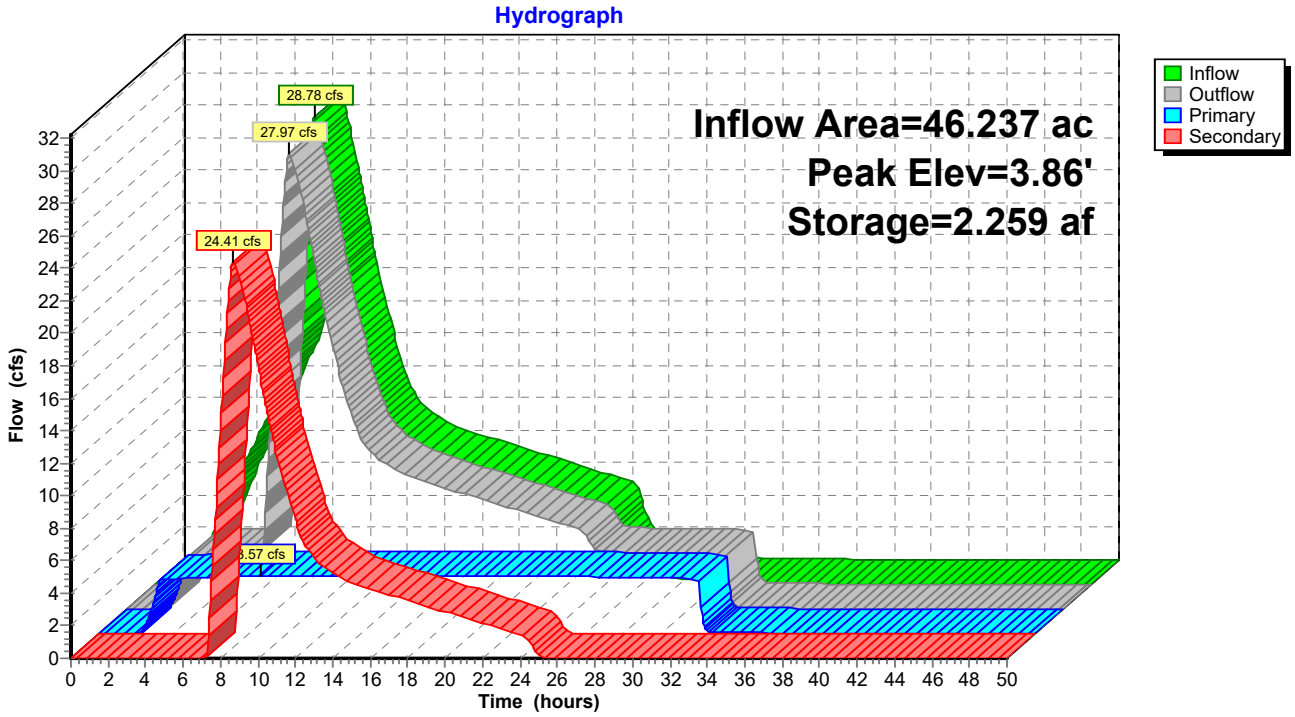
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	**270.00'W x 270.00'L x 5.00'H Infiltration Trench** 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.57 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 3.57 cfs)

Secondary OutFlow Max=24.40 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 24.40 cfs @ 3.03 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[81] Warning: Exceeded Pond 19P by 47.00' @ 49.95 hrs

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 6.90" for 25-year event
Inflow = 65.60 cfs @ 8.14 hrs, Volume= 25.625 af
Outflow = 33.98 cfs @ 9.62 hrs, Volume= 19.092 af, Atten= 48%, Lag= 88.8 min
Primary = 33.98 cfs @ 9.62 hrs, Volume= 19.092 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 47.56' @ 9.62 hrs Surf.Area= 87,202 sf Storage= 331,489 cf

Plug-Flow detention time= 260.2 min calculated for 19.092 af (75% of inflow)
Center-of-Mass det. time= 114.9 min (857.4 - 742.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

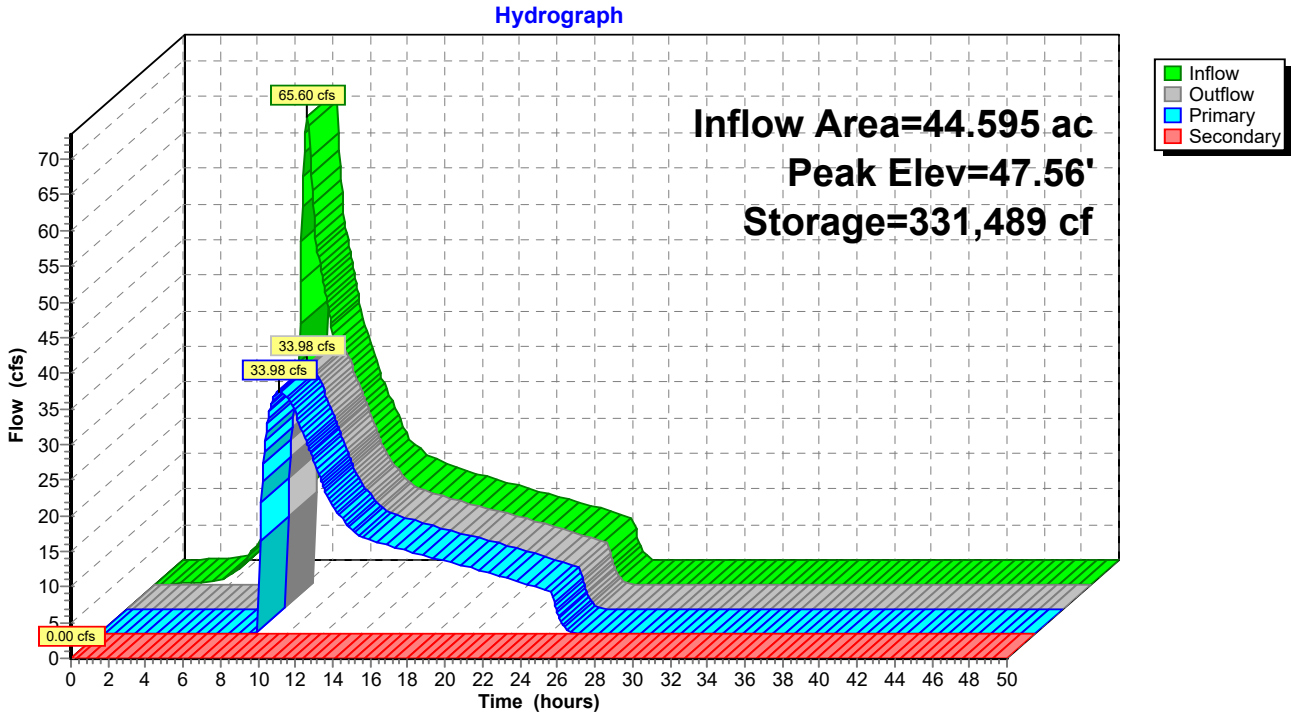
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

Device	Routing	Invert	Outlet Devices
#1	Primary	38.00'	**42.0" Round Culvert** L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 9.62 sf
#2	Secondary	48.00'	**30.0' long + 1.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=34.02 cfs @ 9.62 hrs HW=47.56' TW=47.00' (Fixed TW Elev= 47.00')
└**1=Culvert** (Outlet Controls 34.02 cfs @ 3.54 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond N1: Node D



Summary for Pond N2: Node C

[57] Hint: Peaked at 48.92' (Flood elevation advised)
[81] Warning: Exceeded Pond 7P by 7.23' @ 2.10 hrs
[81] Warning: Exceeded Pond 15P by 48.74' @ 7.90 hrs
[81] Warning: Exceeded Pond 16P by 47.56' @ 1.60 hrs

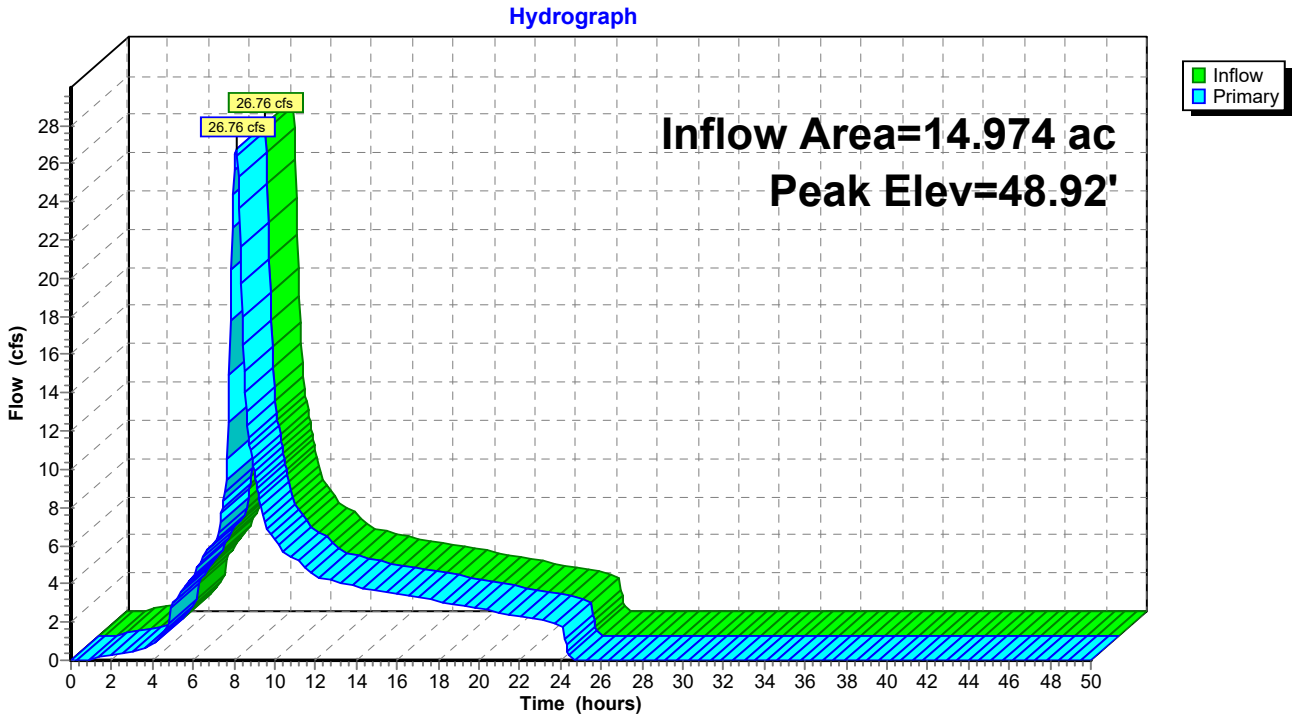
Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 6.37" for 25-year event
Inflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
Outflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af, Atten= 0%, Lag= 0.0 min
Primary = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 48.92' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	**30.0" Round Culvert** L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf
#2	Primary	48.80'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=26.41 cfs @ 8.10 hrs HW=48.92' TW=47.56' (Fixed TW Elev= 47.56')
1=Culvert (Outlet Controls 21.77 cfs @ 4.44 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 4.64 cfs @ 1.11 fps)

Pond N2: Node C



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.51' (Flood elevation advised)
[81] Warning: Exceeded Pond 4P by 49.73' @ 31.50 hrs
[81] Warning: Exceeded Pond 5P by 49.73' @ 35.90 hrs

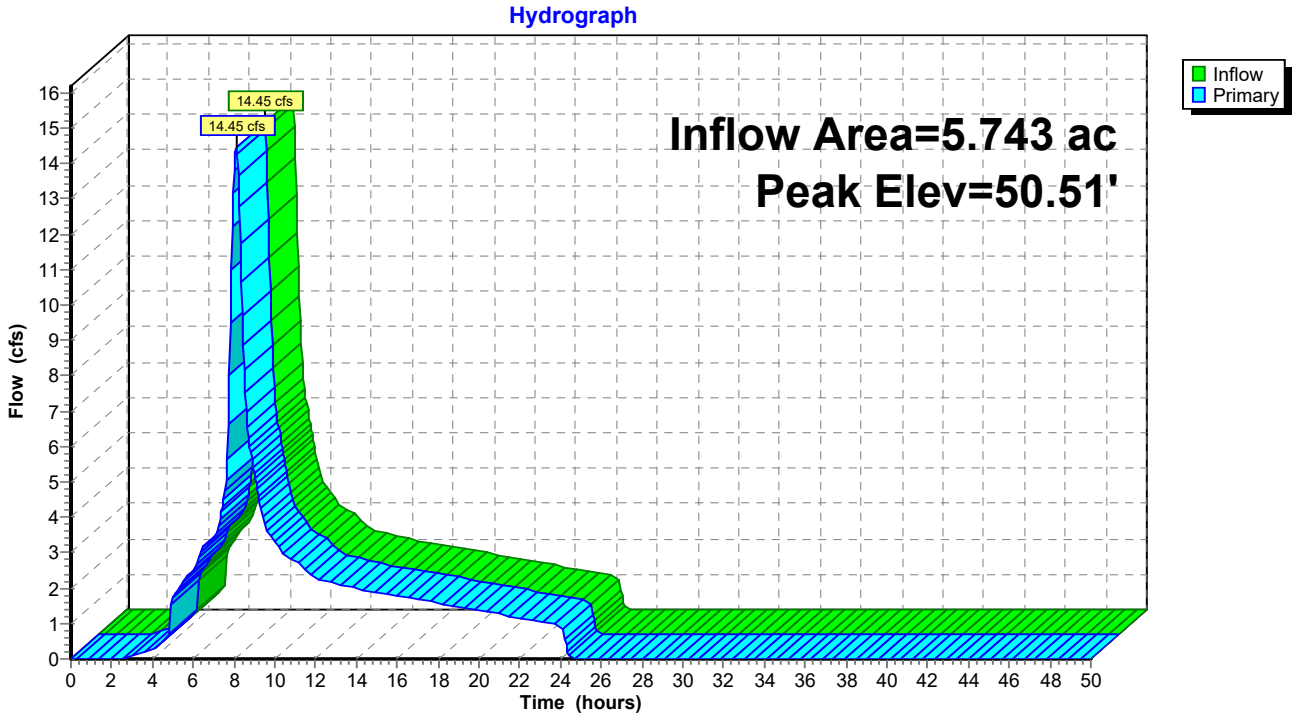
Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 8.63" for 25-year event
Inflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
Outflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af, Atten= 0%, Lag= 0.0 min
Primary = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
Routed to Pond 7P : Node B

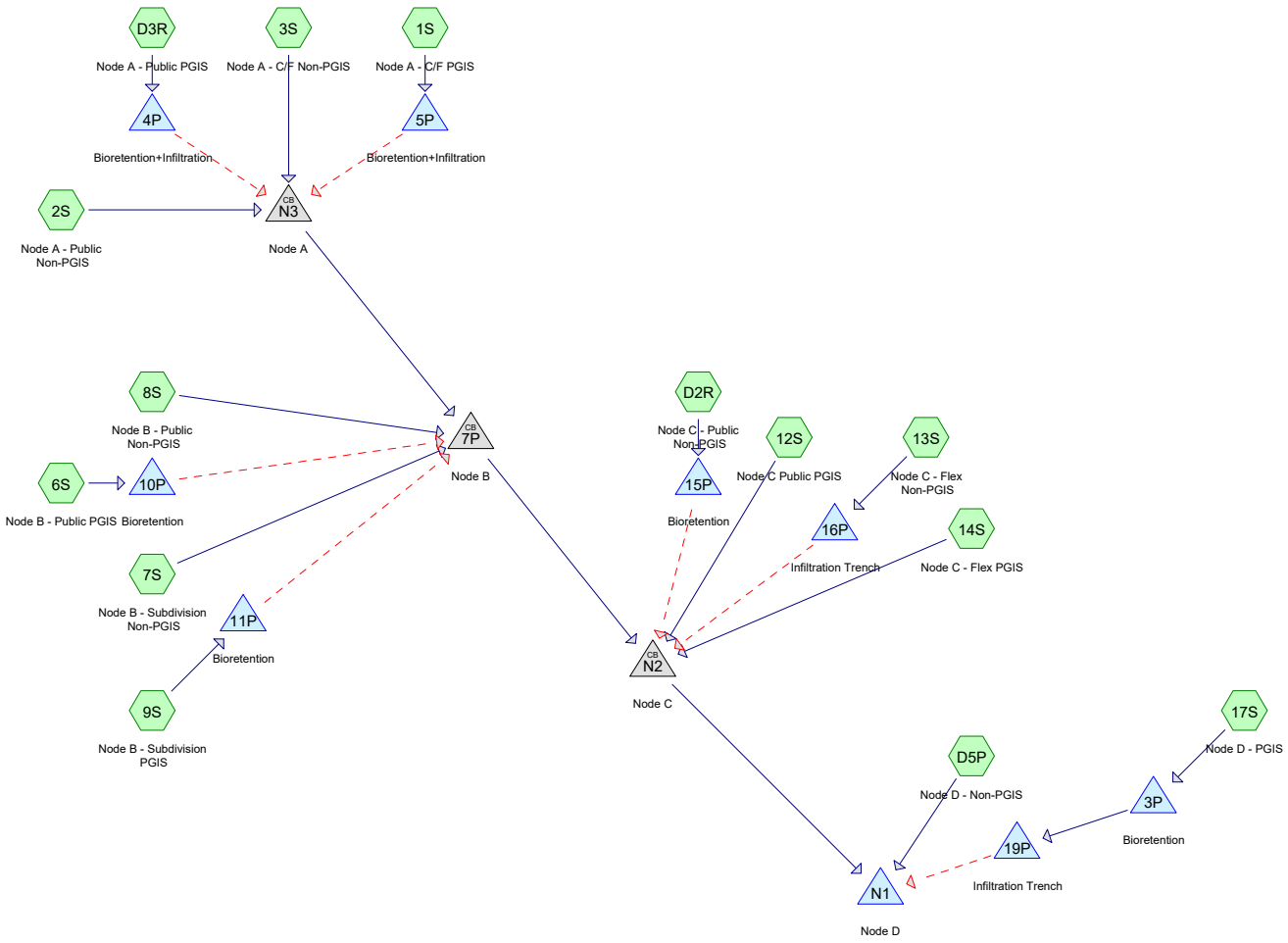
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 50.51' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	**24.0" Round Culvert** L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	50.40'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=14.35 cfs @ 8.10 hrs HW=50.51' TW=49.73' (Fixed TW Elev= 49.73')
1=Culvert (Outlet Controls 9.86 cfs @ 3.14 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 4.48 cfs @ 1.10 fps)

Pond N3: Node A





Subcat Reach Pond Link

Routing Diagram for ALTERNATE _Onsite 100-Year Storm - Moderate Flood
Prepared by MacKay & Sposito, Inc, Printed 3/10/2025
HydroCAD® 10.20-5c s/n 01662 © 2023 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	**38.896**	**0.000**	**0.000**	**0.000**	**104.075**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=10.54 cfs 3.734 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.97"
Tc=20.0 min CN=59 Runoff=0.38 cfs 0.190 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=4.82"
Tc=20.0 min CN=88 Runoff=5.43 cfs 1.840 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=0.35 cfs 0.124 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=4.49"
Tc=20.0 min CN=85 Runoff=7.39 cfs 2.525 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=3.86"
Tc=20.0 min CN=79 Runoff=0.08 cfs 0.029 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=3.05 cfs 1.081 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=1.00 cfs 0.353 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=5.27"
Tc=20.0 min CN=92 Runoff=1.78 cfs 0.605 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=64.81 cfs 22.971 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=2.78"
Tc=20.0 min CN=68 Runoff=0.14 cfs 0.055 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=4.17"
Tc=20.0 min CN=82 Runoff=29.72 cfs 10.297 af

Pond 3P: Bioretention Peak Elev=54.89' Storage=3.301 af Inflow=64.81 cfs 22.971 af
Outflow=40.37 cfs 22.657 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.84' Storage=0.039 af Inflow=2.36 cfs 0.837 af
Primary=0.15 cfs 0.283 af Secondary=2.20 cfs 0.554 af Outflow=2.35 cfs 0.837 af

Pond 5P: Bioretention+Infiltration Peak Elev=5.04' Storage=0.241 af Inflow=10.54 cfs 3.734 af
Primary=0.36 cfs 0.890 af Secondary=10.21 cfs 2.844 af Outflow=10.57 cfs 3.734 af

Pond 7P: Node B Peak Elev=49.80' Inflow=28.83 cfs 8.778 af
Outflow=28.83 cfs 8.778 af

Pond 10P: Bioretention Peak Elev=3.28' Storage=0.005 af Inflow=0.35 cfs 0.124 af
Primary=0.02 cfs 0.046 af Secondary=0.33 cfs 0.078 af Outflow=0.35 cfs 0.124 af

Pond 11P: Bioretention Peak Elev=5.06' Storage=0.055 af Inflow=3.05 cfs 1.081 af
Primary=0.19 cfs 0.364 af Secondary=2.82 cfs 0.717 af Outflow=3.02 cfs 1.081 af

Pond 15P: Bioretention Peak Elev=1.52' Storage=0.007 af Inflow=0.14 cfs 0.055 af
Primary=0.05 cfs 0.055 af Secondary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.055 af

Pond 16P: Infiltration Trench Peak Elev=4.70' Storage=0.045 af Inflow=1.78 cfs 0.605 af
Primary=0.09 cfs 0.193 af Secondary=1.68 cfs 0.411 af Outflow=1.77 cfs 0.605 af

Pond 19P: Infiltration Trench Peak Elev=4.09' Storage=2.393 af Inflow=40.37 cfs 22.657 af
Primary=3.58 cfs 8.734 af Secondary=34.89 cfs 13.923 af Outflow=38.47 cfs 22.657 af

Pond N1: Node D Peak Elev=48.12' Storage=383,550 cf Inflow=84.32 cfs 34.599 af
Primary=48.30 cfs 27.890 af Secondary=3.24 cfs 0.176 af Outflow=51.54 cfs 28.066 af

Pond N2: Node C Peak Elev=49.06' Inflow=33.86 cfs 10.379 af
Outflow=33.86 cfs 10.379 af

Pond N3: Node A Peak Elev=50.57' Inflow=18.21 cfs 5.428 af
Outflow=18.21 cfs 5.428 af

Total Runoff Area = 104.075 ac Runoff Volume = 45.478 af Average Runoff Depth = 5.24"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

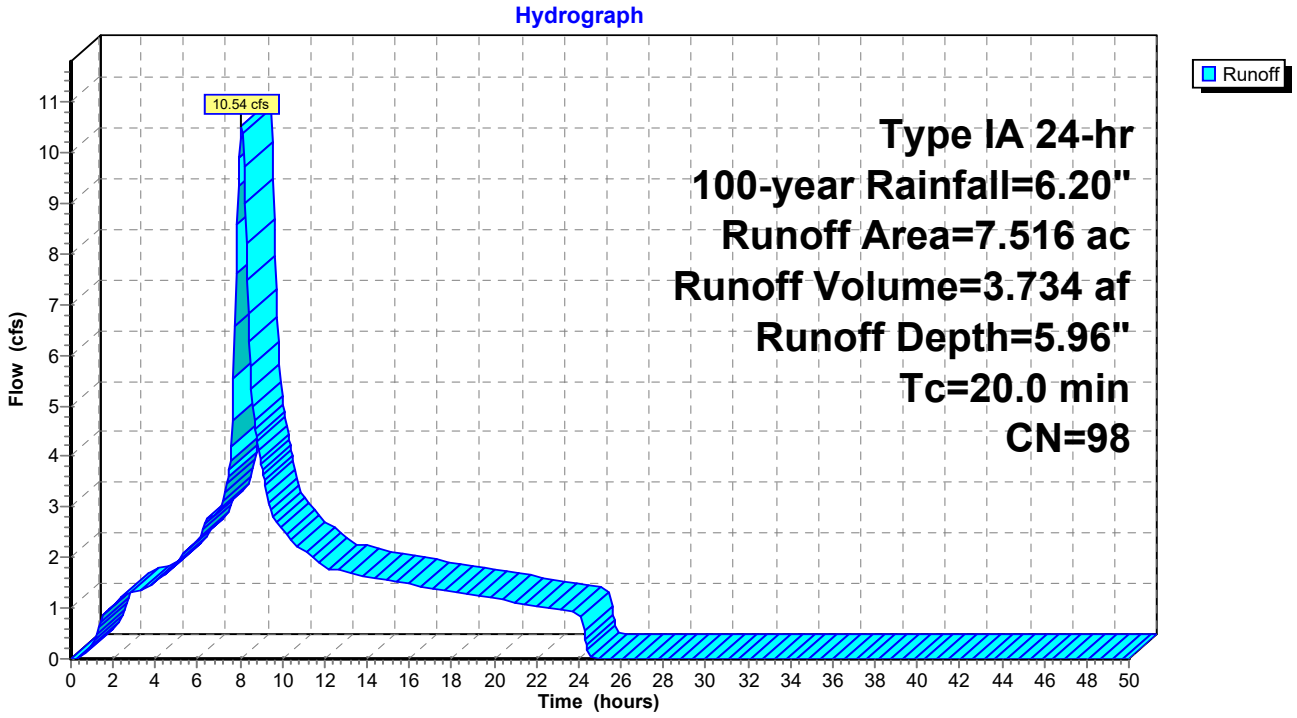
Runoff = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af, Depth= 5.96"
Routed to Pond 5P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 1S: Node A - C/F PGIS



Summary for Subcatchment 2S: Node A - Public Non-PGIS

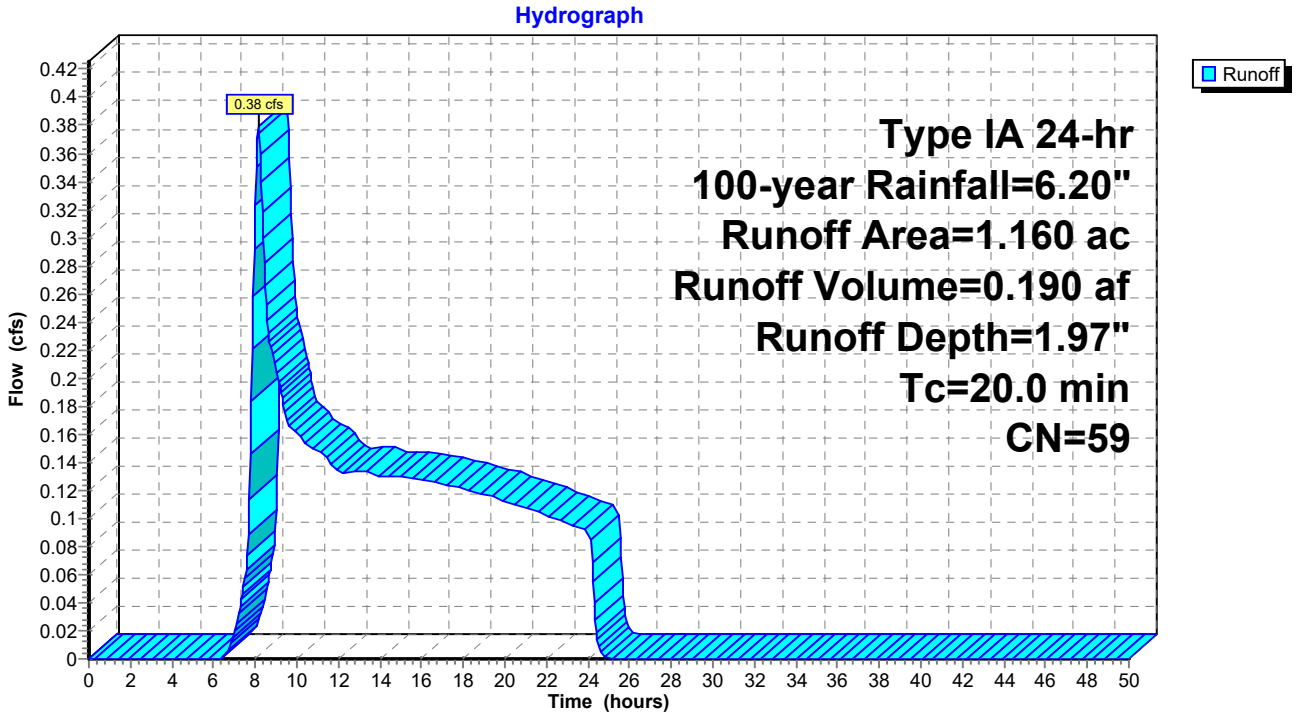
Runoff = 0.38 cfs @ 8.16 hrs, Volume= 0.190 af, Depth= 1.97"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
	1.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 2S: Node A - Public Non-PGIS



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

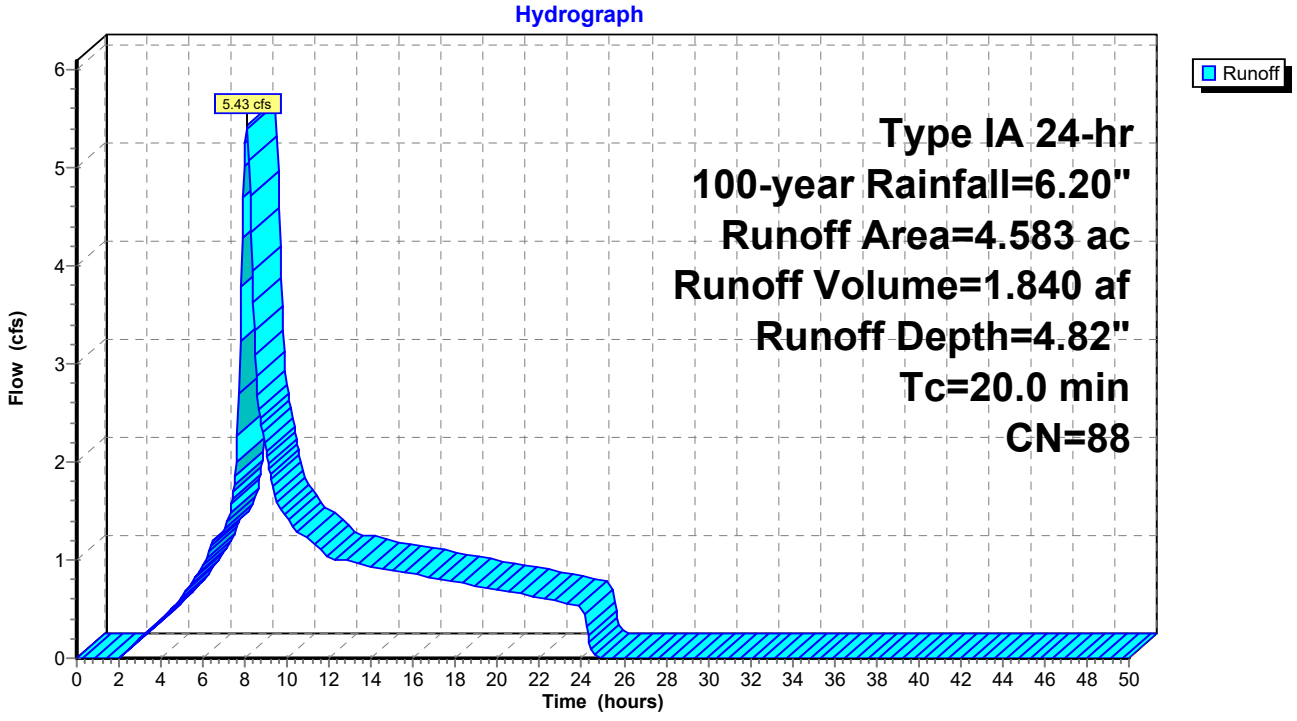
Runoff = 5.43 cfs @ 8.09 hrs, Volume= 1.840 af, Depth= 4.82"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
	3.373	98	Roofs, HSG A
	4.583	88	Weighted Average
	1.210		26.40% Pervious Area
	3.373		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 3S: Node A - C/F Non-PGIS



Summary for Subcatchment 6S: Node B - Public PGIS

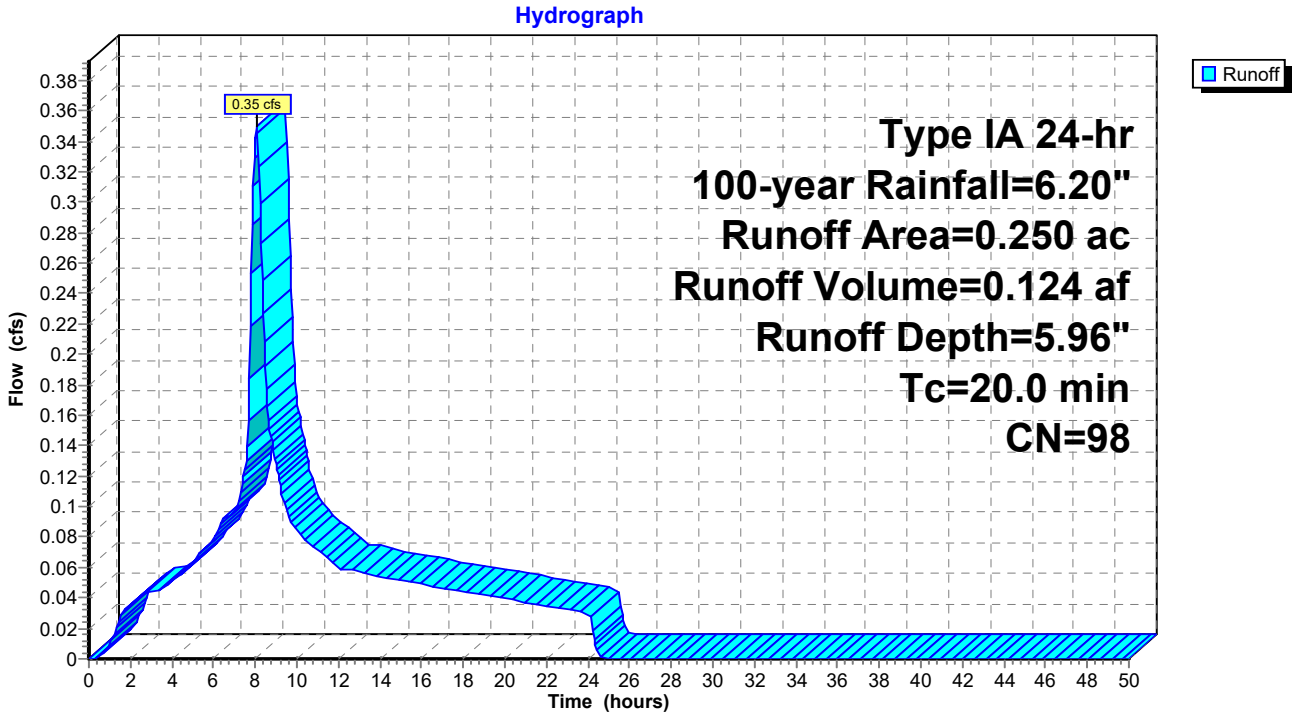
Runoff = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af, Depth= 5.96"
Routed to Pond 10P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 6S: Node B - Public PGIS



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

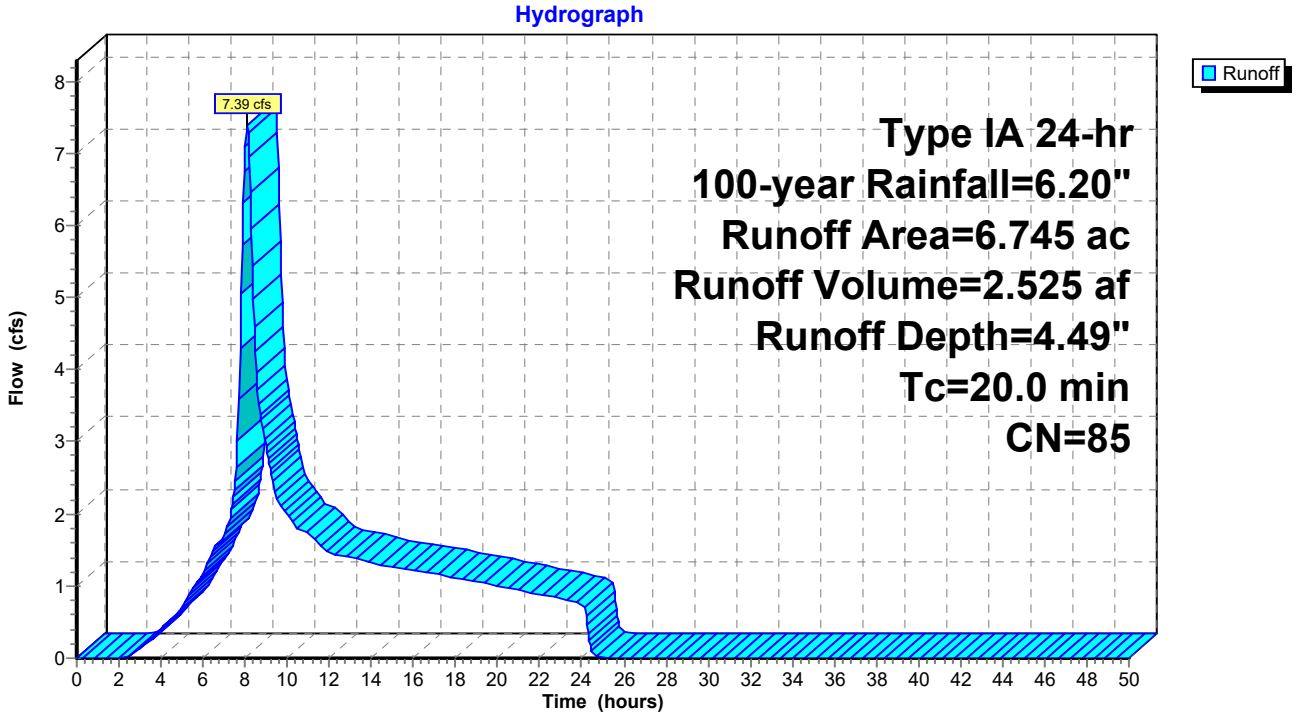
Runoff = 7.39 cfs @ 8.09 hrs, Volume= 2.525 af, Depth= 4.49"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 7S: Node B - Subdivision Non-PGIS



Summary for Subcatchment 8S: Node B - Public Non-PGIS

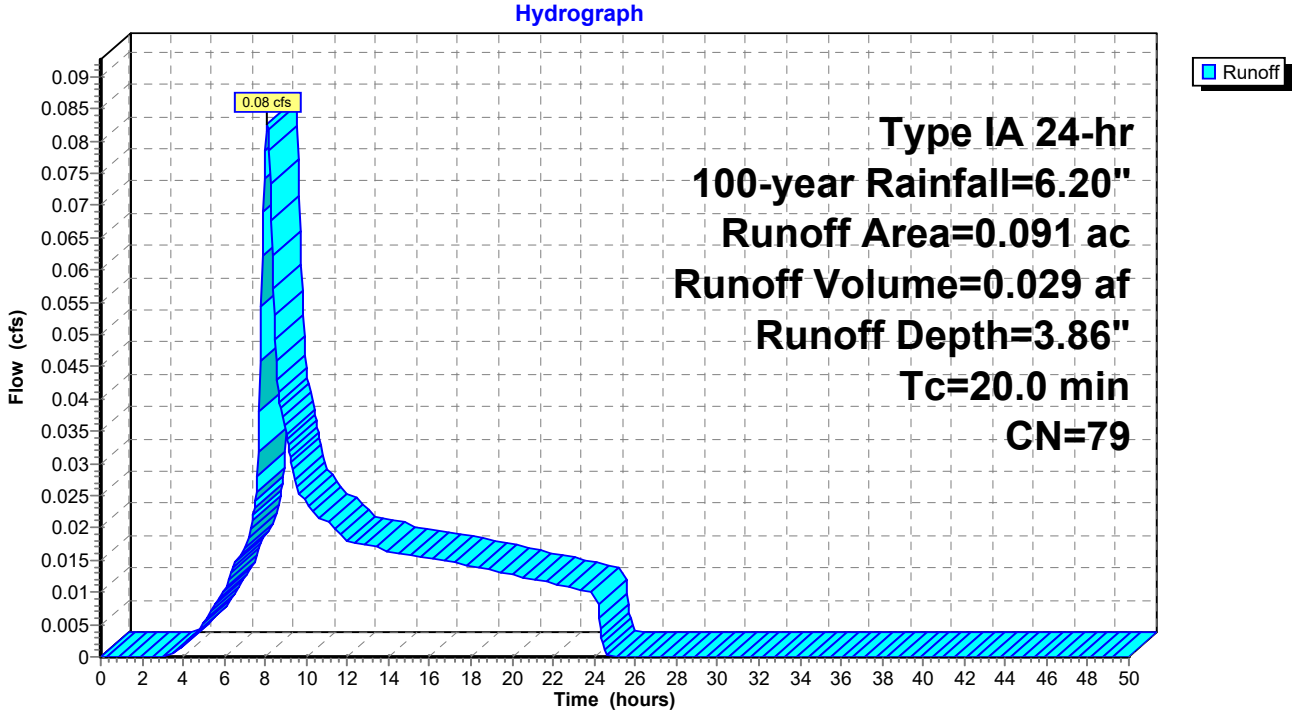
Runoff = 0.08 cfs @ 8.11 hrs, Volume= 0.029 af, Depth= 3.86"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 8S: Node B - Public Non-PGIS



Summary for Subcatchment 9S: Node B - Subdivision PGIS

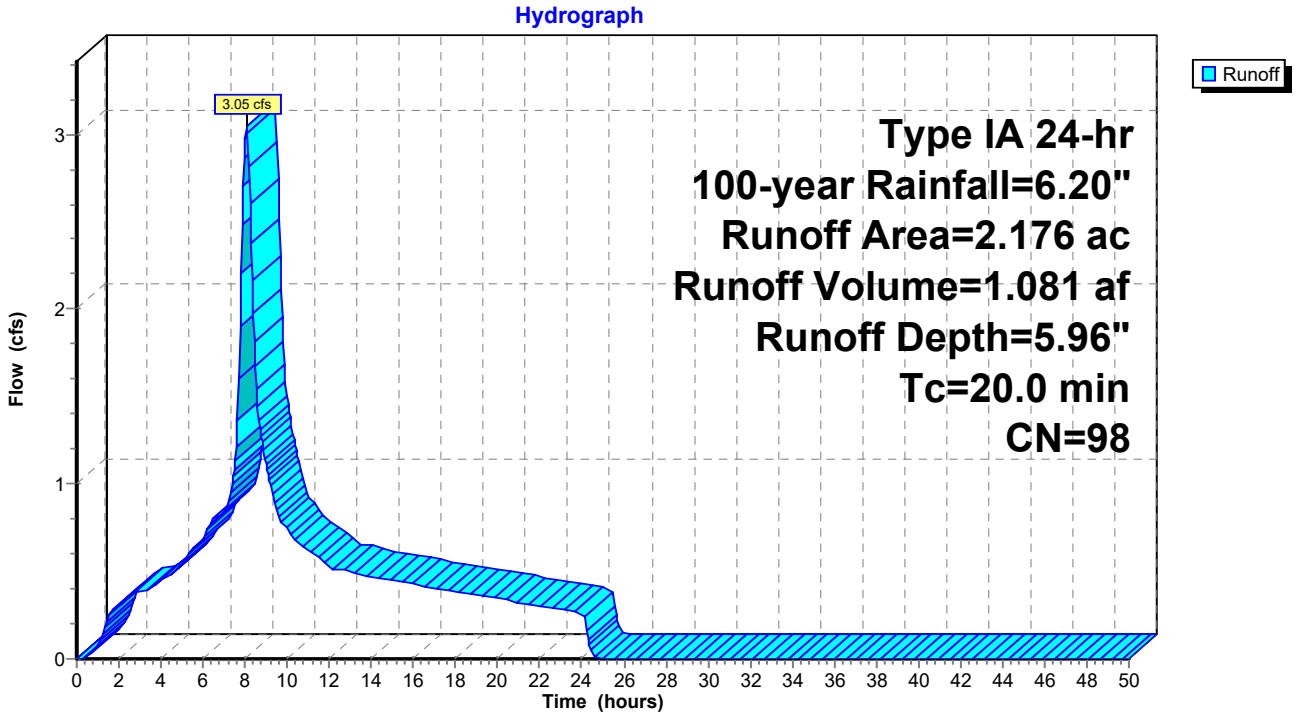
Runoff = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af, Depth= 5.96"
Routed to Pond 11P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 9S: Node B - Subdivision PGIS



Summary for Subcatchment 12S: Node C Public PGIS

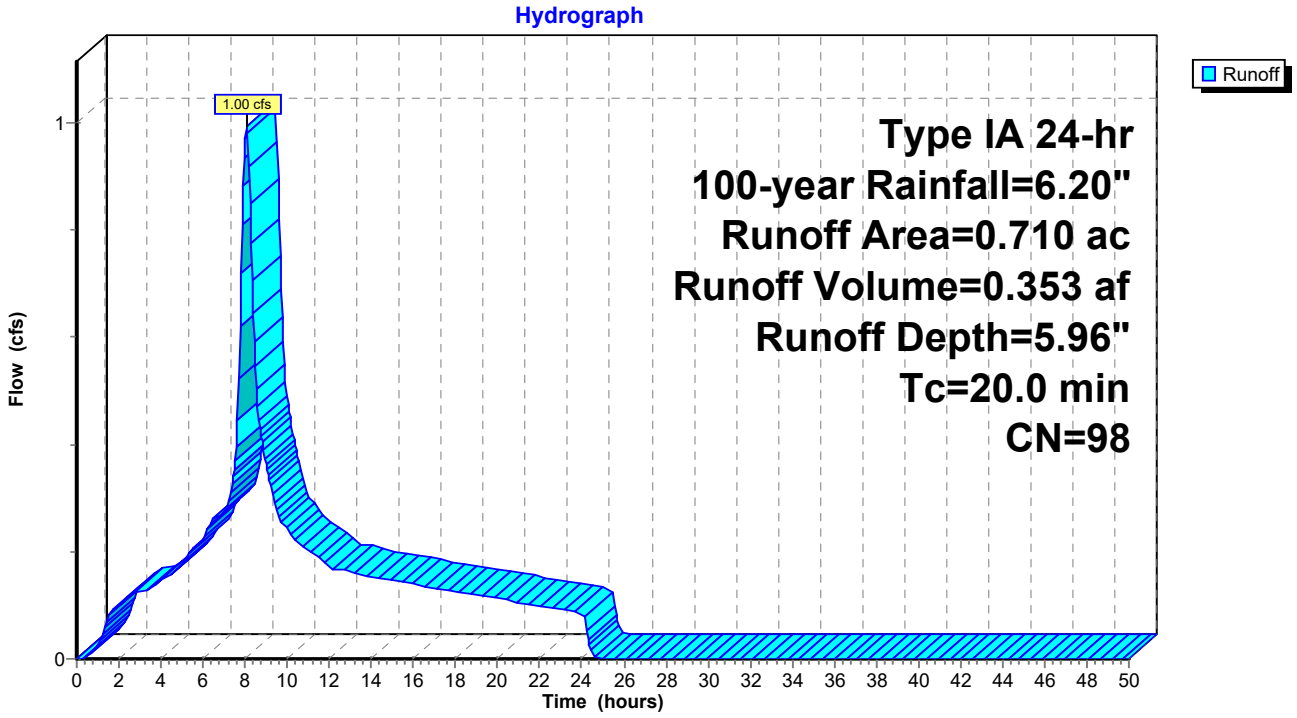
Runoff = 1.00 cfs @ 8.08 hrs, Volume= 0.353 af, Depth= 5.96"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 12S: Node C Public PGIS



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

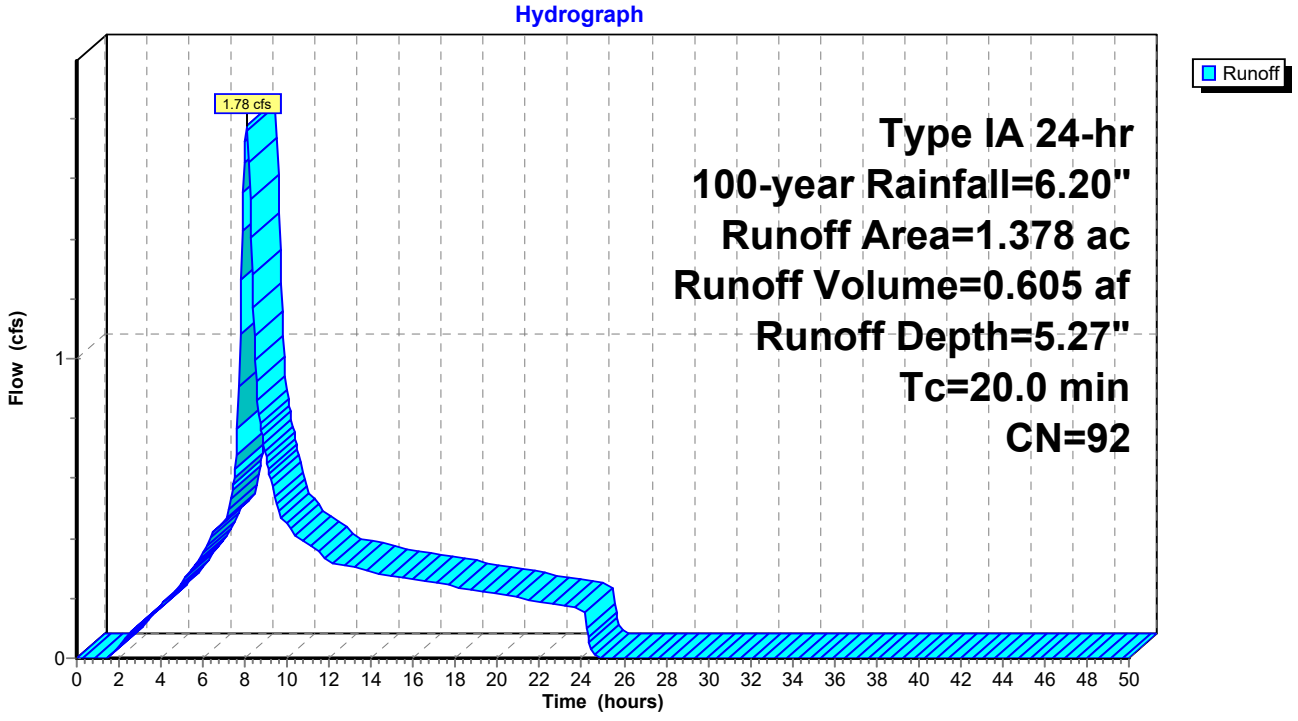
Runoff = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af, Depth= 5.27"
Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

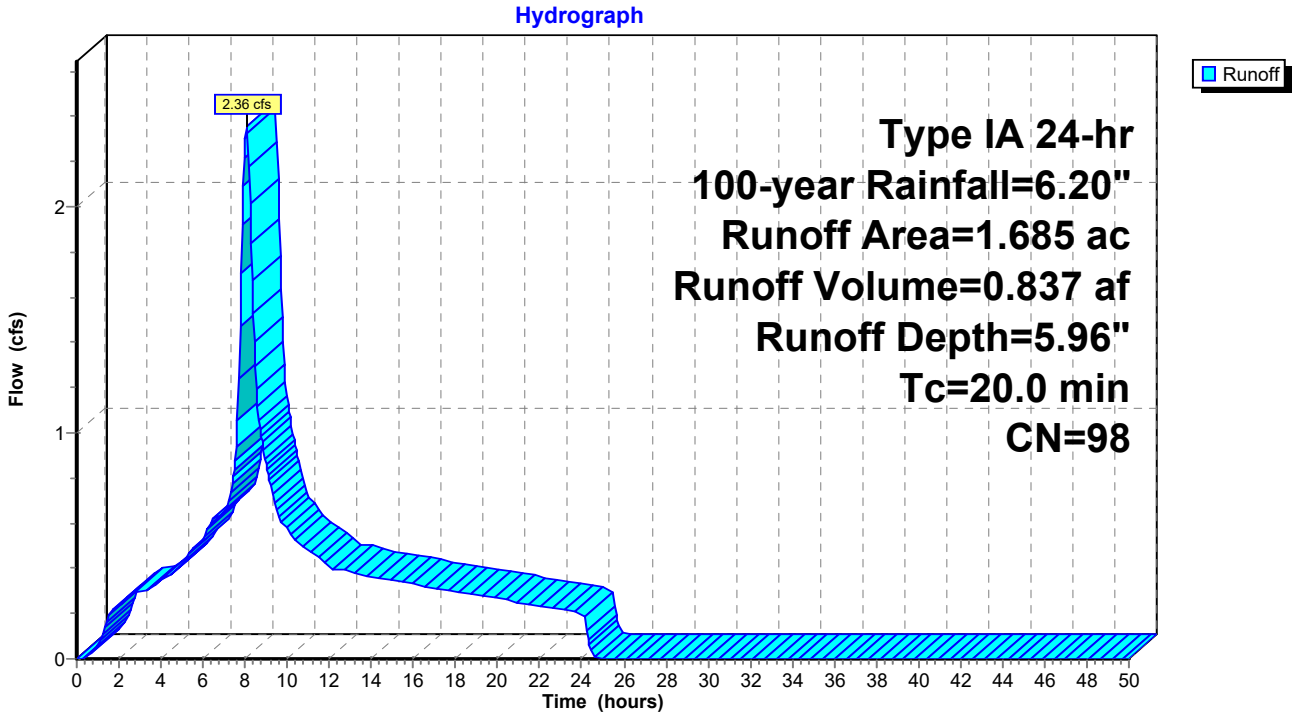
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 14S: Node C - Flex PGIS



Summary for Subcatchment 17S: Node D - PGIS

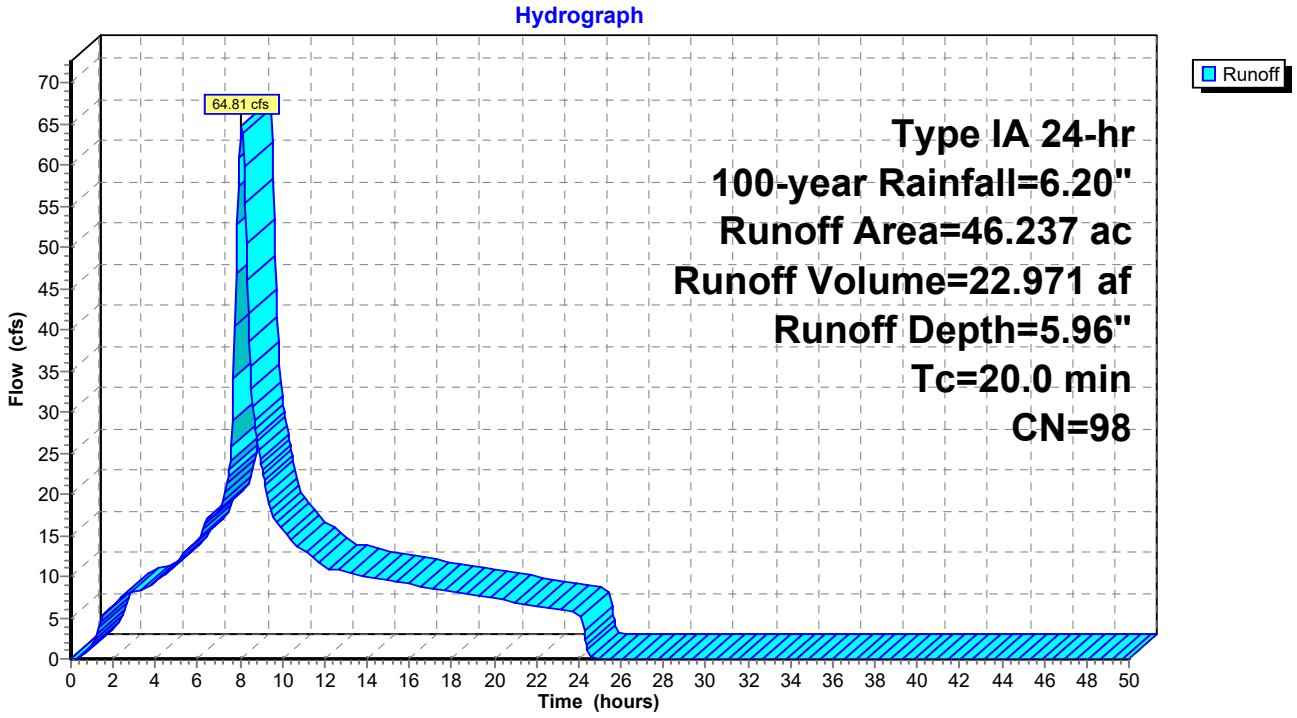
Runoff = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af, Depth= 5.96"
Routed to Pond 3P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 17S: Node D - PGIS



Summary for Subcatchment D2R: Node C - Public Non-PGIS

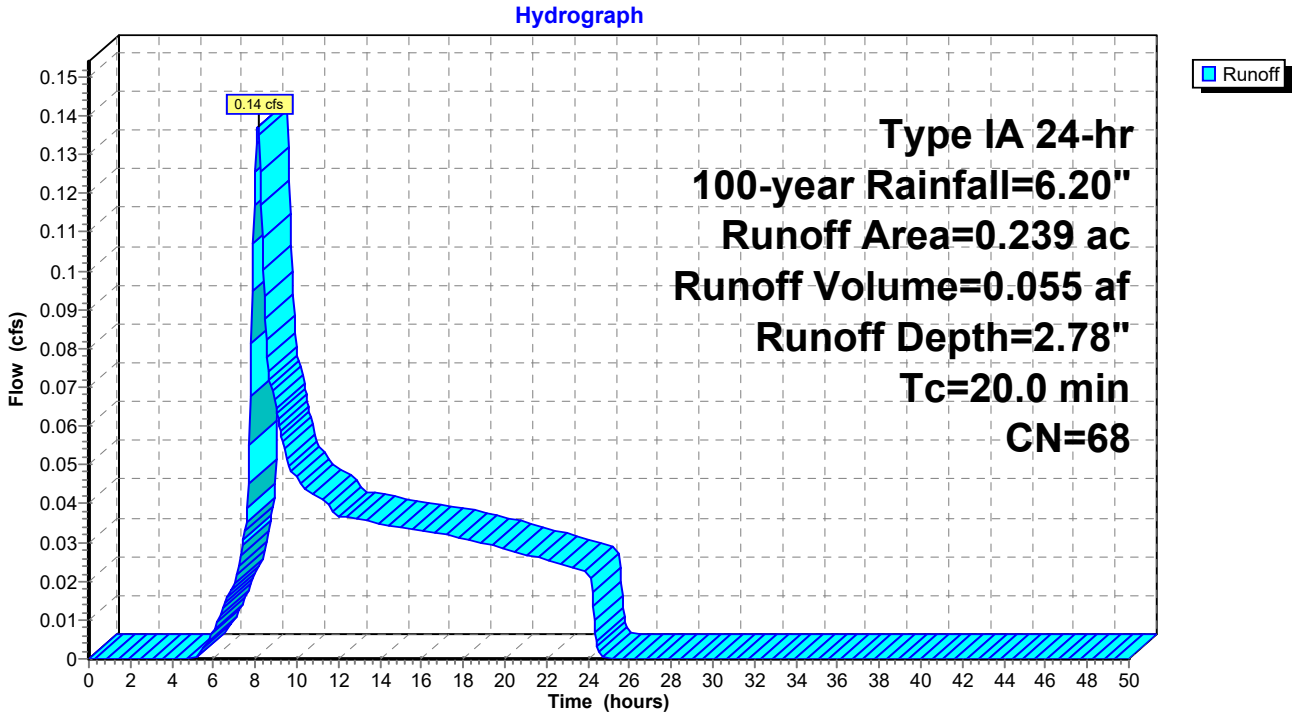
Runoff = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af, Depth= 2.78"
Routed to Pond 15P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D2R: Node C - Public Non-PGIS



Summary for Subcatchment D3R: Node A - Public PGIS

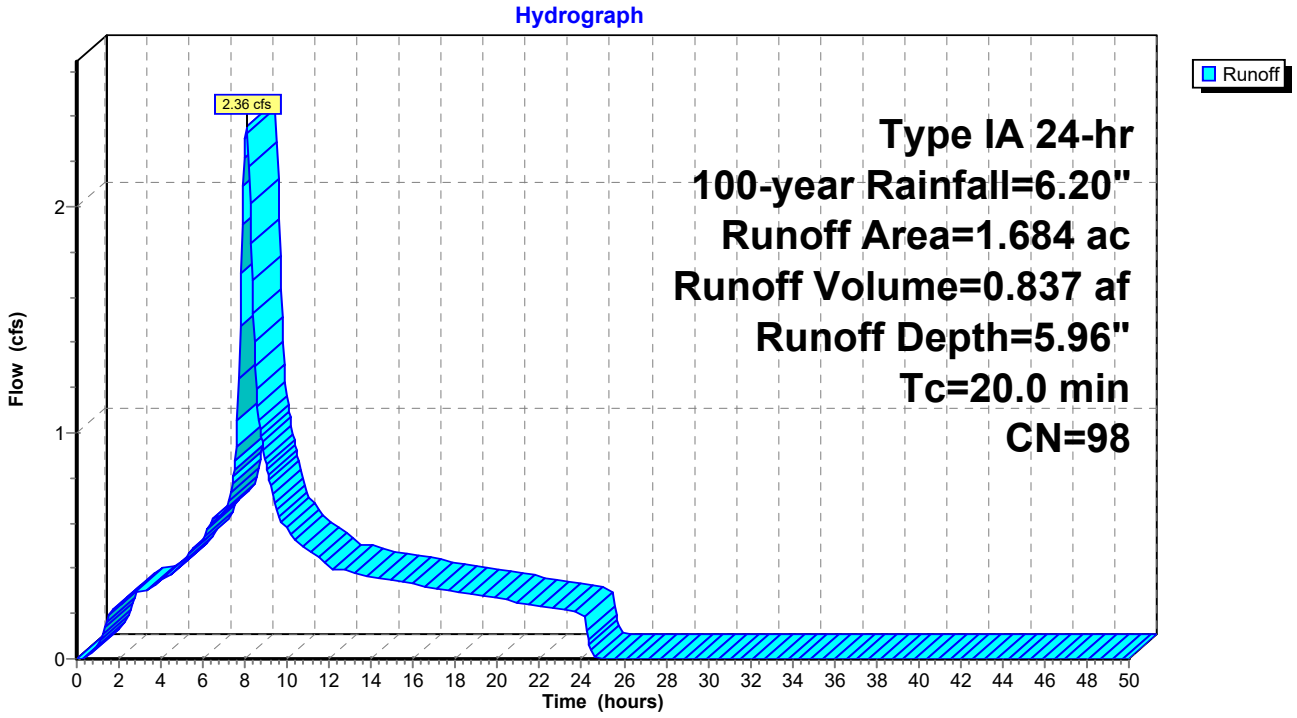
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

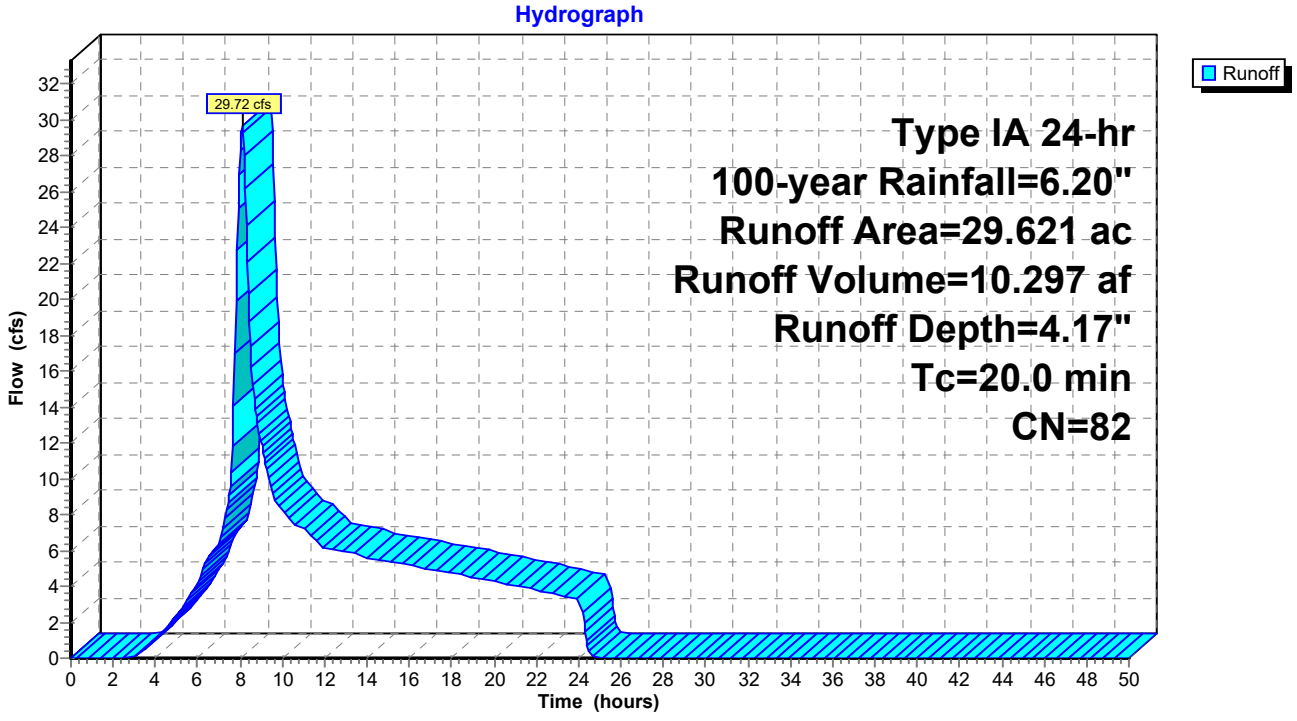
Runoff = 29.72 cfs @ 8.10 hrs, Volume= 10.297 af, Depth= 4.17"
Routed to Pond N1 : Node D

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D5P: Node D - Non-PGIS



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af
Outflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af, Atten= 38%, Lag= 20.8 min
Primary = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 54.89' @ 8.42 hrs Surf.Area= 1.674 ac Storage= 3.301 af

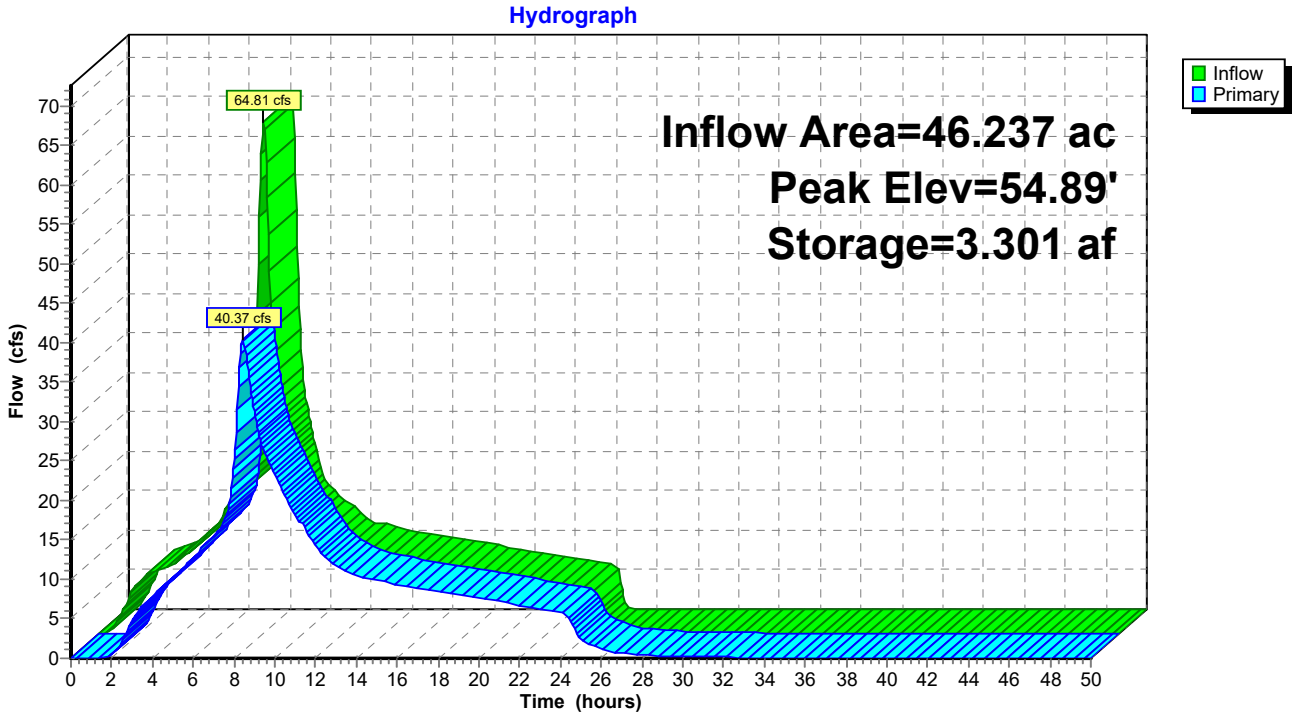
Plug-Flow detention time= 83.2 min calculated for 22.657 af (99% of inflow)
Center-of-Mass det. time= 72.4 min (736.4 - 664.0)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	**270.00'W x 270.00'L x 6.50'H Prismatoid** 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	**270.00'W x 270.00'L x 2.00'H Prismatoid** Inside #1
#3	50.50'	0.019 af	**24.0" Round Pipe Storage** Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	**60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=40.28 cfs @ 8.42 hrs HW=54.89' (Free Discharge)
1=Orifice/Grate (Weir Controls 12.44 cfs @ 2.04 fps)
2=Orifice/Grate (Orifice Controls 27.85 cfs @ 8.86 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af
Outflow = 2.35 cfs @ 8.11 hrs, Volume= 0.837 af, Atten= 1%, Lag= 1.8 min
Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.283 af
Secondary = 2.20 cfs @ 8.11 hrs, Volume= 0.554 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.84' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.039 af

Plug-Flow detention time= 55.2 min calculated for 0.836 af (100% of inflow)
Center-of-Mass det. time= 55.4 min (719.4 - 664.0)

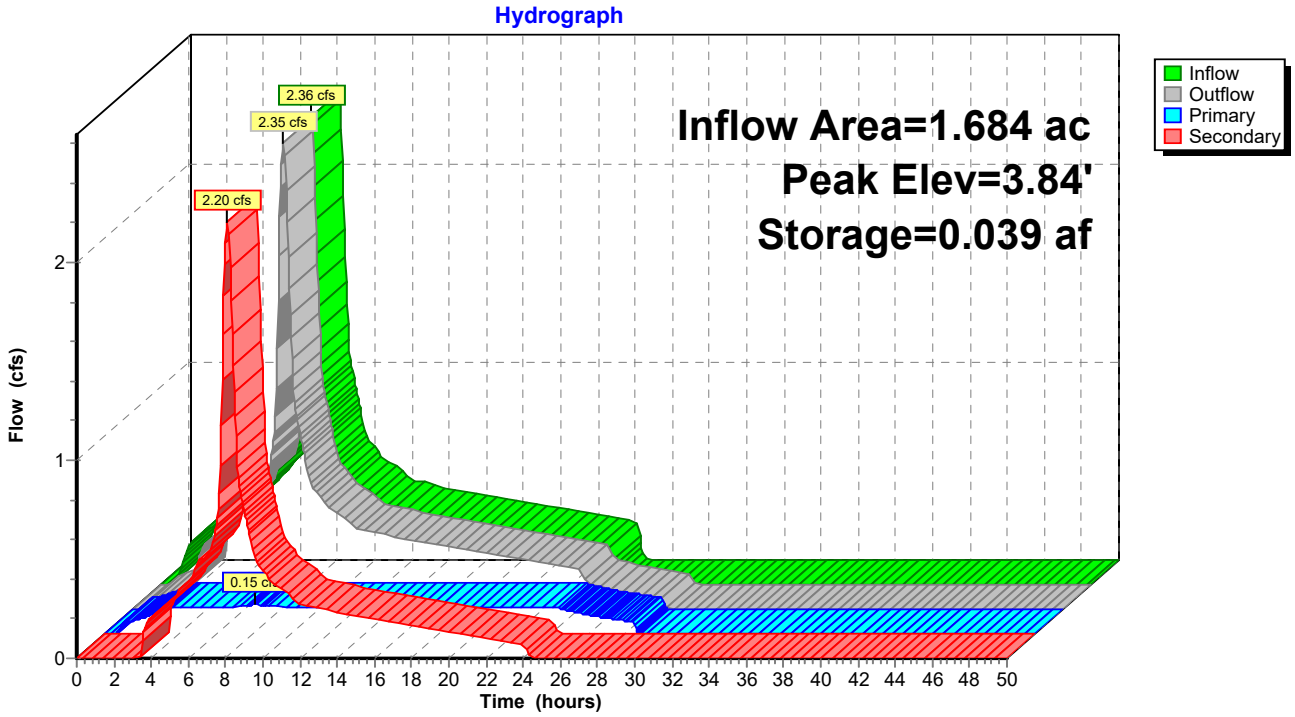
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	**5.00'W x 250.00'L x 5.00'H Bioretention** 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=2.20 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 2.20 cfs @ 3.12 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

[93] Warning: Storage range exceeded by 0.04'
[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 7.516 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af
Outflow = 10.57 cfs @ 8.09 hrs, Volume= 3.734 af, Atten= 0%, Lag= 0.5 min
Primary = 0.36 cfs @ 7.95 hrs, Volume= 0.890 af
Secondary = 10.21 cfs @ 8.09 hrs, Volume= 2.844 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 5.04' @ 8.09 hrs Surf.Area= 0.138 ac Storage= 0.241 af

Plug-Flow detention time= 91.6 min calculated for 3.730 af (100% of inflow)
Center-of-Mass det. time= 92.0 min (756.0 - 664.0)

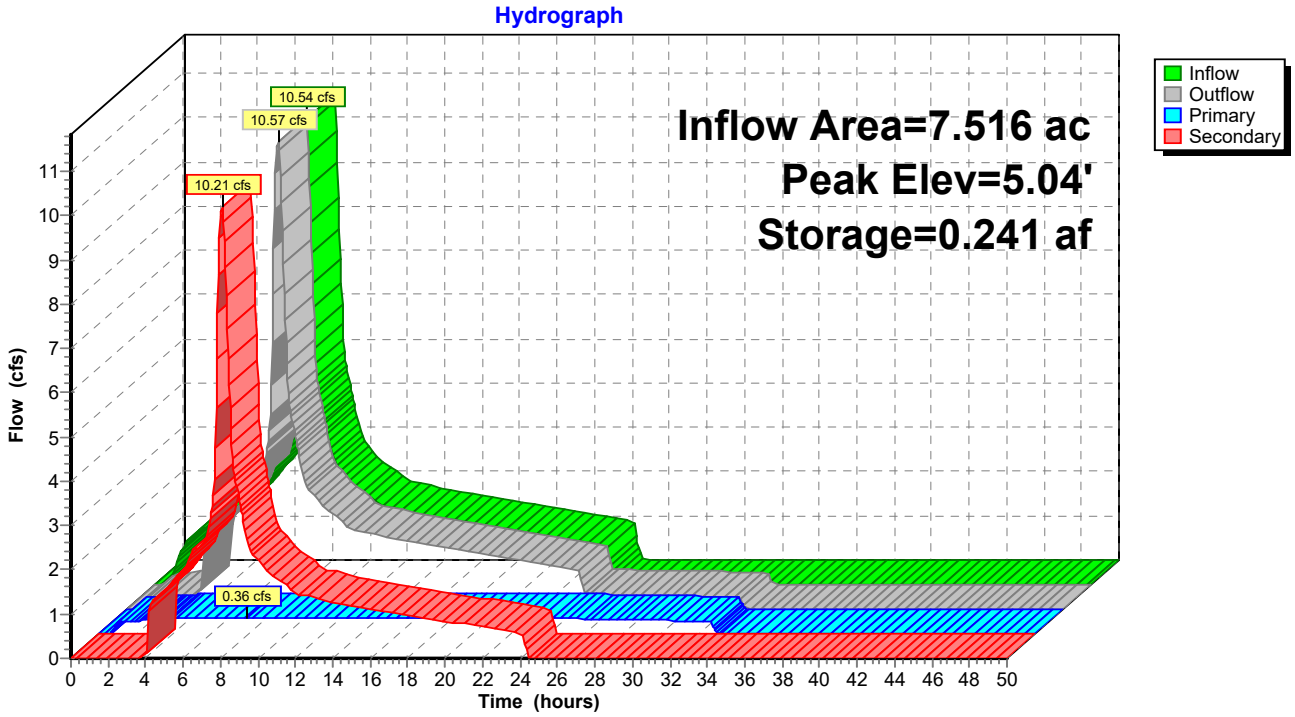
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	**50.00'W x 120.00'L x 5.00'H Infiltration Trench** 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.50'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 7.95 hrs HW=5.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=10.16 cfs @ 8.09 hrs HW=5.04' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 10.16 cfs @ 2.40 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 7P: Node B

[57] Hint: Peaked at 49.80' (Flood elevation advised)
[81] Warning: Exceeded Pond 10P by 49.06' @ 31.35 hrs
[81] Warning: Exceeded Pond 11P by 49.06' @ 33.05 hrs

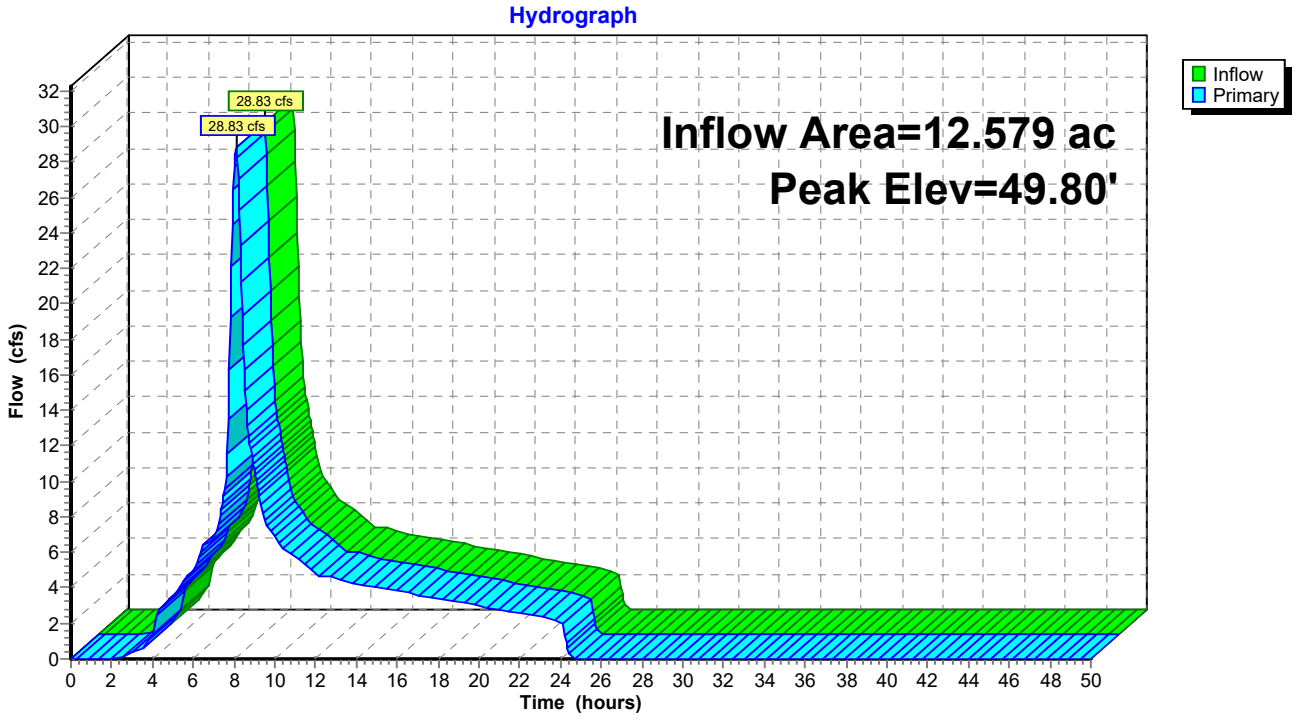
Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 8.37" for 100-year event
Inflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
Outflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af, Atten= 0%, Lag= 0.0 min
Primary = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 49.80' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	**24.0" Round Culvert** L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	49.50'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=28.70 cfs @ 8.09 hrs HW=49.80' TW=49.06' (Fixed TW Elev= 49.06')
1=Culvert (Outlet Controls 9.48 cfs @ 3.02 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 19.22 cfs @ 1.79 fps)

Pond 7P: Node B



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af
Outflow = 0.35 cfs @ 8.09 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.5 min
Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.046 af
Secondary = 0.33 cfs @ 8.09 hrs, Volume= 0.078 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.28' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 56.2 min calculated for 0.124 af (100% of inflow)
Center-of-Mass det. time= 56.3 min (720.4 - 664.0)

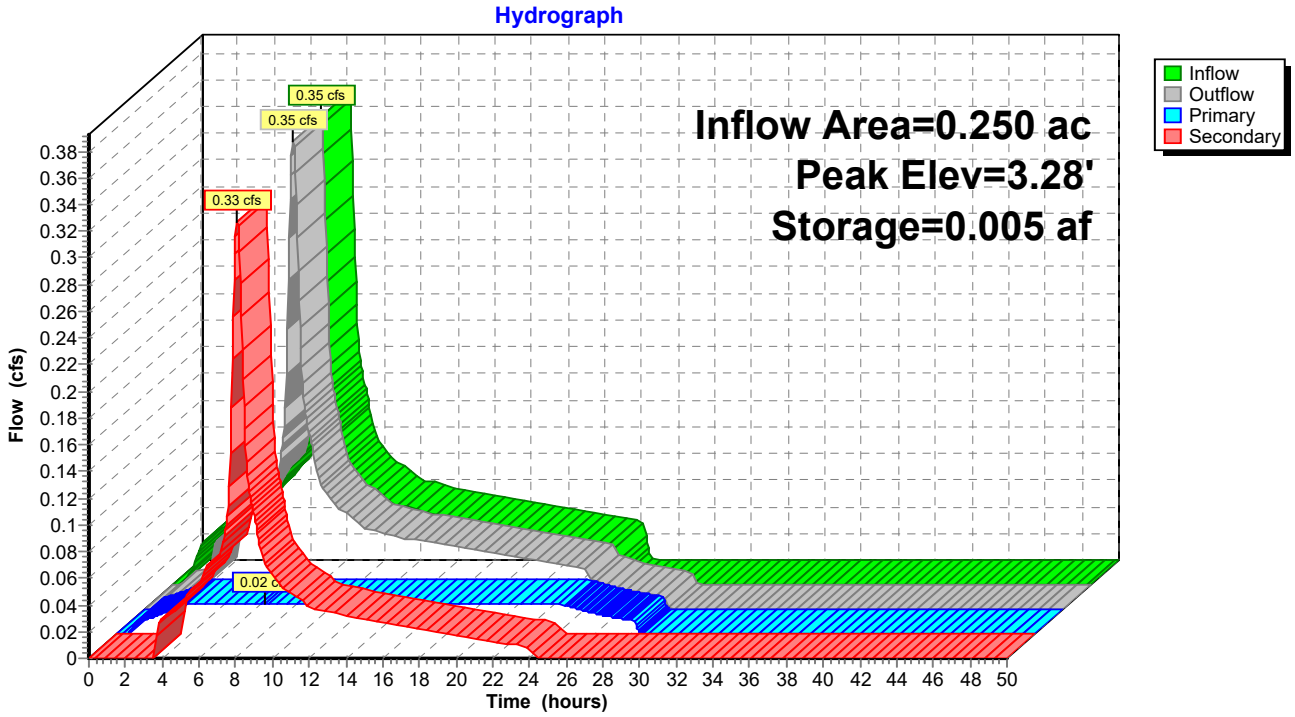
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	**5.00'W x 40.00'L x 5.00'H Bioretention** 0.023 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.32 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
2=Orifice/Grate (Orifice Controls 0.32 cfs @ 1.80 fps)

Pond 10P: Bioretention



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af
Outflow = 3.02 cfs @ 8.12 hrs, Volume= 1.081 af, Atten= 1%, Lag= 2.8 min
Primary = 0.19 cfs @ 8.12 hrs, Volume= 0.364 af
Secondary = 2.82 cfs @ 8.12 hrs, Volume= 0.717 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 5.06' @ 8.12 hrs Surf.Area= 0.031 ac Storage= 0.055 af

Plug-Flow detention time= 61.6 min calculated for 1.080 af (100% of inflow)
Center-of-Mass det. time= 61.8 min (725.8 - 664.0)

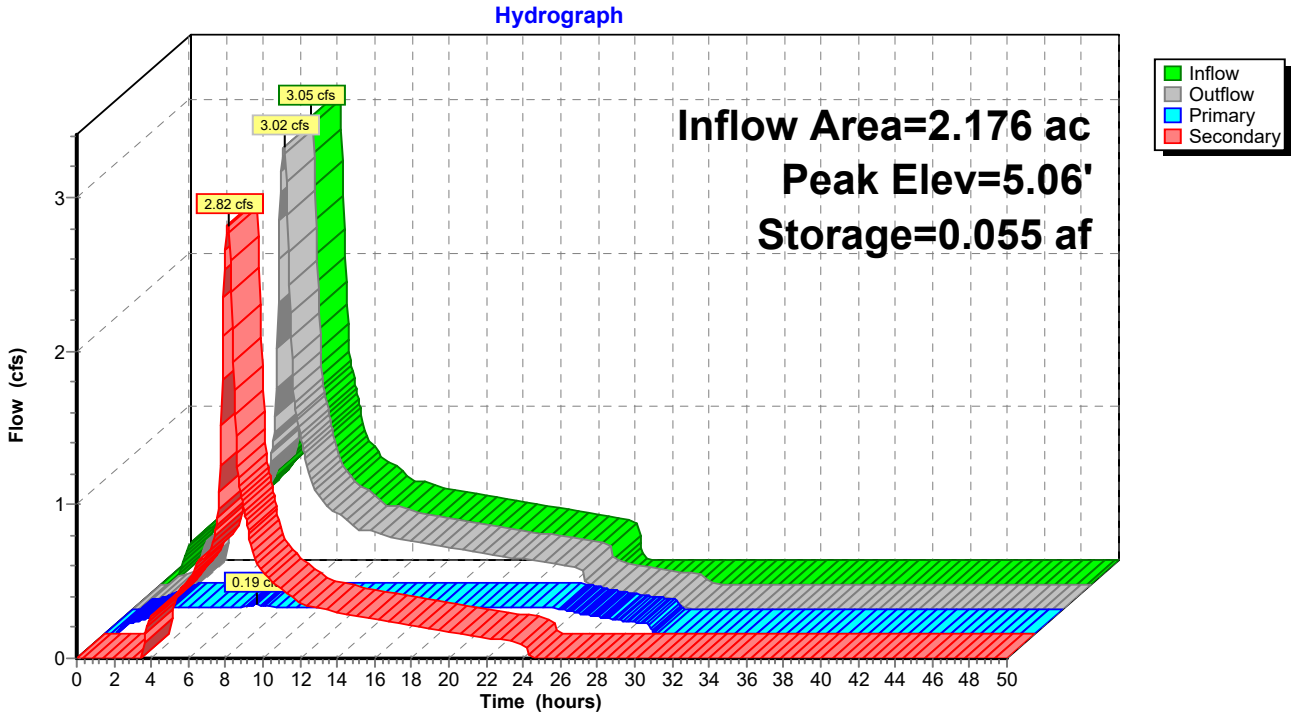
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	**5.00'W x 270.00'L x 6.00'H Bioretention** 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.82 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 2.82 cfs @ 3.59 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 2.78" for 100-year event
Inflow = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af
Outflow = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af, Atten= 67%, Lag= 125.5 min
Primary = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 1.52' @ 10.22 hrs Surf.Area= 0.014 ac Storage= 0.007 af

Plug-Flow detention time= 77.6 min calculated for 0.055 af (100% of inflow)
Center-of-Mass det. time= 77.5 min (908.4 - 830.8)

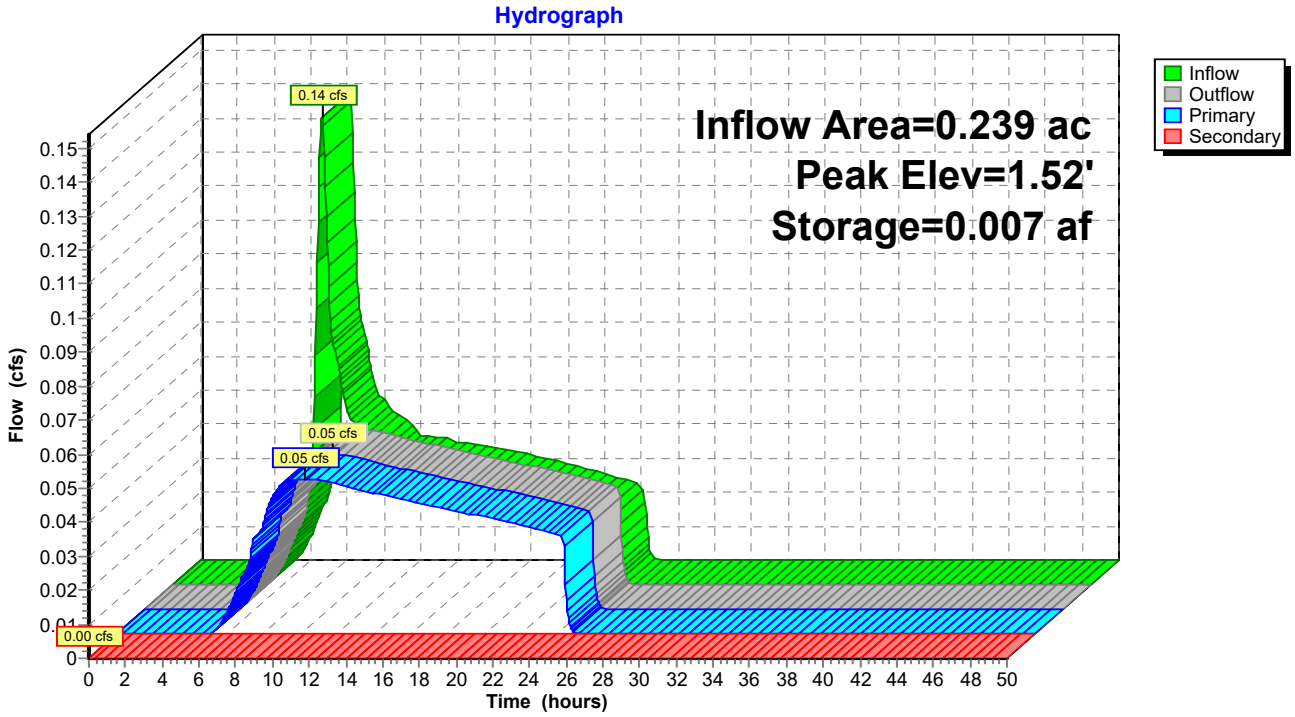
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	**5.00'W x 120.00'L x 5.00'H Bioretention** 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.05 cfs @ 10.22 hrs HW=1.52' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.05 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
2=Orifice/Grate (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 5.27" for 100-year event
Inflow = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af
Outflow = 1.77 cfs @ 8.11 hrs, Volume= 0.605 af, Atten= 0%, Lag= 1.7 min
Primary = 0.09 cfs @ 8.11 hrs, Volume= 0.193 af
Secondary = 1.68 cfs @ 8.11 hrs, Volume= 0.411 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.70' @ 8.11 hrs Surf.Area= 0.028 ac Storage= 0.045 af

Plug-Flow detention time= 91.8 min calculated for 0.604 af (100% of inflow)
Center-of-Mass det. time= 92.1 min (798.9 - 706.8)

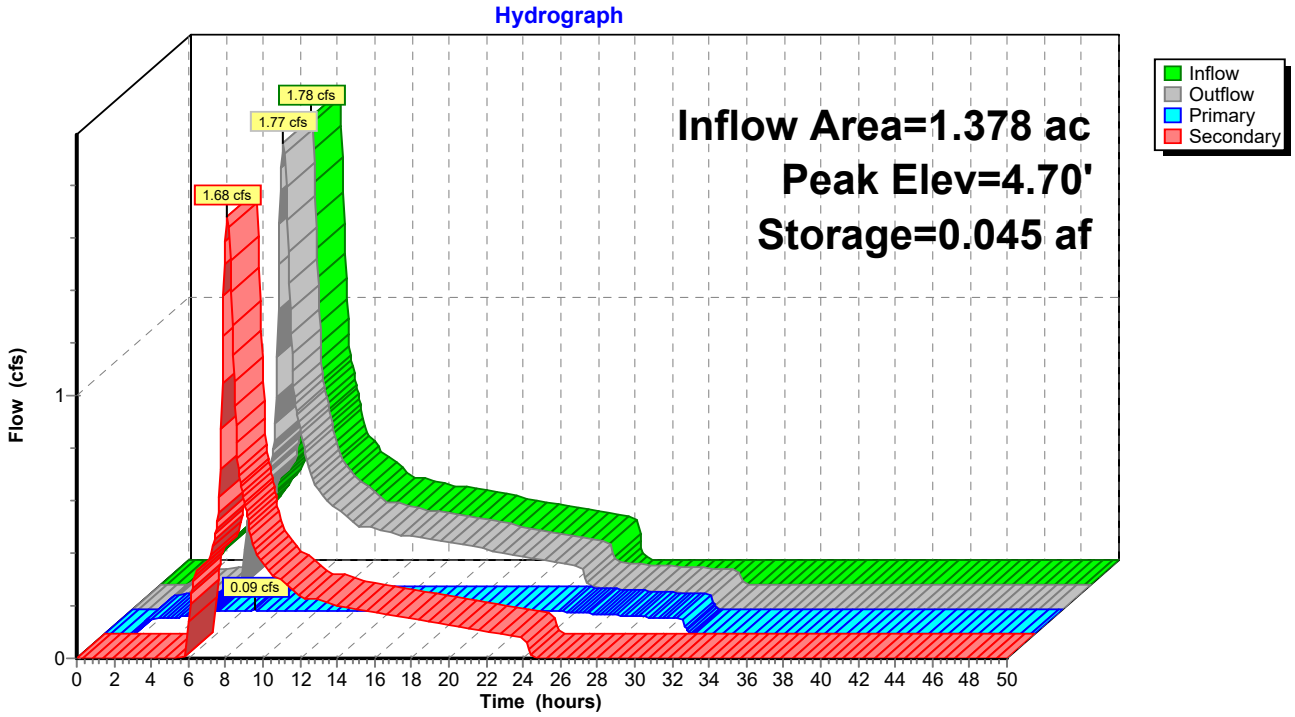
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	**20.00'W x 60.00'L x 6.00'H Infiltration Trench** 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.68 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.68 cfs @ 2.85 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth > 5.88" for 100-year event
Inflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
Outflow = 38.47 cfs @ 8.60 hrs, Volume= 22.657 af, Atten= 5%, Lag= 10.4 min
Primary = 3.58 cfs @ 8.60 hrs, Volume= 8.734 af
Secondary = 34.89 cfs @ 8.60 hrs, Volume= 13.923 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.09' @ 8.60 hrs Surf.Area= 1.674 ac Storage= 2.393 af

Plug-Flow detention time= 123.7 min calculated for 22.657 af (100% of inflow)
Center-of-Mass det. time= 123.7 min (860.1 - 736.4)

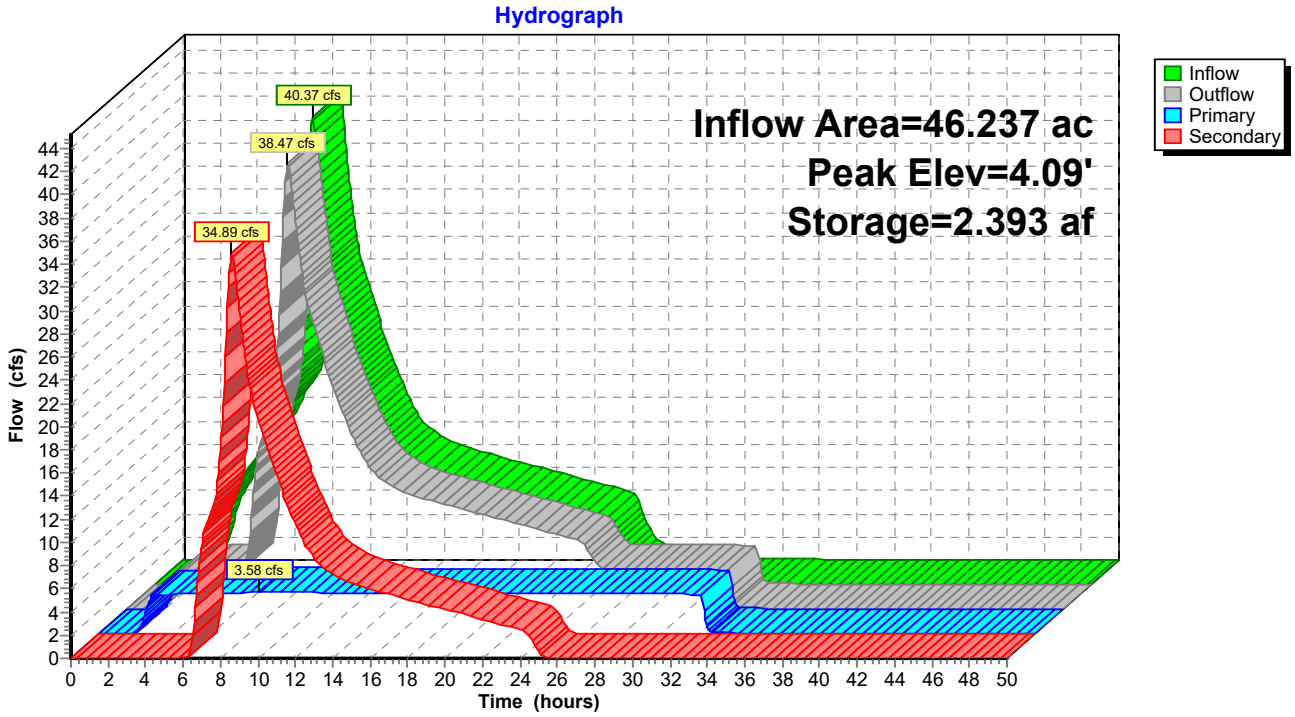
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	**270.00'W x 270.00'L x 5.00'H Infiltration Trench** 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.58 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 3.58 cfs)

Secondary OutFlow Max=34.87 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 34.87 cfs @ 3.41 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[81] Warning: Exceeded Pond 19P by 47.00' @ 49.95 hrs
[79] Warning: Submerged Pond N2 Primary device # 1 INLET by 8.93'

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 9.31" for 100-year event
Inflow = 84.32 cfs @ 8.14 hrs, Volume= 34.599 af
Outflow = 51.54 cfs @ 9.11 hrs, Volume= 28.066 af, Atten= 39%, Lag= 58.0 min
Primary = 48.30 cfs @ 9.11 hrs, Volume= 27.890 af
Secondary = 3.24 cfs @ 9.11 hrs, Volume= 0.176 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 48.12' @ 9.11 hrs Surf.Area= 113,213 sf Storage= 383,550 cf

Plug-Flow detention time= 210.3 min calculated for 28.066 af (81% of inflow)
Center-of-Mass det. time= 94.4 min (829.9 - 735.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

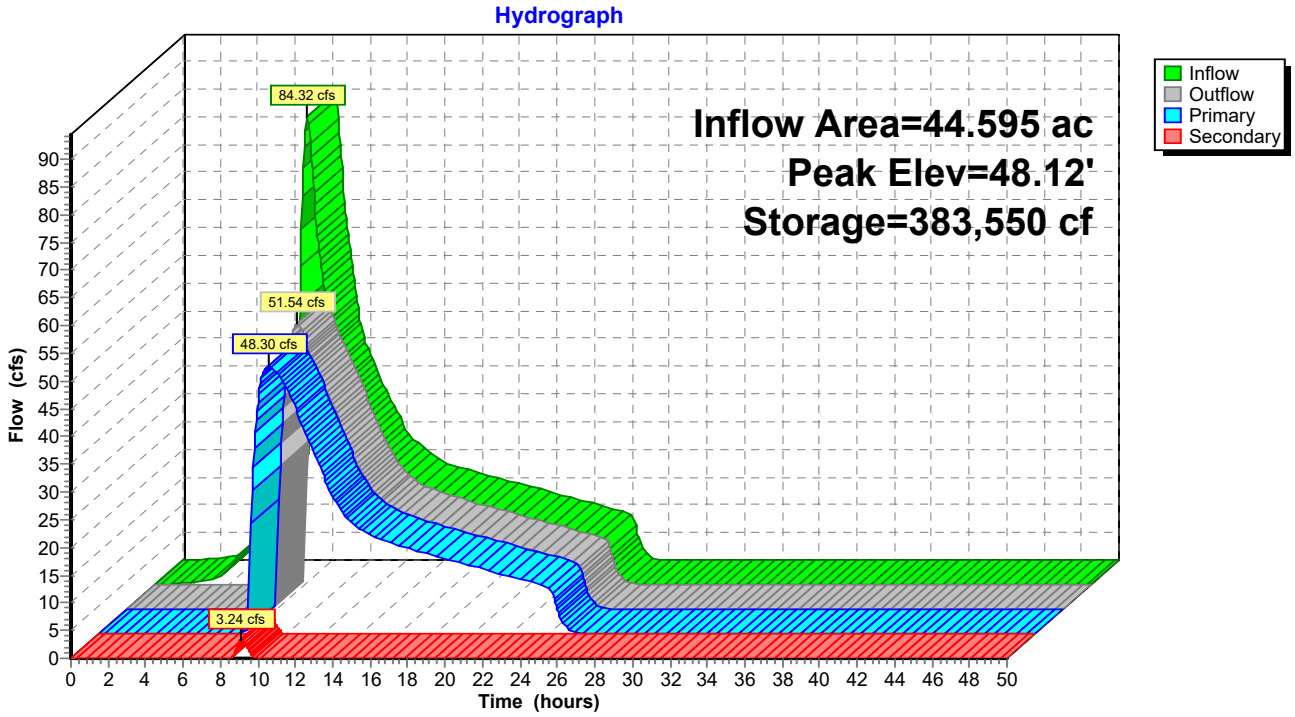
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

Device	Routing	Invert	Outlet Devices
#1	Secondary	48.00'	**30.0' long + 1.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Primary	38.00'	**42.0" Round Culvert** L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 9.62 sf

Primary OutFlow Max=48.31 cfs @ 9.11 hrs HW=48.12' TW=47.00' (Fixed TW Elev= 47.00')
└**2=Culvert** (Outlet Controls 48.31 cfs @ 5.02 fps)

Secondary OutFlow Max=2.99 cfs @ 9.11 hrs HW=48.12' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 2.99 cfs @ 0.82 fps)

Pond N1: Node D



Summary for Pond N2: Node C

[57] Hint: Peaked at 49.06' (Flood elevation advised)
[81] Warning: Exceeded Pond 7P by 7.79' @ 1.75 hrs
[81] Warning: Exceeded Pond 15P by 48.77' @ 7.80 hrs
[81] Warning: Exceeded Pond 16P by 48.12' @ 1.45 hrs

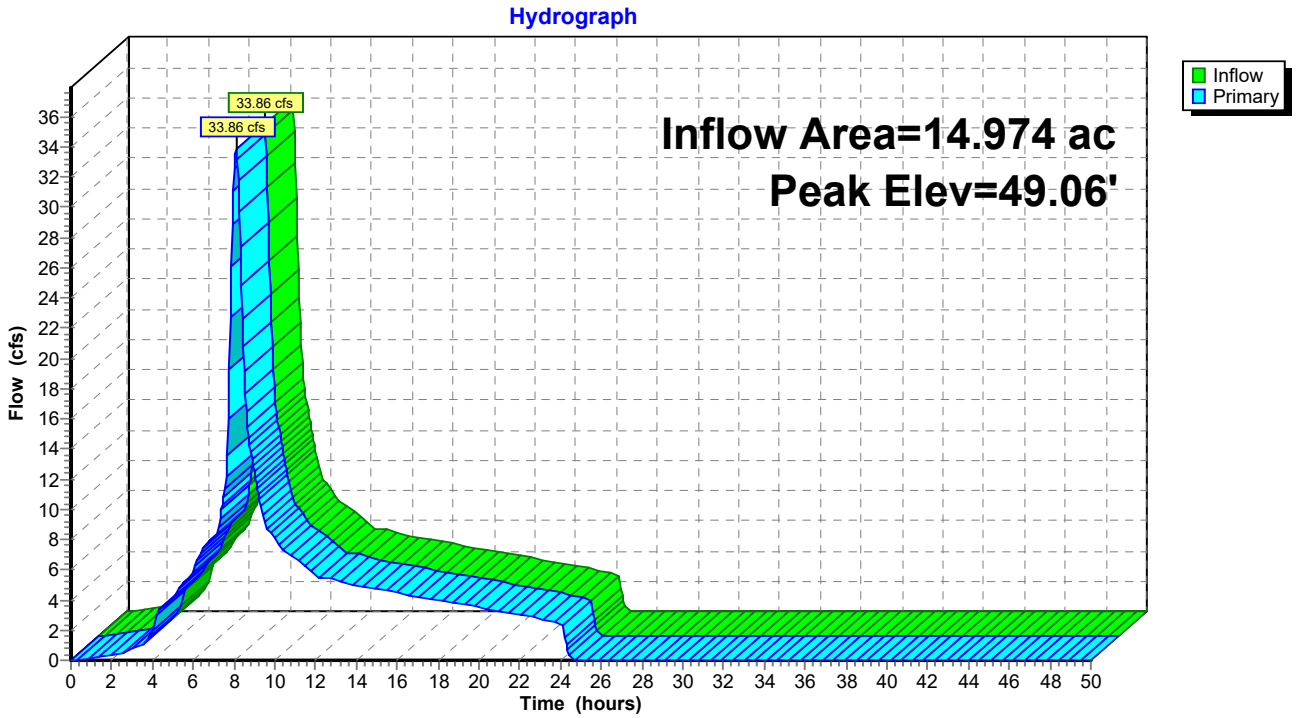
Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 8.32" for 100-year event
Inflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
Outflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af, Atten= 0%, Lag= 0.0 min
Primary = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 49.06' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	**30.0" Round Culvert** L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf
#2	Primary	48.80'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=33.77 cfs @ 8.09 hrs HW=49.06' TW=48.12' (Fixed TW Elev= 48.12')
1=Culvert (Outlet Controls 18.13 cfs @ 3.69 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 15.64 cfs @ 1.67 fps)

Pond N2: Node C



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.57' (Flood elevation advised)
[81] Warning: Exceeded Pond 4P by 49.80' @ 31.55 hrs
[81] Warning: Exceeded Pond 5P by 49.80' @ 35.95 hrs

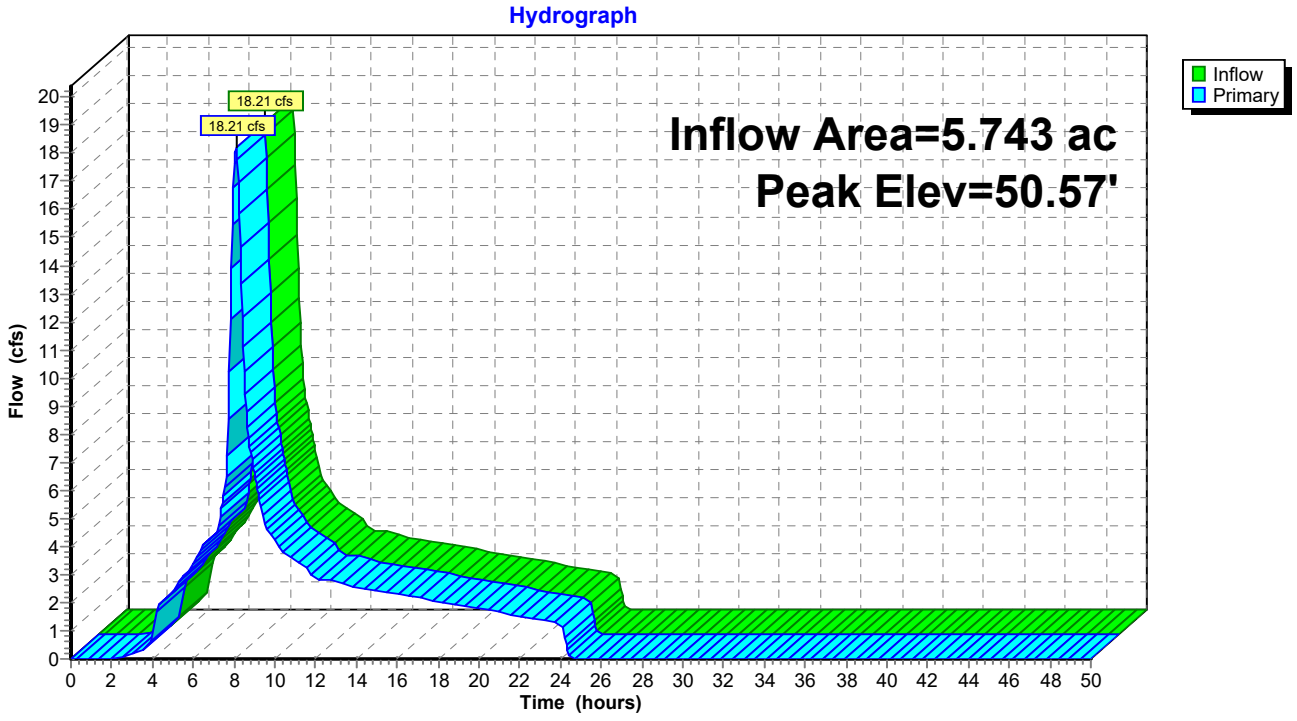
Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 11.34" for 100-year event
Inflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
Outflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af, Atten= 0%, Lag= 0.0 min
Primary = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
Routed to Pond 7P : Node B

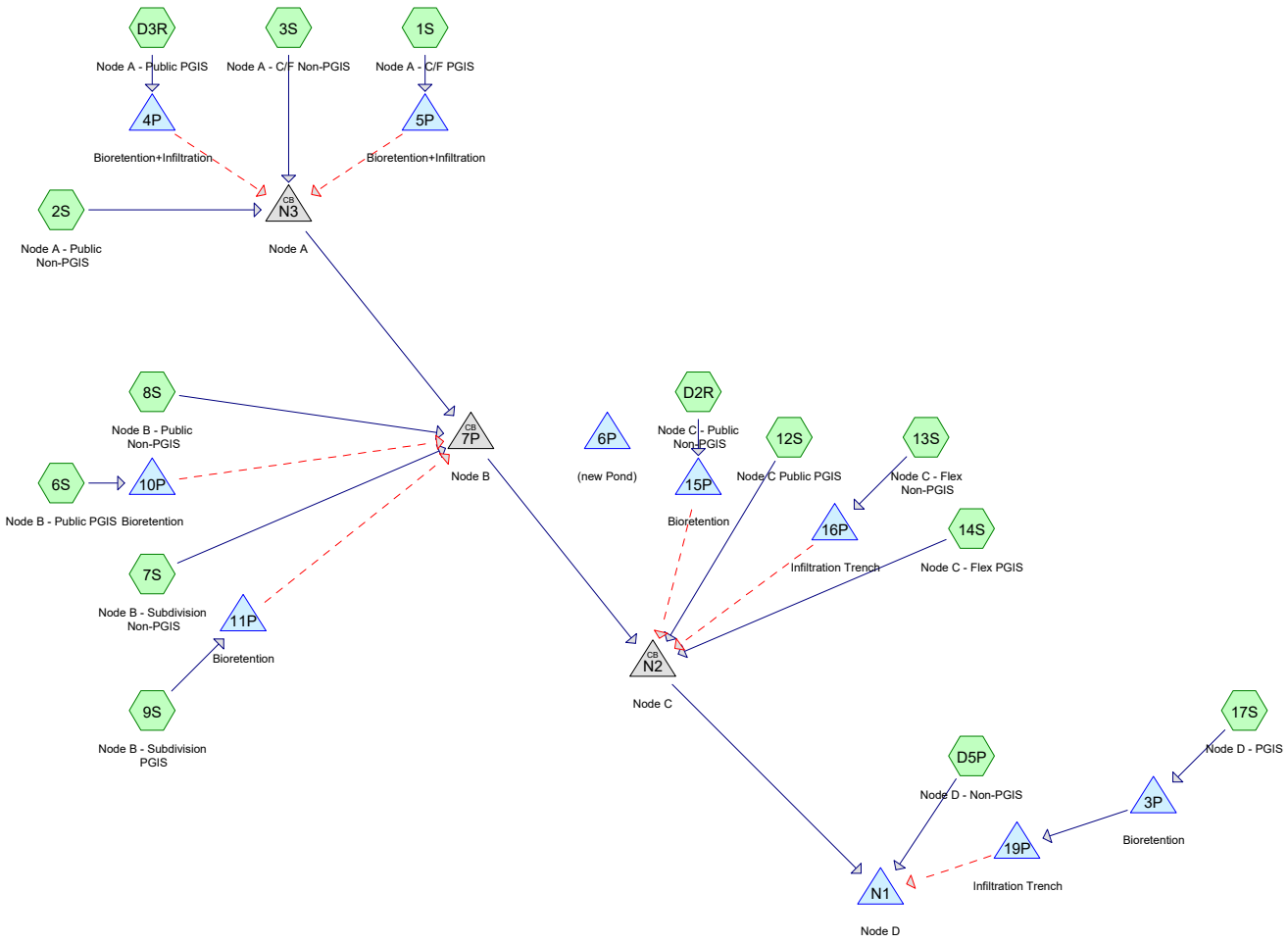
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 50.57' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	**24.0" Round Culvert** L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	50.40'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=17.91 cfs @ 8.09 hrs HW=50.57' TW=49.80' (Fixed TW Elev= 49.80')
1=Culvert (Outlet Controls 9.77 cfs @ 3.11 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 8.14 cfs @ 1.34 fps)

Pond N3: Node A





Subcat Reach Pond Link

Routing Diagram for ALTERNATE _Onsite 100-Year Storm Flooded and Closed

Prepared by MacKay & Sposito, Inc, Printed 2/10/2025

HydroCAD® 10.20-5c s/n 01662 © 2023 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	**38.896**	**0.000**	**0.000**	**0.000**	**104.075**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N2	39.19	37.96	410.7	0.0030	0.012	0.0	30.0	0.0	
3	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=10.54 cfs 3.734 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.97"
Tc=20.0 min CN=59 Runoff=0.38 cfs 0.190 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=4.82"
Tc=20.0 min CN=88 Runoff=5.43 cfs 1.840 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=0.35 cfs 0.124 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=4.49"
Tc=20.0 min CN=85 Runoff=7.39 cfs 2.525 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=3.86"
Tc=20.0 min CN=79 Runoff=0.08 cfs 0.029 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=3.05 cfs 1.081 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=1.00 cfs 0.353 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=5.27"
Tc=20.0 min CN=92 Runoff=1.78 cfs 0.605 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=64.81 cfs 22.971 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=2.78"
Tc=20.0 min CN=68 Runoff=0.14 cfs 0.055 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=4.17"
Tc=20.0 min CN=82 Runoff=29.72 cfs 10.297 af

Pond 3P: Bioretention Peak Elev=54.89' Storage=3.301 af Inflow=64.81 cfs 22.971 af
Outflow=40.37 cfs 22.657 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.84' Storage=0.039 af Inflow=2.36 cfs 0.837 af
Primary=0.15 cfs 0.283 af Secondary=2.20 cfs 0.554 af Outflow=2.35 cfs 0.837 af

Pond 5P: Bioretention+Infiltration Peak Elev=5.04' Storage=0.241 af Inflow=10.54 cfs 3.734 af
Primary=0.36 cfs 0.890 af Secondary=10.21 cfs 2.844 af Outflow=10.57 cfs 3.734 af

Pond 6P: (new Pond)

Pond 7P: Node B Peak Elev=49.80' Inflow=28.83 cfs 8.778 af
Outflow=28.83 cfs 8.778 af

Pond 10P: Bioretention Peak Elev=3.28' Storage=0.005 af Inflow=0.35 cfs 0.124 af
Primary=0.02 cfs 0.046 af Secondary=0.33 cfs 0.078 af Outflow=0.35 cfs 0.124 af

Pond 11P: Bioretention Peak Elev=5.06' Storage=0.055 af Inflow=3.05 cfs 1.081 af
Primary=0.19 cfs 0.364 af Secondary=2.82 cfs 0.717 af Outflow=3.02 cfs 1.081 af

Pond 15P: Bioretention Peak Elev=1.52' Storage=0.007 af Inflow=0.14 cfs 0.055 af
Primary=0.05 cfs 0.055 af Secondary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.055 af

Pond 16P: Infiltration Trench Peak Elev=4.70' Storage=0.045 af Inflow=1.78 cfs 0.605 af
Primary=0.09 cfs 0.193 af Secondary=1.68 cfs 0.411 af Outflow=1.77 cfs 0.605 af

Pond 19P: Infiltration Trench Peak Elev=4.09' Storage=2.393 af Inflow=40.37 cfs 22.657 af
Primary=3.58 cfs 8.734 af Secondary=34.89 cfs 13.923 af Outflow=38.47 cfs 22.657 af

Pond N1: Node D Peak Elev=48.85' Storage=142,568 cf Inflow=84.32 cfs 34.599 af
Outflow=64.36 cfs 34.599 af

Pond N2: Node C Peak Elev=49.14' Inflow=33.86 cfs 10.379 af
Outflow=33.86 cfs 10.379 af

Pond N3: Node A Peak Elev=50.57' Inflow=18.21 cfs 5.428 af
Outflow=18.21 cfs 5.428 af

Total Runoff Area = 104.075 ac Runoff Volume = 45.478 af Average Runoff Depth = 5.24"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

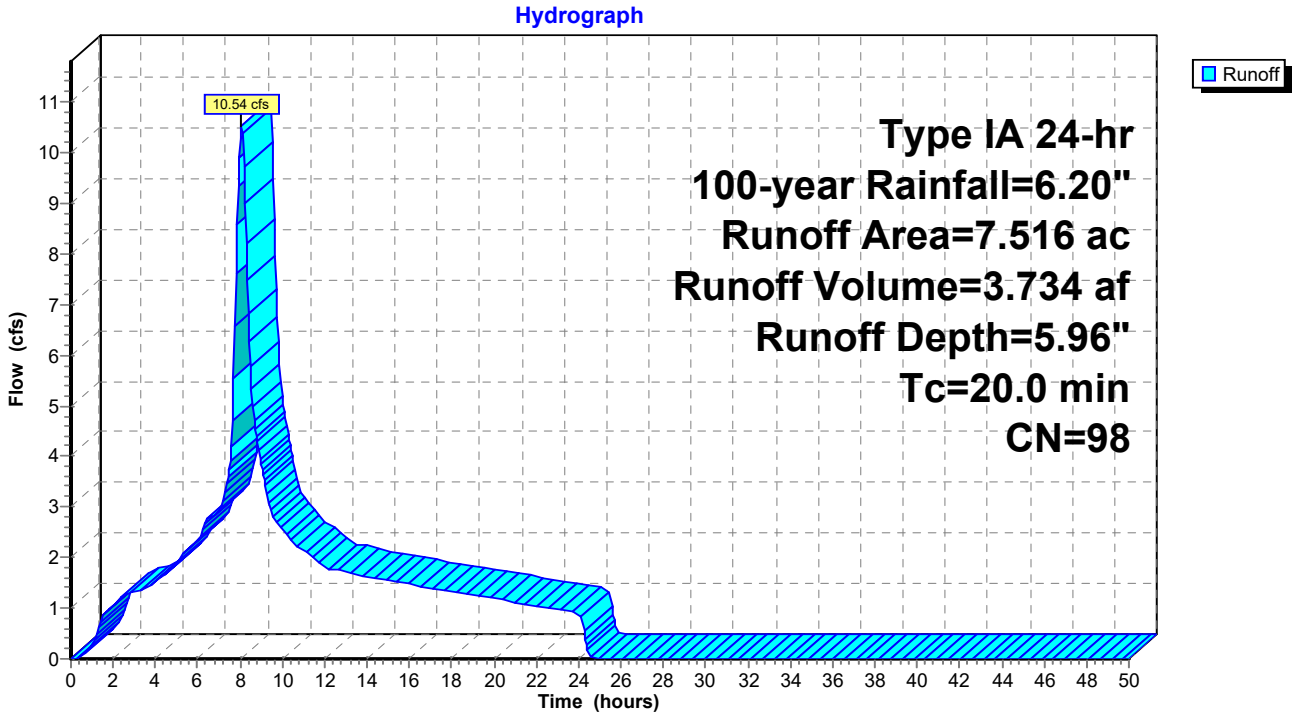
Runoff = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af, Depth= 5.96"
Routed to Pond 5P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 1S: Node A - C/F PGIS



Summary for Subcatchment 2S: Node A - Public Non-PGIS

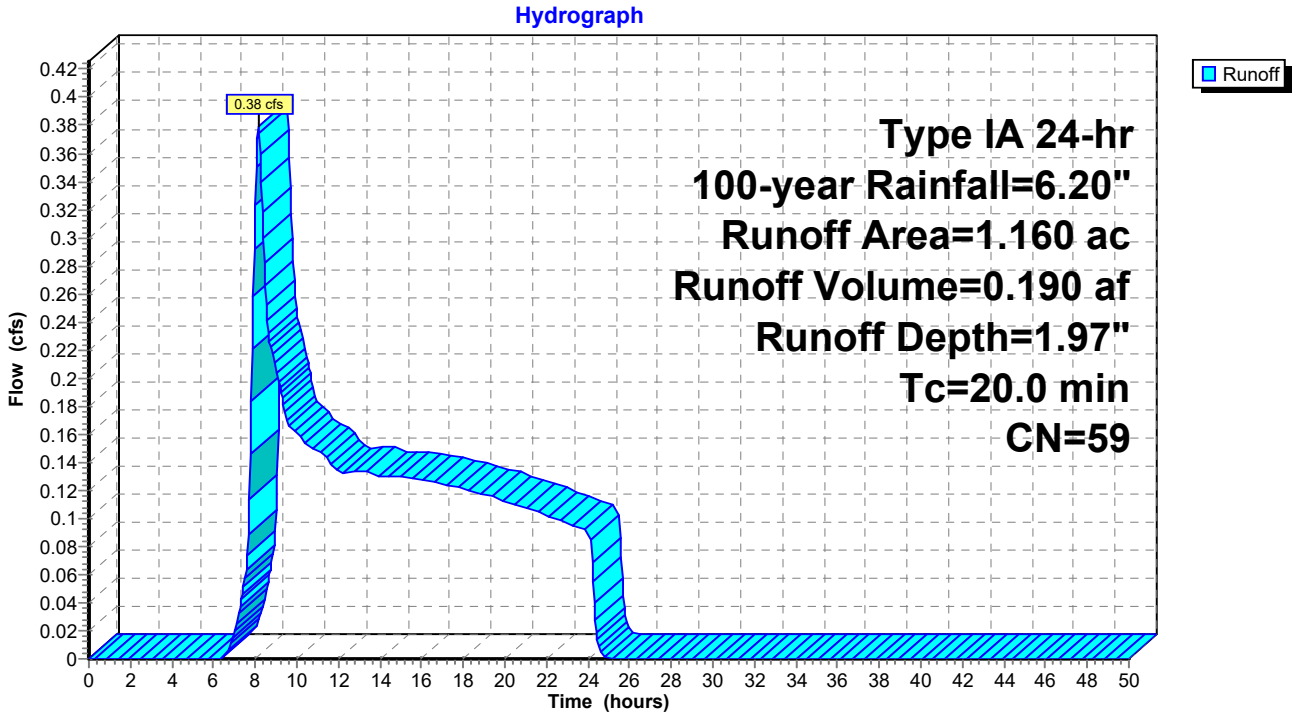
Runoff = 0.38 cfs @ 8.16 hrs, Volume= 0.190 af, Depth= 1.97"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
	1.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 2S: Node A - Public Non-PGIS



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

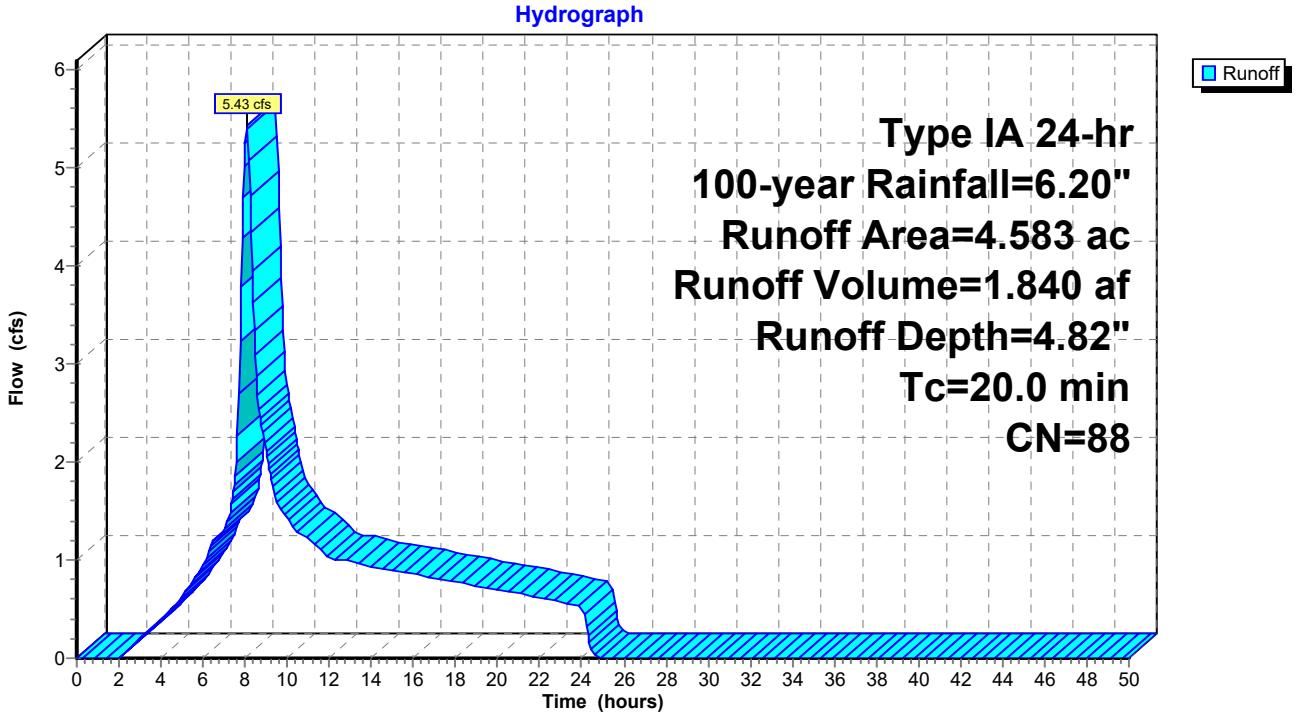
Runoff = 5.43 cfs @ 8.09 hrs, Volume= 1.840 af, Depth= 4.82"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
	3.373	98	Roofs, HSG A
	4.583	88	Weighted Average
	1.210		26.40% Pervious Area
	3.373		73.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 3S: Node A - C/F Non-PGIS



Summary for Subcatchment 6S: Node B - Public PGIS

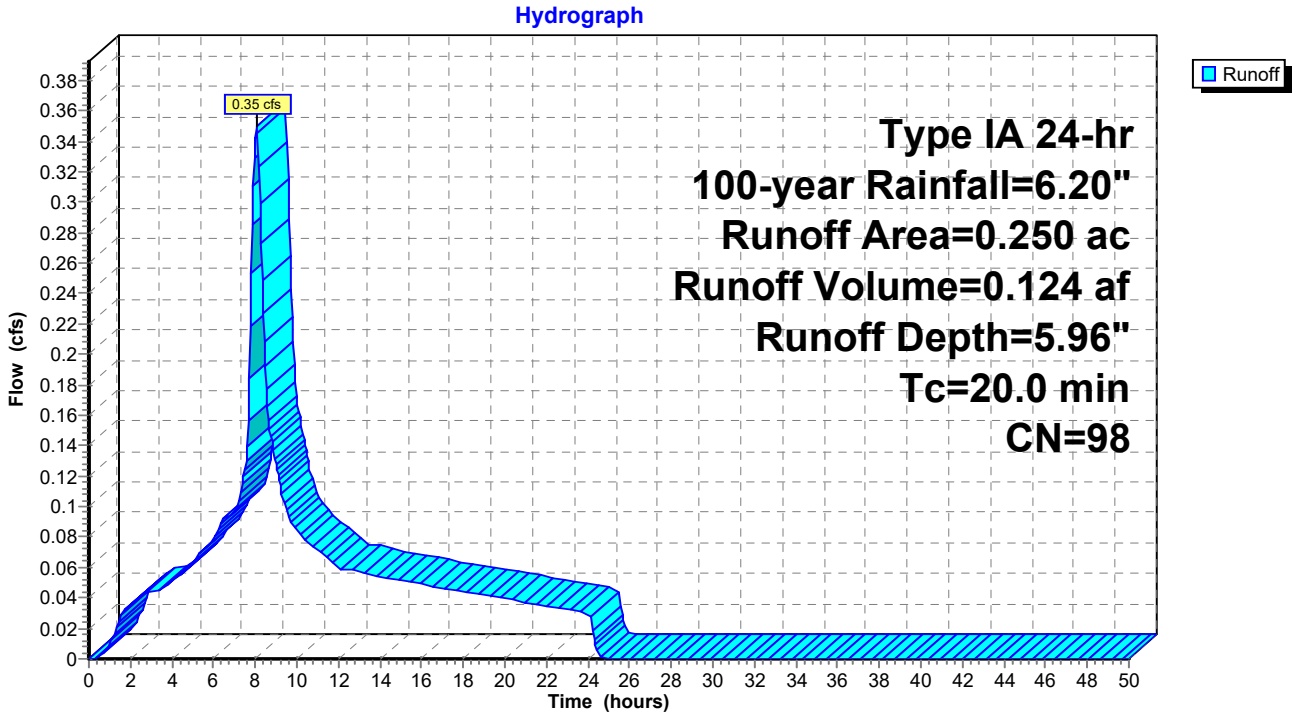
Runoff = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af, Depth= 5.96"
Routed to Pond 10P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 6S: Node B - Public PGIS



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

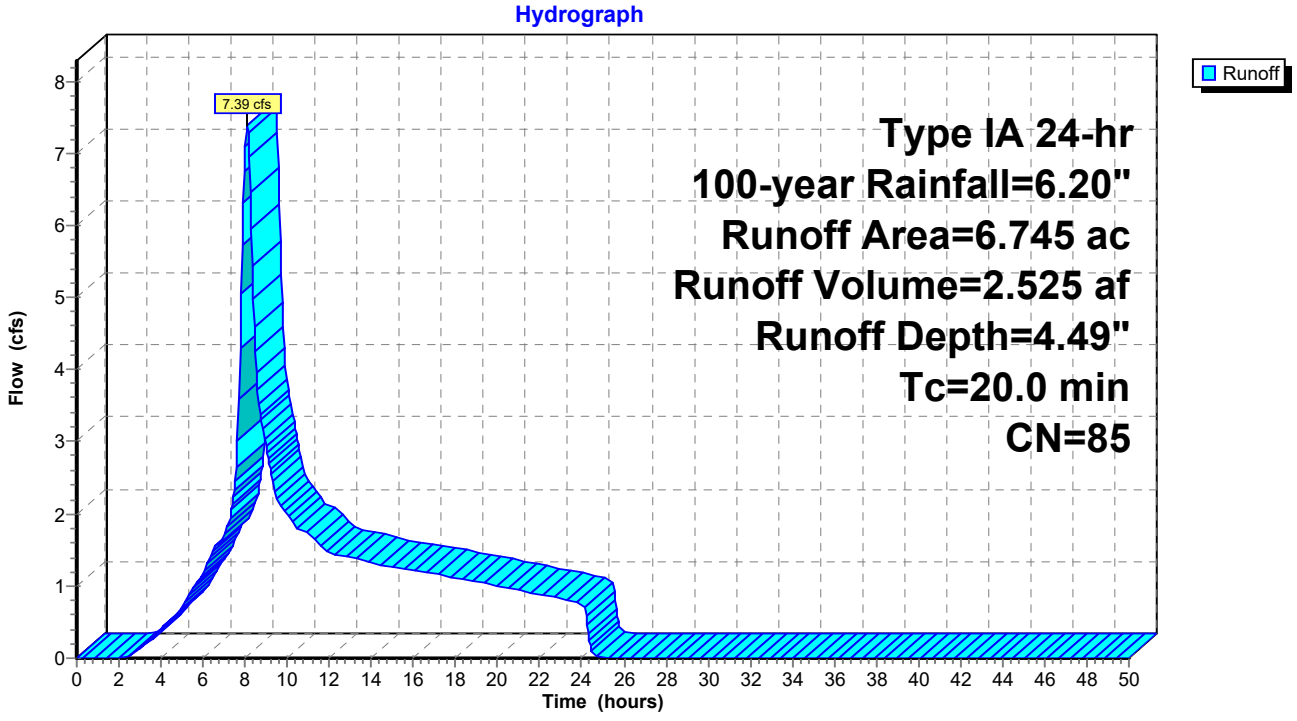
Runoff = 7.39 cfs @ 8.09 hrs, Volume= 2.525 af, Depth= 4.49"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 7S: Node B - Subdivision Non-PGIS



Summary for Subcatchment 8S: Node B - Public Non-PGIS

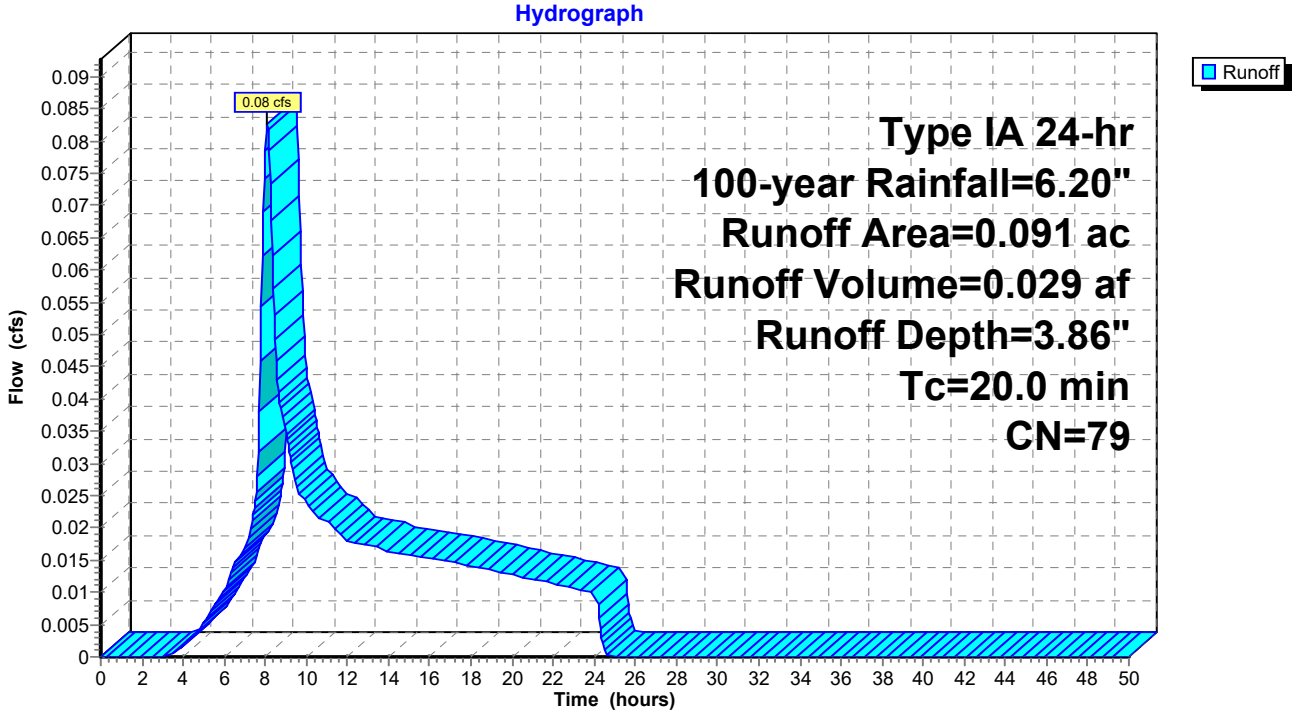
Runoff = 0.08 cfs @ 8.11 hrs, Volume= 0.029 af, Depth= 3.86"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 8S: Node B - Public Non-PGIS



Summary for Subcatchment 9S: Node B - Subdivision PGIS

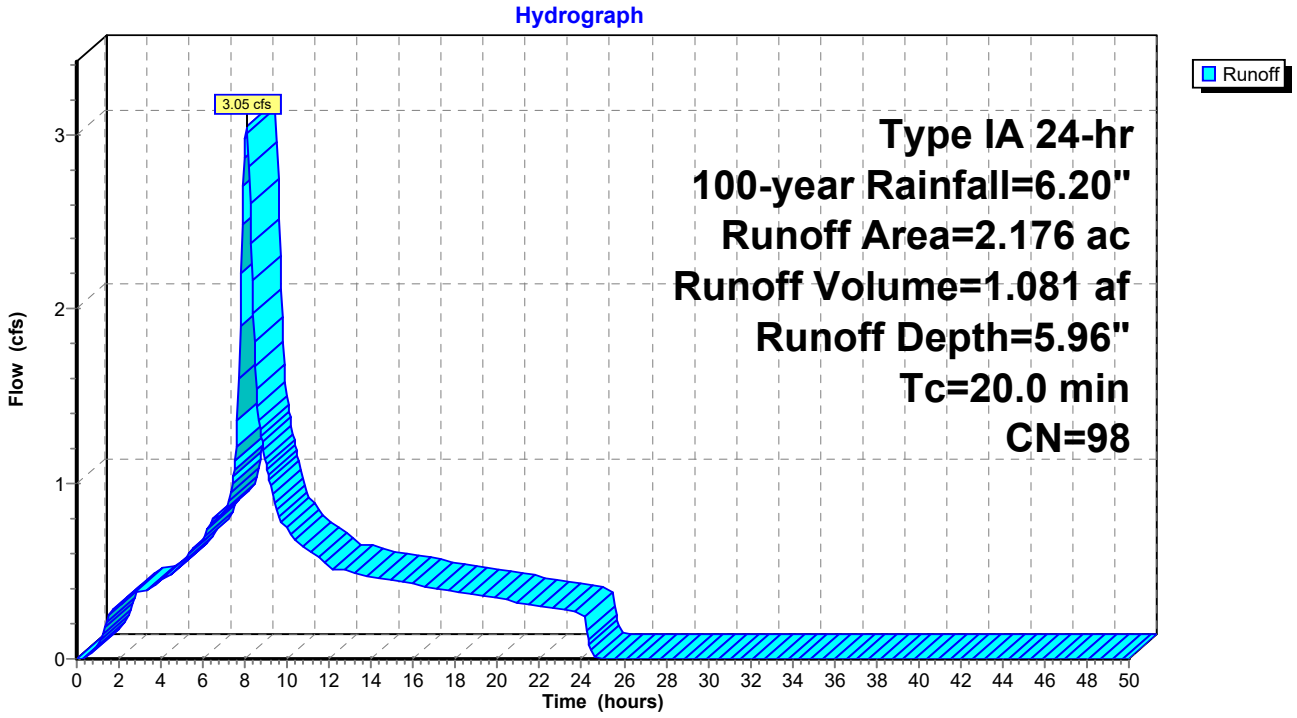
Runoff = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af, Depth= 5.96"
Routed to Pond 11P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 9S: Node B - Subdivision PGIS



Summary for Subcatchment 12S: Node C Public PGIS

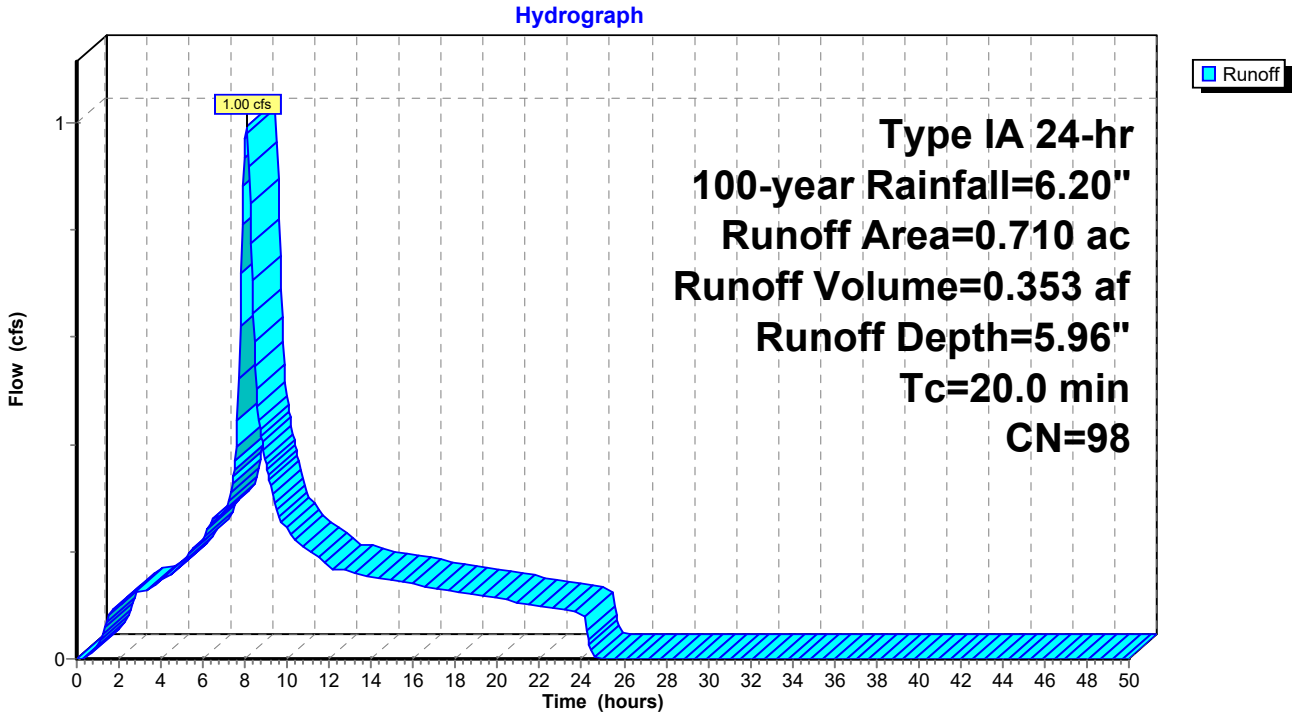
Runoff = 1.00 cfs @ 8.08 hrs, Volume= 0.353 af, Depth= 5.96"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 12S: Node C Public PGIS



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

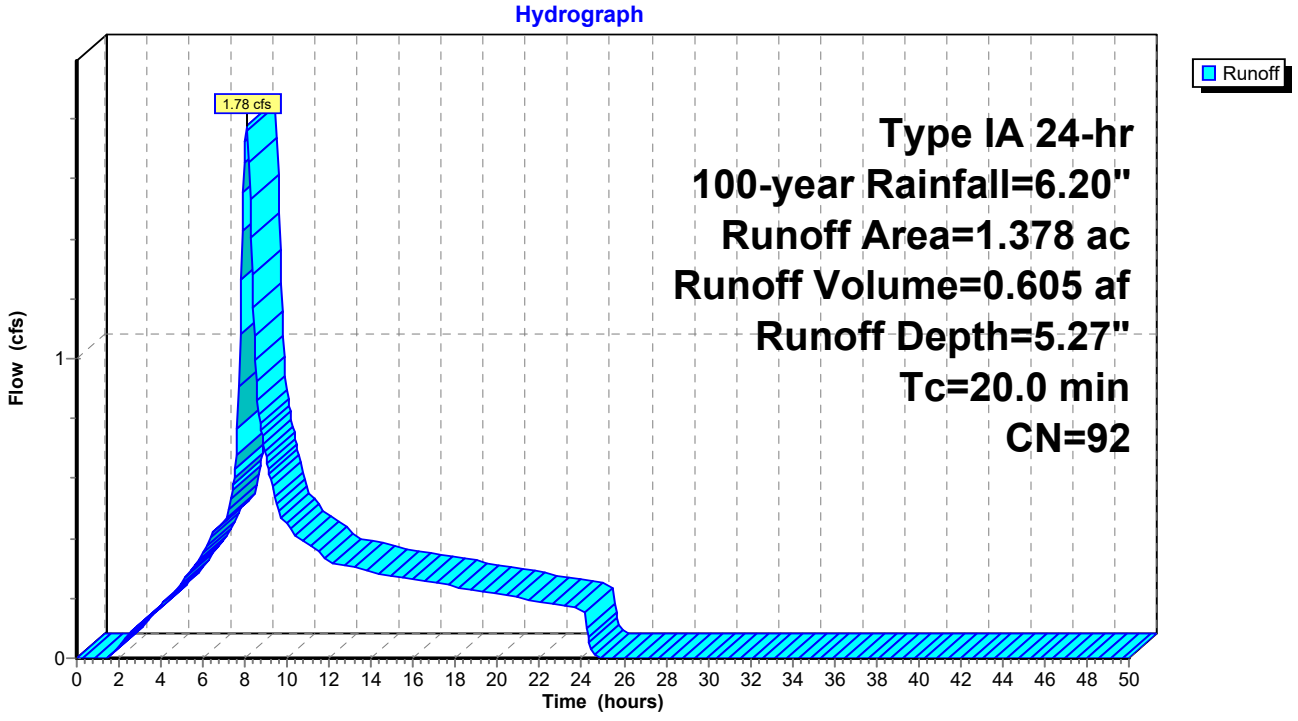
Runoff = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af, Depth= 5.27"
Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

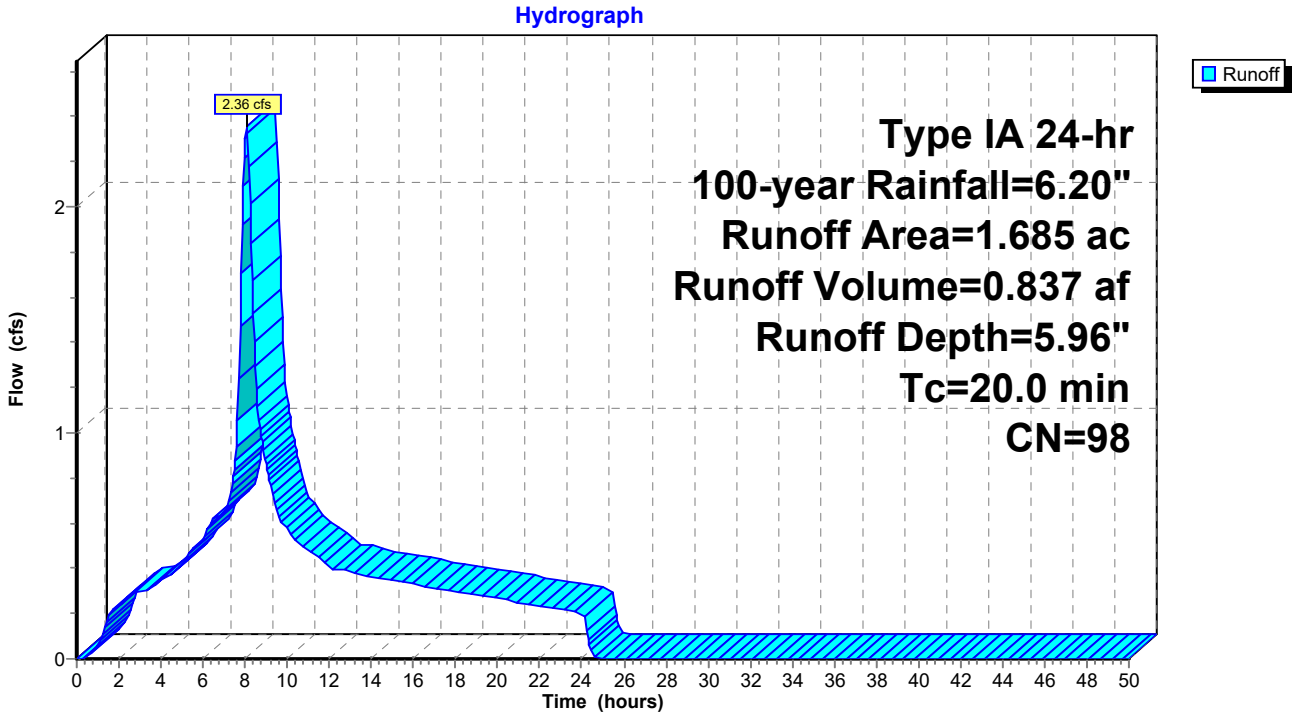
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 14S: Node C - Flex PGIS



Summary for Subcatchment 17S: Node D - PGIS

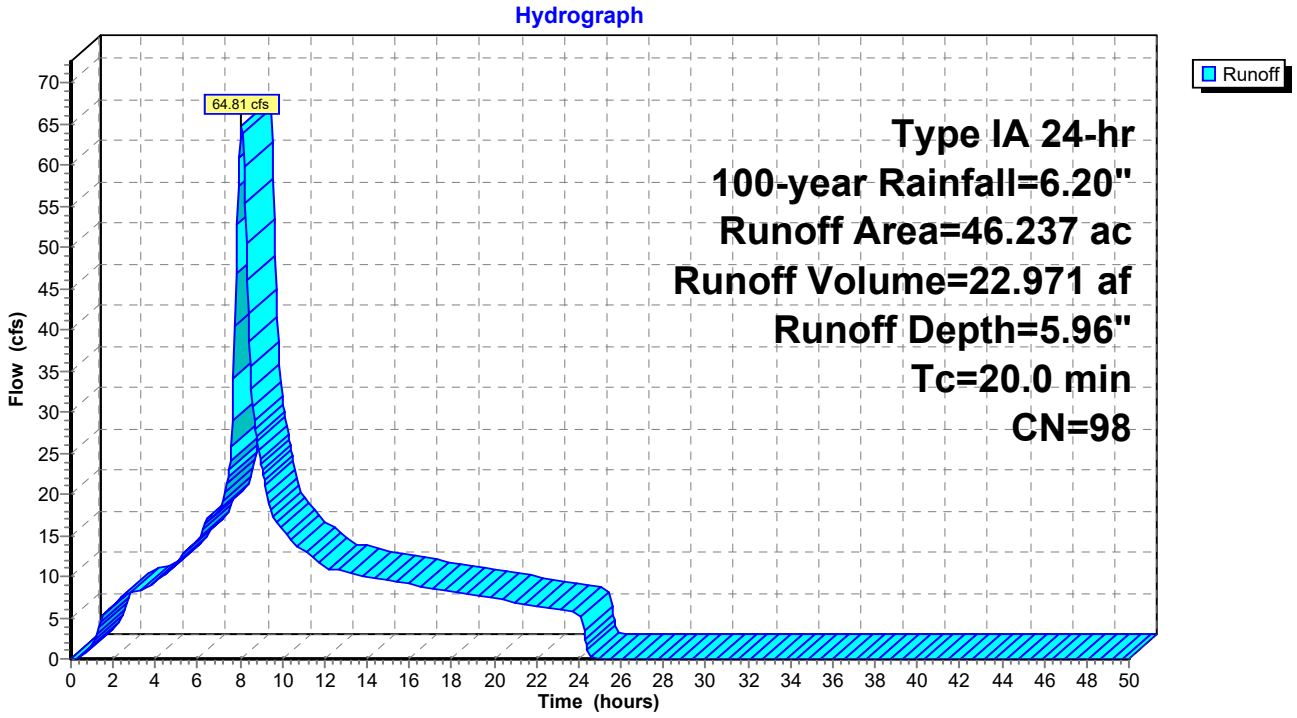
Runoff = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af, Depth= 5.96"
Routed to Pond 3P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 17S: Node D - PGIS



Summary for Subcatchment D2R: Node C - Public Non-PGIS

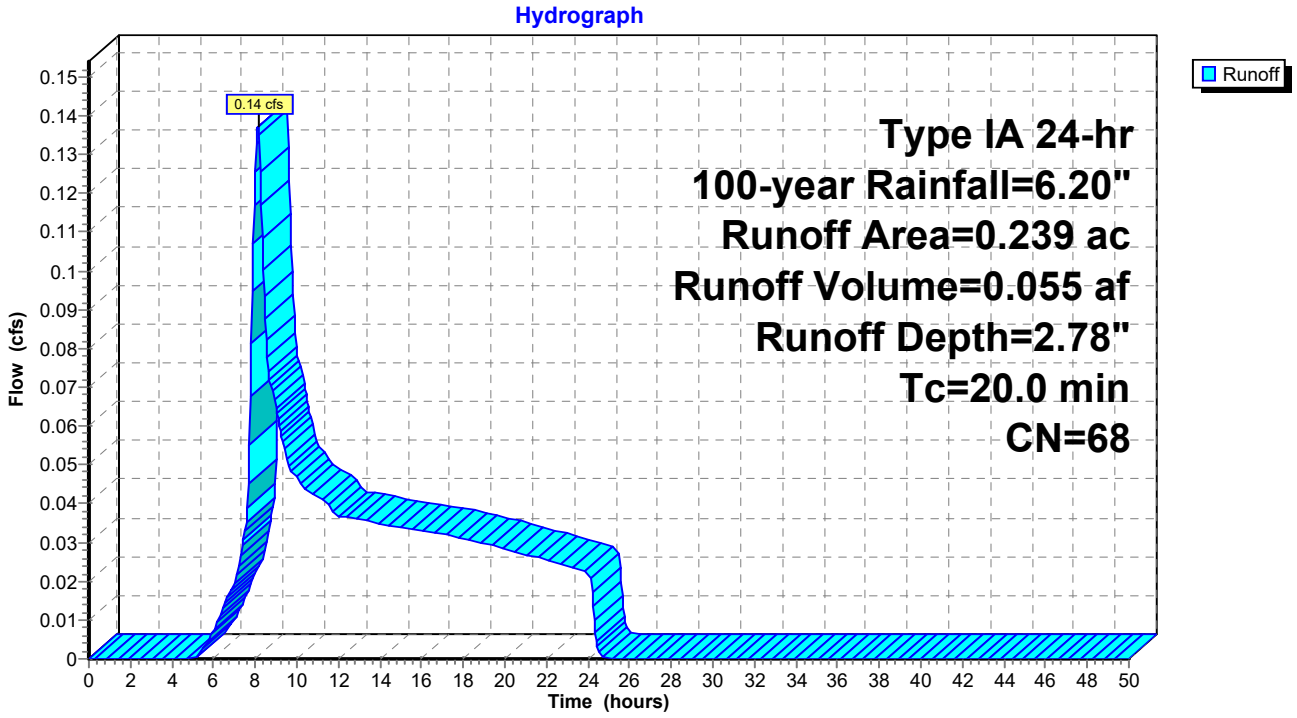
Runoff = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af, Depth= 2.78"
Routed to Pond 15P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D2R: Node C - Public Non-PGIS



Summary for Subcatchment D3R: Node A - Public PGIS

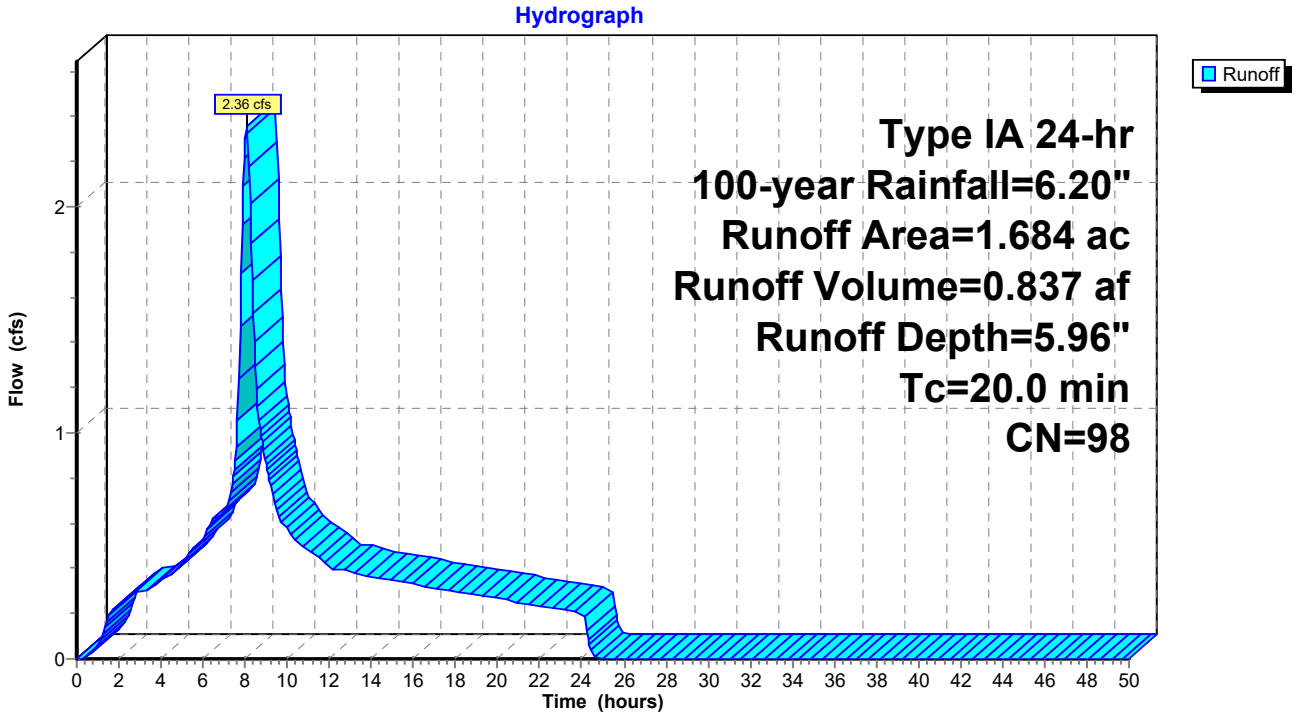
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

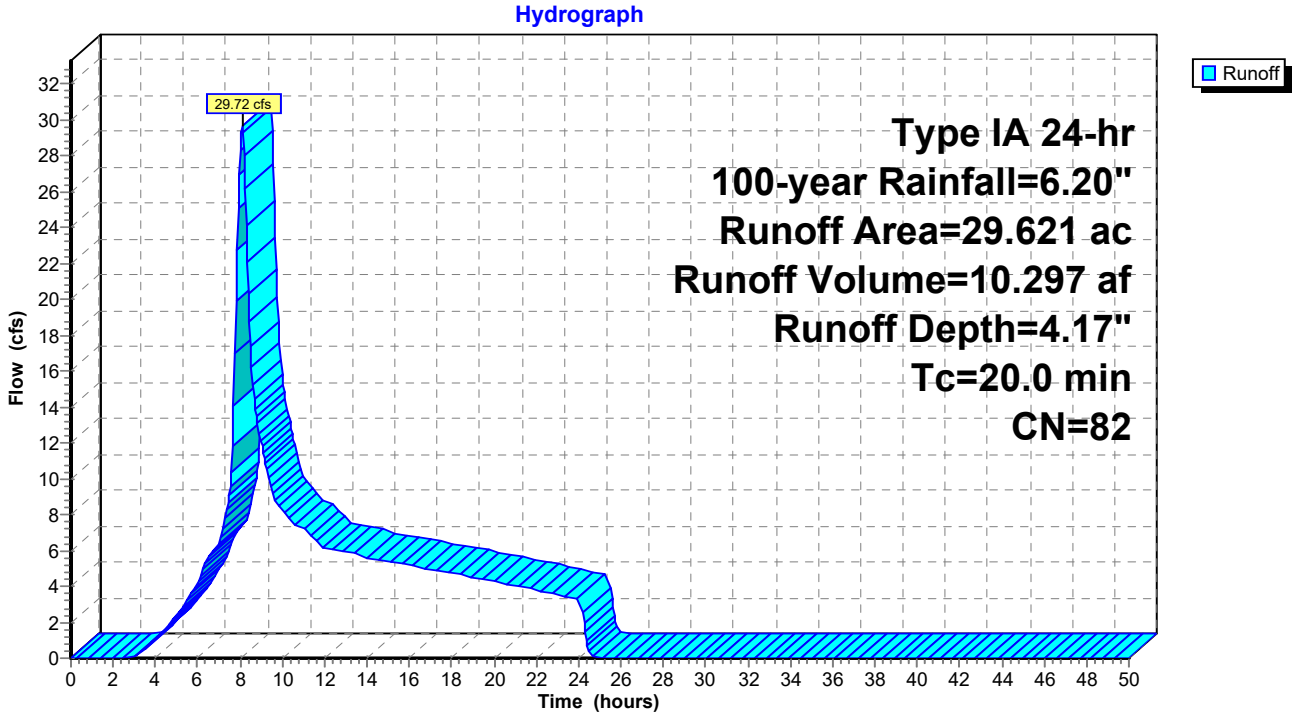
Runoff = 29.72 cfs @ 8.10 hrs, Volume= 10.297 af, Depth= 4.17"
Routed to Pond N1 : Node D

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment D5P: Node D - Non-PGIS



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af
Outflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af, Atten= 38%, Lag= 20.8 min
Primary = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 54.89' @ 8.42 hrs Surf.Area= 1.674 ac Storage= 3.301 af

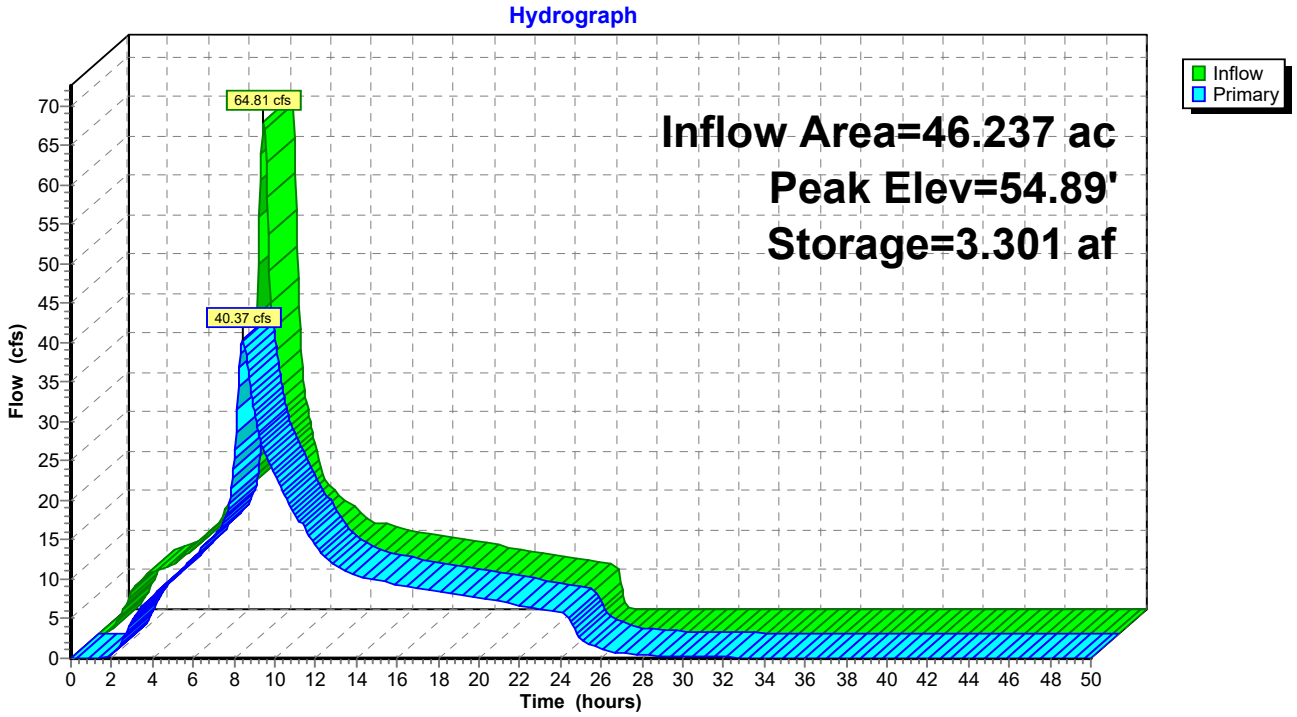
Plug-Flow detention time= 83.2 min calculated for 22.657 af (99% of inflow)
Center-of-Mass det. time= 72.4 min (736.4 - 664.0)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	**270.00'W x 270.00'L x 6.50'H Prismatoid** 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	**270.00'W x 270.00'L x 2.00'H Prismatoid** Inside #1
#3	50.50'	0.019 af	**24.0" Round Pipe Storage** Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	**60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=40.28 cfs @ 8.42 hrs HW=54.89' (Free Discharge)
1=Orifice/Grate (Weir Controls 12.44 cfs @ 2.04 fps)
2=Orifice/Grate (Orifice Controls 27.85 cfs @ 8.86 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af
Outflow = 2.35 cfs @ 8.11 hrs, Volume= 0.837 af, Atten= 1%, Lag= 1.8 min
Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.283 af
Secondary = 2.20 cfs @ 8.11 hrs, Volume= 0.554 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.84' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.039 af

Plug-Flow detention time= 55.2 min calculated for 0.836 af (100% of inflow)
Center-of-Mass det. time= 55.4 min (719.4 - 664.0)

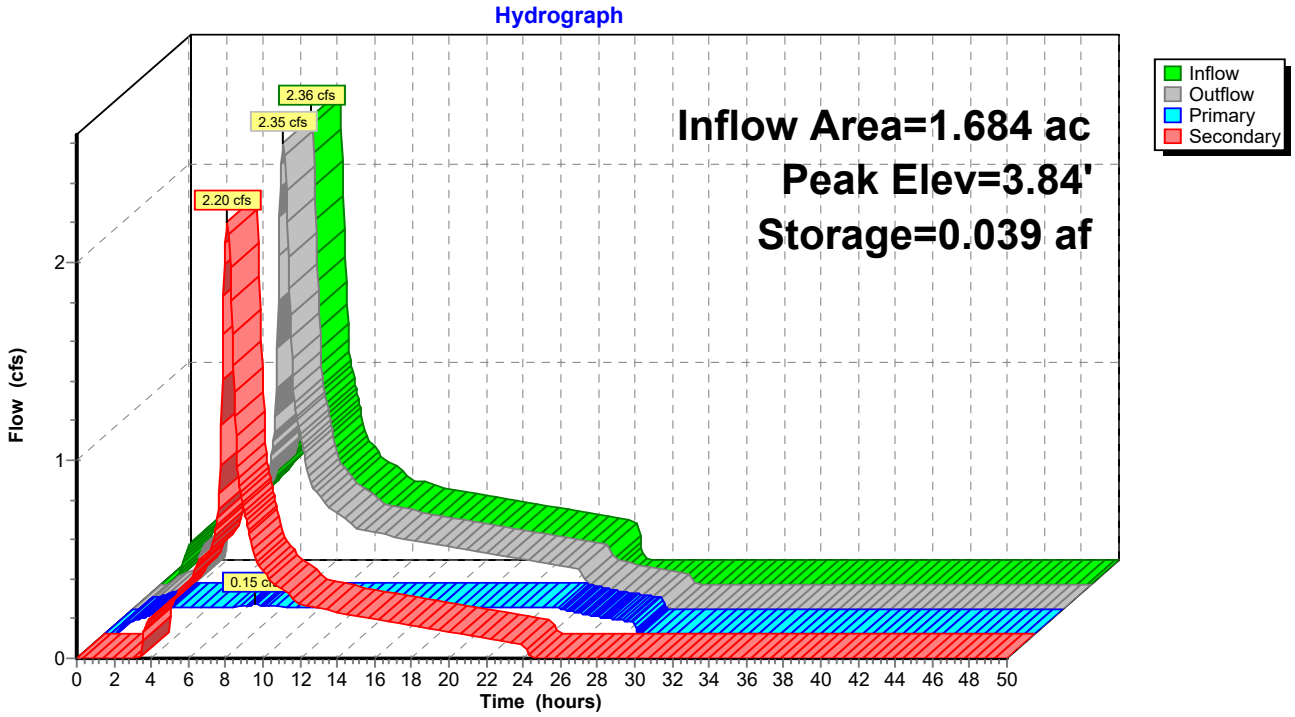
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	**5.00'W x 250.00'L x 5.00'H Bioretention** 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=2.20 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
2=Orifice/Grate (Orifice Controls 2.20 cfs @ 3.12 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

[93] Warning: Storage range exceeded by 0.04'
[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 7.516 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af
Outflow = 10.57 cfs @ 8.09 hrs, Volume= 3.734 af, Atten= 0%, Lag= 0.5 min
Primary = 0.36 cfs @ 7.95 hrs, Volume= 0.890 af
Secondary = 10.21 cfs @ 8.09 hrs, Volume= 2.844 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 5.04' @ 8.09 hrs Surf.Area= 0.138 ac Storage= 0.241 af

Plug-Flow detention time= 91.6 min calculated for 3.730 af (100% of inflow)
Center-of-Mass det. time= 92.0 min (756.0 - 664.0)

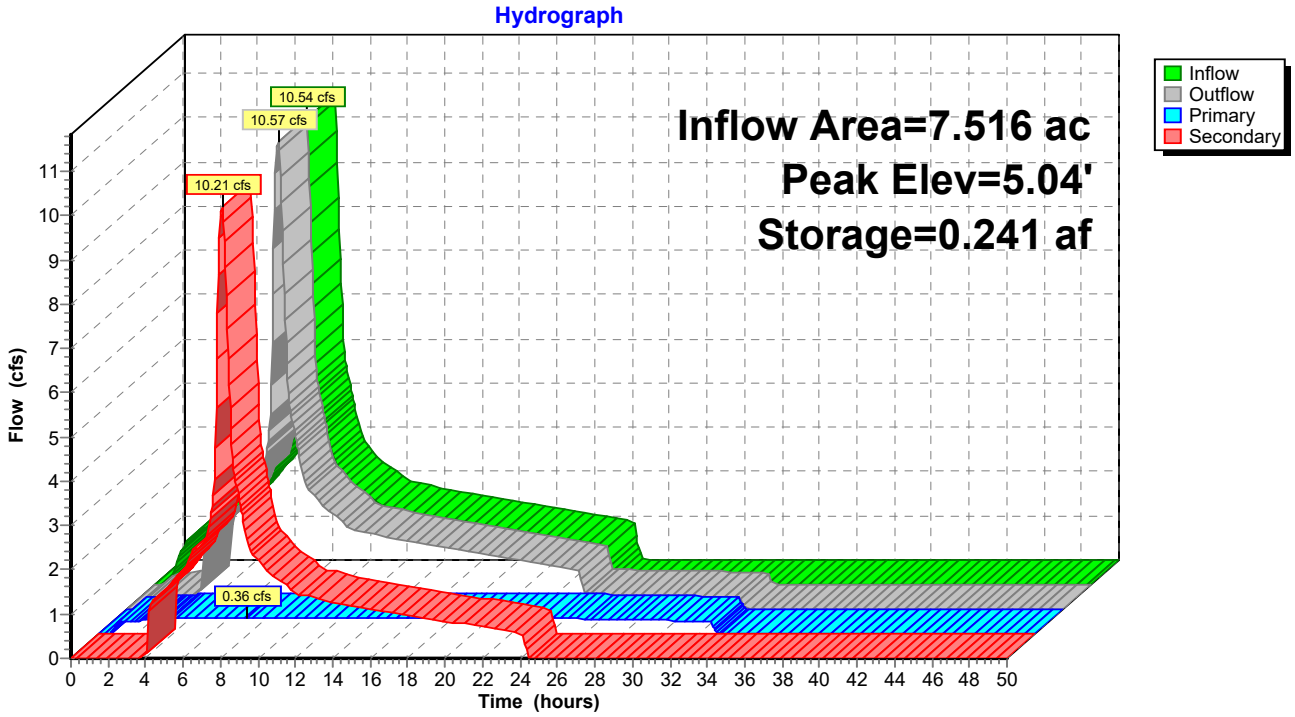
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	**50.00'W x 120.00'L x 5.00'H Infiltration Trench** 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.50'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 7.95 hrs HW=5.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=10.16 cfs @ 8.09 hrs HW=5.04' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 10.16 cfs @ 2.40 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 6P: (new Pond)

[40] Hint: Not Described (Outflow=Inflow)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' TW=0.00' (Free Discharge)

Summary for Pond 7P: Node B

[57] Hint: Peaked at 49.80' (Flood elevation advised)
[81] Warning: Exceeded Pond 10P by 49.14' @ 31.35 hrs
[81] Warning: Exceeded Pond 11P by 49.14' @ 33.05 hrs
[79] Warning: Submerged Pond N3 Primary device # 1 INLET by 8.36'

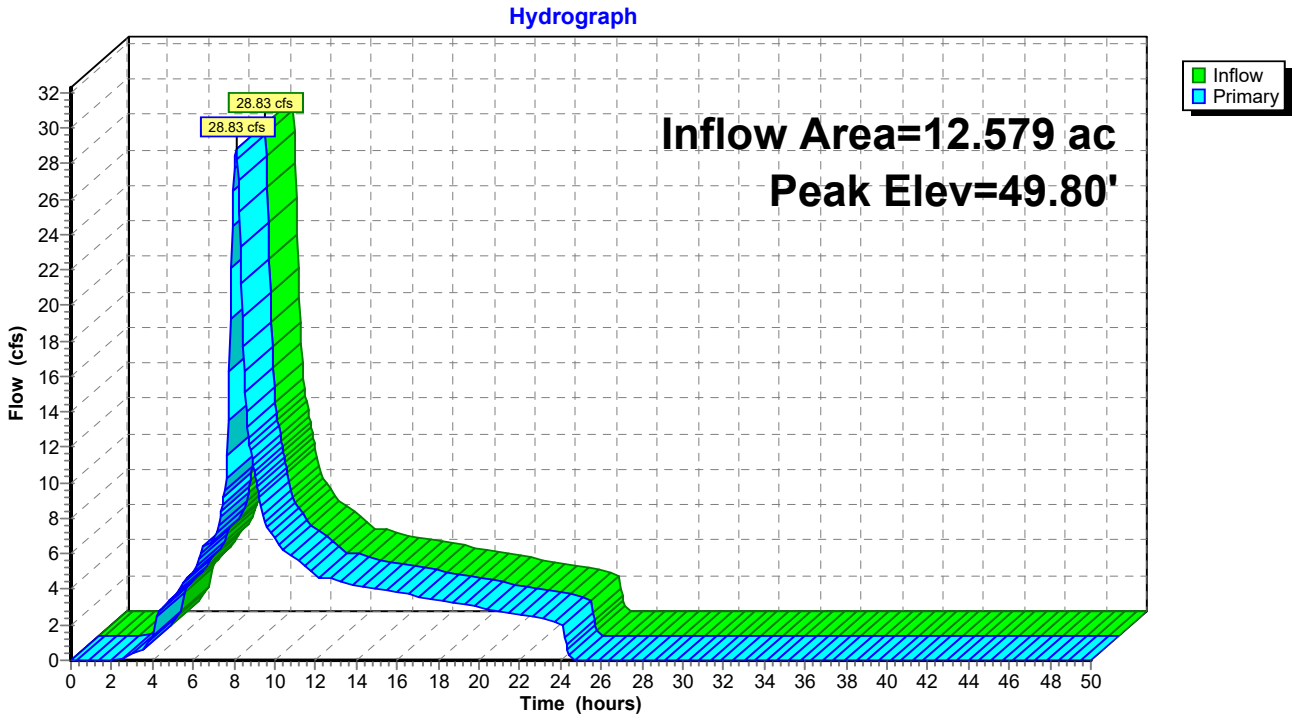
Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 8.37" for 100-year event
Inflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
Outflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af, Atten= 0%, Lag= 0.0 min
Primary = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 49.80' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	**24.0" Round Culvert** L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	49.50'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=28.67 cfs @ 8.09 hrs HW=49.80' TW=49.14' (Fixed TW Elev= 49.14')
1=Culvert (Outlet Controls 8.98 cfs @ 2.86 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 19.69 cfs @ 1.80 fps)

Pond 7P: Node B



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af
Outflow = 0.35 cfs @ 8.09 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.5 min
Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.046 af
Secondary = 0.33 cfs @ 8.09 hrs, Volume= 0.078 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.28' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 56.2 min calculated for 0.124 af (100% of inflow)
Center-of-Mass det. time= 56.3 min (720.4 - 664.0)

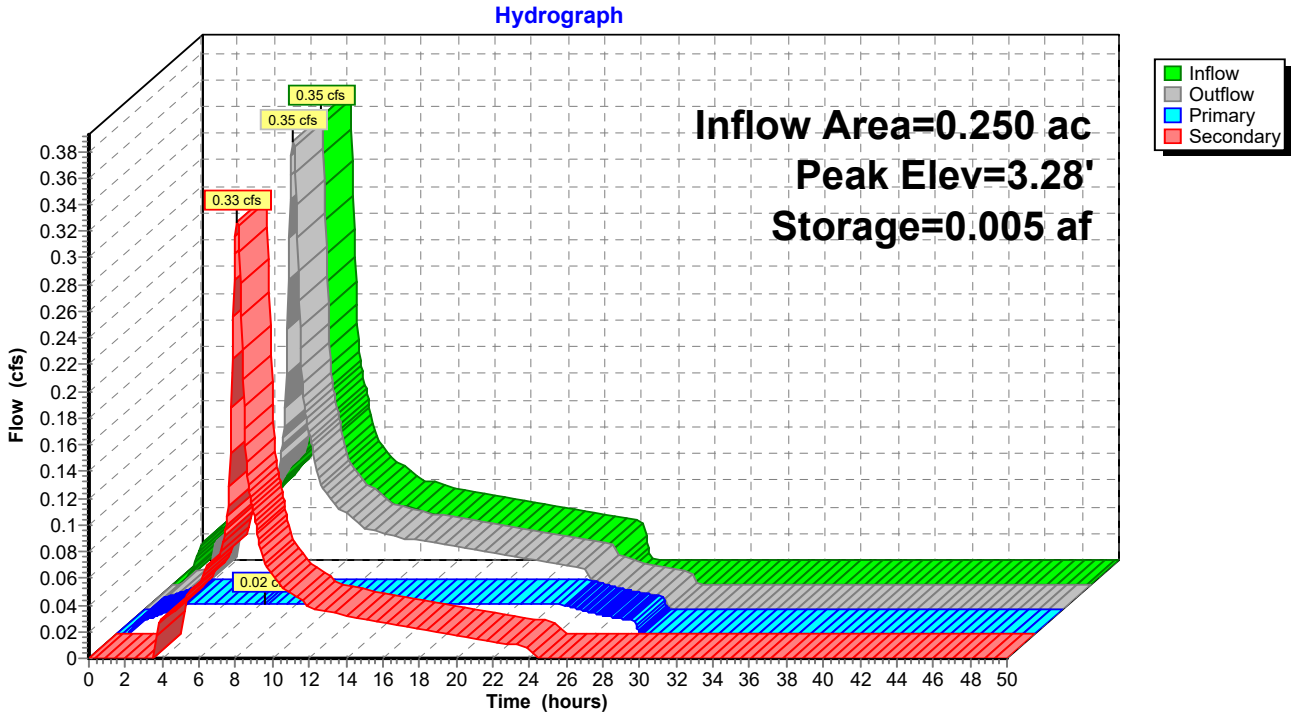
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	**5.00'W x 40.00'L x 5.00'H Bioretention** 0.023 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.32 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 0.32 cfs @ 1.80 fps)

Pond 10P: Bioretention



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af
Outflow = 3.02 cfs @ 8.12 hrs, Volume= 1.081 af, Atten= 1%, Lag= 2.8 min
Primary = 0.19 cfs @ 8.12 hrs, Volume= 0.364 af
Secondary = 2.82 cfs @ 8.12 hrs, Volume= 0.717 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 5.06' @ 8.12 hrs Surf.Area= 0.031 ac Storage= 0.055 af

Plug-Flow detention time= 61.6 min calculated for 1.080 af (100% of inflow)
Center-of-Mass det. time= 61.8 min (725.8 - 664.0)

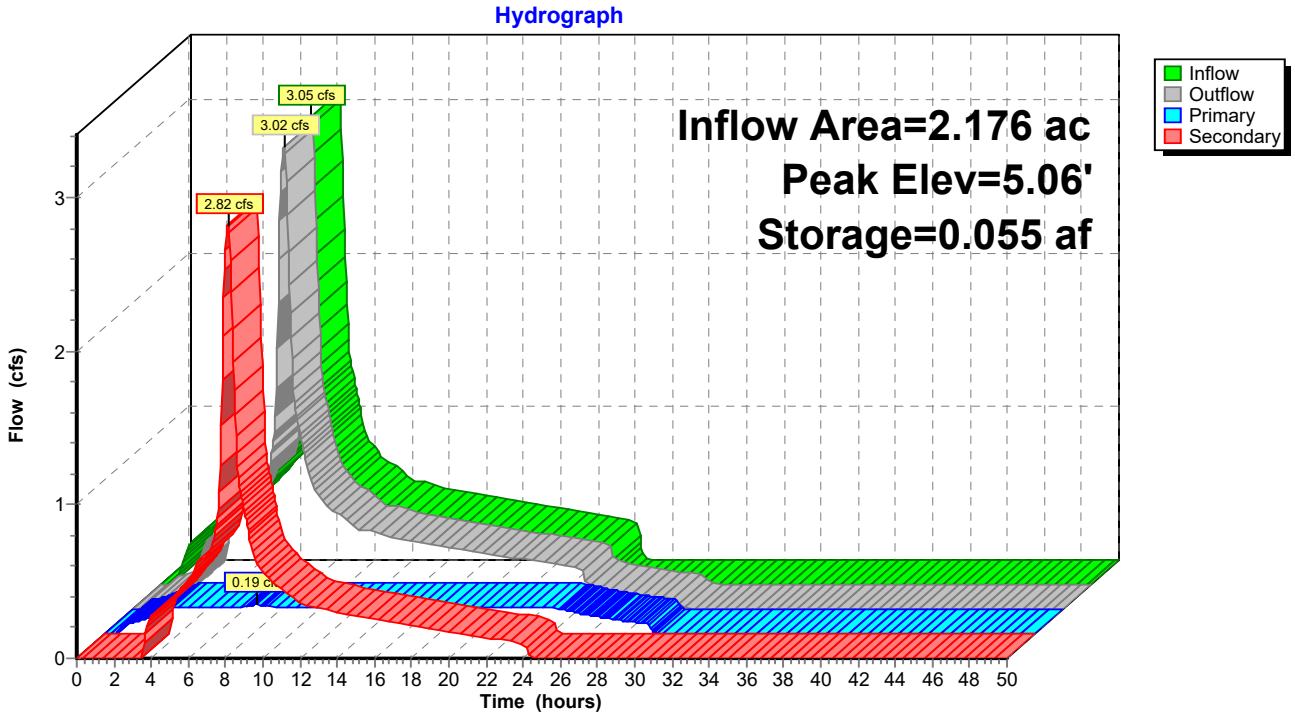
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	**5.00'W x 270.00'L x 6.00'H Bioretention** 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.82 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 2.82 cfs @ 3.59 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 2.78" for 100-year event
Inflow = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af
Outflow = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af, Atten= 67%, Lag= 125.5 min
Primary = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 1.52' @ 10.22 hrs Surf.Area= 0.014 ac Storage= 0.007 af

Plug-Flow detention time= 77.6 min calculated for 0.055 af (100% of inflow)
Center-of-Mass det. time= 77.5 min (908.4 - 830.8)

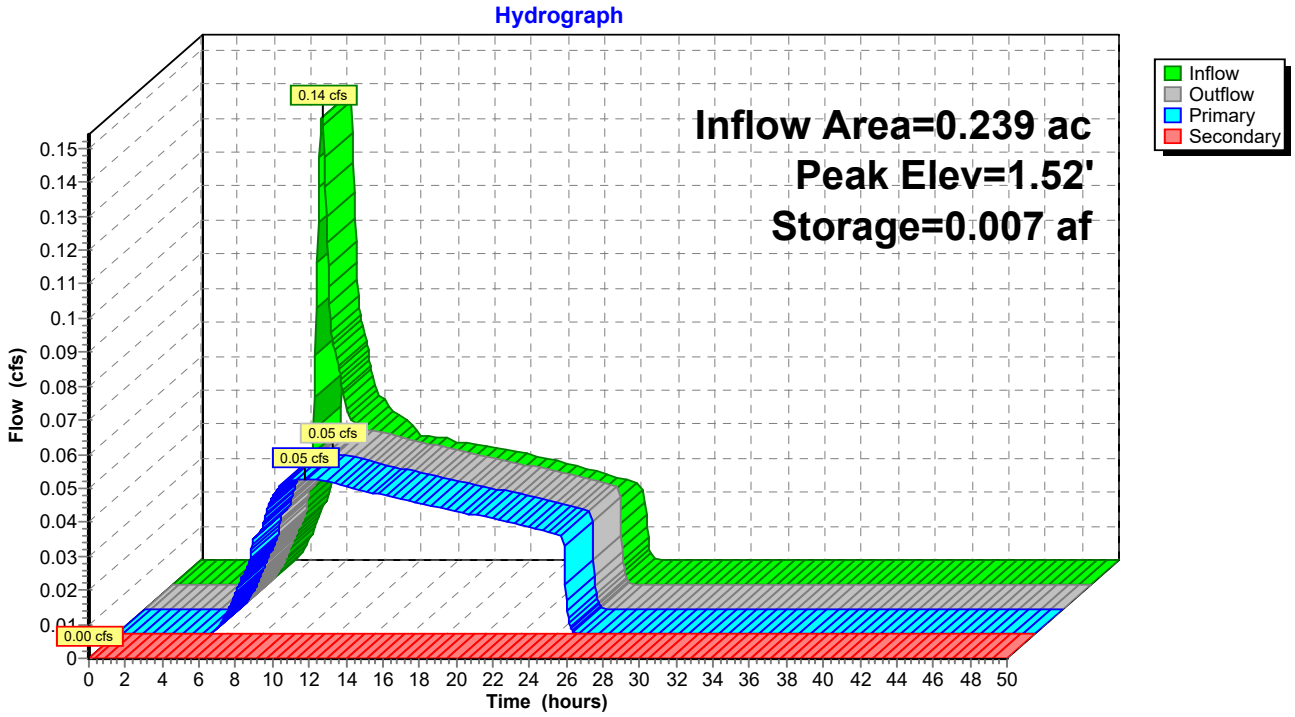
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	**5.00'W x 120.00'L x 5.00'H Bioretention** 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.05 cfs @ 10.22 hrs HW=1.52' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 5.27" for 100-year event
Inflow = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af
Outflow = 1.77 cfs @ 8.11 hrs, Volume= 0.605 af, Atten= 0%, Lag= 1.7 min
Primary = 0.09 cfs @ 8.11 hrs, Volume= 0.193 af
Secondary = 1.68 cfs @ 8.11 hrs, Volume= 0.411 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.70' @ 8.11 hrs Surf.Area= 0.028 ac Storage= 0.045 af

Plug-Flow detention time= 91.8 min calculated for 0.604 af (100% of inflow)
Center-of-Mass det. time= 92.1 min (798.9 - 706.8)

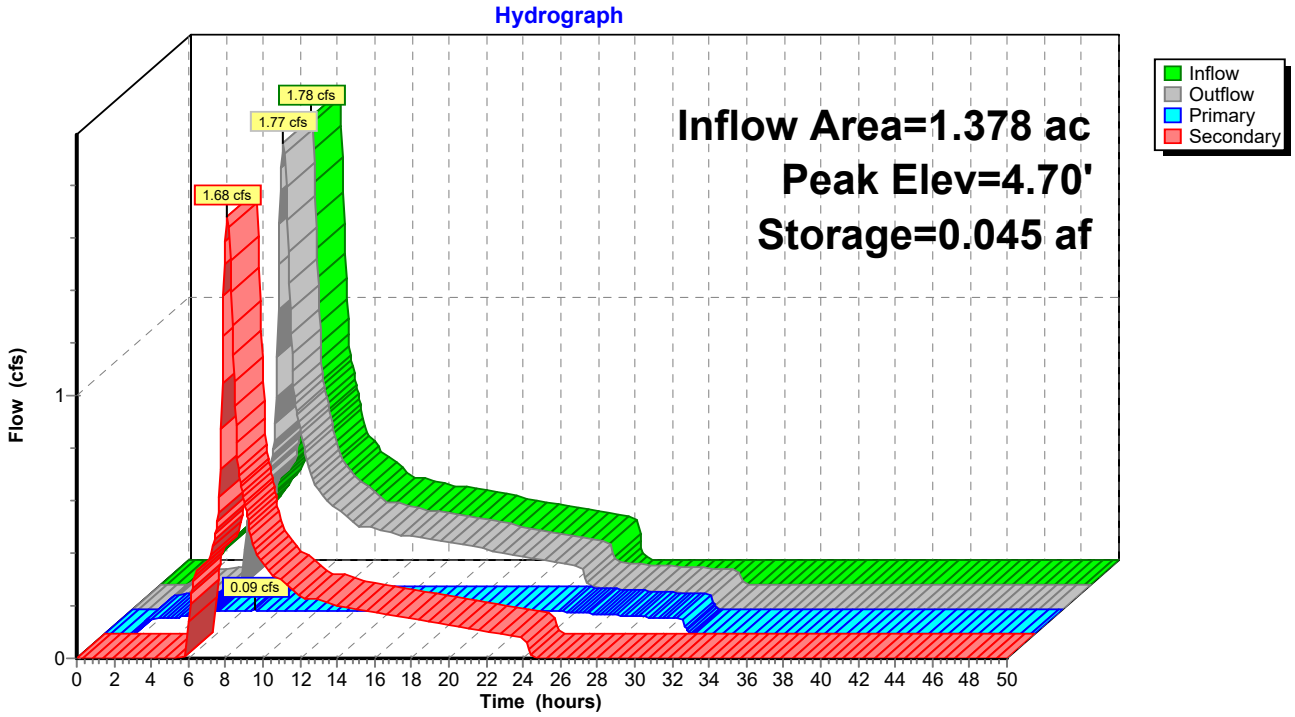
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	**20.00'W x 60.00'L x 6.00'H Infiltration Trench** 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.68 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.68 cfs @ 2.85 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth > 5.88" for 100-year event
Inflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
Outflow = 38.47 cfs @ 8.60 hrs, Volume= 22.657 af, Atten= 5%, Lag= 10.4 min
Primary = 3.58 cfs @ 8.60 hrs, Volume= 8.734 af
Secondary = 34.89 cfs @ 8.60 hrs, Volume= 13.923 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.09' @ 8.60 hrs Surf.Area= 1.674 ac Storage= 2.393 af

Plug-Flow detention time= 123.7 min calculated for 22.657 af (100% of inflow)
Center-of-Mass det. time= 123.7 min (860.1 - 736.4)

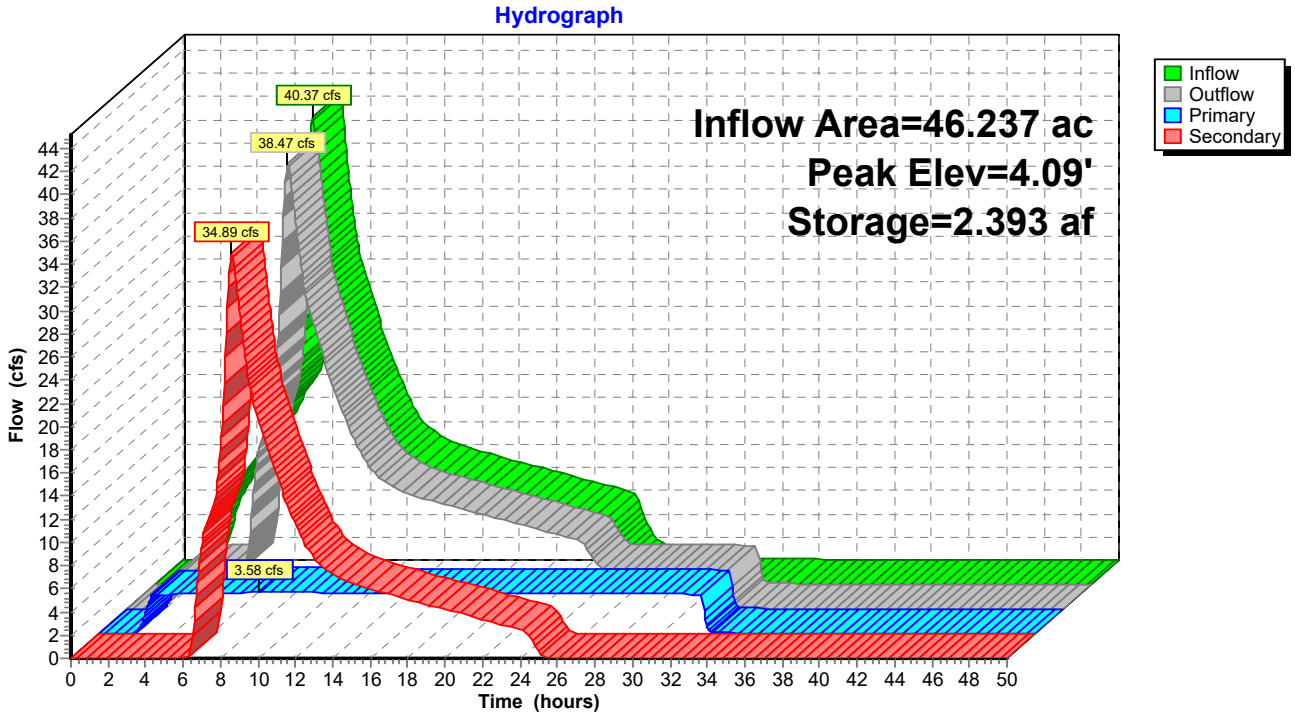
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	**270.00'W x 270.00'L x 5.00'H Infiltration Trench** 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.58 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 3.58 cfs)

Secondary OutFlow Max=34.87 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
↑**2=Orifice/Grate** (Weir Controls 34.87 cfs @ 3.41 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[81] Warning: Exceeded Pond 19P by 48.01' @ 1.90 hrs
[81] Warning: Exceeded Pond N2 by 8.81' @ 0.00 hrs

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 9.31" for 100-year event
Inflow = 84.32 cfs @ 8.14 hrs, Volume= 34.599 af
Outflow = 64.36 cfs @ 8.66 hrs, Volume= 34.599 af, Atten= 24%, Lag= 30.9 min
Primary = 64.36 cfs @ 8.66 hrs, Volume= 34.599 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 48.85' @ 8.66 hrs Surf.Area= 243,905 sf Storage= 142,568 cf

Plug-Flow detention time= 43.8 min calculated for 34.599 af (100% of inflow)
Center-of-Mass det. time= 43.3 min (778.9 - 735.5)

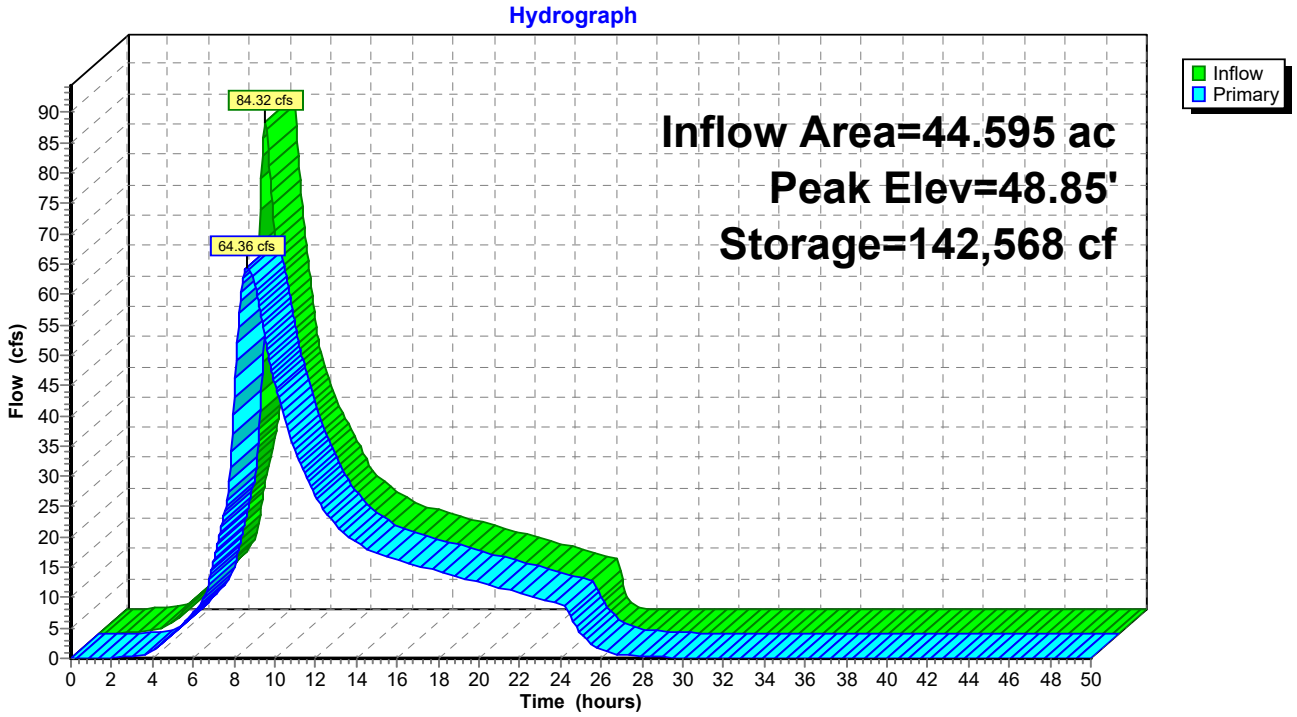
Volume	Invert	Avail.Storage	Storage Description
#1	48.00'	551,632 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.00	91,616	0	0
49.00	270,816	181,216	181,216
50.00	470,016	370,416	551,632

Device	Routing	Invert	Outlet Devices
#1	Primary	48.00'	**30.0' long + 1.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=64.34 cfs @ 8.66 hrs HW=48.85' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 64.34 cfs @ 2.45 fps)

Pond N1: Node D



Summary for Pond N2: Node C

[57] Hint: Peaked at 49.14' (Flood elevation advised)
[81] Warning: Exceeded Pond 7P by 8.52' @ 1.75 hrs
[81] Warning: Exceeded Pond 15P by 48.89' @ 7.75 hrs
[81] Warning: Exceeded Pond 16P by 48.85' @ 1.40 hrs

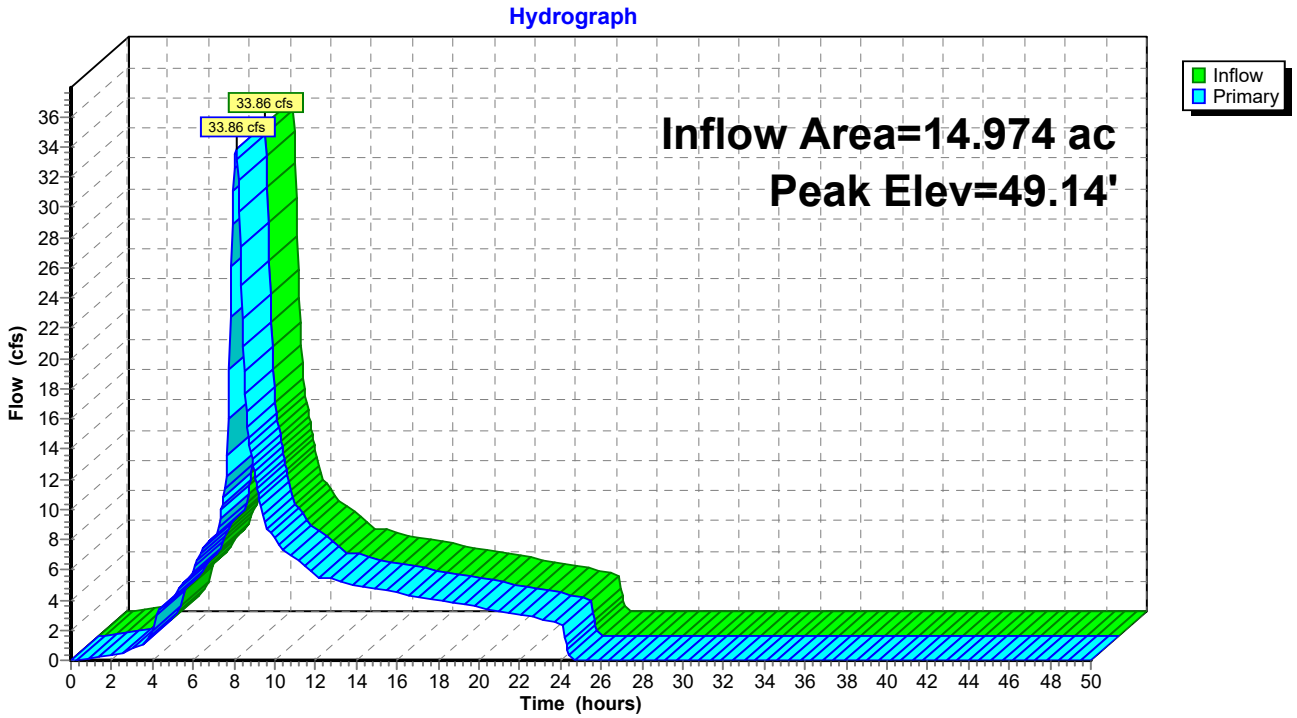
Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 8.32" for 100-year event
Inflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
Outflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af, Atten= 0%, Lag= 0.0 min
Primary = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 49.14' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	**30.0" Round Culvert** L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 37.96' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf
#2	Primary	48.80'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=33.70 cfs @ 8.09 hrs HW=49.14' TW=48.85' (Fixed TW Elev= 48.85')
1=Culvert (Outlet Controls 10.14 cfs @ 2.07 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 23.55 cfs @ 1.90 fps)

Pond N2: Node C



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.57' (Flood elevation advised)
[81] Warning: Exceeded Pond 4P by 49.80' @ 31.55 hrs
[81] Warning: Exceeded Pond 5P by 49.80' @ 35.95 hrs

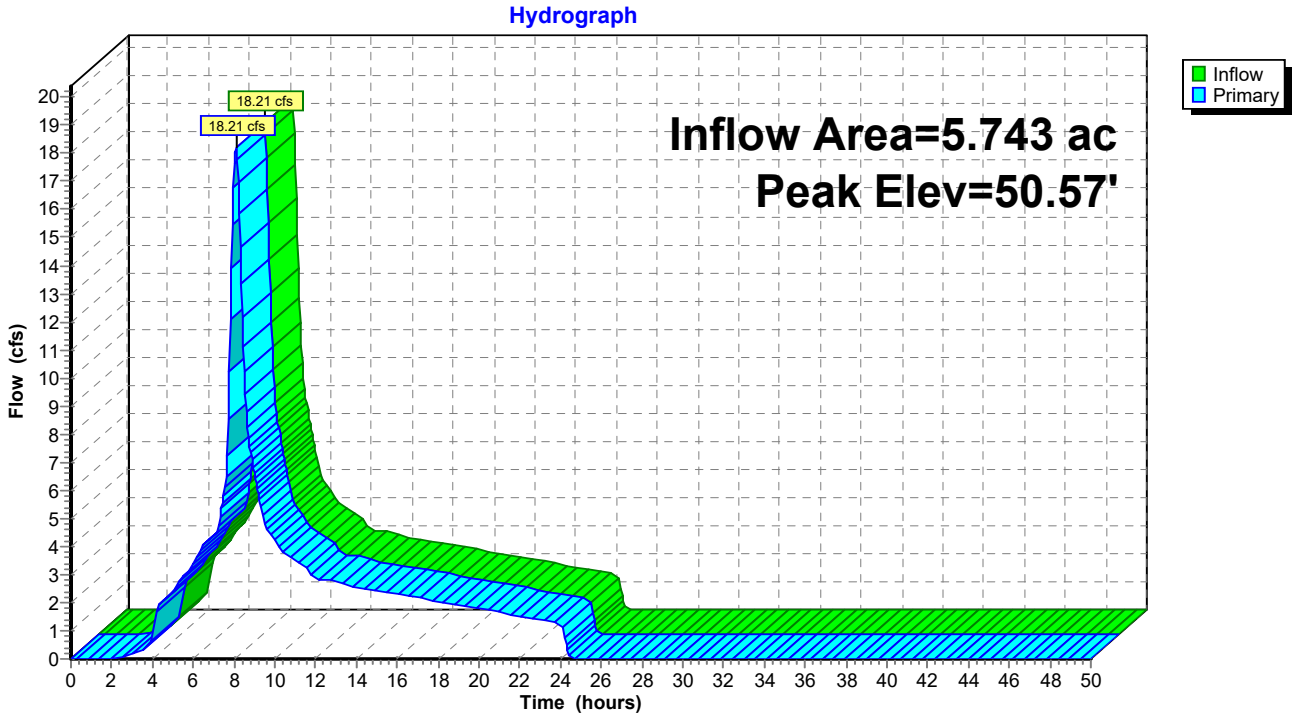
Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 11.34" for 100-year event
Inflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
Outflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af, Atten= 0%, Lag= 0.0 min
Primary = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
Routed to Pond 7P : Node B

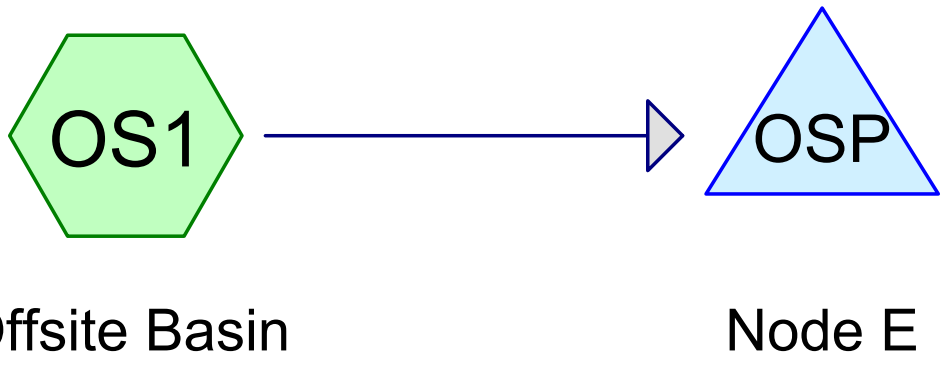
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 50.57' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	**24.0" Round Culvert** L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	50.40'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=17.91 cfs @ 8.09 hrs HW=50.57' TW=49.80' (Fixed TW Elev= 49.80')
1=Culvert (Outlet Controls 9.77 cfs @ 3.11 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 8.14 cfs @ 1.34 fps)

Pond N3: Node A





Subcat Reach Pond Link

Routing Diagram for Offsite 25-Year Storm - Water @ OHWM or Below
Prepared by MacKay & Sposito, Inc, Printed 3/10/2025
HydroCAD® 10.20-5c s/n 01662 © 2023 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
25.493	74	50-75% Grass cover, Poor/Fair, HSG B (OS1)
6.502	98	Paved parking, HSG A (OS1)
31.995	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
6.502	HSG A	OS1
25.493	HSG B	OS1
0.000	HSG C	
0.000	HSG D	
0.000	Other	
31.995		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	25.493	0.000	0.000	0.000	25.493	50-75% Grass cover, Poor/Fair	OS 1
6.502	0.000	0.000	0.000	0.000	6.502	Paved parking	OS 1
6.502	**25.493**	**0.000**	**0.000**	**0.000**	**31.995**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	OSP	38.00	37.50	270.3	0.0018	0.012	0.0	30.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment OS1: Offsite Basin Runoff Area=31.995 ac 20.32% Impervious Runoff Depth=2.89"
Tc=20.0 min CN=79 Runoff=21.13 cfs 7.700 af

Pond OSP: Node E Peak Elev=40.30' Storage=22,776 cf Inflow=21.13 cfs 7.700 af
Primary=16.75 cfs 7.699 af Secondary=0.00 cfs 0.000 af Outflow=16.75 cfs 7.699 af

Total Runoff Area = 31.995 ac Runoff Volume = 7.700 af Average Runoff Depth = 2.89"
79.68% Pervious = 25.493 ac 20.32% Impervious = 6.502 ac

Summary for Subcatchment OS1: Offsite Basin

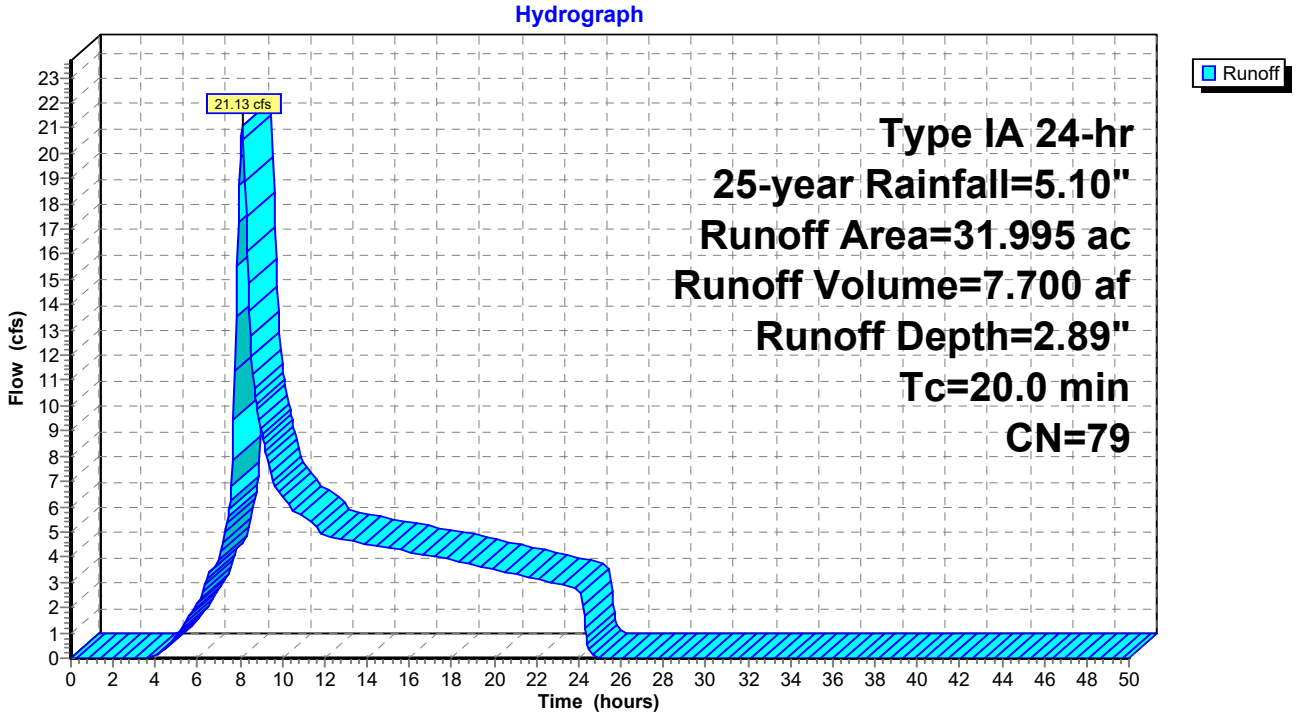
Runoff = 21.13 cfs @ 8.11 hrs, Volume= 7.700 af, Depth= 2.89"
Routed to Pond OSP : Node E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

	Area (ac)	CN	Description
*	25.493	74	50-75% Grass cover, Poor/Fair, HSG B
	6.502	98	Paved parking, HSG A
	31.995	79	Weighted Average
	25.493		79.68% Pervious Area
	6.502		20.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment OS1: Offsite Basin



Summary for Pond OSP: Node E

[92] Warning: Device #1 is above defined storage

Inflow Area = 31.995 ac, 20.32% Impervious, Inflow Depth = 2.89" for 25-year event
Inflow = 21.13 cfs @ 8.11 hrs, Volume= 7.700 af
Outflow = 16.75 cfs @ 8.33 hrs, Volume= 7.699 af, Atten= 21%, Lag= 12.9 min
Primary = 16.75 cfs @ 8.33 hrs, Volume= 7.699 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 40.30' @ 8.33 hrs Surf.Area= 13,869 sf Storage= 22,776 cf

Plug-Flow detention time= 31.7 min calculated for 7.691 af (100% of inflow)
Center-of-Mass det. time= 32.4 min (825.9 - 793.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	51,730 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

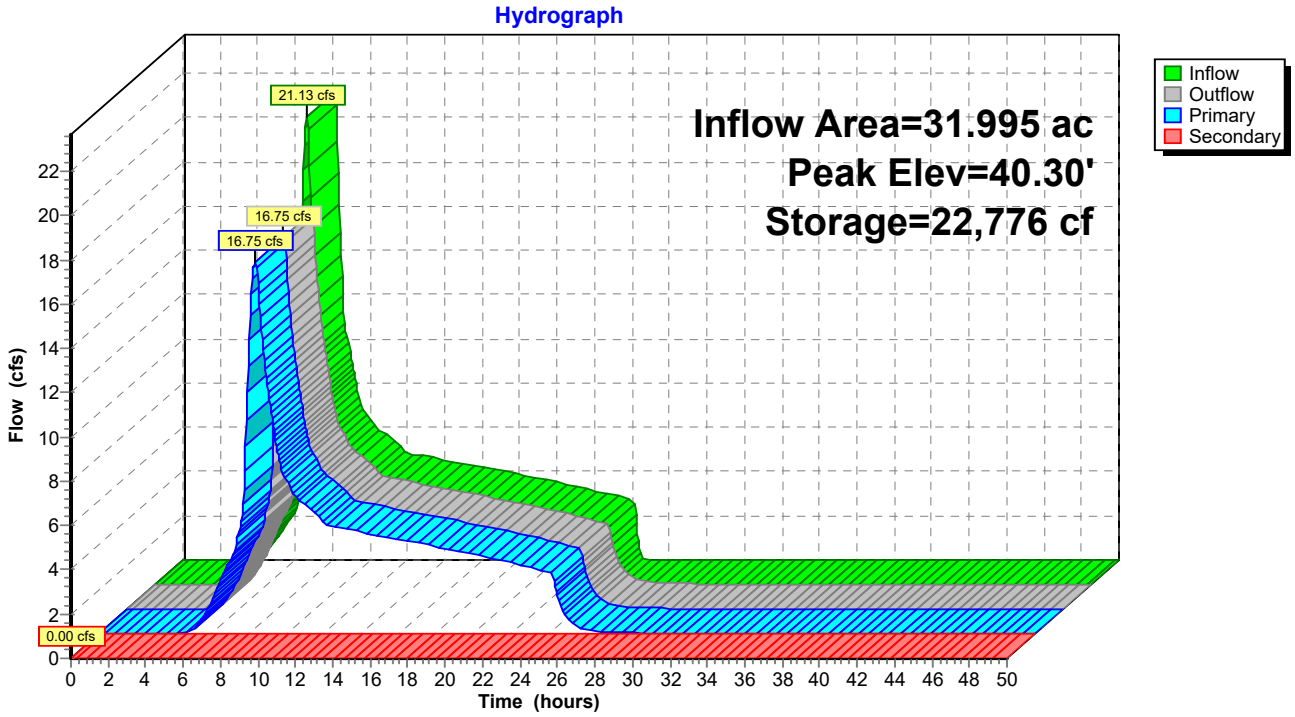
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	6,450	0	0
39.00	9,192	7,821	7,821
40.00	12,778	10,985	18,806
41.00	16,440	14,609	33,415
42.00	20,190	18,315	51,730

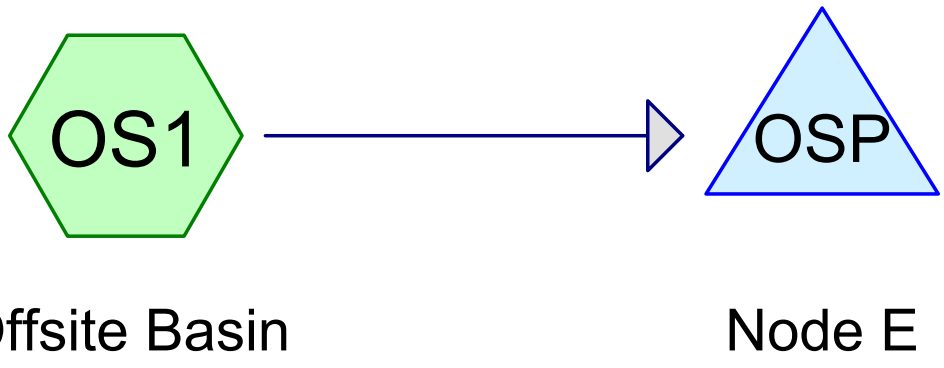
Device	Routing	Invert	Outlet Devices
#1	Secondary	45.00'	**3.000 cfs Constant Flow/Skimmer** Phase-In= 0.10'
#2	Primary	38.00'	**30.0" Round Culvert** L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 4.91 sf

Primary OutFlow Max=16.73 cfs @ 8.33 hrs HW=40.30' (Free Discharge)
↑—**2=Culvert** (Barrel Controls 16.73 cfs @ 4.64 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.00' (Free Discharge)
↑—**1=Constant Flow/Skimmer** (Controls 0.00 cfs)

Pond OSP: Node E





Subcat Reach Pond Link

Routing Diagram for Offsite 100-Year Storm - Water @ OHWM or Below
Prepared by MacKay & Sposito, Inc, Printed 3/10/2025
HydroCAD® 10.20-5c s/n 01662 © 2023 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
25.493	74	50-75% Grass cover, Poor/Fair, HSG B (OS1)
6.502	98	Paved parking, HSG A (OS1)
31.995	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
6.502	HSG A	OS1
25.493	HSG B	OS1
0.000	HSG C	
0.000	HSG D	
0.000	Other	
31.995		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	25.493	0.000	0.000	0.000	25.493	50-75% Grass cover, Poor/Fair	OS 1
6.502	0.000	0.000	0.000	0.000	6.502	Paved parking	OS 1
6.502	**25.493**	**0.000**	**0.000**	**0.000**	**31.995**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	OSP	38.00	37.50	270.3	0.0018	0.012	0.0	30.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment OS1: Offsite Basin Runoff Area=31.995 ac 20.32% Impervious Runoff Depth=3.86"
Tc=20.0 min CN=79 Runoff=29.10 cfs 10.288 af

Pond OSP: Node E Peak Elev=40.85' Storage=31,017 cf Inflow=29.10 cfs 10.288 af
30.0" Round Culvert n=0.012 L=270.3' S=0.0018 '/' Outflow=22.26 cfs 10.286 af

Total Runoff Area = 31.995 ac Runoff Volume = 10.288 af Average Runoff Depth = 3.86"
79.68% Pervious = 25.493 ac 20.32% Impervious = 6.502 ac

Summary for Subcatchment OS1: Offsite Basin

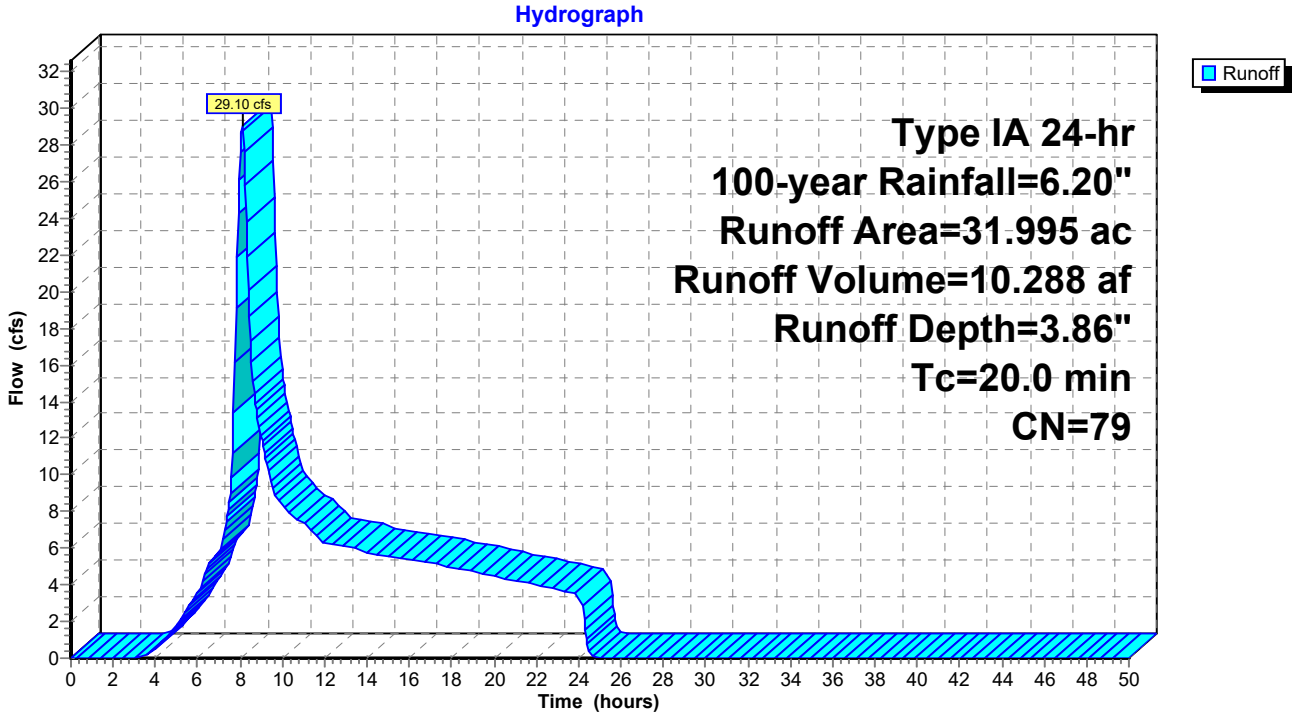
Runoff = 29.10 cfs @ 8.11 hrs, Volume= 10.288 af, Depth= 3.86"
Routed to Pond OSP : Node E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	25.493	74	50-75% Grass cover, Poor/Fair, HSG B
	6.502	98	Paved parking, HSG A
	31.995	79	Weighted Average
	25.493		79.68% Pervious Area
	6.502		20.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment OS1: Offsite Basin



Summary for Pond OSP: Node E

Inflow Area = 31.995 ac, 20.32% Impervious, Inflow Depth = 3.86" for 100-year event
Inflow = 29.10 cfs @ 8.11 hrs, Volume= 10.288 af
Outflow = 22.26 cfs @ 8.34 hrs, Volume= 10.286 af, Atten= 23%, Lag= 14.2 min
Primary = 22.26 cfs @ 8.34 hrs, Volume= 10.286 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 40.85' @ 8.34 hrs Surf.Area= 15,897 sf Storage= 31,017 cf

Plug-Flow detention time= 28.9 min calculated for 10.276 af (100% of inflow)
Center-of-Mass det. time= 29.5 min (806.2 - 776.7)

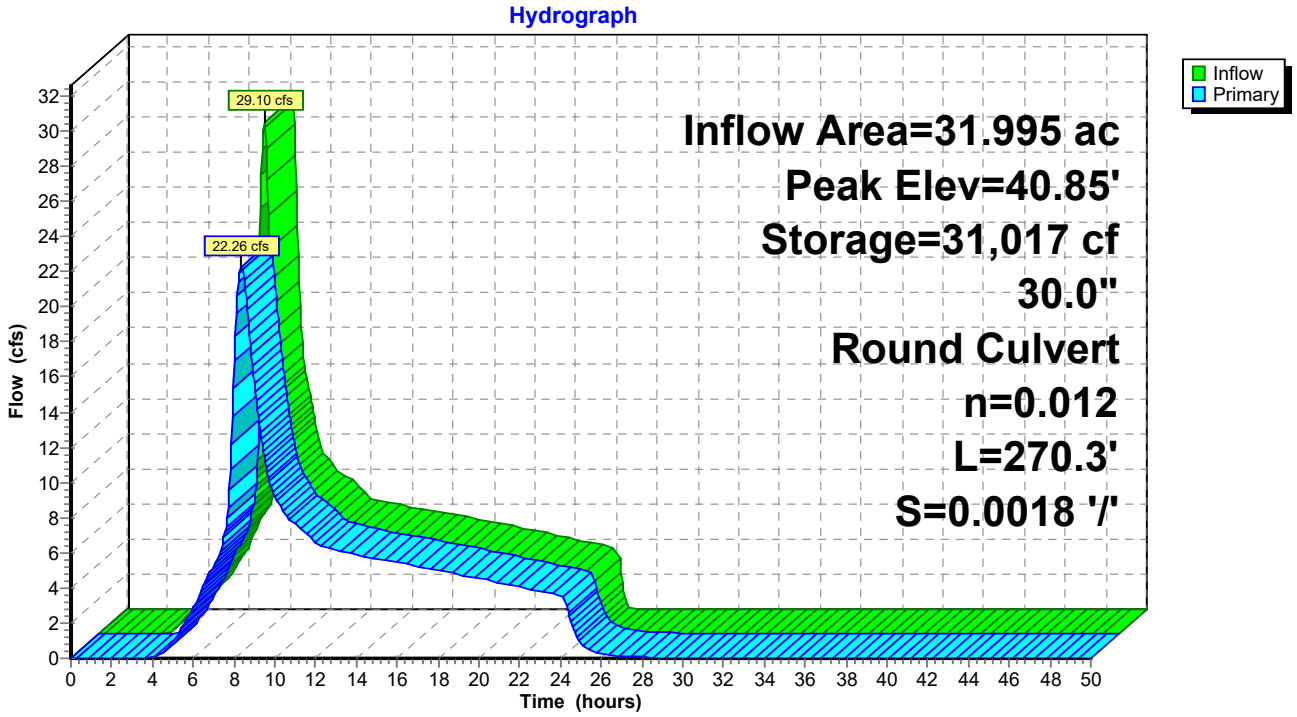
Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	102,732 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

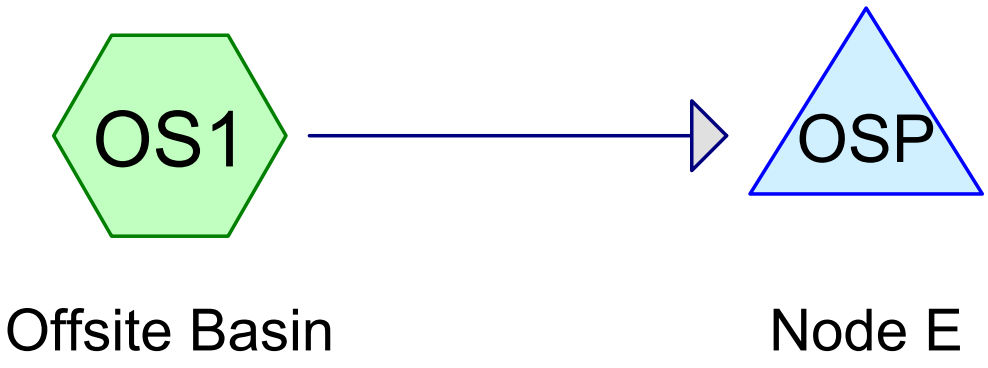
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	6,450	0	0
39.00	9,192	7,821	7,821
40.00	12,778	10,985	18,806
41.00	16,440	14,609	33,415
42.00	38,154	27,297	60,712
43.00	45,886	42,020	102,732

Device	Routing	Invert	Outlet Devices
#1	Primary	38.00'	**30.0" Round Culvert** L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=22.25 cfs @ 8.34 hrs HW=40.85' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 22.25 cfs @ 4.98 fps)

Pond OSP: Node E





Subcat Reach Pond Link

Routing Diagram for Offsite 25-Year w Vavle Closed
Prepared by MacKay & Sposito, Inc, Printed 3/10/2025
HydroCAD® 10.20-5c s/n 01662 © 2023 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
25.493	74	50-75% Grass cover, Poor/Fair, HSG B (OS1)
6.502	98	Paved parking, HSG A (OS1)
31.995	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
6.502	HSG A	OS1
25.493	HSG B	OS1
0.000	HSG C	
0.000	HSG D	
0.000	Other	
31.995		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	25.493	0.000	0.000	0.000	25.493	50-75% Grass cover, Poor/Fair	OS 1
6.502	0.000	0.000	0.000	0.000	6.502	Paved parking	OS 1
6.502	**25.493**	**0.000**	**0.000**	**0.000**	**31.995**	**TOTAL AREA**	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment OS1: Offsite Basin Runoff Area=31.995 ac 20.32% Impervious Runoff Depth=2.89"
Tc=20.0 min CN=79 Runoff=21.13 cfs 7.700 af

Pond OSP: Node E Peak Elev=42.45' Storage=78,763 cf Inflow=21.13 cfs 7.700 af
Outflow=5.00 cfs 7.268 af

Total Runoff Area = 31.995 ac Runoff Volume = 7.700 af Average Runoff Depth = 2.89"
79.68% Pervious = 25.493 ac 20.32% Impervious = 6.502 ac

Summary for Subcatchment OS1: Offsite Basin

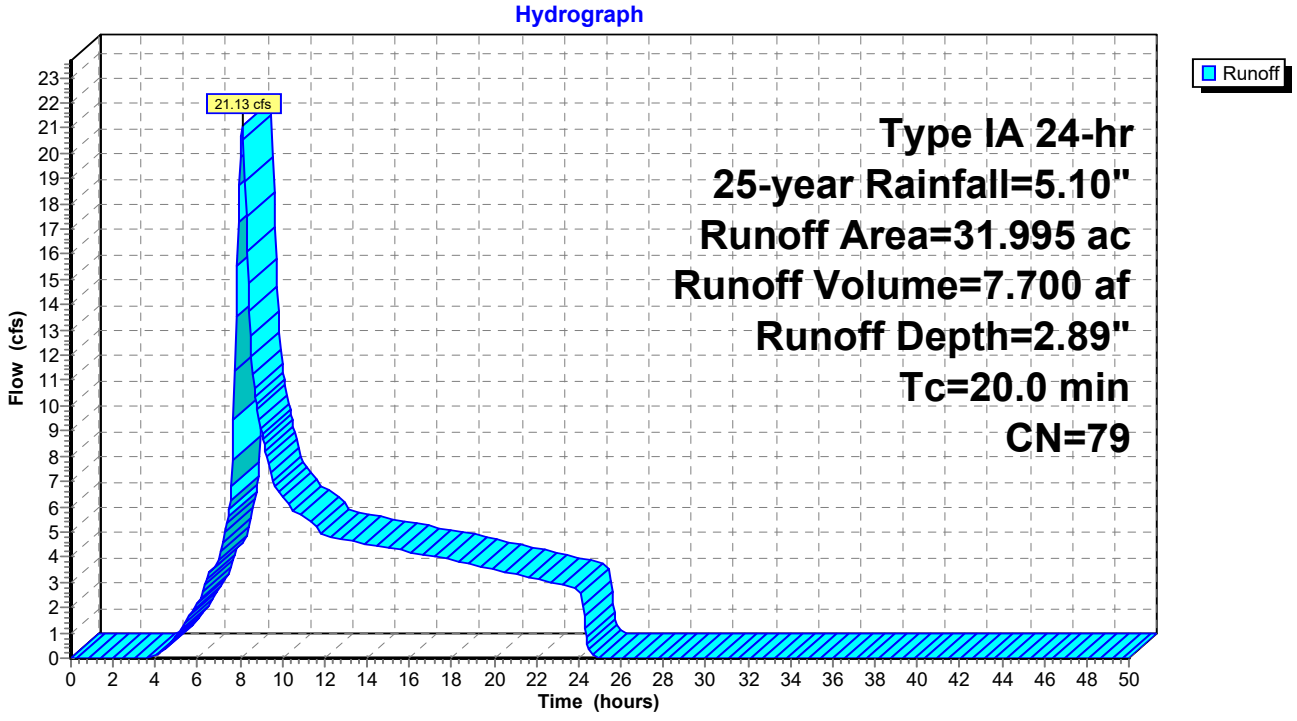
Runoff = 21.13 cfs @ 8.11 hrs, Volume= 7.700 af, Depth= 2.89"
Routed to Pond OSP : Node E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

	Area (ac)	CN	Description
*	25.493	74	50-75% Grass cover, Poor/Fair, HSG B
	6.502	98	Paved parking, HSG A
	31.995	79	Weighted Average
	25.493		79.68% Pervious Area
	6.502		20.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment OS1: Offsite Basin



Summary for Pond OSP: Node E

Inflow Area = 31.995 ac, 20.32% Impervious, Inflow Depth = 2.89" for 25-year event
Inflow = 21.13 cfs @ 8.11 hrs, Volume= 7.700 af
Outflow = 5.00 cfs @ 7.45 hrs, Volume= 7.268 af, Atten= 76%, Lag= 0.0 min
Primary = 5.00 cfs @ 7.45 hrs, Volume= 7.268 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 42.45' @ 11.76 hrs Surf.Area= 41,652 sf Storage= 78,763 cf

Plug-Flow detention time= 197.9 min calculated for 7.268 af (94% of inflow)
Center-of-Mass det. time= 161.8 min (955.3 - 793.5)

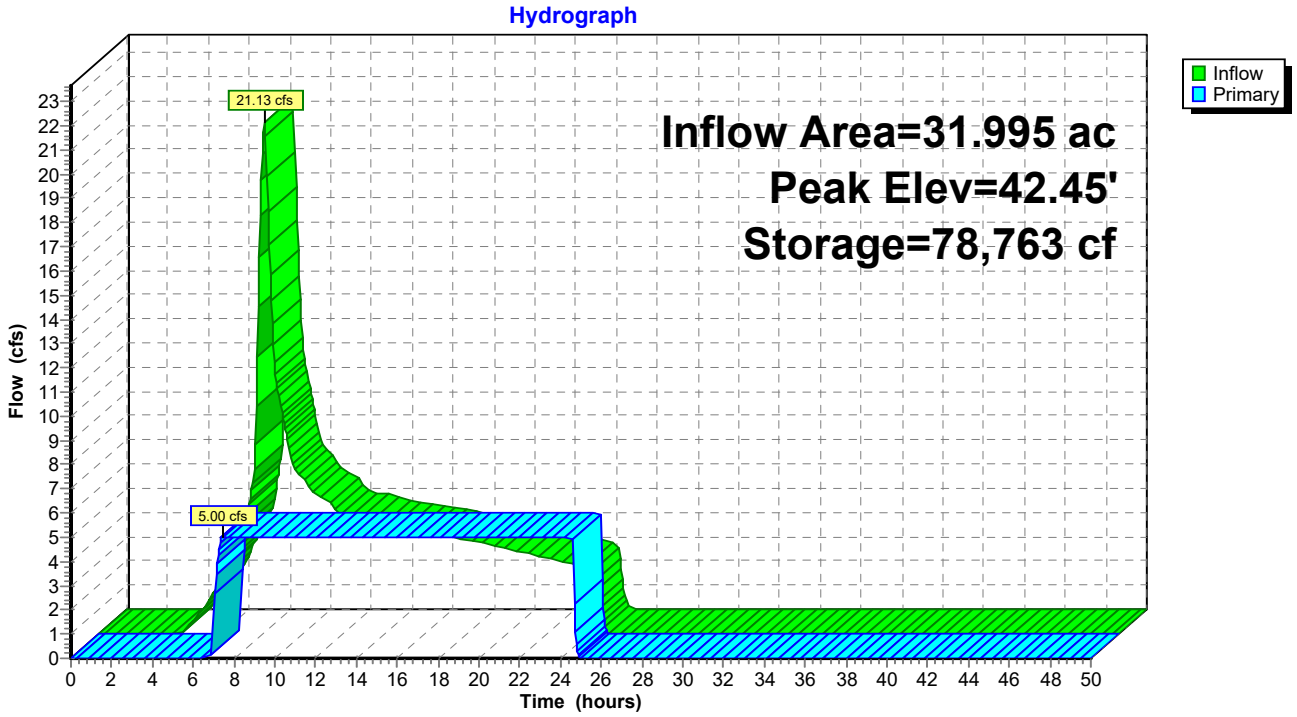
Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	102,732 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

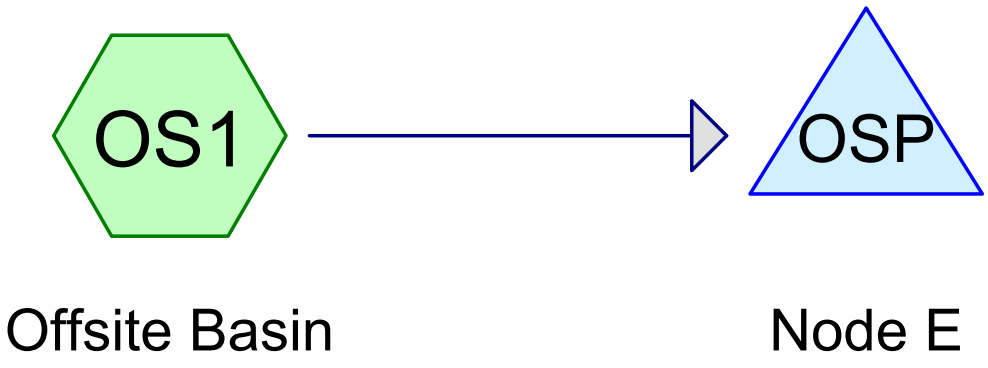
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	6,450	0	0
39.00	9,192	7,821	7,821
40.00	12,778	10,985	18,806
41.00	16,440	14,609	33,415
42.00	38,154	27,297	60,712
43.00	45,886	42,020	102,732

Device	Routing	Invert	Outlet Devices
#1	Primary	40.00'	**5.000 cfs Constant Flow/Skimmer** Phase-In= 0.10'

Primary OutFlow Max=5.00 cfs @ 7.45 hrs HW=40.11' (Free Discharge)
1=Constant Flow/Skimmer (Constant Controls 5.00 cfs)

Pond OSP: Node E





Subcat Reach Pond Link

Routing Diagram for Offsite 100-Year Storm w Valve Closed
Prepared by MacKay & Sposito, Inc, Printed 3/10/2025
HydroCAD® 10.20-5c s/n 01662 © 2023 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
25.493	74	50-75% Grass cover, Poor/Fair, HSG B (OS1)
6.502	98	Paved parking, HSG A (OS1)
31.995	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
6.502	HSG A	OS1
25.493	HSG B	OS1
0.000	HSG C	
0.000	HSG D	
0.000	Other	
31.995		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	25.493	0.000	0.000	0.000	25.493	50-75% Grass cover, Poor/Fair	OS 1
6.502	0.000	0.000	0.000	0.000	6.502	Paved parking	OS 1
6.502	**25.493**	**0.000**	**0.000**	**0.000**	**31.995**	**TOTAL AREA**	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment OS1: Offsite Basin Runoff Area=31.995 ac 20.32% Impervious Runoff Depth=3.86"
Tc=20.0 min CN=79 Runoff=29.10 cfs 10.288 af

Pond OSP: Node E Peak Elev=43.65' Storage=143,898 cf Inflow=29.10 cfs 10.288 af
Outflow=5.00 cfs 9.857 af

Total Runoff Area = 31.995 ac Runoff Volume = 10.288 af Average Runoff Depth = 3.86"
79.68% Pervious = 25.493 ac 20.32% Impervious = 6.502 ac

Summary for Subcatchment OS1: Offsite Basin

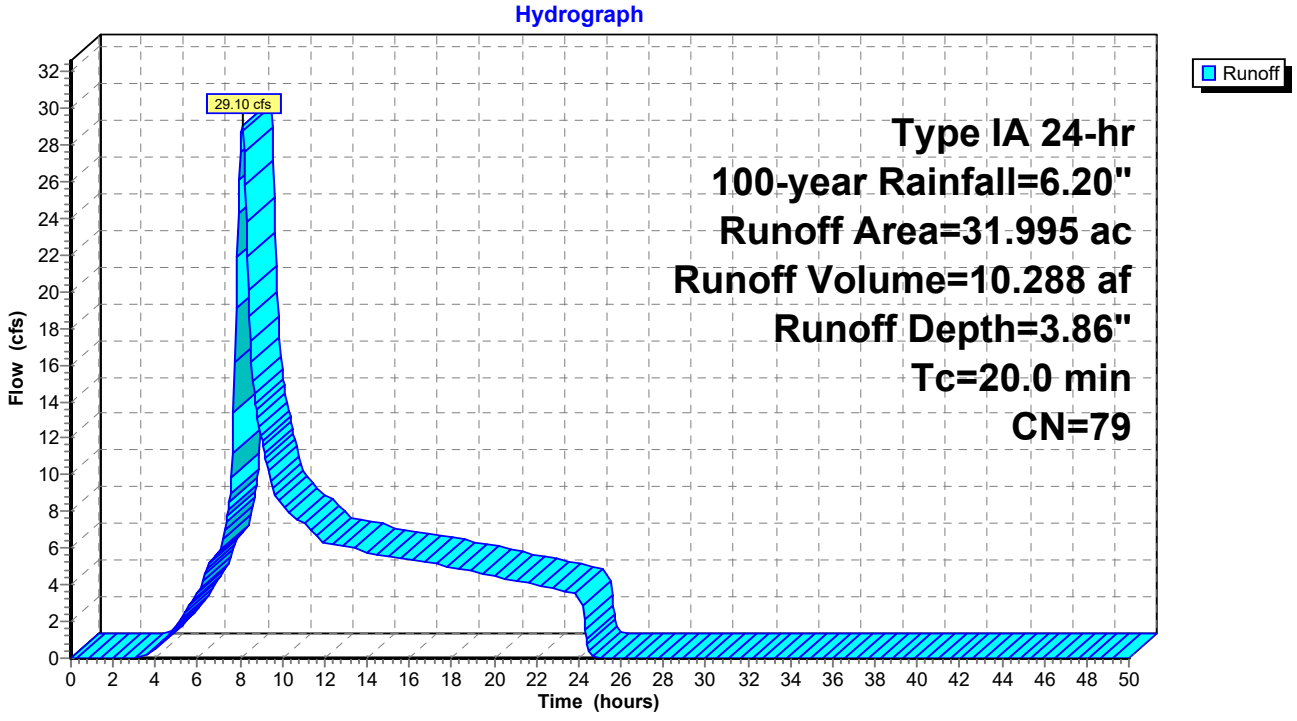
Runoff = 29.10 cfs @ 8.11 hrs, Volume= 10.288 af, Depth= 3.86"
Routed to Pond OSP : Node E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	25.493	74	50-75% Grass cover, Poor/Fair, HSG B
	6.502	98	Paved parking, HSG A
	31.995	79	Weighted Average
	25.493		79.68% Pervious Area
	6.502		20.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment OS1: Offsite Basin



Summary for Pond OSP: Node E

Inflow Area = 31.995 ac, 20.32% Impervious, Inflow Depth = 3.86" for 100-year event
Inflow = 29.10 cfs @ 8.11 hrs, Volume= 10.288 af
Outflow = 5.00 cfs @ 6.60 hrs, Volume= 9.857 af, Atten= 83%, Lag= 0.0 min
Primary = 5.00 cfs @ 6.60 hrs, Volume= 9.857 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 43.65' @ 17.77 hrs Surf.Area= 81,478 sf Storage= 143,898 cf

Plug-Flow detention time= 348.7 min calculated for 9.847 af (96% of inflow)
Center-of-Mass det. time= 321.0 min (1,097.7 - 776.7)

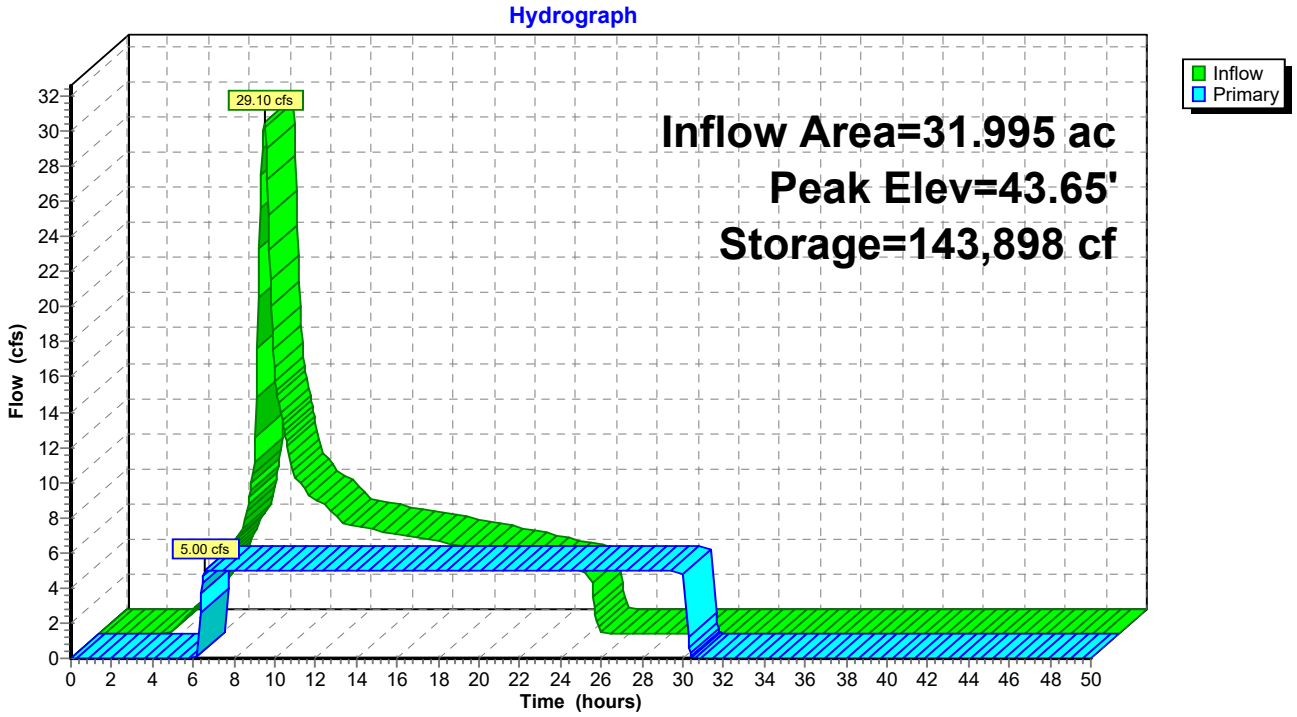
Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	176,147 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	6,450	0	0
39.00	9,192	7,821	7,821
40.00	12,778	10,985	18,806
41.00	16,440	14,609	33,415
42.00	38,154	27,297	60,712
43.00	45,886	42,020	102,732
44.00	100,944	73,415	176,147

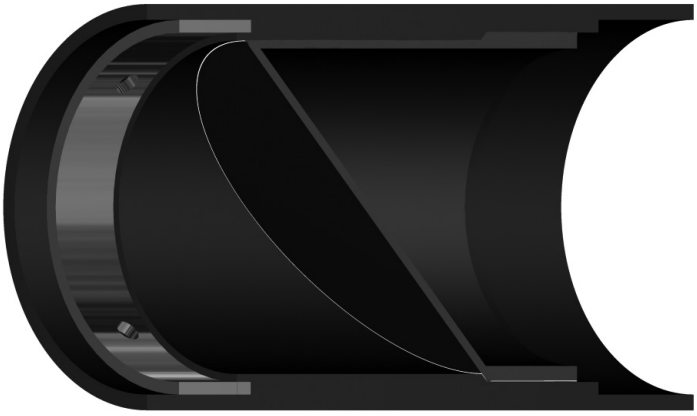
Device	Routing	Invert	Outlet Devices
#1	Primary	40.00'	**5.000 cfs Constant Flow/Skimmer** Phase-In= 0.10'

Primary OutFlow Max=5.00 cfs @ 6.60 hrs HW=40.10' (Free Discharge)
1=Constant Flow/Skimmer (Constant Controls 5.00 cfs)

Pond OSP: Node E



Tideflex® CheckMate UltraFlex® Inline Check Valve Installation, Operation and Maintenance Manual



The revolutionary design of the CheckMate® Inline Check Valve provides superior backflow prevention and odor mitigation in stormwater, CSO and SSO outfalls. The CheckMate's® custom-engineered, all-rubber unibody design eliminates costly backflow from oceans, rivers and interceptors. The valve's unique elastomer fabric and wire reinforced design provides a proven record of maintenance-free performance, cost savings and results that no other inline check valve can match. The CheckMate® is built to suit all your site-specific and flow needs.

The CheckMate® has a 100% fabric and elastomer construction that eliminates corrosion problems. Because the CheckMate® is made with a unibody construction, there are no mechanical components that trap debris, corrode or fail.

The CheckMate® Valve's inherent flexibility virtually eliminates seating problems. The CheckMate® remains in the closed position until forward differential pressure opens it. The fabric-reinforced elastomer CheckMate® Valve seals around silt and small debris, preventing unwanted backflow.

The major advantage of the CheckMate® Valve is its extremely low headloss. The CheckMate® can open to a near full pipe diameter. This maximizes flow capacity of the outfall, which is particularly beneficial in low-lying areas where limited driving head is available.

Tideflex® recommends pinning all CheckMate® Valves for added security and stability. CheckMate's® effectively have a zero face-to-face dimension because they fit completely inside of the pipe. No modification of piping is required provided adequate pipe length exists.

IMPORTANT

Please take a moment to review this manual. The improper installation or use of this product may result in personal injury, product failure, or reduced product life. Tideflex® can accept NO liability resulting from the improper use or installation of this product. If you have any questions or problems, please call the customer service department at (412) 279-0044. We appreciate your comments. Thank you for choosing Tideflex®.

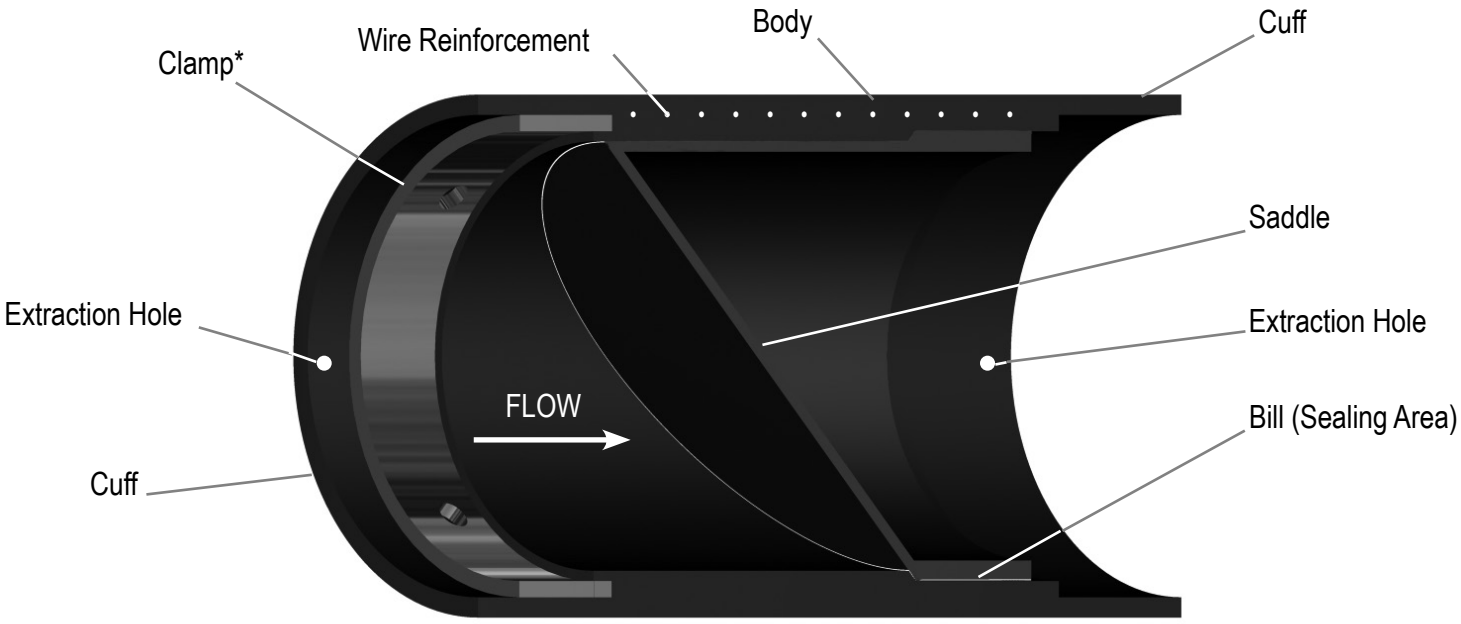
CheckMate® Installation Procedure

NEVER...
Install the valve at an angle

NEVER...
Use Sharp Tools on Rubber

NEVER...
Exceed Design Back Pressure

NEVER...
Install the Valve Backwards



*Clamps are installed in the upstream or downstream cuff, depending upon the application.
The illustration above is shown clamped upstream.

CHECKMATE® INSTALLATION

1. Product Shipping

Valve sizes 3" - 18" are furnished with one clamp. Valves 20" - 60" ship with two clamps. 72" valves ship with three clamps.

NOTE: A clamp is installed on each end of the valve to keep the valve's shape during transit and storage. Once the installation orientation is determined the CheckMate® valve will be clamped from either the upstream or downstream side. **For valves with two or three clamps, they can be installed onto the same side of the valve and offset from each other, as illustrated in Figure 1.**

2. Unpacking & Lifting

Do not use sharp tools when unpacking this product as it may damage the valve.

For larger CheckMate® valves, the valve should be lifted with either a sling or with supports around the O.D. at each side of the valve to ease the installation procedure. Do not place an object through the valve in order to lift.

CAUTION: Do not try to bend, collapse or fold the valve in order to facilitate the installation as this will cause permanent damage and will not allow the valve to return to a fully round shape.

3. Inspection of Pipe I.D.

Check the inside diameter (I.D.) of the pipe section for rough or damaged areas. The inside surface should be uniform and relatively smooth. Long gouges or cracks in the pipe may allow water to pass and should be filled prior to installation. Do not attempt to install a CheckMate® in a smaller pipe I.D.

4. Pipe I.D. Measurements

The pipe I.D. is to be checked in the field. It should be a consistent diameter for the length of valve and should not be out of round. When there is a +/- tolerance on the pipe I.D., the CheckMate® Valve should be ordered to the smallest pipe I.D.. Then, rubber adhesive strip can be applied to both CheckMate® cuffs to build the cuff O.D. up to the actual pipe I.D. See procudure in #5.

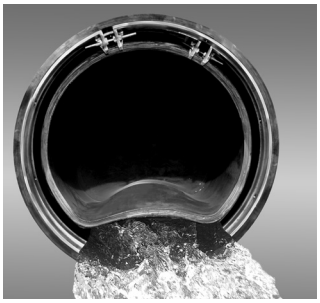


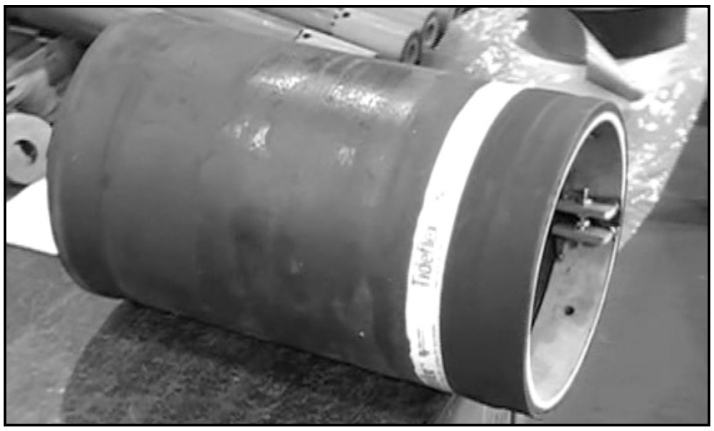
Figure 1 – Clamps shown installed on the same side of valve

CheckMate® Rubber Adhesive Strip Build Up Procedure

5. Rubber Adhesive Strip Build up

When valve O.D. is smaller than the pipe I.D., one-sided rubber adhesive strip is used to build up the O.D. of both CheckMate® cuffs to the actual pipe I.D.

NOTICE: Clean and dry the exterior of the valve prior to beginning rubber adhesive strip build up procedure.



STEP A: Place the valve on a solid, flat surface with the clamped end hanging slightly over the edge of the surface.

STEP B: Slowly rotate the valve while firmly pressing the rubber adhesive strip onto itself in concentric layers until valve O.D. is equal to or a fraction smaller than pipe I.D.

STEP C: Repeat steps A and B on the opposite side of the valve to ensure uniformity of the CheckMate's® O.D. is consistent and matches the pipe I.D.

STEP D: Lubricate the valve and rubber adhesive strip surface. Slide valve into pipe. Ensure the area marked TOP is in the 12:00 position.

STEP E: Check O.D. of the valve to ensure it fits snugly into the I.D. of pipe. If loose, add another layer(s) of the rubber adhesive strip.

STEP F: Once in place, tighten the clamp to secure it against the pipe and compress the rubber ahesive strip.

CheckMate® Installation Procedure

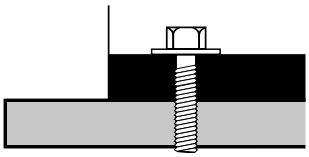
6. Preparation

The CheckMate® Valve uses expanding clamp(s) to exert pressure outwards on the walls of the valve to wedge it in place within the pipe. The walls of the pipe should be clean and free of debris prior to installation.

The valve should be inserted fully into the pipe so that no part of the cuff or bill extends outside the pipe. Ensure that the valve is not slanted at an angle with the bill pointing upwards or downwards. The valve centerline should be parallel to the pipe centerline.

Tideflex® Technologies recommends pinning the CheckMate® Valve on all installations. See below.

Four pre-drilled holes are provided in each expansion clamp. At least one clamp should be pinned. On exposed pipe, holes can be drilled through the valve and pipe, and a bolt run through secured with a nut. For buried pipe, silicon or similar sealant should be used to seal bolts.



7. Lubrication

The outside of the valve can be lubricated with a water-based lubricant prior to inserting the valve into the pipe. If the taping procedure has been used, the surface of the tape can be lubricate to aid insertion.

CAUTION: **Do not use petroleum-based lubricants** on this product or on the vulcanized rubber tape.

8. Plumb Lines and Arrows

The CheckMate® Valve arrives with a “top” arrow, “flow” arrow and plumb lines, marked in white, at the 12:00 and 6:00 position of the valve. Utilize this marking to orient the valve in the pipe, as well as to ensure the valve is oriented correctly in pipe section.

9. Valve Orientation

The CheckMate® Valve must be installed in a horizontal pipe. Valves 4" – 18" (nominal) are supplied with a single clamp. The clamp turnbuckle should be oriented at top dead center as delinated by the plumb line.

Valves 20” – 60” (nominal) are supplied with two clamps. The turnbuckles should be oriented 45° from the top center plumb line.

The 72” is supplied with three clamps. The turnbuckle for one clamp to be at top center. The other clamps to be 45° to each side of top center.

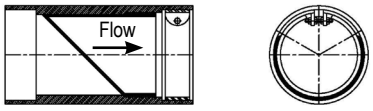
10. Insertion Into Pipe

Clamp to support the shape of the cuff should be hand tight and should be extended outward, but only tight enough to loosely keep the shape of the cuff during installation.

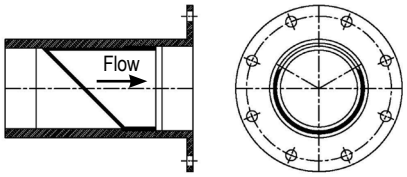
CAUTION: If you expand the clamp excessively at this step it will hinder or prevent the CheckMate® valve being fully inserted into the pipe.

CheckMate® Clamping Diagrams

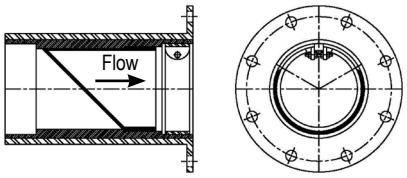
Downstream Clamp



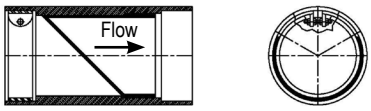
Downstream Flanged



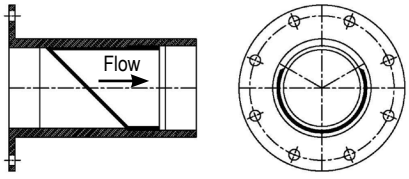
Downstream Flanged Thimble Insert



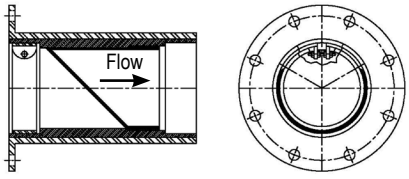
Upstream Clamp



Upstream Flanged



Upstream Flanged Thimble Insert



11. Pallet Push for Larger CheckMate® Valves

Larger CheckMate® valves can be pushed into the pipe utilizing the shipping pallet. The pallet should be placed perpendicular to the valve being inserted into the pipe. Then, with assistance from an excavator, push with consistent even force against the shipping pallet to insert the CheckMate® valve into the pipe.

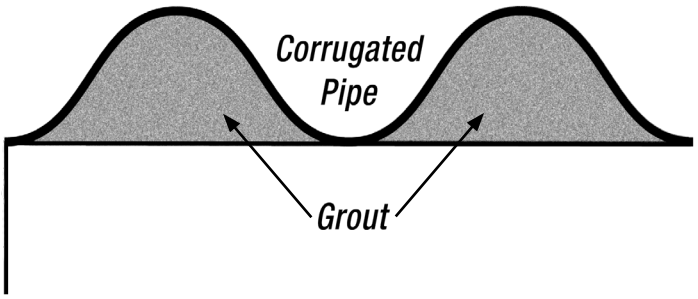
See the image to the right for the suggested positioning and usage of the excavator's shovel assistance for larger-sized CheckMate® valves. Clamps must be installed to prevent damage to cuff.

Pallet Push method for installing CheckMate® Valve

12. Corrugated Pipe and Smooth Wall (PVC, HDPE) Pipe Installation

For installation on corrugated pipe, it is recommended that the corrugations be filled with hydraulic cement (or similar material) that will provide a smooth I.D.

For smooth wall pipe, it is recommended that the valve be pinned.



CheckMate® can be made for any pipe I.D. Built to fit in sizes from 3-72" (75-1800mm).

Flange shape and bolt pattern can be customized. Flangeless thimble inserts are available.

	DIMENSIONS										
	NOMINAL PIPE SIZE I.D.		OVERALL LENGTH*		NUMBER OF CLAMPS	CUFF DEPTH		BACK PRESSURE RATING**		WEIGHT***	
	Inches	Millimeters	Inches	Millimeters		Inches	Millimeters	Feet	Meters	lbs	Kg
Low Pressure	3	75	5.1	130	1	1.5	38	10	3.0	0.7	0.3
	4	100	7.9	201	1	**1.5**	38	10	3.0	1.5	0.7
Standard Pressure	4	100	7.9	201	1	1.5	38	85	26.0	3	1.5
	5	125	9.5	241	1	1.5	38	83	25.3	4	2
	6	150	11.0	279	1	2.0	51	83	25.3	9	4
	7	175	12.8	325	1	2.0	51	79	24.1	11	5
	8	200	15.2	386	1	2.0	51	79	24.1	13	6
	9	225	15.4	391	1	2.0	51	75	22.9	17	8
	10	250	16.1	409	1	2.0	51	71	21.6	20	10
	12	300	19.8	503	1	2.0	51	68	20.1	37	17
	14	350	25.8	655	1	4.0	102	64	20.0	110	50
	15	381	25.8	655	1	4.0	102	62	18.9	120	55
	16	400	28.6	726	1	4.0	102	60	18.3	133	52
	18	450	31.0	787	1	4.0	102	56	17.1	143	65
	20	500	42.1	1069	2	8.0	203	53	16.2	223	102
	24	600	47.5	1207	2	8.0	203	45	13.7	304	137
	26	650	50.0	1270	2	8.0	203	42	12.8	370	168
	28	700	52.0	1321	2	8.0	203	40	12.2	434	197
	30	750	54.9	1395	2	8.0	203	38	11.6	500	227
	36	900	62.3	1582	2	8.0	203	30	9.1	828	376
	42	1050	70.6	1793	2	8.0	203	28	8.5	1423	646
	48	1200	79.0	2007	2	8.0	203	26	7.9	1801	817
	54	1350	86.4	2195	2	8.0	203	20	6.1	2700	1225
	60	1500	96.8	2459	2	9.0	229	18	5.5	3315	1504
	72	1800	119.0	3023	3	12.0	305	15	4.6	6100	2767

*Shorter lengths available.

**Back pressure measured from pipe invert.
Higher back pressure ratings available. Consult factory.

***Weights are approximate and do not include crating.

13. Flanged Valve Bolt Torques

The valve end with the rubber flange shall be installed using the backup rings provided. The sleeve split should be installed facing downstream, with the split in the vertical position.

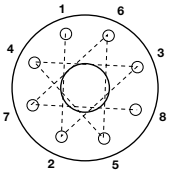
The installation bolt torque on the end flange bolts are listed in the table below.

RECOMMENDED MINIMUM BOLT TORQUE

Valve Size	Bolt Size	Torque (ft*lb.)
1”	1/2” - 13NC	20
1-1/2”	1/2” - 13NC	20
2”	5/8” - 11NC	30
2-1/2”	5/8” - 11NC	40
3”	5/8” - 11NC	40
4”	5/8” - 11NC	30
5”	3/4” - 10NC	40
6”	3/4” - 10NC	30
8”	3/4” - 10NC	40
10”	7/8” - 9NC	40
12”	7/8” - 9NC	50
14”	1” - 8NC	50
16”	1” - 8NC	50
18”	1-1/8” - 7NC	30
20”	1-1/8” - 7NC	30
24”	1-1/4” - 7NC	40
30”	1-1/4” – 7NC	30
36”	1-1/2” – 6NC	40
42”	1-1/2” – 6NC	50
48”	1-1/2” – 6NC	55
54”	1-3/4”– 5NC	60
60”	1-3/4”– 5NC	80
72”	1-3/4”– 5NC	100

Torque values are suggested minimum values.

Torque all flange bolts in a star pattern, first to 50% of tabulated values, then retorque to 100% of tabulated values. If greater torque is required, continue retorquing in increments of 50% of tabulated values. Use of a high quality anti–seize compound on all bolt threads is recommended.



Always use a “star” pattern when bolting a check valve.

Variables such as the surface finish on bolt threads, type of anti–seize compound used, and surface finish of the mating flanges all have an effect on the minimum torque required to obtain a leak–tight flange seal.

During installation you may need to retorque the flange bolts several times for a proper seal. This will overcome any leaks due to the cold flow of the rubber sleeve flange.

CheckMate® Installation Notes

1. It is important that the CheckMate® is installed level within the pipe. The CheckMate® may "gap open" if installed improperly.

2. The sealing area of the CheckMate® must have room to expand outwards, while bottom of the sealing area rises. The area around the sealing area must be kept free of debris to allow the bill to close in order for the valve to seal properly.

3. The CheckMate® effectively reduces the inside diameter of the pipe in which it is installed, creating a restriction. It may also create a "ledge" inside the pipe, causing standing water.

4. Back pressure in excess of the back pressure rating may cause valve failure.

5. Should the conditions that the CheckMate® was designed for change, (line pressure, back pressure, chemical compatibility) the performance of the valve may suffer.

6. CheckMate® Valves must be installed in true round pipe which is concentric across the entire length. Out of round pipe may cause the sealing area of the valve to distort and gap, which will cause the valve to leak.

MAINTENANCE

Inspection
Valves should occasionally be inspected for damage, wear, and buildup of debris. The frequency of the inspections should be determined by the severity of the service and the environment in which it operates.

The clamps should be checked for proper tension, and be sure that the inside of the valve is free of debris. Soft marine growth is normal on valves in submerged applications. Because hard marine growth such as barnacles will not bond well to the CheckMate®, they can be easily removed. Also insert pins to ensure they are tight.

STORAGE

If your CheckMate®, is to be stored for a period of time prior to installation, the following storage guidelines will help to preserve the valve and assure a trouble-free installation:

1. Store in a clean, cool, dry location. Avoid exposure to light, electric motors, dirt, or chemicals.
2. Store valve vertically on floor or pallet.
3. Store valve to prevent other items from contacting check sleeve to prevent possible damage.
4. Store this manual with the valve, so that it is readily available at time of installation.

TROUBLESHOOTING GUIDE

Sleeve Inverted or Distorted
1. Excessive back pressure, water surge, or water hammer.

Leaking Around Perimeter of Valve
1. Tighten clamp.
2. Check for cracks and holes in surface of pipe.
3. If taped, check tape to ensure the pipe I.D. has been fully sealed

Backflow
1. Debris lodged inside bill.

© 2024 Red Valve Company

Limited Warranty

Red Valve Company (“Seller”) manufactured products, auxiliaries and parts thereof that we manufacture for a period of twenty-four (24) months from date of shipment from Seller’s factory, are warranted to the original purchaser only against defective workmanship and material, but only if properly stored, installed, operated, and serviced in accordance with Seller’s recommendations and instructions.

For items proven to be defective within the warranty period, your exclusive remedy under this limited warranty is repair or replacement of the defective item, at Seller’s option, FCA Incoterms 2020 Seller’s facility with removal, transportation, and installation at your cost.

Products or parts manufactured by others but furnished by Seller are not covered by this limited warranty. Seller may provide repair or replacement for other’s products or parts only to the extent provided in and honored by the original manufacturer’s warranty to Seller, in each case subject to the limitations contained in the original manufacturer’s warranty.

No claim for transportation, labor, or special or consequential damages or any other loss, cost or damage is being provided in this limited warranty. You shall be solely responsible for determining suitability for use and in no event shall Seller be liable in this respect.

This limited warranty does not warrant that any Seller product or part is resistant to corrosion, erosion, abrasion or other sources of failure, nor does Seller warrant a minimum length of service.

Your failure to give written notice to us of any alleged defect under this warranty within twenty (20) days of its discovery, or attempts by someone other than Seller or its authorized representatives to remedy the alleged defects therein, or failure to return product or parts for repair or replacement as herein provided, or failure to store, install, or operate said products and parts according to the recommendations and instructions furnished by Seller shall be a waiver by you of all rights under this limited warranty.

This limited warranty is voided by any misuse, modification, abuse or alteration of Seller’s product or part, accident, fire, flood or other Act of God, or your failure to pay entire contract price when due.

The foregoing limited warranty shall be null and void if, after shipment from our factory, the item is modified in any way or a component of another manufacturer, such as but not limited to; an actuator is attached to the item by anyone other than a Seller factory authorized service personnel.

All orders accepted shall be deemed accepted subject to this limited warranty, which shall be exclusive of any other or previous warranty, and this shall be the only effective guarantee or warranty binding on Seller, despite anything to the contrary contained in the purchase order or represented by any agent or employee of Seller in writing or otherwise, notwithstanding, including but not limited to implied warranties.

THE FOREGOING REPAIR AND REPLACEMENT LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, OBLIGATIONS AND LIABILITIES, INCLUDING, BUT NOT LIMITED TO, ALL WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR OF MERCHANTABILITY OR OTHERWISE, EXPRESSED OR IMPLIED IN FACT OR BY LAW, AND STATE SELLER’S ENTIRE AND EXCLUSIVE LIABILITY AND YOUR EXCLUSIVE REMEDY FOR ANY CLAIM IN CONNECTION WITH THE SALE AND FURNISHING OF SERVICES, GOODS OR PARTS, THEIR DESIGN, SUITABILITY FOR USE, INSTALLATION OR OPERATIONS. NEITHER ANY PERFORMANCE OR OTHER CONDUCT, NOR ANY ORAL OR WRITTEN INFORMATION, STATEMENT, OR ADVICE PREPARED BY SELLER OR ANY OF OUR EMPLOYEES OR AGENTS WILL CREATE A WARRANTY, OR IN ANY WAY INCREASE THE SCOPE OR DURATION OF THIE LIMITED WARRANTY.

Limitation of Liability

IN NO EVENT SHALL SELLER BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, PUNITIVE, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, DAMAGE TO OR LOSS OF OTHER PROPERTY OR EQUIPMENT, BUSINESS INTERUPTION, COST OF SUBSTITUTE PRODUCTS, LOSS OF TIME, LOSS PROFITS OR REVENUE, COST OF CAPITAL, LOSS OF USE, OR DIMINUTION IN VALUE) WHATSOEVER, AND SELLER’S LIABILITY, UNDER NO CIRCUMSTANCES, WILL EXCEED THE CONTRACT PRICE FOR THE GOODS AND/OR SERVICES FOR WHICH LIABILITY IS CLAIMED. ANY ACTION FOR BREACH OF CONTRACT BY YOU, OTHER THAN RIGHTS RESPECTING OUR LIMITED WARRANTY DESCRIBED ABOVE, MUST BE COMMENCED WITHIN 12 MONTHS AFTER THE DATE OF SALE.

Sales and Service

For information about our worldwide locations, approvals, certifications and local representative:

Web site: RedValve.com E-Mail: support@redvalve.com

Red Valve®

750 Holiday Drive, Suite 400, Pittsburgh, PA 15220 • Phone: 412-279-0044

Red Valve Company reserves the right to incorporate our latest design and material changes without notice or obligation. Design features, materials of construction and dimensional data, as described in this manual, are provided for your information only and should not be relied upon unless confirmed in writing by Red Valve Company. Certified drawings are available upon request.

February 2023

CD150M Dri-Prime® Pump

WITH FINAL TIER 4 (FT4) DIESEL ENGINE

The Godwin Dri-Prime CD150M pump offers flow rates to 2290 USGPM and has the capability of handling solids up to 3.0" in diameter.

The CD150M is able to automatically prime to 28' of suction lift from dry. Automatic or manual starting/stopping available through integral mounted control panel or optional wireless-remote access.

Indefinite dry-running is no problem due to the unique Godwin liquid bath mechanical seal design. Solids handling, dry-running, and portability make the CD150M the perfect choice for dewatering and bypass applications.

Features and Benefits

- Simple maintenance normally limited to checking fluid levels and filters.
- Dri-Prime (continuously operated Venturi air ejector priming device) requiring no periodic adjustment. Optional compressor clutch available.
- Extensive application flexibility handling sewage, slurries, and liquids with solids up to 3.0" in diameter.
- Dry-running high pressure liquid bath mechanical seal with high abrasion resistant solid silicon carbide faces.
- Close-coupled centrifugal pump with Dri-Prime system coupled to a diesel engine or electric motor.
- All cast iron construction (stainless steel construction option available) with cast steel impeller.
- Also available in a critically silenced unit which reduces noise levels to less than 70 dBA at 30'.
- Standard engine JCB TCAE-55 (FT4). Also available with John Deere 4045TFC03 (FT4).

Specifications

Suction connection	6" 150# ANSI B16.5
Delivery connection	6" 150# ANSI B16.5
Max capacity	2290 USGPM †
Max solids handling	3.0"
Max impeller diameter	11.0"
Max operating temp	176°F*
Max working pressure	70 psi
Max suction pressure	58 psi
Max casing pressure	104 psi
Max operating speed	2200 rpm

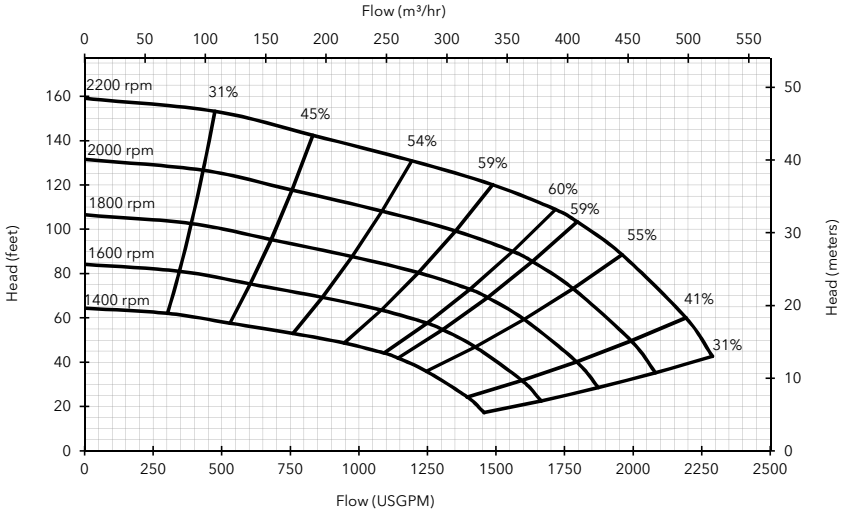
* Please contact our office for applications in excess of 176°F.

† Larger diameter pipes may be required for maximum flows.

Please contact the factory or office for further details. A typical picture of the pump is shown.
All information is approximate and for general guidance only.

godwin
a xylem brand

Performance Curve



Materials

Pump casing & suction cover	Cast iron BS EN 1561 - 1997
Wearplates	Cast iron BS EN 1561 - 1997
Pump Shaft	Carbon steel BS 970 - 1991 817M40T
Impeller	Cast Steel BS3100 A5 Hardness to 200 HB Brinell
Non-return valve body	Cast iron BS EN 1561 - 1997
Mechanical seal	Silicon carbide face; Viton elastomers; Stainless steel body

Engine option 1

JCB TCAE-55 (FT4), 74 HP @ 2200 rpm

Impeller diameter 11.0"

Pump speed 2200 rpm

Suction Lift Table

Total Suction Head (feet)	Total Delivery Head (feet)				
	30	46	62	81	121
	Output (USGPM)				
10	2179	2131	2083	1889	1356
15	2058	1937	1816	1574	1162
20	1453	1453	1453	1332	848
25	1259	1211	1114	969	484

Fuel capacity: 60 US Gal

Max fuel consumption @ 2200 rpm: 4.5 US Gal/hr

Max fuel consumption @ 1800 rpm: 2.4 US Gal/hr

Weight (Dry): 3,200 lbs

Weight (Wet): 3,630 lbs

Dim.: (L) 119" x (W) 66" x (H) 77"

Performance data provided in tables is based on water tests at sea level and 20°C ambient. All information is approximate and for general guidance only. Please contact the factory or office for further details.

Engine option 2

John Deere 4045TFC03 (FT4), 74 HP @ 2200 rpm

Impeller diameter 11.0"

Pump speed 2200 rpm

Suction Lift Table

Total Suction Head (feet)	Total Delivery Head (feet)				
	30	46	62	81	121
	Output (USGPM)				
10	2179	2131	2083	1889	1356
15	2058	1937	1816	1574	1162
20	1453	1453	1453	1332	848
25	1259	1211	1114	969	484

Fuel capacity: 60 US Gal

Max fuel consumption @ 2200 rpm: 5.2 US Gal/hr

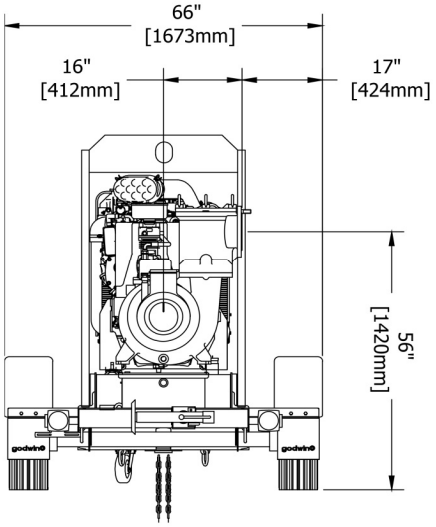
Max fuel consumption @ 1800 rpm: 2.6 US Gal/hr

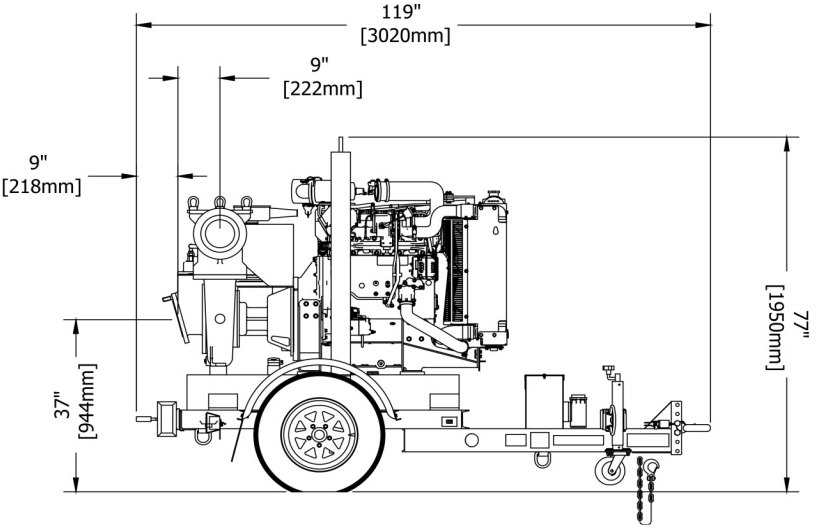
Weight (Dry): 3,180 lbs

Weight (Wet): 3,610 lbs

Dim.: (L) 119" x (W) 66" x (H) 91"

Performance data provided in tables is based on water tests at sea level and 20°C ambient. All information is approximate and for general guidance only. Please contact the factory or office for further details.





xylem
Let's Solve Water

84 Floodgate Road
Bridgeport, NJ 08014 USA
(856) 467-3636 . Fax (856) 467-4841

Reference number : 200GPA0000980
Date of issue : November 2, 2015
Issue : -

www.godwinpumps.com

© 2015 Xylem, Inc. All rights reserved. Godwin is a trademark of Xylem Dewatering Solutions, Inc., a wholly-owned subsidiary of Xylem Inc. Specifications and illustrations are subject to revision without notice. Xylem makes no representation regarding the completeness or accuracy of this information and is not liable for any direct or indirect damages arising from or relating to this information or its use.

Appendix E: Geotechnical Report

Geotechnical Report (prepared by Columbia West)

Initial Infiltration Testing Map and Results

Additional Infiltration Testing Preliminary Results

Additional Infiltration Test Pit Logs

Additional Infiltration Testing Map and Results

Geotechnical Site Investigation

Landing on the Cowlitz

Castle Rock, Washington

March 30, 2023

Geotechnical ■ Environmental ■ Special Inspections
Columbia West
Engineering, Inc

11917 NE 95th Street
Vancouver, Washington
98682
Phone: 360-823-2900

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

GEOTECHNICAL SITE INVESTIGATION
LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

Prepared For:

CT6, LLC
Attn: Janette Pipkin
PO Box 1419
Battle Ground, Washington 98604

Site Location:

2542 SW Larson Lane
Parcel Nos. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031
Castle Rock, Washington

Prepared By:

Columbia West Engineering, Inc.
11917 NE 95th Street
Vancouver, Washington 98682
Phone: 360-823-2900

Date Prepared:

March 30, 2023

EXECUTIVE SUMMARY

This executive summary presents the primary geotechnical considerations associated with the proposed Landing on the Cowlitz project located in Castle Rock, Washington. Our conclusions and recommendations are based upon the subsurface information presented in this report and proposed development information provided by the design team. Detailed discussion of the geotechnical considerations summarized here is presented in respective sections of the report.

- Based on subsurface exploration and testing, liquefiable soil is present at the site. Maximum total liquefaction settlement is estimated to range from approximately 4 to 7 inches. Differential settlement is estimated to be approximately one-half of the total over a 50-foot span. Detailed discussion of site liquefaction potential is presented in Section 6.1, *Liquefaction*.
- Review of *Table 12.13-3* of *ASCE 7-16* indicates that anticipated seismic differential settlement will be near the upper bound, tolerable limit for typical structures that may be proposed on the site. Provided that proposed structures can tolerate the estimated seismic settlement, the buildings can be supported on conventional spread footings bearing on firm native soil or engineered structural fill. Shallow foundations, if proposed, will require foundations ties if differential settlement exceeds one-quarter of the thresholds presented in *Table 12.13-3*. Ground improvement or deep foundations may be necessary if buildings cannot tolerate the estimated seismic settlement or if project stakeholders desire to minimize risk of building damage following a seismic event.
- Groundwater was observed in site explorations at depths ranging from 9 to 35 feet below ground surface (bgs). The shallow depth to groundwater may impact site cuts for foundations, utilities, pump stations, and stormwater detention ponds. Dewatering should be assumed where proposed excavations extend more than a few feet below existing grade. Significant excavation depths for the proposed pump station and potential for rapid groundwater flow through permeable sand and gravel deposits will dictate the need for a robust dewatering plan designed by a licensed professional engineer.
- Based on groundwater conditions and expected site grading, cut off drains may be required to intercept water in areas of significant cut. Our experience indicates that installation of cut-off drains prior to site grading activity will assist in dewatering during site construction, particularly during the wet-weather season.
- Perimeter building foundation drains can reduce the potential for water intrusion below structures. Perimeter footing drains are recommended for shallow foundations constructed 5 or more feet below existing site grades. Foundations constructed less than 5 feet below existing grades do not require drains, however,

it may be prudent to install foundations drains to collect incidental or perched water. The final decision for foundations drains should be made by the owner and architect.

- Moisture conditioning will be required to use onsite soil as structural fill. If moisture conditioning is not feasible due to weather conditions or other factors, soils may require cement-amendment to be used as structural fill.
- Near-surface native soils will be sensitive to disturbance and softening when at a moisture content that is above optimum. Haul roads and staging areas will be necessary to minimize damage to exposed subgrade soils during construction. Subgrade protection is discussed in Section 8.2, *Construction Traffic and Staging*.
- Design and construction of proposed stormwater management facilities should account for shallow groundwater conditions observed at the site.
- This report has been prepared to provide general recommendations for overall site development. We recommend additional explorations and geotechnical reports be completed for specific developments/structures prior to design and construction.

TABLE OF CONTENTS

LIST OF FIGURES ii
LIST OF APPENDICES iii
1.0 INTRODUCTION 1
1.1 General Site Information 1
1.2 Project Understanding 1
1.3 Site Background Information 1
2.0 SCOPE OF SERVICES 2
3.0 REGIONAL GEOLOGY AND SOIL CONDITIONS 3
4.0 REGIONAL SEISMOLOGY 4
5.0 GEOTECHNICAL AND GEOLOGIC FIELD INVESTIGATION 5
5.1 Surface Investigation and Site Description 5
5.2 Subsurface Conditions 6
6.0 SEISMIC HAZARDS 8
6.1 Liquefaction 8
6.2 Lateral Spreading 9
7.0 DESIGN RECOMMENDATIONS 10
7.1 Shallow Foundation Support 10
7.2 Seismic Design Considerations 12
7.3 Retaining Structures 13
7.4 Pavement Design 14
7.5 Drainage 16
8.0 CONSTRUCTION RECOMMENDATIONS 18
8.1 Site Preparation and Grading 18
8.2 Construction Traffic and Staging 18
8.3 Cut and Fill Slopes 19
8.4 Excavation 20
8.5 Dewatering 20
8.6 Materials 21
8.7 Erosion Control Measures 26
9.0 CONCLUSION AND LIMITATIONS 27
REFERENCES
FIGURES
APPENDICES

LIST OF FIGURES

Number	Title
1	Site Location Map
2	Exploration Location Map
3	Preliminary Master Development Plan
4	Phase I Rough Grading Plan
5	Surcharge-Induced Lateral Earth Pressures
6	Typical Perimeter Footing Drain Detail
7	Typical Perforated Drainpipe Trench Detail
8	Typical Drainage Mat Detail
9	Typical Cut and Fill Slope Cross-Section
10	Minimum Foundation Slope Setback Detail

LIST OF APPENDICES

Number	Title
A	Subsurface Exploration Logs
B	Soil Classification Information
C	Pertinent Subsurface Information Collected by Others
D	Report Limitations and Important Information

GEOTECHNICAL SITE INVESTIGATION
LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

1.0 INTRODUCTION

Columbia West Engineering, Inc. (Columbia West) was retained by CT6, LLC to conduct a geotechnical site investigation for the proposed Landing on the Cowlitz master development project located in Castle Rock, Washington. The purpose of the investigation was to provide geotechnical engineering recommendations for use during design and construction of the proposed development. This report summarizes the investigation and provides field assessment documentation. This report is subject to the limitations expressed in Section 9.0, *Conclusion and Limitations*, and Appendix D, *Report Limitations and Important Information*.

1.1 General Site Information

As indicated on Figures 1 and 2, the subject site is located at 2542 Larson Lane in Castle Rock, Washington. The site is comprised of tax parcels 3092824, 3040258, 3040259, 3040322, 3014867, and 3045031 totaling approximately 118.2 acres. The approximate latitude and longitude are N 45° 15' 25" and W 122° 53' 30", and the legal description includes portions of the SE ¼ of Section 14, the NE ¼ of Section 23, and the NW ¼ of Section 24, T9N, R2W, Willamette Meridian. The regulatory jurisdictional agency is the City of Castle Rock.

1.2 Project Understanding

Based on client correspondence and review of the preliminary master development plan shown on Figure 3, Columbia West understands that proposed development consists of a mixed-use district with approximately 7.8 acres of residential zoning, 9.5 acres of commercial zoning, 18.3 acres of recreational zoning, and 55.9 acres of light industrial and office space zoning. Proposed development also includes public roadway construction, installation of underground utilities, and stormwater management facilities. A sanitary sewer pump station is also proposed approximately 35 feet below ground surface. The *Phase 1 Rough Grading Plan*, presented on Figure 4, includes cuts and fills up to 10 feet.

Lot- and zoning-specific building plans were not available at the time this report was prepared. In general, buildings on the site are expected to be lightly-loaded and less than three stories in height. We anticipate that commercial, recreational, and light industrial areas will include concrete tilt-up or metal-framed buildings. Residential structures will likely be of wood-framed construction. We should be contacted to revise our recommendations if the assumptions stated above are incorrect.

1.3 Site Background Information

Columbia West was retained by CT6, LLC in October, 2022 to provide on-call geotechnical construction monitoring and material testing services during Phase I rough grading as shown

on Figure 4. On-call geotechnical services conducted between October, 2022 and January, 2023 included organic stripping observations, moisture-density testing of structural fill, proof-roll observations, bearing probe analysis, and laboratory testing. Field reports documenting Phase I grading activity were submitted to project team members under separate cover. Columbia West also prepared preliminary grading recommendations for the Phase I rough grading plan which is presented in a technical memorandum dated November 8, 2022 (Columbia West, 2022). At the time this report was prepared, Phase I rough grading was in progress with expected completion in summer of 2023.

To characterize site groundwater conditions and facilitate stormwater management design by others, Columbia West oversaw five borings at the site with piezometer installations (BP-1 through BP-5) on January 31, February 1, and February 2, 2023. Piezometers extended up to 35 feet below existing grade, were backfilled with silica sand, sealed with bentonite, and completed with flush mount monuments. Monitoring of the piezometers commenced in February, 2023 and continues on a bi-weekly basis at the direction of the design team. Piezometer monitoring results are discussed in greater detail in Section 5.2.2, *Groundwater*.

Prior to Phase I rough grading, a geotechnical due-diligence study of the site was conducted by others in 2020. Field exploration and testing conducted as part of the due-diligence study included six test pits (TP-1 through TP-6), two borings (B-1 and B-2), and five cone penetration tests (CPT-1 through CPT-5) extending to a maximum depth of 81.5 feet bgs. Exploration locations are shown on Figure 2. Exploration logs and CPT soundings are presented in Appendix C, *Pertinent Subsurface Information Collected by Others*. Subsurface conditions observed by others during the due-diligence study are discussed in Section 5.2.1, *Soil Type Description*.

2.0 SCOPE OF SERVICES

Columbia West's scope of services was outlined in a proposal dated November 8, 2022. In accordance with our proposal, we performed the following geotechnical services:

- Reviewed information available in our files from previous geological and geotechnical studies conducted at and in the vicinity of the site. Our review included the following site explorations conducted by others and presented in Appendix C, *Pertinent Subsurface Information Collected by Others*:
    - Five CPT soundings explored to a maximum depth of 35.43 feet bgs.
    - Two borings explored to a maximum depth of 81.5 feet bgs.
    - Six test pits explored to a maximum depth of 13 feet bgs.
- Reviewed the preliminary master development plan, the Phase I rough grading plan, and a conceptual stormwater management plan provided by the design team.
- Conducted subsurface exploration at the site, to include:
    - Drilled five borings to a maximum depth of 45 feet bgs and installed piezometers in each borehole.
- Classified and logged observed soil and groundwater conditions.

- Prepared this geotechnical site investigation report for the proposed development, which includes:
  - Summary of soil index properties, regional geology, soil conditions, and observed groundwater conditions
  - Summary of geologic and seismic literature research used to evaluate relevant seismic risks, including locations of faults, earthquake magnitudes, and seismic factors from the *2018 IBC* and *ASCE 7-16*
  - Liquefaction analysis, predicted seismic settlement, and mitigation discussion
  - Foundation settlement potential
  - Geotechnical design and construction recommendations for:
    - Shallow foundations
    - Slab subgrade preparation
    - Retaining walls, including drainage, backfill, and lateral earth pressures
    - Site preparation and grading, organic stripping, fill placement and compaction, over-excavation, wet/dry weather earthwork, and construction monitoring and testing
    - Structural fill materials, onsite soil suitability, and import aggregate specifications
    - Utility trench excavation and backfill
    - Drainage and management of groundwater conditions
    - Asphaltic concrete pavement construction for private access roads and parking lots, including section thicknesses for base aggregate and asphalt layers
    - Portland cement concrete pavement construction for loading docks, including section thicknesses for base aggregate and PCC layers
    - Code-based seismic design parameters in accordance with *ASCE 7-16*

3.0 REGIONAL GEOLOGY AND SOIL CONDITIONS

The subject site lies within the Cowlitz River drainage basin, a physiographic river valley flanked to the east and west by mountainous foothills of the western Cascade Range. The site is located along the east bank of the Cowlitz River, approximately 11 miles north of the confluence with the Columbia River in Longview, Washington.

According to the *Geologic Map of the Mount St. Helens Quadrangle, Washington and Oregon* (Phillips, USGS Open File Report 87-4, 1987), near-surface soils are expected to consist of Quaternary-aged alluvium of silt, sand, and gravel deposited by the Cowlitz River. The Cowlitz Formation is mapped below the alluvium and consists of Eocene-aged sandstone, siltstone, and shale with interbeds of basalt and conglomerate.

In areas proposed for development, the *Web Soil Survey* (USDA, NRCS, 2023 Website) identifies various loamy sands, fine sandy loams, and gravelly sands of the Newberg, Carrolls, Pilchuck, Panamaker, and Cowlitz soil series. The mapped soils generally consist of silts, sands, and gravels with moderately rapid to rapid permeability, low to moderate

water capacity, and low shrink-swell potential. These soils exhibit a slight to severe erosion hazard based primarily on slope grade. As discussed in Section 1.3, *Site Background Information*, surface soils at the site have been disturbed, moved, or manipulated as part of Phase I rough grading activity and may no longer be representative of the NRCS soil survey mapping.

4.0 REGIONAL SEISMOLOGY

Recent research and subsurface mapping investigations within the Pacific Northwest appear to suggest the historic potential risk for a large earthquake event with strong localized ground movement may be underestimated. Past earthquakes in the Pacific Northwest appear to have caused landslides and ground subsidence, in addition to severe flooding near coastal areas. Earthquakes may also induce soil liquefaction, which occurs when elevated horizontal ground acceleration and velocity cause soil particles to interact as a fluid as opposed to a solid. Liquefaction of soil can result in lateral spreading and temporary loss of bearing capacity and shear strength. Liquefaction is discussed later in Section 5.9, *Liquefaction*.

Three scenario earthquakes are possible with the local seismic setting. Two of the possible earthquake sources are associated with the CSZ, and the third event is a shallow, local crustal earthquake that could occur in the North American Plate. The three earthquake scenarios are discussed below.

Cascadia Subduction Zone

The Cascadia Subduction Zone is a potential source of strong earthquake activity in the Portland/Vancouver Basin. This phenomenon is the result of the earth's large tectonic plate movement. Geologic evidence indicates that volcanic ocean floor activity along the Juan de Fuca ridge in the Pacific Ocean causes the Juan de Fuca Plate to perpetually move east and subduct under the North American Continental Plate. The subduction zone results in historic volcanic and potential earthquake activity in proximity to the plate interface, believed to lie approximately 20 to 50 miles west of the general location of the Oregon and Washington coast (Geomatrix Consultants, 1995).

Evidence suggests that this subduction zone has generated eight great earthquakes in the last 4,000 years, with the most recent event occurring approximately 300 years ago (Weaver and Shedlock, 1991).

Two types of subduction zone earthquakes are possible and considered in this report:

1. An interface event earthquake on the seismogenic part of the interface between the Juan de Fuca Plate and the North American Plate on the CSZ. This source is capable of generating earthquakes with a moment magnitude of 9.0.
2. A deep intraplate earthquake on the seismogenic part of the subducting Juan de Fuca Plate. These events typically occur at depths of between 30 and 60 km. This source is capable of generating an event with a moment magnitude of up to 8.0.

Crustal Events

An earthquake could also occur on a local fault within the North American Plate. The nearest mapped crustal faults are more than 40 miles from the site, and based on deaggregation at the anticipated fundamental period of planned structures, contribute less than one percent of the overall seismic hazard at the site. Therefore, significant ground shaking as a result of crustal faults is anticipated to be minimal.

5.0 GEOTECHNICAL AND GEOLOGIC FIELD INVESTIGATION

This geotechnical site investigation is based upon five borings drilled by Columbia West (BP-1 through BP-5), visual site reconnaissance, construction monitoring observations as previously described, and review of pertinent subsurface information collected by others. Borings BP-1 through BP-5 were explored with a track-mounted drill rig on January 31, February 1, and February 2, 2023. Subsurface soil profiles were logged in accordance with Unified Soil Classification System (USCS) specifications. Disturbed soil samples were collected at representative depth intervals. Exploration locations are shown on Figure 2. Subsurface exploration logs are presented in Appendix A, *Subsurface Exploration Logs*. Soil descriptions and classification information are provided in Appendix B, *Soil Classification Information*.

Subsurface information collected by others and reviewed as part of this investigation included six test pit logs (TP-1 through TP-6), two boring logs (B-1 and B-2), and results from five cone penetrations tests (CPT-1 through CPT-5). As reported on the logs provided in Appendix C, *Pertinent Subsurface Information Collected by Others*, test pits TP-1 through TP-6 were explored with a mini-excavator on January 14, 2020. Borings B-1 and B-2 were explored with a truck-mounted, mud-rotary drill rig on February 13 and 14, 2020. CPT-1 through CPT-5 were explored on January 13 and 14, 2020 with a cone penetrometer rig.

5.1 Surface Investigation and Site Description

The approximate 108.2-acre subject site consists of six tax parcels located at 2542 Larson Lane in Castle Rock, Washington. The site is generally flat to gently rolling and situated on an alluvial plain between the Cowlitz River and Interstate 5. As discussed in Section 1.3, *Site Background Information*, the site is currently under construction and being actively graded per the Phase I rough grading plan shown on Figure 4.

Surface conditions in large portions of the site consist of exposed sand and gravel associated with recent cuts and fills throughout the property. Other areas of the site remain unstripped and covered with grass. Observed trees on the site were generally limited to the site perimeter or wetland area. In the central portion of the site, a single-family residential structure and several agricultural outbuildings were observed. Stockpiles of soil, organic material, and demolition debris were observed in the vicinity of the existing structures.

As indicated on Figures 3 and 4, the proposed stormwater conveyance channel along the southern and eastern portion of the site is currently under construction. Surface water flow was observed in the channel during drilling of BP-1 through BP-5. Surface water flow appeared to trend east and north towards a temporary sediment pond located adjacent to

the wetland. Standing water was observed within the pond cells at the time of drilling. Stockpiles of organic material and disturbed soil were also observed near the temporary ponds.

5.2 Subsurface Conditions

Borings were advanced to a maximum depth of 81.5 feet bgs. CPTs were advanced to a maximum depth of 35.43 feet bgs. Test pits were advanced to a maximum depth of 13 feet bgs. Exploration locations are shown on Figure 2. Field logs and observed stratigraphy for encountered materials are presented in Appendix A, *Subsurface Exploration Logs* and Appendix C*, Pertinent Subsurface Information Collected by Others*.

5.2.1 Soil Type Description

As previously described, large portions of the site have been stripped of vegetation as part of Phase I rough grading activity. Boring BP-1 was explored through fill material consisting of sand with gravel. Borings BP-2, BP-3, and BP-5 were explored through apparent native soil consisting of sand with gravel. Boring BP-4 was explored through grass and a three-inch-thick root zone underlain by approximately 12 inches of topsoil. Below surface soil, fill material, and the topsoil layer, alluvial silt, sand, and gravel was observed to an approximate depth 45 feet. Review of boring logs B-1 and B-2 indicates that the alluvium extends up to 81.5 feet bgs. Subsurface lithology may generally be described by the soil units identified in the following text.

Topsoil

Topsoil below the vegetation root zone generally consists of silty sand with a low organic content. Review of test pits logs TP-1 through TP-6 indicates that organic topsoil may extend up to 36 inches below existing grade in unstripped portions of the site.

Structural Fill

Structural fill associated with Phase I rough grading is present on the site and generally consists of dense sand with gravel. The depth of fill is variable and actively changing during site improvements construction. Upon completion of Phase I rough grading, fill thickness, site topography, and finished grade elevations may be represented by the contours shown on Figure 4. As the on-call construction monitoring and material testing firm for the project, Columbia West has conducted moisture-density testing, proof-roll observations, and third-party oversight during Phase I rough grading. Observed and tested fill materials meet typical specifications for engineering structural fill and were placed in general conformance with the recommendations outlined in Columbia West's preliminary grading memorandum (Columbia West, 2022).

Upper Sand

Underlying surface soils, topsoil layers, and structural fill, loose to medium dense sand was encountered and extended to approximate depths of 17 to 35 feet bgs. The sand is moist to wet and contains interbedded layers and lenses of silt and clay. The silt and clay interbeds range from very soft to medium stiff in consistency.

Upper Gravel

The upper sand layer is underlain by medium dense to very dense gravel with varying proportions of sand, silt, and clay. The gravel is wet and rounded to sub-rounded. Review of boring logs B-1 and B-2 indicate that the gravel layer is approximately 20 to 25 feet thick and extends to depths of 38 to 40 feet bgs in the drilled locations. Cone penetration tests CPT-1 through CPT-5 encountered practical refusal on the upper gravel unit.

Lower Sand and Gravel

The upper gravel layer is underlain by medium dense to dense sand with gravel and trace silt. The sand is fine-textured and wet and extends to depths of 66 and 55.5 feet bgs respectively in borings B-1 and B-2. The sand is underlain by dense to very dense gravel with sand and trace silt. The gravel extends to the maximum explored depth of 81.5 feet bgs in B-1 and to a depth of 63.5 feet bgs in B-2.

Silt

Underlying the lower gravel layer in B-2, medium stiff to very stiff silt was encountered and extended to the maximum explored depth of 81.5 feet bgs. The silt is wet with trace clay and organic debris.

5.2.2 Groundwater

Groundwater was encountered in borings BP-1 through BP-5 at depths ranging from 15 to 35 feet bgs. Groundwater was reported at depths between 9 and 15 feet bgs on the exploration logs prepared by others and presented in Appendix C, *Pertinent Subsurface Information Collected by Others*. As discussed in Section 1.3, *Site Background Information*, Columbia West installed open standpipe piezometers in BP-1 through BP-5 to further characterize site groundwater conditions. Monitoring of the piezometers commenced in February, 2023 and continues on a bi-weekly basis at the direction of the design team. Groundwater monitoring results collected to date are presented in Table 1. Groundwater elevations are based upon piezometer rim survey data provided by Mackay Sposito. Upon completion of groundwater monitoring, the piezometers should be decommissioned by a licensed contractor in accordance with Washington Department of Ecology regulations.

Table 1. Piezometer Monitoring Data

Location	Measurement Date			
	2-13-23	2-20-23	3-2-23	3-20-23
BP-1	18.8 ft bgs Elev. 27.6 ft	18.1 ft bgs Elev. 28.3 ft	18.0 ft bgs Elev. 28.4 ft	18.0 ft bgs Elev. 28.4 ft
BP-2	36.5 ft bgs Elev. 28.1 ft	36.6 ft bgs Elev. 28.0 ft	36.6 ft bgs Elev. 28.0 ft	37.7 ft bgs Elev. 26.9 ft
BP-3	12.3 ft bgs Elev. 28.4 ft	12.4 ft bgs Elev. 28.3 ft	12.3 ft bgs Elev. 28.4 ft	12.2 ft bgs Elev. 28.5 ft

BP-4	12.1 ft bgs Elev. 29.3 ft	12.3 ft bgs Elev. 29.1 ft	12.5 ft bgs Elev. 28.9 ft	12.5 ft bgs Elev. 28.9 ft
BP-5	18.8 ft bgs Elev. 27.4 ft	17.3 ft bgs Elev. 28.9 ft	16.3 ft bgs Elev. 29.9 ft	17.3 ft bgs Elev. 28.9 ft

Note that groundwater levels are subject to seasonal variance and may rise during extended periods of increased precipitation. Groundwater elevations may also be influenced by fluctuations of the adjacent Cowlitz River. Perched groundwater may also be present in localized areas. Seeps and springs may become evident during site grading, primarily along slopes or in areas cut below existing grade. Structures, pavements, and drainage design should be planned accordingly.

6.0 SEISMIC HAZARDS

6.1 Liquefaction

Liquefaction is caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. Granular soil, which relies on interparticle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. In general, loose, saturated sand with low silt and clay content is most susceptible to liquefaction. Silty soil with low plasticity is moderately susceptible to liquefaction under relatively higher levels of ground shaking.

Liquefaction analysis at the site was performed by evaluating CPT data in the upper sand layer and standard penetration test (SPT) data in the lower sand layer. Results were combined to estimate the total anticipated seismic settlement. Analysis was conducted using methods developed by Boulanger and Idriss (2014) and Robertson (2009) with application of the depth weighting method published by Cetin (2009). A static groundwater level of 9 feet bgs was used in the liquefaction analysis.

Liquefaction analysis indicates that the upper sand layer and portions of the lower sand layer are susceptible to liquefaction under design levels of ground shaking. Total estimated seismic settlement at ground surface in the locations of CPT-1 through CPT-3 and CPT-5 is 4 to 5 inches. Total estimated seismic settlement at the location of CPT-4 is 7 inches. Differential settlement is estimated to be approximately one-half of the total settlement over a 50-foot span. Most of the seismic settlement is in the upper sand layer with the lower sand layer contributing approximately 0.5 to 1.0 inch to the total estimate. Note that the increased magnitude of settlement at CPT-4 reflects that the upper sand layer was observed to be approximately 10 to 15 feet thicker than elsewhere on the site.

Total seismic settlement estimates are likely near the upper bound tolerable limit for typical buildings that may be proposed on the site. Differential settlement thresholds for various building types and risk categories are provided in *Table 12.13-3* of *ASCE 7-16*. The thresholds presented in *Table 12.13-3* are code-specified minimum requirements and buildings may remain susceptible to damage if designed near the upper limits. Structural engineers on the project should calculate the allowable settlement tolerance and expected

performance based upon the specific building types proposed. Provided a building can tolerate the seismic settlement presented above, the structure may be supported by conventional spread footings bearing on firm native soil or engineered structural fill. Shallow foundations, if proposed, will require foundation ties if differential seismic settlement exceeds one-quarter of the thresholds presented in *Table 12.13-3*.

6.1.1 Liquefaction Mitigation

If proposed buildings cannot tolerate the estimated seismic settlement or project stakeholders desire to minimize risk of building damage, the upper sand layer may be improved to reduce the total seismic settlement. Rammed aggregate piers (RAPs) that extend to, and bear on the upper gravel layer are a viable option for ground improvement. RAPs are proprietary technology that are designed and constructed by design-build specialty contractors. The RAPs would need to be at least 17 to 35 feet long to penetrate through the upper sand layer and bear on the upper gravel unit. Additionally, the design-build contractor should provide analysis that shows rammed aggregate piers will support the structures when surrounding soil strength is reduced as a result of liquefaction. A design-build contractor should be contacted to provide the actual RAP configurations based on building serviceability and performance requirements. We anticipate that a RAP foundation system can be installed to meet the settlement criteria for site buildings. Installation of driven grout piles or standard steel or concrete piles may also be considered to mitigate seismic settlement at the site.

Soil improvements may reduce potential seismic settlement to an acceptable level of risk. If ground improvement utilizing RAPs is selected, additional in-situ testing and liquefaction analysis should be conducted following installation to determine the level of improvement achieved. Improved seismic settlement in the upper sand layer should be combined with results from the unimproved lower sand layer to determine the total seismic settlement following mitigation.

Selection of an appropriate mitigation plan may depend upon site planning, architectural, and structural engineering factors in addition to geotechnical concerns. All parties involved should work closely together to develop a suitable improvement plan with a clear understanding of the risks.

6.2 Lateral Spreading

Lateral spreading is a liquefaction-related seismic hazard that occurs on gently sloping or flat sites underlain by liquefiable sediment adjacent to an open face, such as a riverbank. Liquefied soil adjacent to an open face can flow toward the open face, resulting in lateral ground displacement.

Due to the presence of liquefiable soils at the site, lateral spreading is possible near the Cowlitz River. The magnitude of lateral spreading will be based on the depth of the river channel and distance between proposed structural improvements and the river. Tolerable lateral spread limits for shallow foundations in specific risk categories are presented in *ASCE 7-16, Table 12.13-2*. Lateral spreading is not anticipated to be a design consideration within approximately 300 feet of the riverbank because structures are not proposed in this

area. If structures are planned within 300 feet of the riverbank, Columbia West should be contacted to conduct additional analysis.

7.0 DESIGN RECOMMENDATIONS

The geotechnical site investigation suggests the proposed development is generally compatible with surface and subsurface soils, provided the recommendations presented in this report are incorporated in design and implemented during construction. The primary geotechnical considerations for the project were summarized previously in the *Executive Summary*. Specific design and construction recommendations are presented in the following sections.

7.1 Shallow Foundation Support

As discussed in Section 1.2, *Project Understanding*, lot- and zoning-specific building plans were not available at the time this report was prepared. We anticipate that future buildings will be lightly-loaded, less than three stories in height, and will consist of metal-framed, wood-framed, or concrete tilt-up construction. Provided that proposed buildings can tolerate the seismic settlement estimates presented in Section 6.1, *Liquefaction*, structures may be supported by shallow foundations bearing on firm native soil or engineered structural fill.

We anticipate maximum column and wall loads for future buildings will be less than 200 kips and 5 kips per foot, respectively. Floor slab loading is expected to be less than 200 psf. If actual loading exceeds anticipated loading, additional analysis should be conducted for the specific load conditions and proposed footing dimensions.

Foundations should not be supported by topsoil, agricultural till zones, or undocumented fill material. If encountered, these materials should be improved or removed and replaced with structural fill. If footings are constructed during wet-weather conditions or when footing subgrade soils are above their optimum moisture content, we recommend that a minimum of 6 inches of compacted aggregate be placed over exposed subgrade soils. The aggregate pad should extend 6 inches beyond the edge of the foundations and consist of imported granular material as described in Section 8.1.1, *Structural Fill*. Columbia West should observe exposed subgrade conditions prior to placement of crushed aggregate to verify adequate subgrade support.

Perimeter foundation drains are recommended for shallow foundations constructed five or more feet below existing site grades. Foundation drainage is discussed later in Section 7.5, *Drainage*.

7.1.1 Footing Dimensions and Bearing Capacity

Continuous perimeter wall and isolated spread footings should have minimum width dimensions of 18 and 24 inches, respectively. The base of exterior footings should bear at least 18 inches below the lowest adjacent exterior grade. The base of interior footings should bear at least 12 inches below the base of the floor slab.

Footings bearing on subgrade prepared as recommended above should be sized based on an allowable bearing pressure of 2,500 psf. As the allowable bearing pressure is a net bearing pressure, the weight of the footing and associated backfill may be ignored when

calculating footing sizes. The recommended allowable bearing pressure applies to the total of dead plus long-term live loads and may be increased by 50 percent for transient lateral forces such as seismic or wind.

7.1.2 Shallow Foundation Settlement

Foundation settlement is a significant structural design consideration. Provided subgrade soils are prepared as described in Section 8.1, *Site Preparation and Grading*, we anticipate that total post-construction static foundation settlement will be less than approximately 1 inch. Differential settlement between comparably-loaded footing elements is not expected to exceed approximately 0.5 inch over a span of 50 feet.

Estimated post-construction settlement assumes that settlement will occur after site grading and slab construction and before establishing structural connections between the building roof and foundation elements. In areas of large column spacing (greater than 50 feet) or where building footprints span significant differences in cut and fill, the potential for differential settlement exceeding the predicted settlement should be understood.

As discussed in Section 6.1, *Liquefaction*, site soils are also susceptible to settlement during a seismic event. Total seismic settlement at the analyzed locations is expected to range from 4 to 7 inches. Differential settlement is estimated to be approximately one-half the total settlement over a 50-foot span. If shallow foundations are proposed and meet the differential settlement thresholds of ASCE 7-16, project stakeholders and the structural engineer should discuss risk associated with seismic settlement and be willing to accept the potential for building damage during a seismic event. If the risk of damage cannot be accepted, liquefaction mitigation through soil improvements or deep foundations will be required.

7.1.3 Resistance to Sliding

Lateral foundation loads can be resisted by passive earth pressure on the sides of the footing and by friction at the base of the footings. Recommended passive earth pressure for footings confined by native soil or engineered structural fill is 350 pcf. The upper 12 inches of soil should be neglected when calculating passive pressure resistance. Adjacent floor slabs and pavement, if present, should also be neglected from the analysis. The recommended passive pressure resistance assumes that a minimum horizontal clearance of 10 feet is maintained between the footing face and adjacent downgradient slopes.

The estimated coefficient of friction between in situ native soil or engineered structural fill and in-place poured concrete is 0.35. The estimated coefficient of friction between compacted crushed aggregate and in-place poured concrete is 0.4.

7.1.4 Subgrade Observation

Footing and floor slab subgrade soils should be evaluated by Columbia West prior to placing forms or reinforcing bar to verify subgrade support conditions are as anticipated in this report. Subgrade observation should confirm that all disturbed material, organic debris, unsuitable fill, remnant topsoil zones, and softened subgrades (if present) have been removed. Over-excavation of footing subgrade soils may be required to remove deleterious material, particularly if footings are constructed during wet-weather conditions.

7.1.5 Floor Slabs

Floor slabs can be supported on firm, competent, native soil or engineered structural fill prepared as described in this report. Disturbed soils and unsuitable fills in proposed slab locations, if encountered, should be removed and replaced with structural fill.

To reduce slab shifting and moisture transmission, slabs should be underlain by at least 6 inches of compacted crushed aggregate. Geotextile may be used below the crushed aggregate layer to increase subgrade support. Recommendations for floor slab base aggregate and subgrade geotextile are discussed in Section 8.6, *Materials*.

Elevated soil moisture was observed within near-surface soil at the time of exploration. In areas where moisture-sensitive flooring will be installed, slab waterproofing or a vapor barrier should be installed according to the flooring manufacturers' recommendations. In our experience, 10- to 15-mil vapor barriers are often required by flooring manufacturers to maintain product warranties. Selection and design of an appropriate vapor barrier should be determined by architectural and structural design team members.

Slab thickness and reinforcement should be designed by an experienced structural engineer in accordance with anticipated loads. Load-bearing concrete slabs with maximum loading of 200 psf may be designed assuming a modulus of subgrade reaction, k, of 150 pci. If slab subgrade soil is cement-amended to a minimum depth of 12 inches, the modulus of subgrade reaction can be increased to 200 pci.

7.2 Seismic Design Considerations

Seismic design for proposed structures is prescribed by *ASCE 7-16.* Based upon site-specific test results, site soils meet the criteria for Site Class E. Seismic design parameters for Site Class E are presented in Table 2.

Table 2. ASCE 7-16 Seismic Design Parameters[1]

	Short Period (T_s = 0.2 s)	1 Second Period (T_1 = 1.0 s)
MCE Spectral Acceleration	0.84	0.40
Site Class	E[2]	
Site Coefficient	Fa = 1.3	Fv = 2.4
Adjusted Spectral Response Acceleration	S_{MS} = 1.1	S_{M1} = 0.96
Design Spectral Response Acceleration	S_{DS} = 0.73	S_{D1} = 0.64

1. The structural engineer should evaluate *ASCE 7-16* code requirements and exceptions to determine if these parameters are valid for design.
2. Seismic site class, site coefficients, and spectral acceleration parameters assume that the fundamental period for proposed structures will be less than 0.5 second.

For Site Class E sites with mapped maximum considered earthquake spectral response acceleration parameter S_S greater than or equal to 1.0 or S_1 greater than or equal to 0.2, a ground motion hazard analysis may be required according to *ASCE 7-16, Section 11.4.8* unless exemption criteria are met. According to *ASCE 7-16, Section 11.4.8 Exception 3,* a ground

motion hazard analysis is not required for Site Class E sites with S_1 greater than or equal to 0.2, provided that T is less than or equal to T_S, where T is the fundamental period of the structure and T_S is equal to the design spectral response acceleration parameter at a one second period (SD_1) divided by the design spectral response acceleration parameter at short periods (SD_S).

Columbia West recommends that structural engineers on the project evaluate code requirements and exceptions to determine if a site-specific ground motion hazard evaluation will be required for proposed structures.

Due to the presence of liquefiable soils at the site and potential for bearing capacity loss at ground surface, Site Class F criteria may be met if the fundamental period of vibration for proposed structures is greater than 0.5 second. If Site Class F criteria is met, a site-specific ground motion response analysis is required in accordance with *Section 21.1* of *ASCE 7-16*. If structures have a fundamental period of less than 0.5 second, seismic design parameters may be determined using the pre-liquefaction seismic site class. In our experience, conventional structures less than three-stories in height will likely have a fundamental period less than 0.5 second, and seismic design parameters may be based on the pre-liquefaction site class designation as provided in Table 2.

7.3 Retaining Structures

Lateral earth pressures should be considered during design of retaining walls and below-grade structures. Hydrostatic pressure and additional surcharge loading should also be considered. Wall foundation construction and bearing capacity should adhere to specifications provided previously in Section 7.1, *Shallow Foundation Support*.

Permanent retaining walls that are not restrained from rotation should be designed for active earth pressures using an equivalent fluid pressure of 35 pcf. Walls that are restrained from rotation should be designed for an at-rest, equivalent fluid pressure of 55 pcf. The recommended earth pressures assume a maximum wall height of 10 feet with well-drained, level backfill. These values also assume that adequate drainage is provided behind retaining walls to prevent hydrostatic pressures from developing. Lateral earth pressures induced by surcharge loads may be estimated using the criteria presented on Figure 5.

Seismic forces may be calculated by superimposing a uniform lateral force of $7H^2$ pounds per lineal foot of wall, where H is the total wall height in feet. The force should be applied as a distributed load with the resultant located at 0.6H from the base of the wall.

7.3.1 Wall Drainage and Backfill

A minimum 6-inch-diameter, perforated collector pipe should be placed at the base of retaining walls. The pipe should be embedded in a minimum 2-foot-wide zone of angular drain rock that is wrapped in a drainage geotextile fabric and extends up the back of the wall to within 1 foot of finished grade. The drain rock and geotextile drainage fabric should meet the specifications provided in Section 8.6, *Materials*. The perforated collector pipes should discharge at an appropriate location away from the base of the wall. The discharge pipe(s) should not be tied directly into stormwater drainage systems, unless measures are taken to prevent backflow into the drainage system of the wall.

Backfill material placed behind the walls and extending a horizontal distance of ½ H, where H is the height of the retaining wall, should consist of select granular material placed and compacted as described in Section 8.6.1, *Structural Fill.*

Settlement of up to 1 percent of the wall height commonly occurs immediately adjacent to the wall as the wall rotates and develops active lateral earth pressures. Consequently, we recommend that construction of flatwork adjacent to retaining walls be delayed at least four weeks after placement of wall backfill, unless survey data indicates that settlement is complete prior to that time.

7.4 Pavement Design

7.4.1 Design Parameters and Traffic

Private asphalt concrete access drives and parking areas may be proposed on individual lots within the master development. Columbia West recommends adherence to City of Castle Rock roadway standards for street improvements in the public right-of-way. Pavement should be installed on firm, competent native subgrade soil or engineered structural fill prepared as described in this report. Our recommendations for private pavement are based on the following design parameters and assumptions:

- 12 inches of subgrade soil directly below the pavement sections are compacted to at least 95 percent of maximum dry density, as determined by *ASTM D1557*.
- Resilient moduli for subgrade soil and aggregate base materials were assumed to be 4,500 psi and 20,000 psi, respectively.
- Pavement design life of 20 years with no expected traffic growth.
- Initial and terminal serviceability indices of 4.2 and 2.5, respectively.
- Reliability of 85 percent and standard deviation of 0.4.
- Pavement may be exposed to a fire apparatus load of 75,000 pounds on an infrequent basis.

The specific type and frequency of traffic was not available at the time we prepared this report. Based on experience, we assume that heavy truck traffic will consist of approximately 40 percent FHWA Class Group 7 type trucks (4-axle, single unit) and 60 percent FHWA Class Group 8 type trucks (tractor/trailer 2- to 3-axle). Lightly-loaded drive aisles and parking stalls are expected to service typical passenger vehicle traffic.

7.4.2 Asphaltic Concrete (AC) Pavement Design Sections

Design recommendations for private pavement across a range of traffic conditions and loading scenarios are presented in Table 3. Material properties and compaction recommendations for asphalt surfacing and crushed aggregate base layers are presented in Section 8.6, *Materials*.

Table 3. Recommended AC Pavement Sections Constructed over Native Soil or Engineered Fill

Traffic	Trucks Per Day	Equivalent Single-Axle Loads (ESALs)	AC Thickness (in)	Base Aggregate Thickness (in)
Passenger Vehicle Parking	0	10,000	2.5	8
Passenger Vehicle Drive Aisles	0	20,000	3	9
Heavy Truck Areas	10	92,000	4	10.5
	25	229,000	4.5	12.5
	50	458,000	5	14
	100	916,000	5.5	16.5

Pavement sections may be reduced in areas where subgrade soils are cement-amended to a minimum depth of 12 inches with a minimum of 6 percent cement by weight. Provided the cement-amended subgrade soil achieves a seven-day unconfined compressive strength of 100 psi, AC pavement sections may be constructed as presented in Table 4.

Table 4. Recommended AC Pavement Sections Constructed over Cement-Amended Subgrade Soil

Traffic	Trucks Per Day	Equivalent Single-Axle Loads (ESALs)	AC Thickness (in)	Base Aggregate Thickness (in)	Cement-Amendment Thickness (in)
Passenger Vehicle Parking	0	10,000	2.5	4	**12**
Passenger Vehicle Drive Aisles	0	20,000	3	4	
Heavy Truck Areas	10	92,000	4	4	
	25	229,000	4.5	4	
	50	458,000	5	4.5	
	100	916,000	5.5	6.5	

7.4.3 Portland Cement Concrete (PCC) Pavement Design Sections

Portland cement concrete pavements may be proposed in future loading dock areas. Loading docks are expected to primarily service heavy truck traffic. Material properties and recommendations for PCC, base aggregate, and cement-amended subgrade layers are presented in Section 8.6, *Materials*. Pavement design recommendations for PCC loading docks constructed over firm native soil or engineered structural fill are presented in Table 5.

Table 5. Recommended PCC Pavement Sections Constructed over Native Soil or Engineered Fill

Traffic	Trucks Per Day	PCC Thickness (in)	Base Aggregate Thickness (in)
Loading Dock Areas	Up to 25	6.5	7
	Up to 50	7	8
	Up to 100	7.5	8

Recommended PCC pavement sections constructed over cement-amended soil meeting the treatment depth, cement content, and strength requirements outlined above are presented in Table 6.

Table 6. Recommended PCC Pavement Sections Constructed over Cement-Amended Subgrade Soil

Traffic	Trucks Per Day	PCC Thickness (in)	Base Aggregate Thickness (in)	Cement-Amendment Thickness (in)
Loading Dock Areas	Up to 25	6.5	4	**12**
	Up to 50	7	4	
	Up to 100	7.5	4	

7.4.4 General Pavement Recommendations

Recommended pavement section thicknesses are intended to be minimum acceptable values and do not include construction traffic loading. The recommendations assume that pavement construction will be completed during an extended period of warm, dry weather. Wet weather construction may require an increased thickness of base aggregate as discussed later in Section 8.2, *Construction Traffic and Staging*.

Cement-amended soil should be allowed to cure for at least four days prior to aggregate base placement or exposure to construction traffic. Prior to construction traffic access, the cement-amended subgrade should be protected by a minimum 4-inch-thick layer of compacted crushed aggregate. Construction traffic should be limited to dedicated haul roads or non-structural, unpaved portions of the site. Construction traffic should not be permitted on new pavement, unless accounted for in the pavement design section. Base aggregate and cement-amended soils supporting pavement are also not intended for construction traffic. Haul roads and staging areas supporting construction traffic are discussed later in Section 8.2, *Construction Traffic and Staging*.

Asphalt paving is generally not recommended during cold weather conditions where ambient air temperatures are less than 40 degrees Fahrenheit. Compacting asphalt in low-temperature conditions can result in low relative density of the asphalt layer and premature pavement distress.

Asphalt mix designs have a recommended compaction temperature range that is specific to the AC binder used. In low-temperature conditions, maintaining the temperature of the AC mix is difficult as heat can be lost during transport, placement, and compaction. The ambient air temperature during paving should be at least 40 degrees Fahrenheit for a lift thickness greater than 2.5 inches and at least 50 degrees Fahrenheit for a lift thickness between 2 and 2.5 inches. If AC paving must take place during cold-weather construction as defined in this section, the contractor and design team should discuss options for minimizing risk to pavement serviceability.

7.5 Drainage

At a minimum, site drainage should include surface water collection and conveyance to properly designed stormwater management structures and facilities. Drainage design in

general should conform to City of Castle Rock regulations. Finished site grading should be conducted with positive drainage away from structures at a minimum 2 percent slope for a distance of at least 10 feet. Depressions or shallow areas that may retain ponding water should be avoided.

Recommendations for foundation drains, subdrains, and drainage mats are presented in the following sections. Drain rock and geotextile drainage fabric should meet the requirements presented in Section 8.6, *Materials*. Drains should be closely monitored after construction to assess their effectiveness. If additional surface or shallow subsurface seeps become evident, the drainage provisions may require modification or additional drains. We should be consulted to provide appropriate recommendations.

7.5.1 Foundation Drains

Roof drains are recommended for all structures. Perimeter building foundation drains can reduce the potential for water intrusion below structures. Perimeter footing drains are recommended for shallow foundations constructed 5 or more feet below existing site grades. Foundations constructed less than 5 feet below existing grades do not require drains, however, it may be prudent to install foundations drains to collect incidental or perched water. The final decision for foundations drains should be made by the owner and architect.

Foundation and roof drains, where installed, should consist of separate systems that gravity flow away from foundations to an approved discharge location. Perimeter foundation drains, where installed, should consist of 4-inch perforated PVC pipe surrounded by a minimum 2-foot-wide zone of clean, washed drain rock wrapped with geotextile drainage fabric. The wrapped drain rock zone should extend up the sides of embedded walls to within 12 inches of proposed finished grade. Foundation drains should be constructed with a minimum slope of ½ percent. The drainpipe's invert elevation should be at least 18 inches below the elevation of the floor slab. Figure 6 presents a typical foundation drain detail.

7.5.2 Subdrains

Subdrains should be considered if portions of the site are cut below surrounding grades. Shallow groundwater, springs, or seeps should be conveyed via drainage channel or perforated pipe into an approved discharge. Recommendations for design and installation of perforated drainage pipe may be performed on a case-by-case basis by Columbia West during construction. Failure to provide adequate surface and sub-surface drainage may result in soil slumping or unanticipated settlement of structures exceeding tolerable limits. A typical perforated drainpipe trench detail is presented in Figure 7.

7.5.3 Drainage Mat

Site improvements construction in some areas may occur at or near the shallow groundwater table, particularly if work is conducted during wet-weather conditions. Dewatering may be necessary, and a drainage mat may be required to achieve sufficient elevation for fill placement. A typical drainage mat is shown on Figure 8. Columbia West should determine drainage mat location, extent, and thickness when subsurface conditions are exposed.

Drainage mats may need to be constructed in conjunction with subdrains to convey captured water to an approved discharge location.

8.0 CONSTRUCTION RECOMMENDATIONS

8.1 Site Preparation and Grading

Vegetation, organic material, unsuitable fill, and deleterious material that may be encountered should be cleared from areas identified for structures and site grading. Vegetation, root zones, organic material, and debris should be removed from the site. Stripped topsoil should also be removed, or used only as landscape fill in nonstructural areas with slopes less than 25 percent. The stripping depth for sod and highly organic topsoil is anticipated to be approximately 4 inches. Following removal of surface vegetation and topsoil, underlying low-organic till zone soils, if present, may be acceptable for stockpiling and reuse as structural fill. Actual stripping depths and suitability of till zone soil for reuse should be determined based upon visual observations made during construction when soil conditions are exposed. The post-construction maximum depth of landscape fill placed or spread at any location onsite should not exceed one foot.

Previously disturbed soil, debris, or undocumented fill encountered during grading or construction activities should be removed completely and thoroughly from structural areas. This includes old remnant foundations, basement walls, utilities, associated soft soils, and debris. Excavation areas should be backfilled with engineered structural fill.

Trees, stumps, and associated roots should also be removed from structural areas, individually and carefully. Resulting cavities and excavation areas should be backfilled with engineered structural fill.

Site grading activities should be performed in accordance with requirements specified in the *2018 International Building Code* (IBC), Chapter 18 and Appendix J, with exceptions noted in the text herein. Site preparation, soil stripping, and grading activities should be observed and documented by Columbia West.

8.1.1 Subgrade Evaluation

Upon completion of stripping and prior to the placement of structural fill or pavement improvements, exposed subgrade soil should be evaluated by proof rolling with a fully-loaded dump truck or similar heavy, rubber tire construction equipment. When the subgrade is too wet for proof rolling, a foundation probe may be used to identify areas of soft, loose, or unsuitable soil. Subgrade evaluation should be performed by Columbia West. If soft or yielding subgrade areas are identified during evaluation, we recommend the subgrade be over-excavated and backfilled with compacted imported granular fill.

8.2 Construction Traffic and Staging

Near-surface silty soil will be easily disturbed during construction. If not carefully executed, site preparation, excavation, and grading can create extensive soft areas resulting in significant repair costs. Earthwork planning should include considerations for minimizing subgrade disturbance, particularly during wet-weather conditions.

If construction occurs during wet-weather conditions, or if the moisture content of the surficial soil is more than a few percentage points above optimum, site stripping and cutting may need to be accomplished using track-mounted equipment. Under these conditions, granular haul roads and staging areas will also be necessary provide a firm support base and sustain construction equipment.

The recommended base aggregate thickness for pavement sections is intended to support post-construction design traffic loads and will not provide adequate support for construction traffic. Staging areas and haul roads will require an increased base thickness during wet weather conditions. The configuration of staging and haul road areas, as well as the required thickness of granular material, will vary with the contractor's means and methods. Therefore, design and construction of staging areas and haul roads should be the responsibility of the contractor. Based on our experience, between 12 and 18 inches of imported granular material is generally required in staging areas and between 18 and 24 inches in haul road areas. In areas of heavy construction traffic, geotextile separation fabric may be placed between the subgrade soil and imported granular material to increase subgrade support and minimize silt migration into the base aggregate layer.

As an alternative to thickened aggregate sections, haul roads and staging areas may be constructed using a combination of cement-amended subgrade and crushed aggregate surfacing. If cement-amendment is used, the base aggregate thickness for staging areas and haul roads can typically be reduced to between 6 and 9 inches, respectively. This recommendation is based on a minimum seven-day unconfined compressive strength of 100 psi for the cement-amended soil with a treatment depth of 12 to 16 inches. Based on experience, 6 to 7 percent cement by weight is typically required to achieve the indicated compressive strength.

Project stakeholders should understand that wet weather construction is risky and costly. Proper construction methods and techniques are critical to overall project integrity and should be observed and documented by Columbia West.

8.3 Cut and Fill Slopes

Fill slopes should consist of structural fill material as discussed in Section 8.1.1, *Structural Fill*. Fill placed on existing grades steeper than 5H:1V should be horizontally benched at least 10 feet into the slope. Fill slopes greater than six feet in height should be vertically keyed into existing subsurface soil. A typical fill slope cross-section is shown in Figure 9. Drainage implementations, including subdrains or perforated drainpipe trenches, may also be necessary in proximity to cut and fill slopes if seeps or springs are encountered. Drainage design may be performed on a case-by-case basis. Extent, depth, and location of drainage may be determined in the field by Columbia West during construction when soil conditions are exposed. Failure to provide adequate drainage may result in soil sloughing, settlement, or erosion.

Final cut or fill slopes at the site should not exceed 2H:1V or 20 feet in height without individual slope stability analysis. The values above assume a minimum horizontal setback for loads of 10 feet from top of cut or fill slope face or overall slope height divided by three

(H/3), whichever is greater. A minimum slope setback detail for structures is presented in Figure 10.

Concentrated drainage or water flow over the face of slopes should be prohibited, and adequate protection against erosion is required. Fill slopes should be overbuilt, compacted, and trimmed at least two feet horizontally to provide adequate compaction of the outer slope face. Proper cut and fill slope construction is critical to overall project stability and should be observed and documented by Columbia West.

8.4 Excavation

The site was explored by Columbia West and others to a maximum depth of 81.5 feet with a drill rig. Conventional earthmoving equipment in proper working condition should be capable of making necessary site excavations.

Groundwater was encountered at depths ranging from 9 and 35 feet bgs in site explorations. Perched groundwater at shallower depths may also be present. Recommendations as described in Section 8.5, *Dewatering,* should be considered where subsurface construction activities intersect the shallow groundwater table.

Excavations in near-surface sandy soil will likely slough and cave, even at shallow depths. Open-cut excavation techniques may be used to excavate trenches between 4 and 8 feet deep, provided the walls of the excavation are cut at a maximum slope of 1H:1V and groundwater seepage is not present. Excavation slopes should be reduced to 1.5H:1V or 2H:1V if excessive sloughing or raveling occurs.

Shoring may be required if open-cut excavations are infeasible or if excavations are proposed adjacent to existing infrastructure. Typical methods for stabilizing excavations consist of solider piles and timber lagging, sheet pile walls, tiebacks and shotcrete, or pre-fabricated hydraulic shoring. As a wide variety of shoring and dewatering systems are available, we recommend that the contractor be responsible for selecting the appropriate shoring and dewatering systems.

The contractor should be held responsible for site safety, sloping, and shoring. All excavation activity should be conducted in accordance with applicable OSHA requirements. Columbia West is not responsible for contractor activities and in no case should excavation be conducted in excess of applicable local, state, and federal laws.

8.5 Dewatering

Based on site observations and piezometer monitoring data, groundwater will likely be encountered in utility trenches, pump station excavations, and in areas of significant cut. Generalized recommendations for temporary construction dewatering are presented in the following section.

8.5.1 Construction Dewatering

The contractor should be responsible for temporary drainage of surface water, perched water, and groundwater. Dewatering should be performed to the extent necessary to prevent standing water and/or erosion of exposed site soils. During rough and finished grading of

building pad areas, the contractor should keep all footing excavations and slab subgrade soils free of standing water.

The contractor's proposed dewatering plan should be capable of maintaining groundwater levels at least two feet below the base of proposed excavations. Without adequate excavation dewatering, running soil, caving, and sloughing will increase backfill volumes and may result in damage to adjacent structures or utilities. Significant pumping and dewatering may be required to temporarily reduce the groundwater elevation to the recommended depth. Dewatering via a sump within excavation zones may be insufficient to control groundwater and provide excavation side slope stability. Dewatering may be more feasibly conducted by installing a system of temporary well points and pumps around proposed excavation areas or utility trenches.

As indicated previously, a sanitary sewer pump station is proposed up to 35 feet below existing grade. Due to the significant depth of excavation and potential for rapid groundwater flow through permeable sand and gravel deposits, the contractor should be required to prepare and present a detailed dewatering plan. The contractor should consult with a licensed professional engineer to provide an adequate dewatering plan for site conditions. If additional subsurface information not provided in this geotechnical report is necessary to complete the dewatering plan, the contractor shall be responsible for securing all the required information necessary for the design of the system.

If groundwater is present at the base of excavations, we recommend placing 18 to 24 inches of stabilization material at the base of the excavation. Subgrade geotextile placed directly over trench subgrade soils may reduce the required thickness of the stabilization material. The actual thickness of stabilization material should be determined at the time of construction based on observed field conditions. The stabilization material should be placed in one lift and compacted until well keyed. Stabilization material and geotextile fabric should meet the requirements presented in Section 8.6, *Materials*.

8.6 Materials

8.6.1 Structural Fill

Areas proposed for fill placement should be appropriately prepared as described in Section 8.1, *Site Preparation and Grading*. Engineered fill placement should be observed by Columbia West. Compaction of engineered structural fill should be verified by nuclear gauge field compaction testing performed in accordance with *ASTM D6938*. Field compaction testing should be performed for each vertical foot of engineered fill placed.

Various materials may be acceptable for use as structural fill. Structural fill should be free of organic material or other unsuitable material and meet specifications provided in the following sections. Representative samples of proposed engineered structural fill should be submitted for laboratory analysis and approval by Columbia West prior to placement.

8.6.1.1 Onsite Soil

Most onsite native soil (silt, sand, and gravel) will be suitable for use as structural fill if adequately dried or moisture-conditioned to achieve recommended compaction

specifications. Moisture conditioning will likely be necessary to achieve the optimum moisture content required for compaction. In addition, near-surface silty soil will be moisture sensitive and difficult to compact during wet weather conditions. Therefore, structural fill placement using onsite soil should be performed during dry summer months if possible. Onsite soil may also require addition of moisture during extended periods of dry weather.

Onsite soil used as structural fill should be placed in loose lifts not exceeding 8 inches in depth and compacted using standard conventional compaction equipment. The soil moisture content should be within a few percentage points of optimum conditions. The soil should be compacted to at least 95 percent of maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).* Compacted onsite fill soils should be covered shortly after placement.

Onsite soil will likely expand during excavation and transport and consolidate during compaction. Development of site-specific expansion and consolidation factors is beyond the scope of this investigation. We can provide site-specific factors upon request.

8.6.1.2 Imported Granular Material

Imported granular material should consist of pit- or quarry-run rock, crushed rock, or crushed gravel and sand meeting *WSDOT 9-03.14(1)* specifications for *Gravel Borrow*. Imported granular material should be placed in loose lifts not exceeding 12 inches in depth and compacted to at least 95 percent of maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).* During wet-weather conditions or where wet subgrade conditions are present, the initial loose lift of granular fill should be approximately 18 inches thick and should be compacted with a smooth-drum roller operating in static mode.

8.6.1.3 Stabilization Material

Stabilization material should consist of durable, 4- or 6-inch-minus pit- or quarry-run rock, crushed rock, or crushed gravel and sand that is free of organics and other deleterious material. The material should have a maximum particle size of 6 inches with less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve. The material should have at least two mechanically-fractured faces.

Stabilization material should be placed in loose lifts between 12 and 24 inches thick and be compacted to a firm, unyielding condition. Equipment with vibratory action should not be used when compacting stabilization material over wet, fine-textured soils. If stabilization material is used to stabilize soft subgrade below pavement or construction haul roads, a subgrade geotextile should be placed as a separation barrier between the soil subgrade and the stabilization material.

8.6.1.4 Trench Backfill

Trench backfill placed below, adjacent to, and up to at least 12 inches above utility lines (i.e., the pipe zone) should consist of well-graded granular material meeting *WSDOT 9-03.12(3)* specifications for *Gravel Backfill for Pipe Zone Bedding.* Pipe zone backfill should be compacted to at least 90 percent of maximum dry density, as determined by the modified

Proctor moisture-density relationship test *(ASTM D1557),* or as required by the local jurisdictional agency or pipe manufacturer.

Within structural areas (below pavement and building pads), trench backfill above the pipe zone should consist of *WSDOT 9-03.19 Bank Run Gravel for Trench Backfill* or *WSDOT 9-03.14(2) Select Borrow* with a maximum particle size of 2 ½-inches. Trench backfill material within 18 inches of the top of utility pipes should be hand compacted (i.e., no heavy compaction equipment). Remaining trench backfill should be compacted to at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557),* or as required by the local jurisdictional agency or pipe manufacturer.

Outside of structural areas, trench backfill placed above the pipe zone should be compacted to at least 90 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557),* or as required by the local jurisdictional agency or pipe manufacturer.

8.6.1.5 Floor Slab Base Aggregate

Base aggregate for building floor slabs should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. Slab base aggregate should be compacted to at least at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).*

8.6.1.6 Pavement Base Aggregate

Base aggregate for pavement should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. Pavement base aggregate should be compacted to at least at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).*

8.6.1.7 Retaining Wall Backfill

Backfill material placed behind retaining walls and extending a horizontal distance of ½ H, where H is the height of the retaining wall, should consist of free-draining granular material meeting *WSDOT 9-03.12(2)* specifications for *Gravel Backfill for Walls*. The wall backfill should be separated from structural fill, native soil, and/or topsoil using a geotextile fabric that meets the specifications provided below for drainage geotextiles.

Wall backfill located within a horizontal distance of 3 feet from the face of a retaining wall should be compacted to 90 percent of the maximum dry density, as determined by *ASTM D1557*. Backfill placed within 3 feet of the wall should be compacted in loose lifts less than 6 inches thick using hand-operated tamping equipment (such as a jumping jack or vibratory plate compactor). Remaining wall backfill should be compacted to at least 95 percent of the maximum dry density, as determined by *ASTM D1557*.

8.6.1.8 Retaining Wall Leveling Pad

Crushed aggregate used as a leveling pad for retaining wall footings should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. The leveling pad material should be compacted to at least 95 percent of the

maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).*

8.6.1.9 Drain Rock

Drain rock should consist of open-graded, angular aggregate meeting WSDOT 9-03.12(4), *Gravel Backfill for Drains*. Drain rock should be free of roots, organic debris, and other unsuitable material and should have at least two mechanically-fractured faces. Drain rock should be compacted to a firm, unyielding condition. Drain rock should be completely wrapped in a geotextile drainage fabric meeting the requirements presented below.

8.6.2 Geotextile Fabric

8.6.2.1 Subgrade Geotextile

Subgrade geotextile should meet the specifications provided in *WSDOT 9-33.2(1), Table 3, Geotextile for Separation or Soil Stabilization*. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles. All stabilization material should be underlain by a subgrade geotextile.

8.6.2.2 Drainage Geotextile

Subgrade geotextile should meet the specifications provided in *WSDOT 9-33.2(1), Table 2, Geotextile for Underground Drainage Filtration Properties*. The AOS should be between the No. 70 and No. 100 sieve. The water permittivity should be greater than 1.5/sec. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles.

8.6.3 Soil Amendment with Cement

The on-site soil can be amended with Portland cement to obtain suitable properties for use as wet-weather structural fill or subbase for pavement. The effectiveness of soil amendment is highly dependent on proper mixing techniques, soil moisture conditioning, and the quantity of cement. The quantity of cement applied during amendment should be based on an assumed dry unit weight of 100 pcf for site soil.

8.6.3.1 Subbase Stabilization

Specific recommendations for soil amendment should be based on exposed site conditions at the time of construction. For preliminary design purposes, we recommend cement-amended subgrade for building pads and pavement subbase (below the base aggregate layer) achieve a target strength of 100 psi. The quantity of cement required to achieve the target strength will vary with moisture content and soil type. Laboratory testing of cement-amended soil should be used to confirm design expectations.

Based on our experience, near-surface silt and sand will require approximately 6 to 7 percent cement by weight to achieve the target strength of 100 psi. This cement percentage assumes that the soil moisture content does not exceed 20 percent at the time of amendment. If the soil moisture content is in the range of 25 to 35 percent, 7 to 8 percent cement by weight may be required to achieve the target strength. The amount of cement

added to the soil at the time of construction should be based on observed field conditions and subgrade performance. During extended periods of dry weather, water may need to be applied during the amendment and tilling process to achieve the optimum moisture content required for compaction.

Cement-amendment equipment should have balloon tires to minimize softening, rutting, and disturbance of fine-grained site soil. A sheepsfoot or segmented pad roller with a minimum static weight of 40,000 pounds should be used for initial compaction. Rollers with vibratory action should not be used to compact fine-grained, cement-amended soil. Final compaction should be conducted with a smooth-drum roller with a minimum applied linear force of 700 pounds per inch. The amended soil should be compacted to at least 95 percent of the maximum dry density as determined by *ASTM D558*.

Following cement amendment, a minimum curing time of four days is required prior to exposure to construction traffic. Construction traffic should not be allowed on unprotected, cement-amended subgrade. To protect cement-amended areas from damage, the finished surface should be covered with 4 to 6 inches of imported granular material. The protective layer of crushed rock often becomes contaminated with soil during construction, particularly in staging and haul road areas. Contaminated aggregate, where present, should be removed and replaced with clean crushed aggregate prior to construction of pavement or other permanent site improvements supported by base aggregate.

Cement amendment should not be attempted during moderate to heavy precipitation or when the ambient air temperature is below 40 degrees Fahrenheit. Cement should not be placed in areas of standing water or where saturated subgrade conditions exist.

8.6.3.2 Cement-Amended Structural Fill

If adequate compaction is not achievable with onsite soil due to moisture or weather conditions, the soil may be cement-amended and placed as general structural fill. Prior to placement of cement-amended fill, subgrade soils should be prepared as described in Section 8.1, *Site Preparation and Grading*. Where multiple lifts of cement-amended fill are necessary to meet finished grade, consecutive lifts may be placed immediately following amendment and compaction of the underlying lift. However, where the final lift of cement-amended fill will serve as building pad or pavement subbase material, the four-day cure period as discussed above is recommended.

8.6.3.3 QA/QC Testing and Inspection

Cement-amendment of site soils should be observed and tested by Columbia West to document conformance with design recommendations. Cement spread rate should be verified with a pan sample test conducted at one random location per lift per 20,000 square-feet of cement-amended fill. Treatment depth should be verified through excavation of a small test pit and measurement at one random location per lift of cement-amended fill. Adequate compaction and moisture content should be verified by conducting nuclear gauge density testing at a frequency of approximately one test per 5,000 square feet of cement-amended fill in accordance with ASTM D6938. At least one representative sample should be collected per day of cement-amendment, cured for 7 days, and tested for

unconfined compressive strength in accordance with ASTM D1633. The tested samples should have a minimum 7-day, unconfined compressive strength of 100 psi.

8.6.3.4 Drainage Considerations

Cement-amended soil will be poorly-drained and will not be suitable for planting areas. The material may also be difficult to excavate with light-duty landscaping equipment. Proposed landscape areas should not be cement-amended unless accommodations are made for drainage and planting.

Cement-amendment within building pad areas should consider the potential for trapped water below the floor slab. Columbia West should be consulted to provide appropriate recommendations if cement-amendment is proposed within building pad areas.

8.6.4 Pavement

8.6.4.1 Asphaltic Concrete

Asphaltic concrete should consist of HMA Class ½" adhering to *WSDOT 9-03.8(6), HMA Proportions of Materials*. The asphalt binder should consist of PG 58-22 meeting *WSDOT 9-02.1(4), Performance Graded (PG) Asphalt Binder*. Asphalt should be compacted to 91 percent of the theoretical maximum density as determined by *ASTM D2041*. Minimum and maximum asphalt lift thicknesses should be 2 and 3 inches, respectively. Nuclear gauge density testing should be conducted to verify adherence to recommended specifications. Testing frequency should be in accordance with WSDOT and City of Castle Rock specifications.

8.6.4.2 Portland Cement Concrete

Portland cement concrete should meet *WSDOT 5-05, Cement Concrete Pavement* with a minimum 28-day compressive strength of 4,000 psi and an air content between 3 and 7 percent. PCC should be placed in general accordance with *WSDOT 5-05.3(7), Placing, Spreading, and Compacting Concrete*. Dowel bars and placement should adhere to *WSDOT 5-05.3(10), Tie Bars and Corrosion Resistant Dowel Bars*. Joints should be constructed in general accordance with *WSDOT 5-05.3(8), Joints* with a maximum transverse joint spacing of 15 feet. The length-to-width ratio for any PCC panel should be between 0.80 and 1.25.

Concrete should be tested during installation in accordance with ASTM C171, C138, C231, C143, C1064, and C31. This includes casting of cylinder specimen at a frequency of four cylinders per 100 cubic yards of poured concrete. Recommended field concrete testing includes slump, air entrainment, temperature, and unit weight.

8.7 Erosion Control Measures

Soil at this site is susceptible to erosion by wind and water; therefore, erosion control measures should be carefully planned and installed. Surface water runoff should be collected and directed away from sloped areas to prevent water from running down the slope face. Measures that can be employed to reduce erosion include the use of silt fences, hay bales, buffer zones of natural growth, sedimentation ponds, and granular haul roads. All erosion control methods should be in accordance with local jurisdiction standards.

9.0 CONCLUSION AND LIMITATIONS

This geotechnical site investigation report was prepared in accordance with accepted standard conventional principles and practices of geotechnical engineering. This investigation pertains only to material tested and observed as of the date of this report and is based upon proposed site development as described in the text herein. This report is a professional opinion containing recommendations established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. Soil conditions may differ between tested locations or over time. Slight variations may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent QA/QC construction observation and testing to verify soil conditions are as anticipated in this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Columbia West cannot accept responsibility for deviations from recommendations described in this report. Future performance of structural facilities is often related to the degree of construction observation by qualified personnel. These services should be performed to the full extent recommended.

This report is not an environmental assessment and should not be construed as a representative warranty of site subsurface conditions. The discovery of adverse environmental conditions, or subsurface soils that deviate from those described in this report, should immediately prompt further investigation. The above statements are in lieu of all other statements expressed or implied.

This report was prepared solely for the client and is not to be reproduced without prior authorization from Columbia West. Final engineering plans and specifications for the project should be reviewed and approved by Columbia West as they relate to geotechnical and grading issues prior to final design approval. Columbia West is not responsible for independent conclusions or recommendations made by other parties based upon information presented in this report. Unless a particular service was expressly included in the scope, it was not performed and there should be no assumptions based upon services not provided. Additional report limitations and important information about this document are presented in Appendix D, *Report Limitations and Important Information*. This information should be carefully read and understood by the client and other parties reviewing this document.

Sincerely,

COLUMBIA WEST ENGINEERING, Inc.

Lance V. Lehto, PE, GE
President

LANCE V. LEHTO
STATE OF WASHINGTON
36301
REGISTERED
PROFESSIONAL ENGINEER

3-30-2023

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

REFERENCES

Annual Book of ASTM Standards, Soil and Rock (I), v04.08, American Society for Testing and Materials, 1999.

ASCE 7-16, Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers, 2016.

Beeson, M.H., Tolan, T.L., Madin, I.P., *Geologic Map of the Lake Oswego Quadrangle, Clackamas, Multnomah, and Washington Counties, Oregon*; Oregon Department of Geology and Mineral Industries; Geological Map Series GMS-59, 1989.

Cetin, et al., *Probabilistic Model for the Assessment of Cyclically Induced Reconsolidation (Volumetric) Settlements*, Journal of Geotechnical and Environmental Engineering, ASCE, March, 2009.

Columbia West Engineering, Inc., *Preliminary Grading Recommendations, Landing on the Cowlitz, Castle Rock, Washington,* November 8, 2022.

Geomatrix Consultants, *Seismic Design Mapping, State of Oregon*, January 1995.

International Building Code: *2018 International Building Code, 2018 edition*, International Code Council, 2018.

Idriss, I.M and Boulanger, R.W, CPT and SPT Based Liquefaction Triggering Procedures, Center for Geotechnical Modeling, Report No. UCD/CGM-14/01, April, 2014.

Phillips, W. M., *Geologic Map of the Mount St. Helens Quadrangle, Washington and Oregon*, USGS Open File Report 87-4, 1987.

Robertson, P.K., 2009*. CPT interpretation – a unified approach, Canadian Geotechnical Journal, 46: 1-19*

Safety and Health Regulations for Construction, 29 CFR Part 1926, Occupational Safety and Health Administration (OSHA), revised July 1, 2001.

State of Washington Department of Ecology, *Washington State Well Log Viewer (apps.exy.wa.gov/wellog/).*

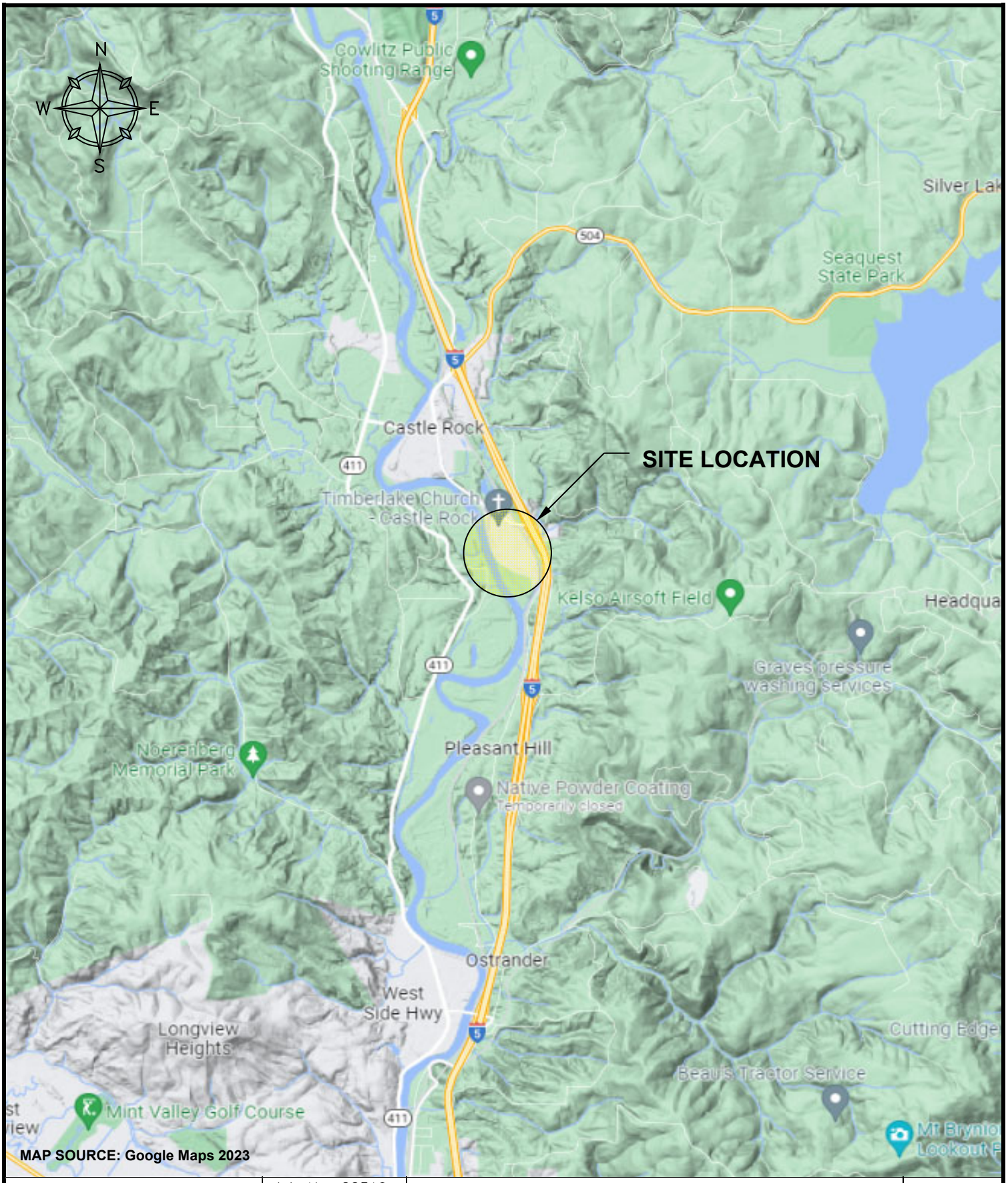
USGS, *Geologic Map of the Greater Portland Metropolitan Area and Surrounding Region, Oregon and Washington*, Scientific Investigations Map 3443, 2020.

Washington Department of Transportation (WSDOT), *Standard Specifications for Road, Bridge, and Municipal Construction*, 2023

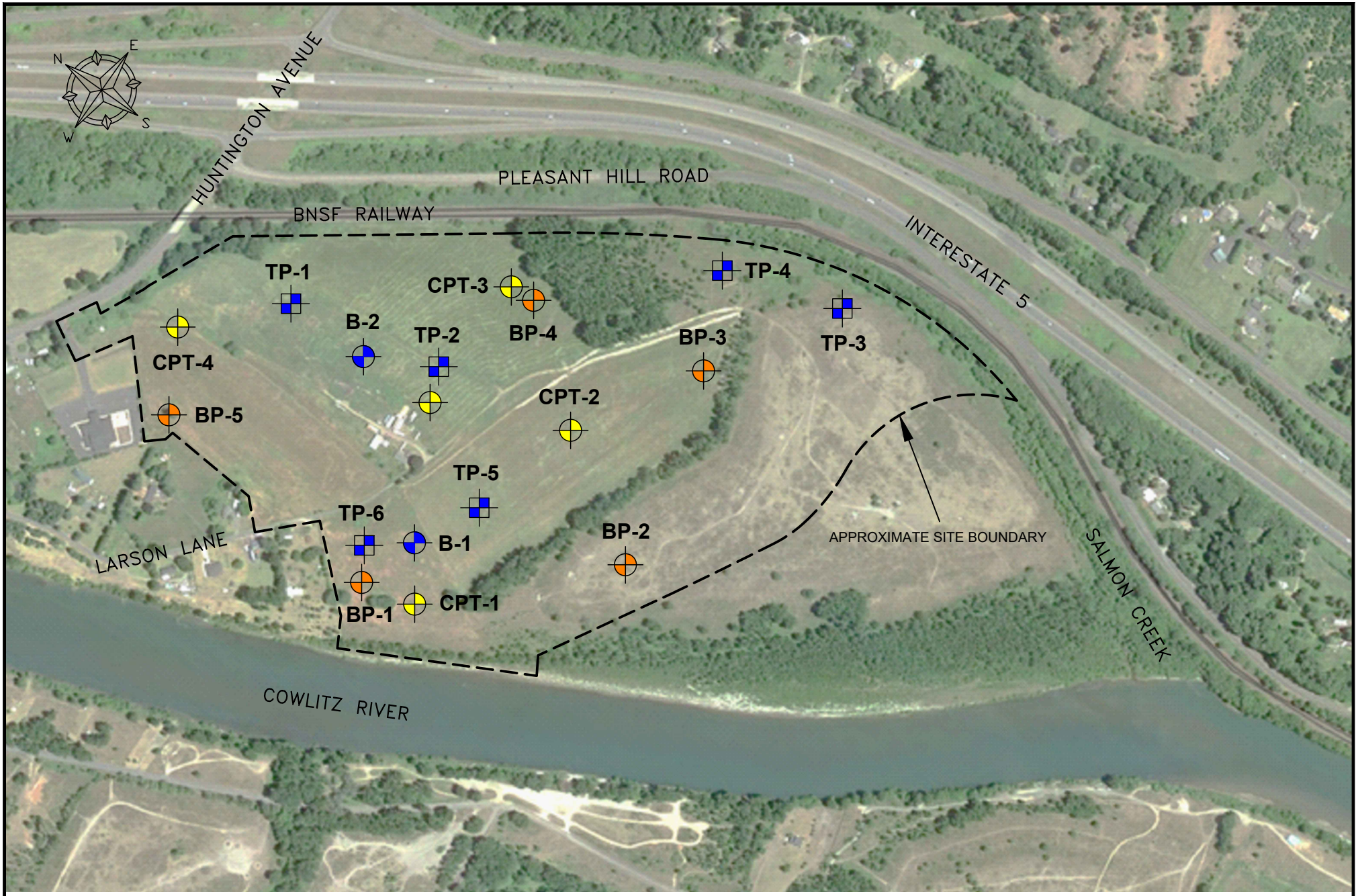
Web Soil Survey, Natural Resources Conservation Service, United States Department of Agriculture, website (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm).

Wong, Ivan, et al, *Earthquake Scenario and Probabilistic Earthquake Ground Shaking Maps for the Portland, Oregon, Metropolitan Area*, IMS-16, Oregon Department of Geology and Mineral Industries, 2000.

FIGURES



Geotechnical ▪ Environmental ▪ Special Inspections Columbia West Engineering, Inc	Job No: 22310 Date: 03/17/23 Drawn: GLW Checked: LVL	SITE LOCATION MAP LANDING ON THE COWLITZ CASTLE ROCK, WASHINGTON	FIGURE 1



BORING AND PIEZOMETER (COLUMBIA WEST, 2023) | BORING (BY OTHERS, 2020) | CONE PENETRATION TEST (BY OTHERS, 2020) | TEST PIT (BY OTHERS, 2020)

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

Project: 22310
Date: 03/17/23
Drawn: GLW
Checked: LVL

EXPLORATION LOCATION MAP
LANDING ON THE COWLITZ

NOTES:
1. SITE LOCATION: 2542 SW LARSON LANE, CASTLE ROCK, WASHINGTON.
2. SITE CONSISTS OF PORTIONS OF TAX PARCEL NOS. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031 TOTALING APPROXIMATELY 118.2 ACRES.
3. DRAWING IS NOT TO SCALE.
4. BASE MAP OBTAINED FROM GOOGLE EARTH, 2023.
5. EXPLORATION LOCATIONS ARE APPROXIMATE AND NOT SURVEYED.
6. BORINGS BP-1 THROUGH BP-5 COMPLETED WITH PIEZOMETER INSTALLATIONS AND FLUSH MOUNT MONUMENTS ON JANUARY 31, FEBRUARY 1, AND FEBRUARY 2, 2023.

FIGURE
2

LEGEND

- RECREATIONAL
- RESIDENTIAL
- COMMERCIAL
- EMPLOYMENT
- FLEX (COM/IND)
- COMMERCIAL OVERLAY
- OPEN SPACE
- DRAINAGE/UTILITIES
- WETLAND BUFFER
- WETLAND
- DEVELOPMENT BOUNDARY
- D.N.R. PROPERTY BOUNDARY
- PROPOSED LOT LINE
- ORDINARY HIGH WATER MARK
- ORDINARY HIGH WATER MARK BUFFER
- CRITICAL AREAS BUFFER

LAND USE SYNOPSIS

	COMMERCIAL	EMPLOYMENT	RES	FLEX	REC	DRAIN	ROW	TOTAL
TOTAL ACREAGE	9.0 - 9.5	46.4	7.8	9.5	18.3			
# OF LOTS	N/A	13	1	4	N/A	N/A	N/A	

LANDING ON THE COWLITZ - DYNAMIC MASTER PLAN

OCTOBER 2022

MacKay Sposito

ENERGY PUBLIC WORKS LAND DEVELOPMENT

www.mackaysposito.com

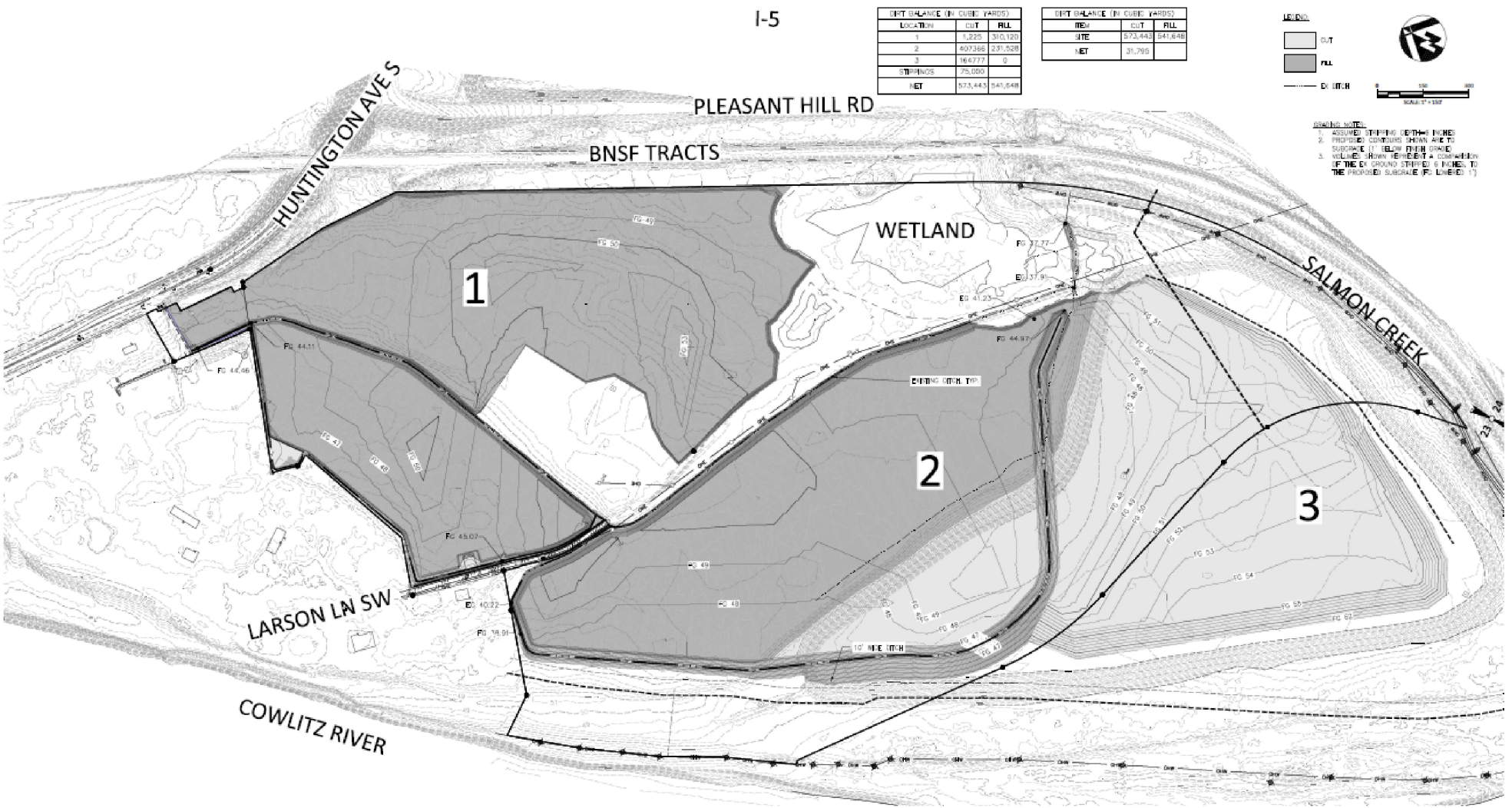
Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

Project: 22310
Date: 03/20/23
Drawn: GLW
Checked: LVL

PRELIMINARY MASTER DEVELOPMENT PLAN
LANDING ON THE COWLITZ

NOTES:
1. SITE LOCATION: 2542 SW LARSON LANE, CASTLE ROCK, WASHINGTON.
2. SITE CONSISTS OF PORTIONS OF TAX PARCEL NOS. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031 TOTALING APPROXIMATELY 118.2 ACRES.
3. DRAWING IS NOT TO SCALE.
4. BASE MAP PROVIDED BY CLIENT.

FIGURE 3



CASTLE ROCK LANDING ON THE COWLITZ - PHASE 1 ROUGH GRADING PLAN

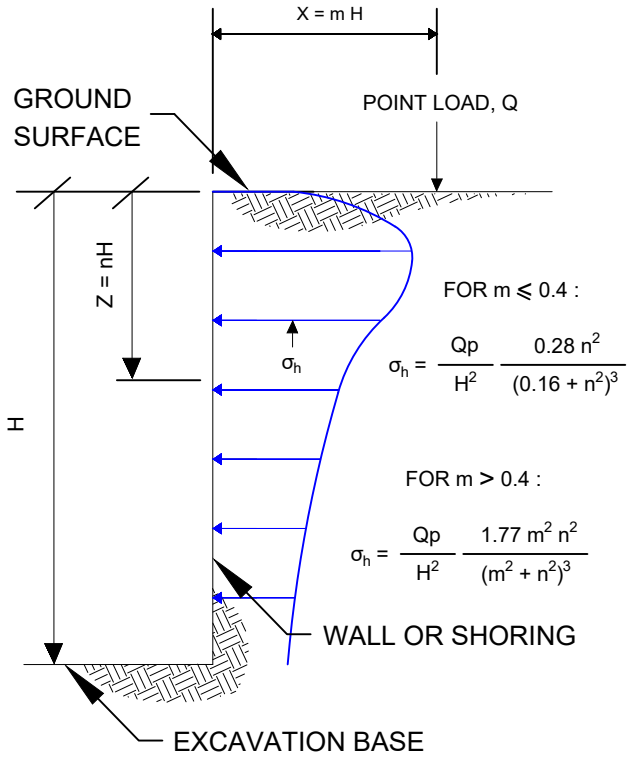
MacKay Sposito

ENERGY PUBLIC WORKS LAND DEVELOPMENT

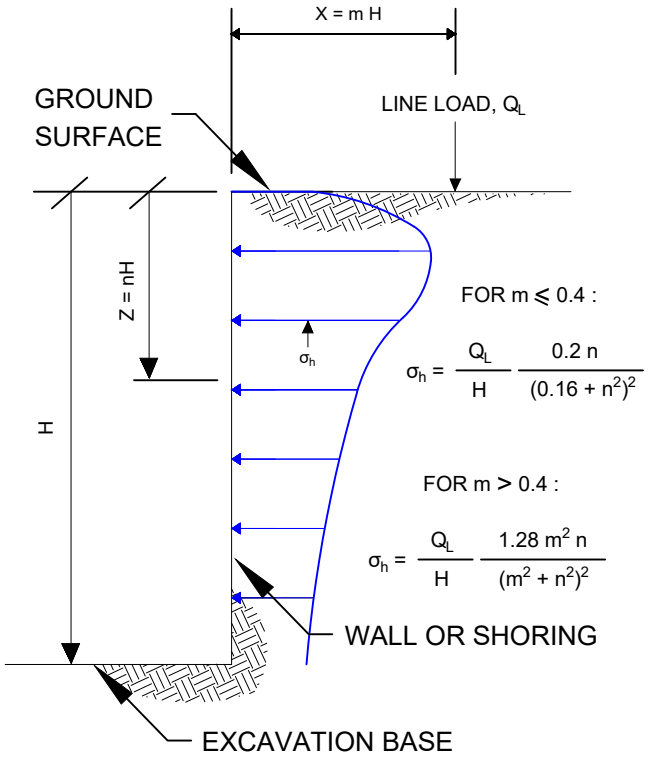
www.mackayssposito.com

Geotechnical ▪ Environmental ▪ Special Inspections Columbia West Engineering, Inc	Project: 22310 Date: 03/23/23 Drawn: GLW Checked: LVL	PHASE I ROUGH GRADING PLAN LANDING ON THE COWLITZ	NOTES: 1. SITE LOCATION: 2542 SW LARSON LANE, CASTLE ROCK, WASHINGTON. 2. SITE CONSISTS OF PORTIONS OF TAX PARCEL NOS. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031 TOTALING APPROXIMATELY 118.2 ACRES. 3. DRAWING IS NOT TO SCALE. 4. BASE MAP PROVIDED BY CLIENT.	FIGURE 4

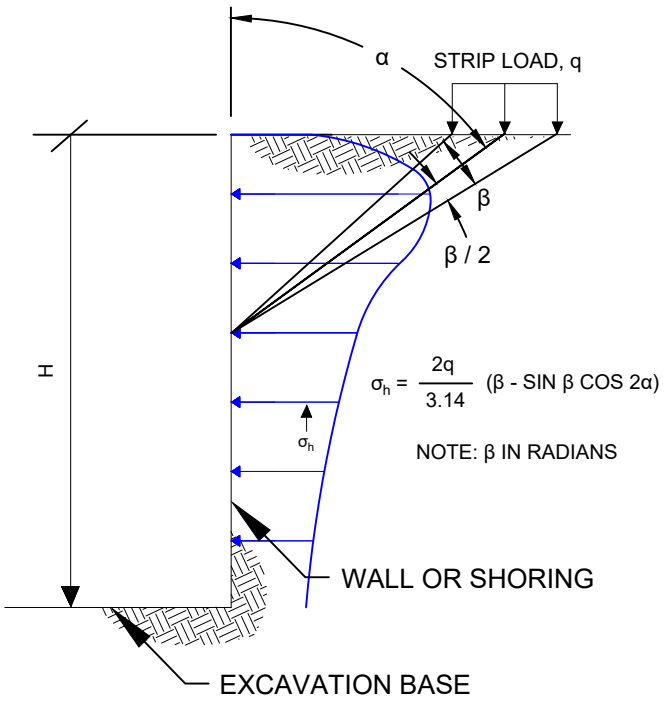
VERTICAL POINT LOAD



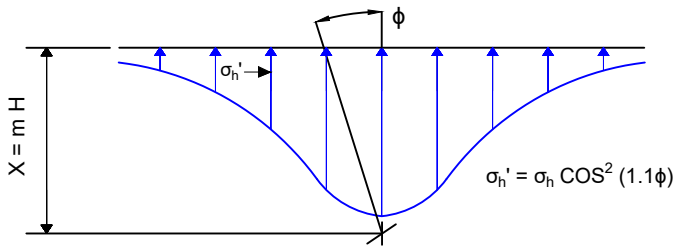
LINE LOAD PARALLEL TO WALL



STRIP LOAD PARALLEL TO WALL

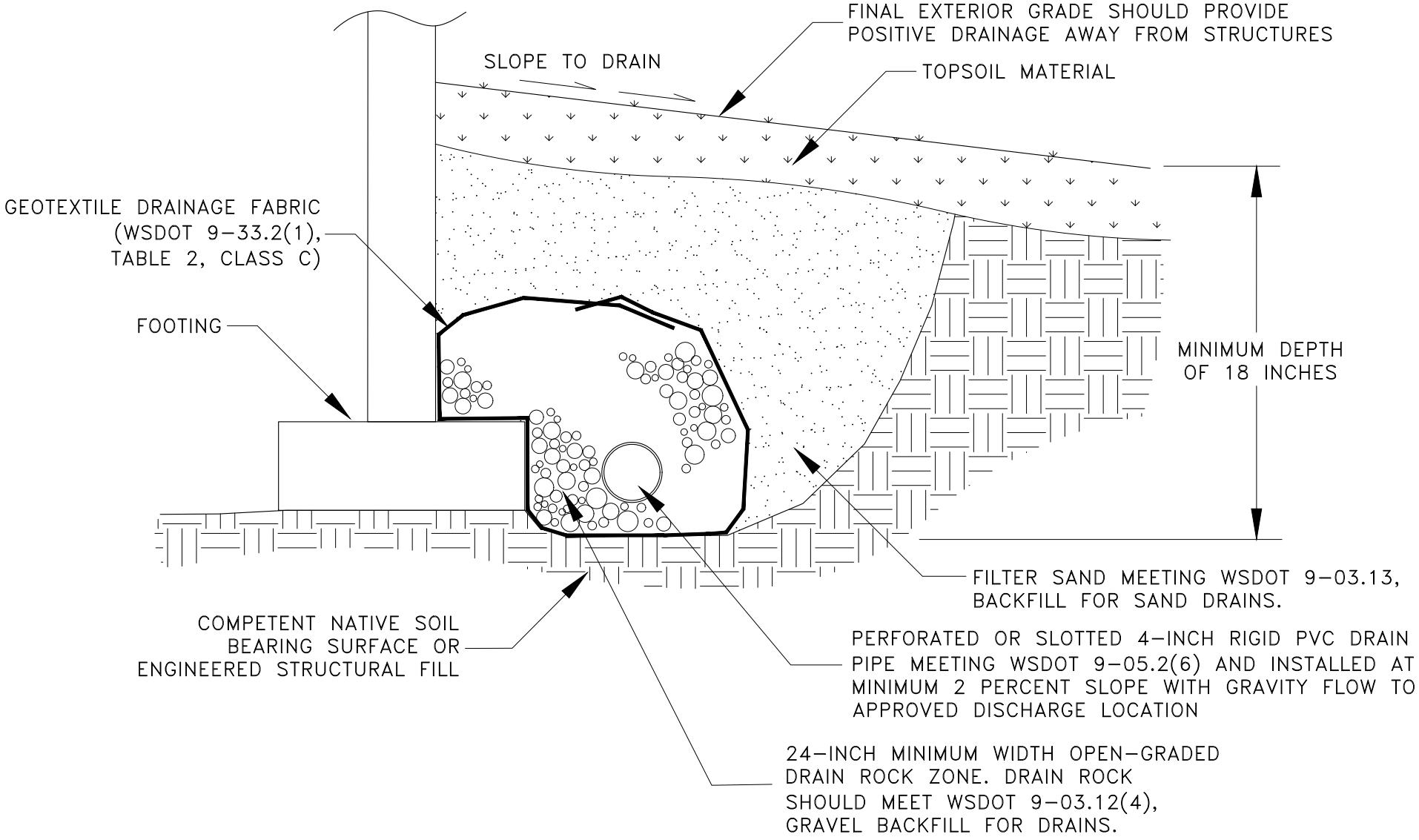


VERTICAL POINT LOAD HORIZONTAL PRESSURE DISTRIBUTION



NOTES:

1. FIGURE SHOULD BE USED JOINTLY WITH RECOMMENDATIONS PRESENTED IN THE REPORT TEXT.
2. LATERAL EARTH PRESSURES ASSUME RIGID WALLS WITH BACKFILL MATERIALS HAVING A POISSON'S RATIO OF 0.5.
3. TOTAL LATERAL EARTH PRESSURES RESULTING FROM COMBINED LOADS MAY BE CALCULATED USING SUPERPOSITION.
4. DRAWING IS NOT TO SCALE.

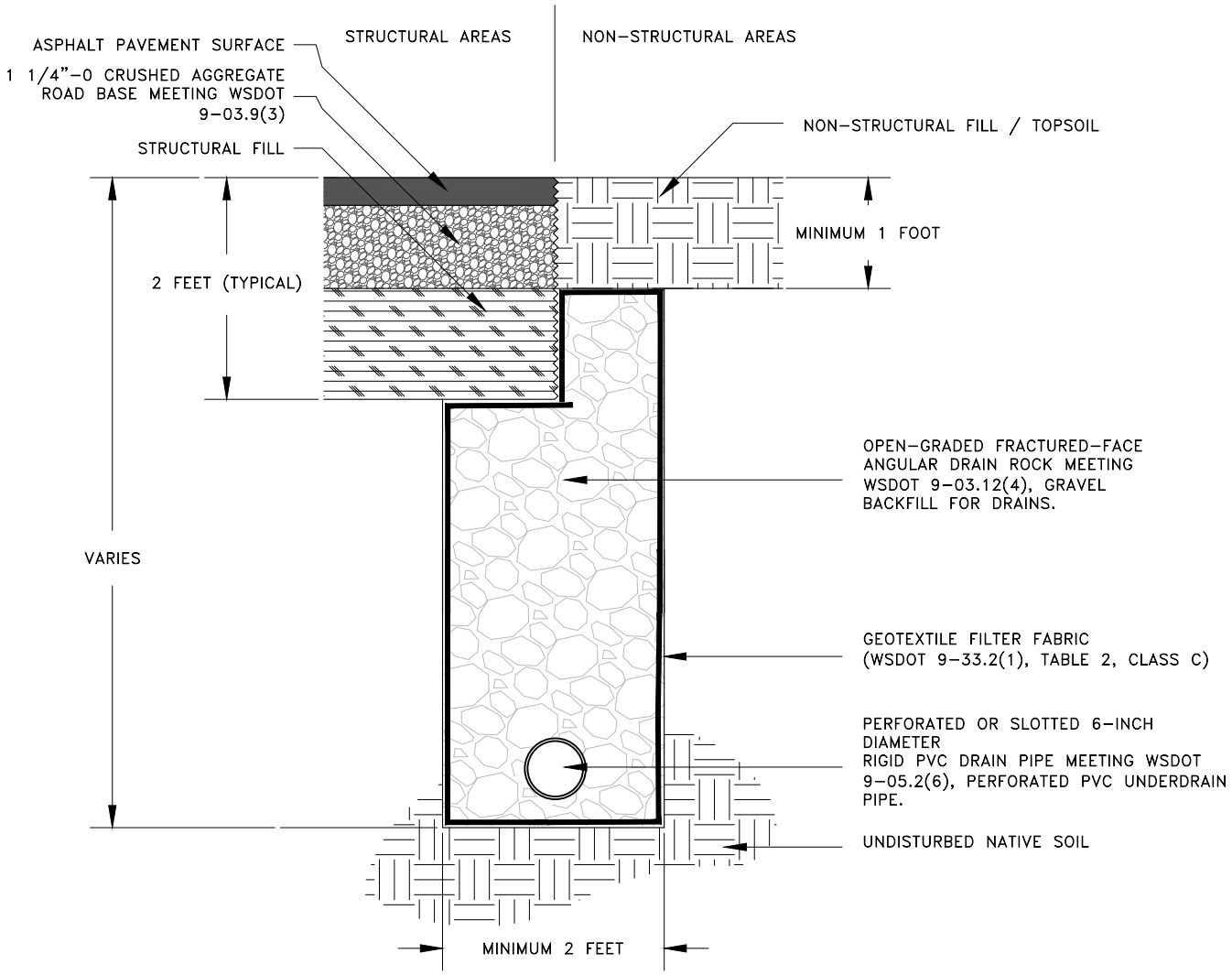


Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

TYPICAL PERIMETER FOOTING DRAIN DETAIL

NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL PERIMETER FOOTING DRAIN DETAIL AND MAY NOT BE SITE-SPECIFIC.

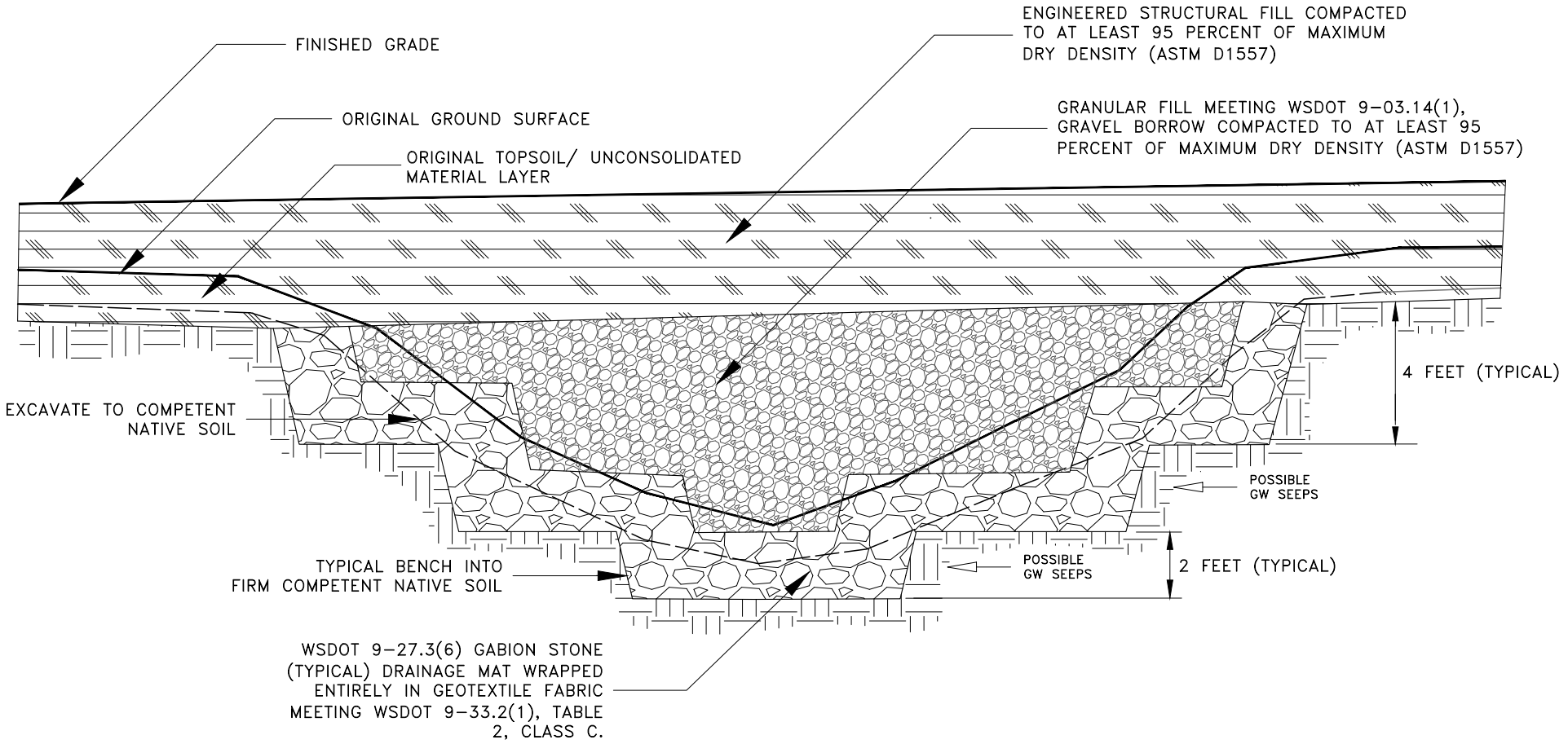
FIGURE 6



NOTE: LOCATION, INVERT ELEVATION, DEPTH OF TRENCH, AND EXTENT OF PERFORATED PIPE REQUIRED MAY BE MODIFIED BY THE GEOTECHNICAL ENGINEER DURING CONSTRUCTION BASED UPON FIELD OBSERVATION AND SITE-SPECIFIC SOIL CONDITIONS.

Geotechnical ▪ Environmental ▪ Special Inspections Columbia West Engineering, Inc	TYPICAL PERFORATED DRAINPIPE TRENCH DETAIL	NOTES: 1. DRAWING IS NOT TO SCALE. 2. DRAWING REPRESENTS TYPICAL PERFORATED DRAIN PIPE TRENCH DETAIL AND MAY NOT BE SITE-SPECIFIC.	FIGURE 7

TYPICAL DRAINAGE MAT CROSS-SECTION

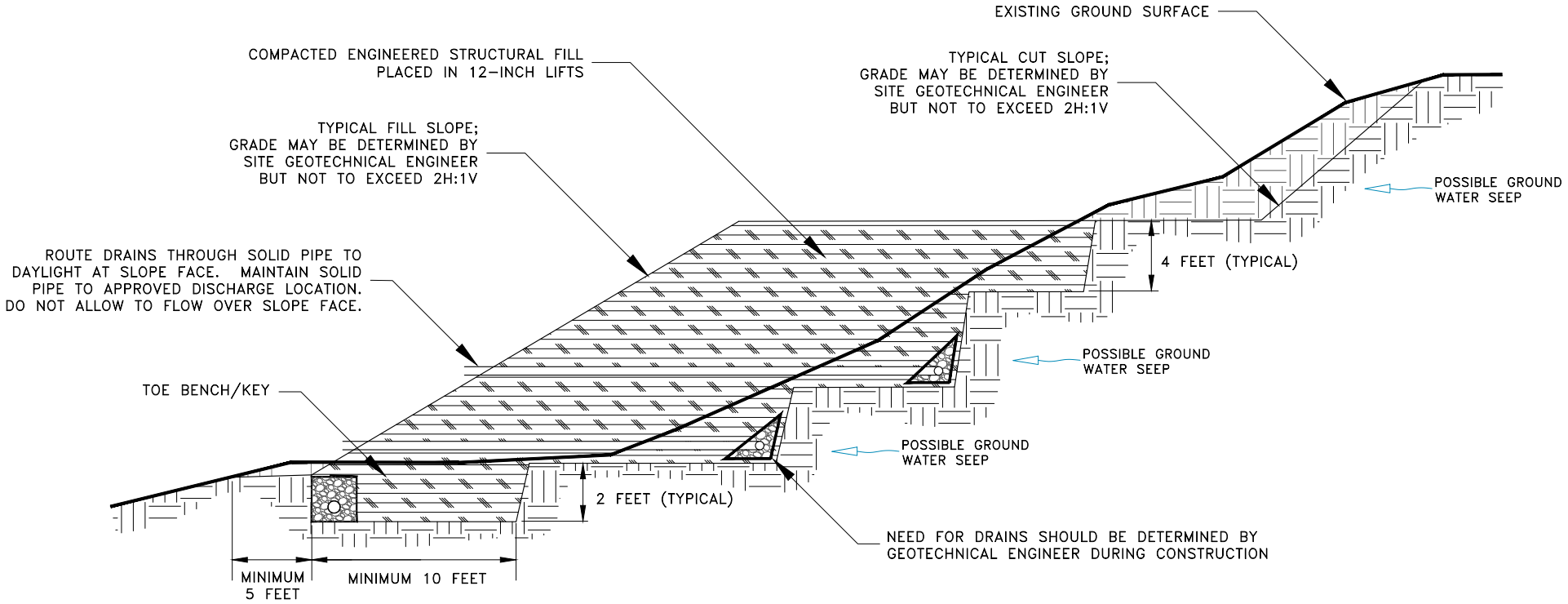


Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

TYPICAL DRAINAGE MAT CROSS SECTION

NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL DRAINAGE MAT SECTION AND MAY NOT BE SITE-SPECIFIC.

FIGURE 8



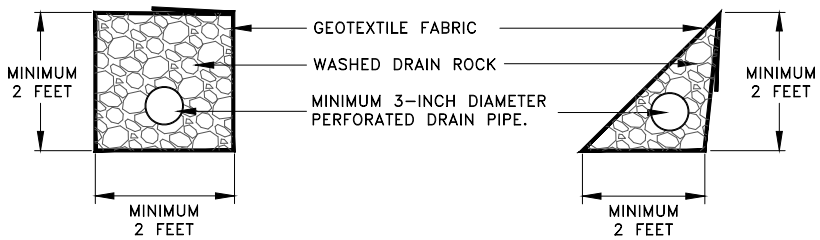
DRAIN SPECIFICATIONS

GEOTEXTILE FABRIC SHALL MEET WSDOT 9–33.2(1), TABLE 2, CLASS C.

WASHED DRAIN ROCK SHALL BE OPEN–GRADED ANGULAR DRAIN ROCK MEETING WSDOT 9–03.12(4), GRAVEL BACKFILL FOR DRAINS.

DRAIN PIPE SHOULD MEET WSDOT 9–05.2(6), PERFORATED PVC UNDERDRAIN PIPE.

TYPICAL DRAIN SECTION DETAIL

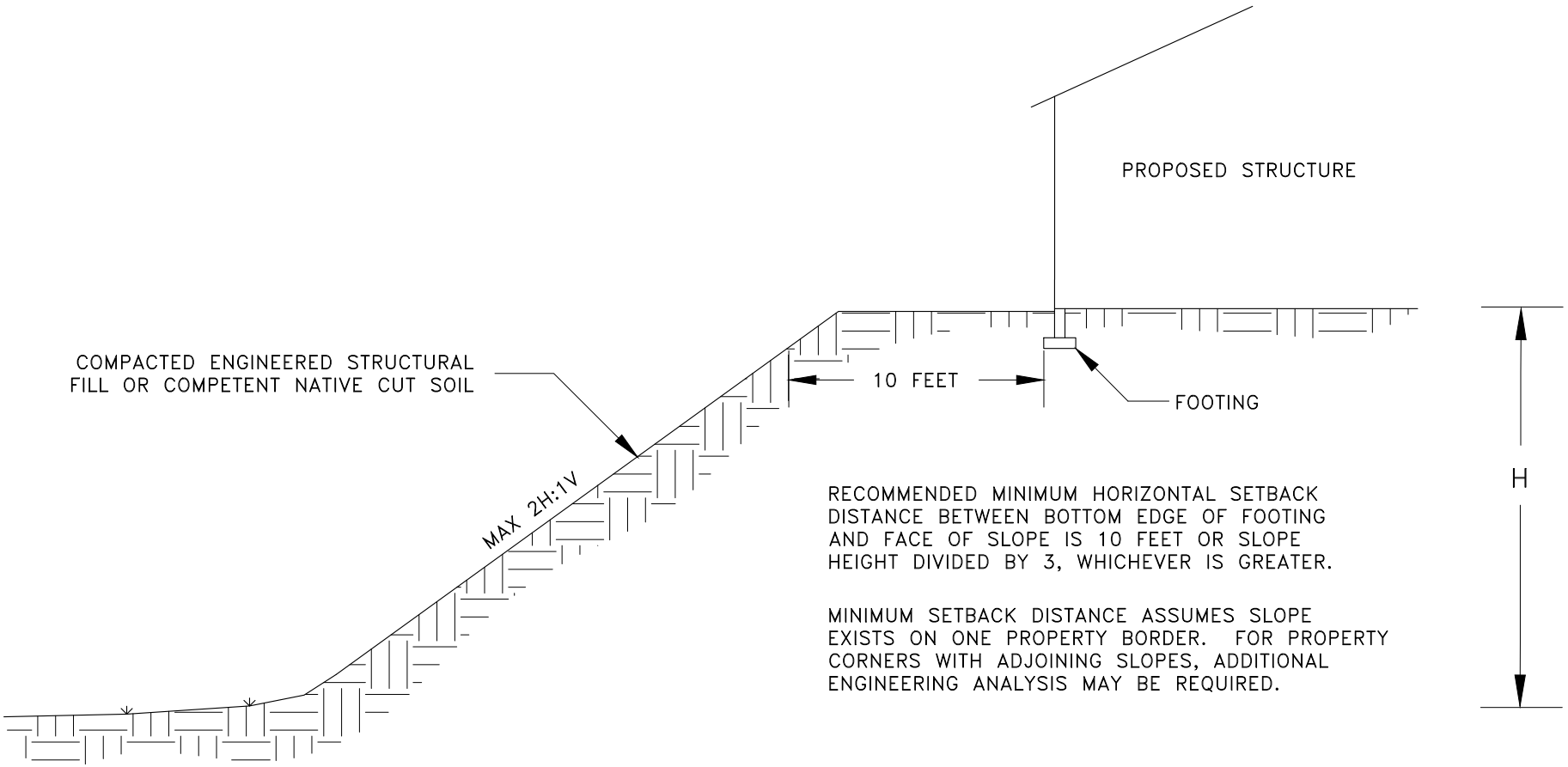


Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

TYPICAL CUT AND FILL SLOPE CROSS SECTION

NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL CUT AND FILL SLOPE CROSS SECTION AND MAY NOT BE SITE–SPECIFIC.

FIGURE 9



Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

TYPICAL MINIMUM FOUNDATION SLOPE SETBACK DETAIL

NOTES:
1. DRAWING IS NOT TO SCALE.
2. SLOPES AND PROFILES SHOWN ARE APPROXIMATE.
3. DRAWING REPRESENTS TYPICAL FOUNDATION SETBACK DETAIL AND MAY NOT BE SITE-SPECIFIC.

FIGURE 10

APPENDIX A
SUBSURFACE EXPLORATION LOGS

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

BORING LOG

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Landing on the Cowlitz	CT6, LLC		22310	BP-1
PROJECT LOCATION	**DRILLING CONTRACTOR**	**DRILL RIG**	**TECHNICIAN**	**PAGE NO.**
Castle Rock, Washington	Western States	CME Track	MAC	1 of 1
BORING LOCATION	**DRILLING METHOD**	**SAMPLING METHOD**	**START DATE**	**START TIME**
See Figure 2	HSA	SPT	1/31/23	0900
REMARKS	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**FINISH DATE**	**FINISH TIME**
None	Not surveyed	20 feet bgs on 1/31/23	1/31/23	1030

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0			SP-SM			Fill. Gray poorly-graded SAND with silt and trace gravel, moist, fine-textured.					
6	SPT BP1.1	5	SP-SM			Brown poorly-graded SAND with silt, loose, moist, fine-textured.					
10	SPT BP1.2	4				Becomes very loose.					
16	SPT BP1.3	9				Becomes loose.					
20	SPT BP1.4	16				Becomes medium dense, wet.					
30						Bottom of boring at 30 feet bgs. Groundwater encountered at 20 feet bgs on 1/31/23. Piezometer installed at 30 feet and completed with flush mount monument on 1/31/23.					

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

BORING LOG

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Landing on the Cowlitz	CT6, LLC		22310	BP-2
PROJECT LOCATION	**DRILLING CONTRACTOR**	**DRILL RIG**	**TECHNICIAN**	**PAGE NO.**
Castle Rock, Washington	Western States	CME Track	MAC	1 of 1
BORING LOCATION	**DRILLING METHOD**	**SAMPLING METHOD**	**START DATE**	**START TIME**
See Figure 2	HSA	SPT	1/31/23	1200
REMARKS	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**FINISH DATE**	**FINISH TIME**
None	Not surveyed	35 feet bgs on 1/31/23	1/31/23	1600

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0			SP-SM			Brown poorly-graded SAND with silt, moist, fine-textured.					
20	SPT BP2.1	57				Becomes very dense with reduced silt content and trace to some gravel.					
26	SPT BP2.2	11				Becomes medium dense, very moist.					
30	SPT BP2.3	10									
35			GP-GM			Gray to reddish gray poorly-graded GRAVEL with silt and sand, medium dense, wet.					
36	SPT BP2.4	30									
40	SPT BP2.5	REFUSAL 50(3")				Becomes very dense.					
45						Bottom of soil boring at 45 feet bgs. Groundwater encountered at 35 feet bgs on 1/31/23. Piezometer installed at 45 feet and completed with flush mount monument on 1/31/23.					

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

BORING LOG

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Landing on the Cowlitz	CT6, LLC		22310	BP-3
PROJECT LOCATION	**DRILLING CONTRACTOR**	**DRILL RIG**	**TECHNICIAN**	**PAGE NO.**
Castle Rock, Washington	Western States	CME Track	MAC	1 of 1
BORING LOCATION	**DRILLING METHOD**	**SAMPLING METHOD**	**START DATE**	**START TIME**
See Figure 2	HSA	SPT	2/1/23	0900
REMARKS	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**FINISH DATE**	**FINISH TIME**
None	Not surveyed	15 feet bgs on 2/1/23	2/1/23	1245

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0			SP-SM			Brown poorly-graded SAND with silt, loose, moist, fine-textured.					
6	SPT BP3.1	6									
10	SPT BP3.2	0				Becomes very loose.					
15			ML			Dark gray SILT with sand, very soft, wet, low plasticity.					
16	SPT BP3.3	1									
20	SPT BP3.4	37	SP			Gray poorly-graded SAND, medium dense, wet.					
25						Bottom of soil boring at 25 feet bgs. Groundwater encountered at 15 feet bgs on 2/1/23. Piezometer installed at 25 feet and completed with flush mount monument on 2/1/23.					

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

BORING LOG

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Landing on the Cowlitz	CT6, LLC		22310	BP-4
PROJECT LOCATION	**DRILLING CONTRACTOR**	**DRILL RIG**	**TECHNICIAN**	**PAGE NO.**
Castle Rock, Washington	Western States	CME Track	MAC	1 of 1
BORING LOCATION	**DRILLING METHOD**	**SAMPLING METHOD**	**START DATE**	**START TIME**
See Figure 2	HSA	SPT	2/1/23	1300
REMARKS	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**FINISH DATE**	**FINISH TIME**
None	Not surveyed	17 feet bgs on 2/2/23	2/2/23	1045

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0						Grass and three-inch-thick root zone underlain by 12 inches of topsoil.					
2			SP-SM			Brown silty SAND to poorly-graded SAND with silt, very loose, moist, fine-textured.					
4											
6	SPT BP4.1	4									
8											
10	SPT BP4.2	1									
12											
14											
16	SPT BP4.3	1				Becomes wet.					
18											
20											
22											
24											
26											
28											
30											
32											
34											
36						Bottom of soil boring at 35 feet bgs. Groundwater encountered at 17 feet bgs on 2/2/23. Piezometer installed at 35 feet and completed with flush mount monument on 2/2/23.					
38											
40											

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

BORING LOG

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Landing on the Cowlitz	CT6, LLC		22310	BP-5
PROJECT LOCATION	**DRILLING CONTRACTOR**	**DRILL RIG**	**TECHNICIAN**	**PAGE NO.**
Castle Rock, Washington	Western States	CME Track	MAC	1 of 1
BORING LOCATION	**DRILLING METHOD**	**SAMPLING METHOD**	**START DATE**	**START TIME**
See Figure 2	HSA	SPT	2/2/23	1100
REMARKS	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**FINISH DATE**	**FINISH TIME**
None	Not surveyed	17.5 feet bgs on 2/2/23	2/2/23	1600

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0			SP-SM			Brown poorly-graded SAND with silt, loose, moist, fine-textured.					
2											
4											
6	SPT BP5.1	7									
8											
10	SPT BP5.2	10				Becomes medium dense.					
12											
14											
16	SPT BP5.3	5				Becomes loose.					
18						Becomes wet.					
20	SPT BP5.4	REFUSAL 50(3")	GP-GM			Gray to reddish gray poorly-graded GRAVEL with silt and sand, very dense, wet.					
22											
24											
26	SPT BP5.5	REFUSAL 50(5")									
28											
30	SPT BP5.6	16				Becomes medium dense.					
32						Bottom of soil boring at 31.5 feet bgs. Groundwater encountered at 17.5 feet bgs on 2/2/23. Piezometer installed at 30 feet and completed with flush mount monument on 2/2/23.					
34											
36											

APPENDIX B
SOIL CLASSIFICATION INFORMATION

SOIL DESCRIPTION AND CLASSIFICATION GUIDELINES

Particle-Size Classification

COMPONENT	ASTM/USCS		AASHTO	
	size range	sieve size range	size range	sieve size range
Cobbles	> 75 mm	greater than 3 inches	> 75 mm	greater than 3 inches
Gravel	75 mm – 4.75 mm	3 inches to No. 4 sieve	75 mm – 2.00 mm	3 inches to No. 10 sieve
Coarse	75 mm – 19.0 mm	3 inches to 3/4-inch sieve	-	-
Fine	19.0 mm – 4.75 mm	3/4-inch to No. 4 sieve	-	-
Sand	4.75 mm – 0.075 mm	No. 4 to No. 200 sieve	2.00 mm – 0.075 mm	No. 10 to No. 200 sieve
Coarse	4.75 mm – 2.00 mm	No. 4 to No. 10 sieve	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve
Medium	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve	-	-
Fine	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve
Fines (Silt and Clay)	< 0.075 mm	Passing No. 200 sieve	< 0.075 mm	Passing No. 200 sieve

Consistency for Cohesive Soil

CONSISTENCY	SPT N-VALUE (BLOWS PER FOOT)	D&M N-VALUE (BLOWS PER FOOT)	POCKET PENETROMETER (UNCONFINED COMPRESSIVE STRENGTH, tsf)
Very Soft	Less than 2	Less than 3	less than 0.25
Soft	2 to 4	3 to 6	0.25 to 0.50
Medium Stiff	4 to 8	6 to 12	0.50 to 1.0
Stiff	8 to 15	12 to 25	1.0 to 2.0
Very Stiff	15 to 30	25 to 65	2.0 to 4.0
Hard	30 to 60	65 to 145	greater than 4.0
Very Hard	greater than 60	greater than 145	-

RELATIVE DENSITY	SPT N-VALUE (BLOWS PER FOOT)	D&M N-VALUE (BLOWS PER FOOT)
Very Loose	0 to 4	0 to 11
Loose	4 to 10	11 to 26
Medium Dense	10 to 30	26 to 74
Dense	30 to 50	74 to 120
Very Dense	more than 50	More than 120

Relative Density for Granular Soil

Moisture Designations

TERM	FIELD IDENTIFICATION
Dry	No moisture. Dusty or dry.
Damp	Some moisture. Cohesive soils are usually below plastic limit and are moldable.
Moist	Grains appear darkened, but no visible water is present. Cohesive soils will clump. Sand will bulk. Soils are often at or near plastic limit.
Wet	Visible water on larger grains. Sand and silt exhibit dilatancy. Cohesive soil can be readily remolded. Soil leaves wetness on the hand when squeezed. Soil is much wetter than optimum moisture content and is above plastic limit.

Additional Constituents

Percent	Silt and Clay In:		Percent	Sand and Gravel In:	
	Fine-Grained Soil	Coarse-Grained Soil		Fine-Grained Soil	Coarse-Grained Soil
< 5	trace	trace	< 5	trace	trace
5 – 12	minor	with	5 – 15	minor	minor
> 12	some	silty/clayey	15 – 30	with	with
			> 30	sandy/gravelly	Indicate approx. percentage

AASHTO SOIL CLASSIFICATION SYSTEM

TABLE 1. Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35 Percent or Less Passing .075 mm)				Silt-Clay Materials (More than 35 Percent Passing 0.075)		
Group Classification	A-1	A-3	A-2	A-4	A-5	A-6	A-7
Sieve analysis, percent passing:							
2.00 mm (No. 10)	-	-	-				
0.425 mm (No. 40)	50 max	51 min	-	-	-	-	-
0.075 mm (No. 200)	25 max	10 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)							
Liquid limit				40 max	41 min	40 max	41 min
Plasticity index	6 max	N.P.		10 max	10 max	11 min	11 min
General rating as subgrade	Excellent to good				Fair to poor		

Note: The placing of A-3 before A-2 is necessary in the "left to right elimination process" and does not indicate superiority of A-3 over A-2.

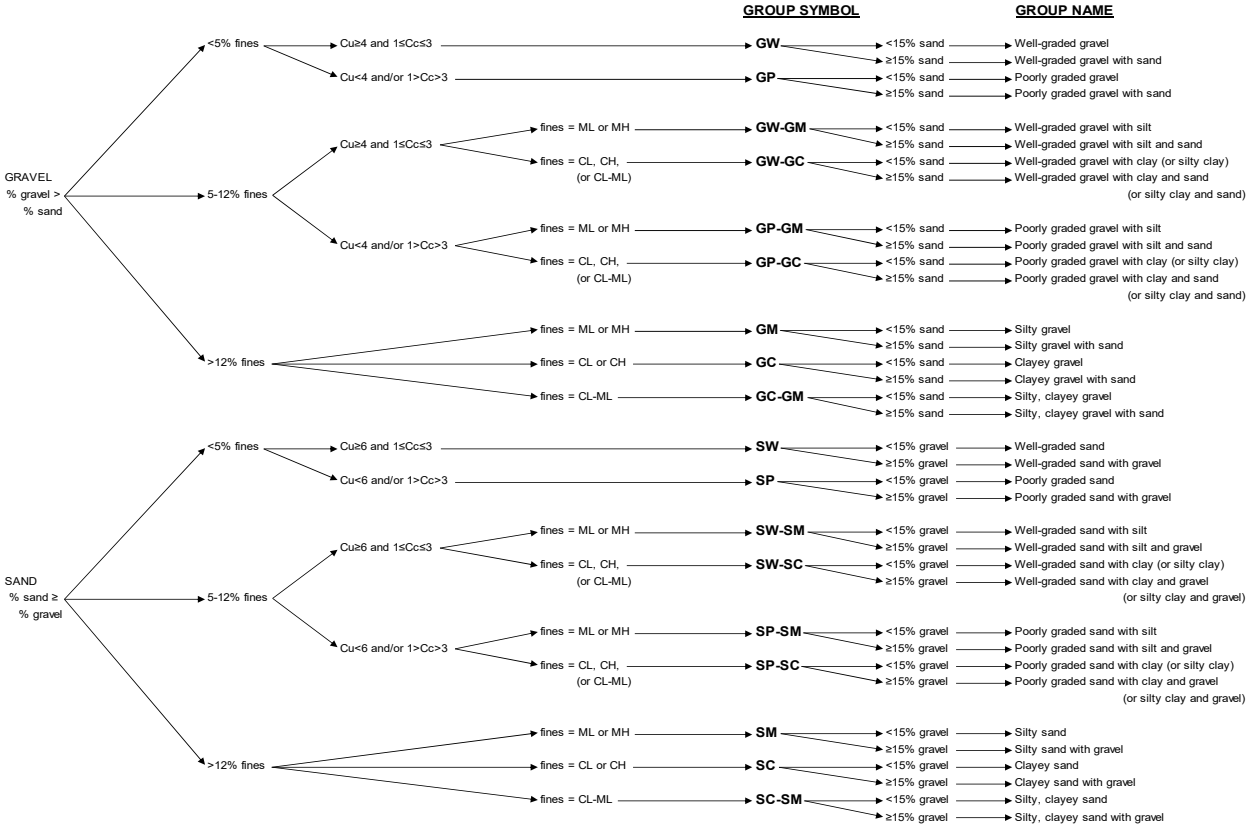
TABLE 2. Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35 Percent or Less Passing 0.075 mm)							Silt-Clay Materials (More than 35 Percent Passing 0.075 mm)			
	A-1			A-2							A-7
Group Classification	A-1-a	A-1-b	A-3	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7-5, A-7-6
Sieve analysis, percent passing:											
2.00 mm (No. 10)	50 max	-	-	-	-	-	-	-	-	-	-
0.425 mm (No. 40)	30 max	50 max	51 min	-	-	-	-	-	-	-	-
0.075 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)											
Liquid limit				40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11min
Usual types of significant constituent materials	Stone fragments, gravel and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
General ratings as subgrade	Excellent to Good							Fair to poor			

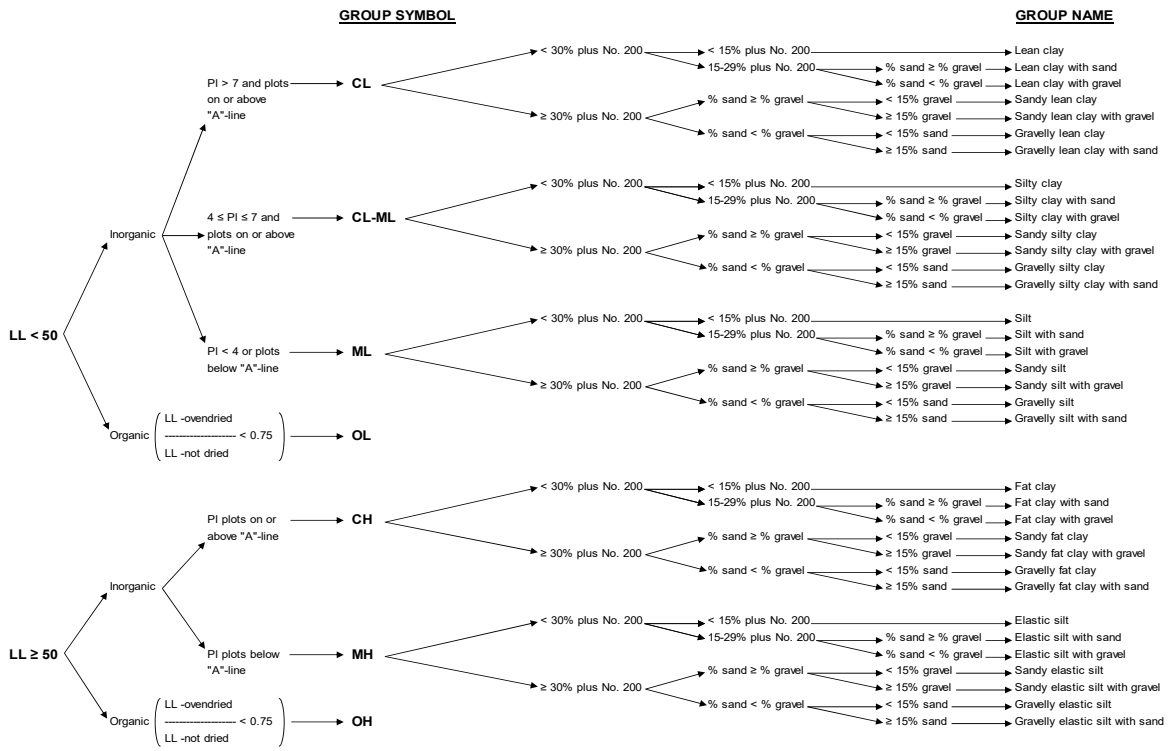
Note: Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30 (see Figure 2).

AASHTO = American Association of State Highway and Transportation Officials

USCS SOIL CLASSIFICATION SYSTEM



Flow Chart for Classifying Coarse-Grained Soils (More Than 50% Retained on No. 200 Sieve)

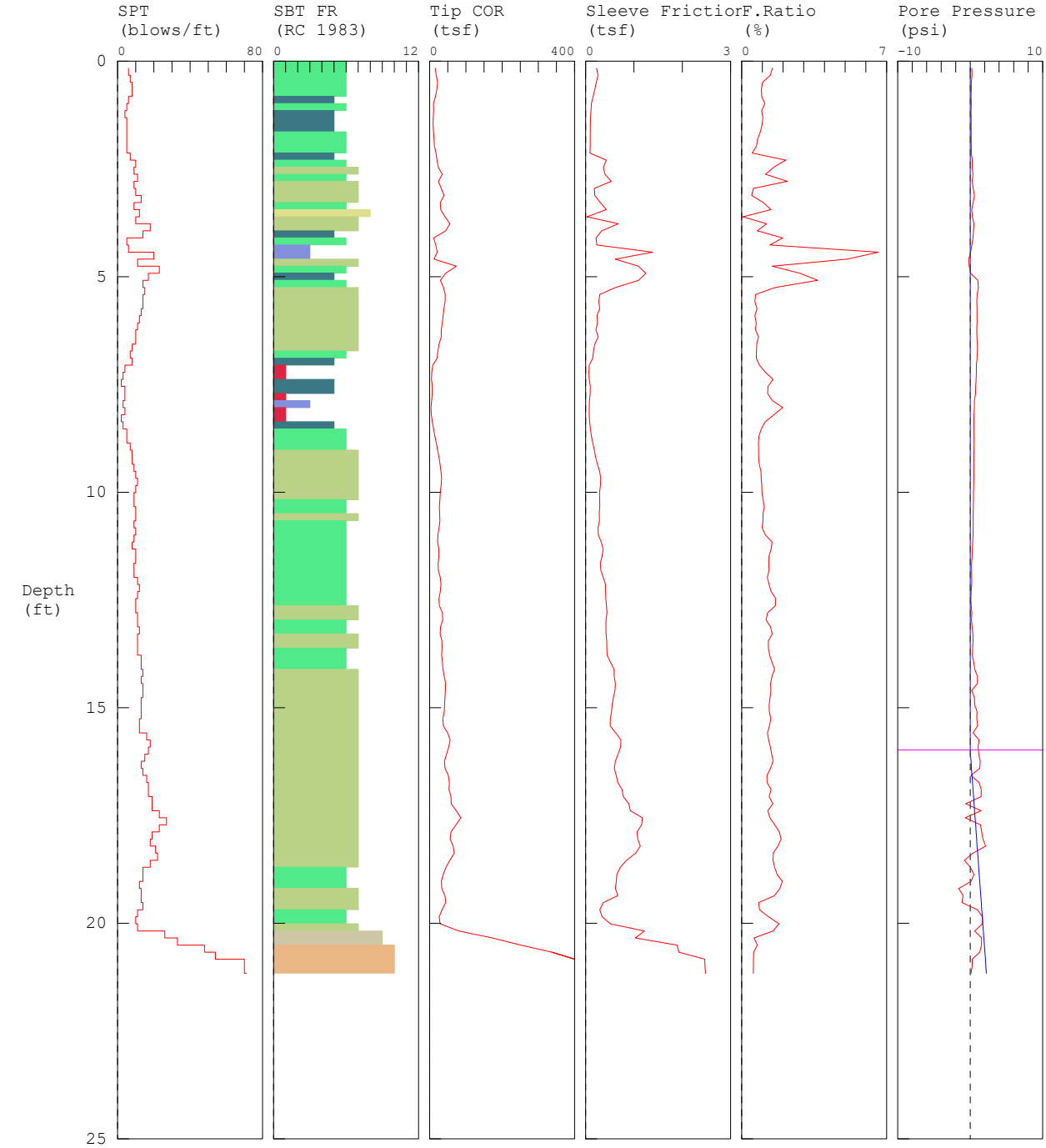


Flow Chart for Classifying Fine-Grained Soil (50% or More Passes No. 200 Sieve)

APPENDIX C
PERTINENT SUBSURFACE INFORMATION COLLECTED BY OTHERS

GeoDesign / CPT-1 / SW Larson Lane Castle Rock

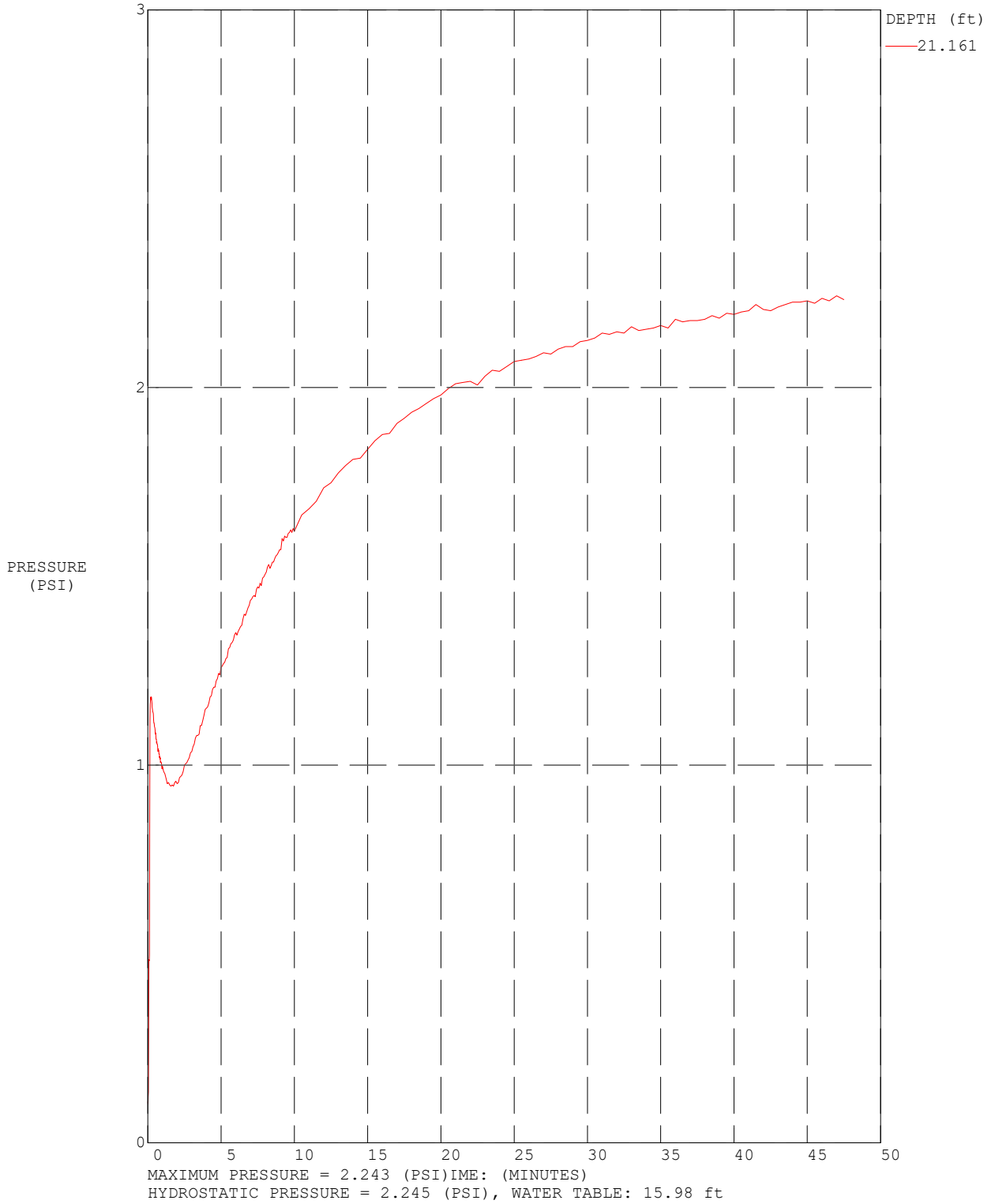
OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-1
TEST DATE: 1/13/2020 10:33:34 AM
TOTAL DEPTH: 21.161 ft



*SBT/SPT CORRELATION: UBC-1983

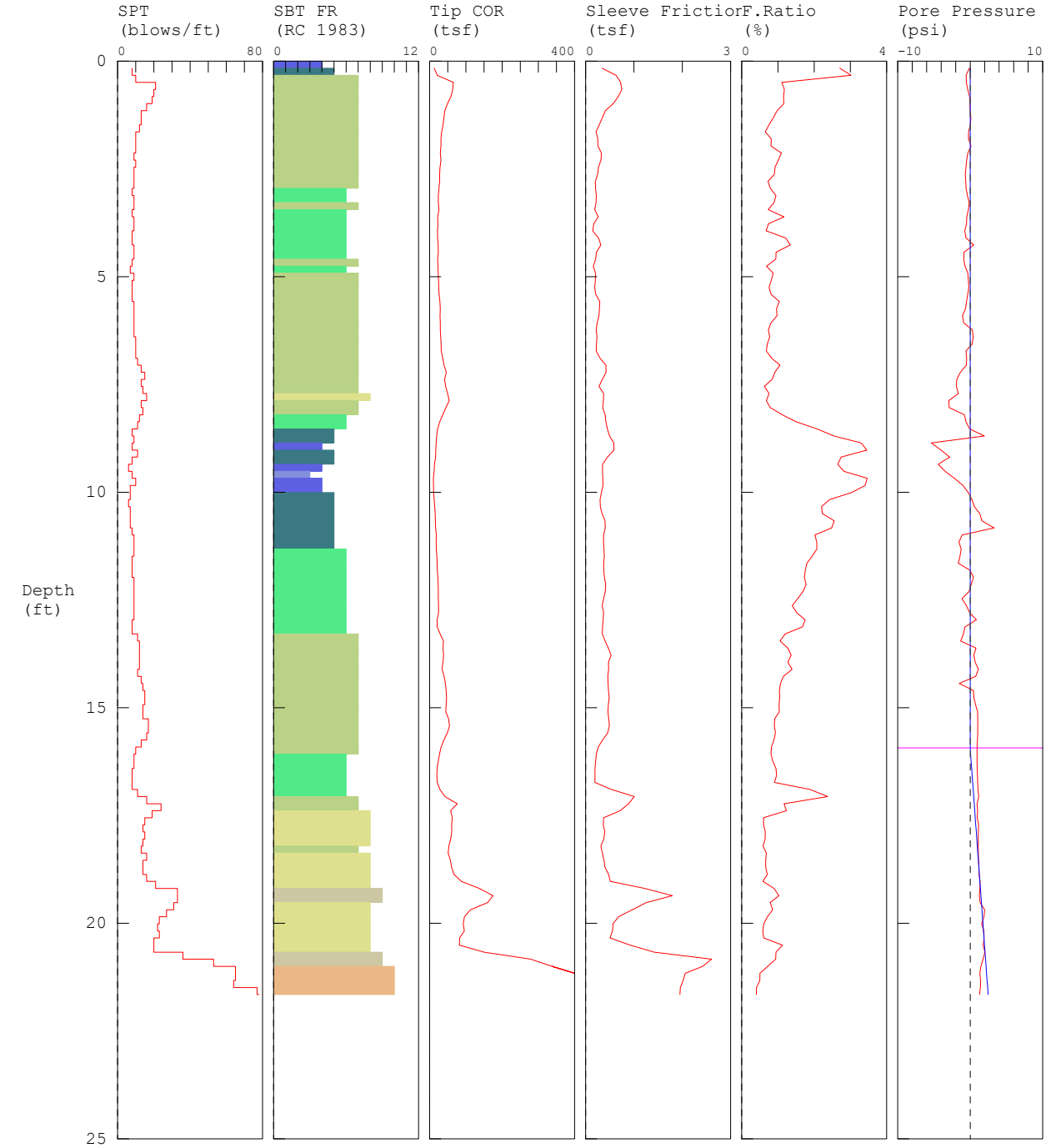
COMMENT: GeoDesign / CPT-1 / SW Larson Lane Castle Rock

TEST DATE: 1/13/2020 10:33:34 AM



GeoDesign / CPT-2 / SW Larson Lane Castle Rock

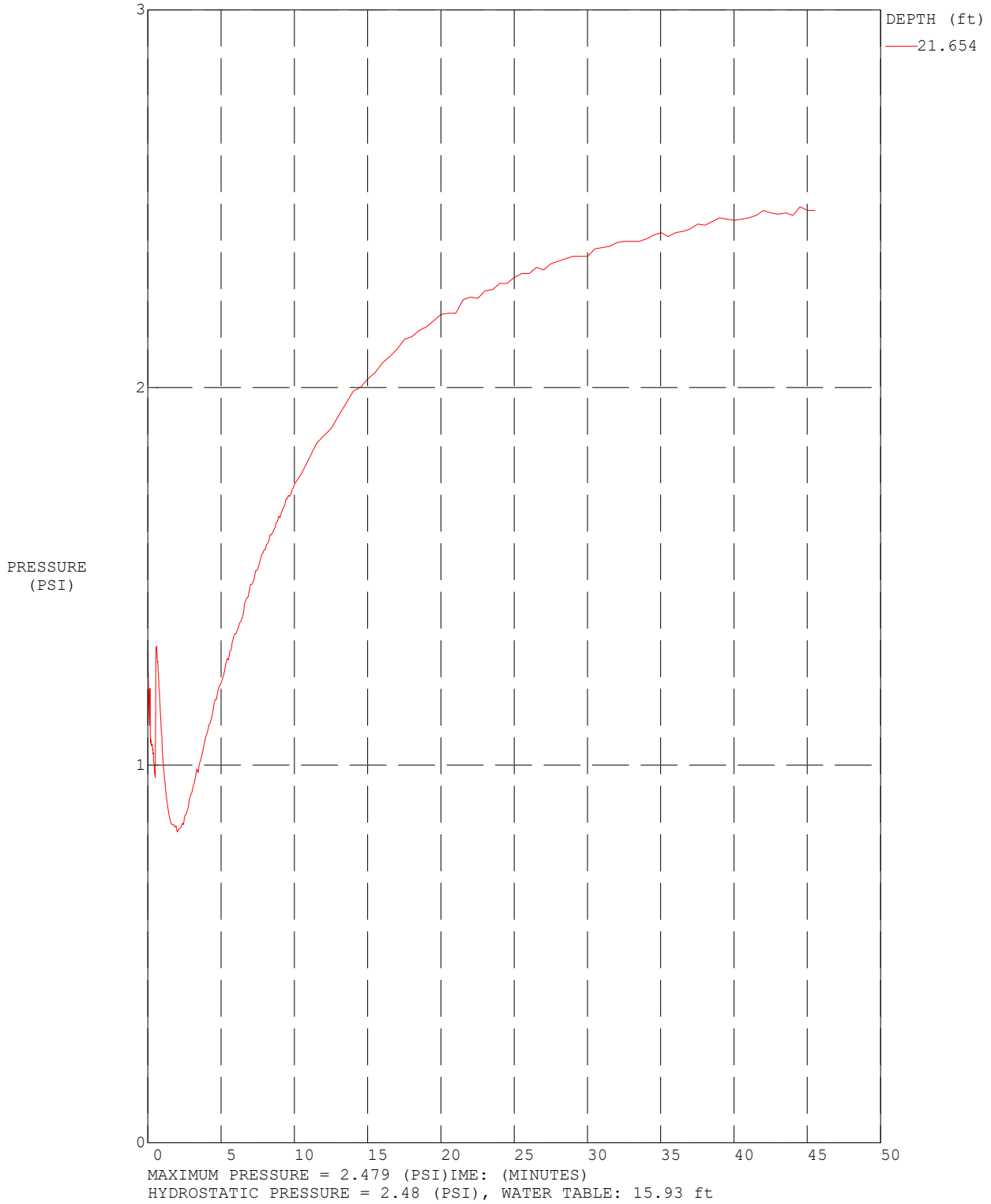
OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-2
TEST DATE: 1/13/2020 12:14:29 PM
TOTAL DEPTH: 21.654 ft



*SBT/SPT CORRELATION: UBC-1983

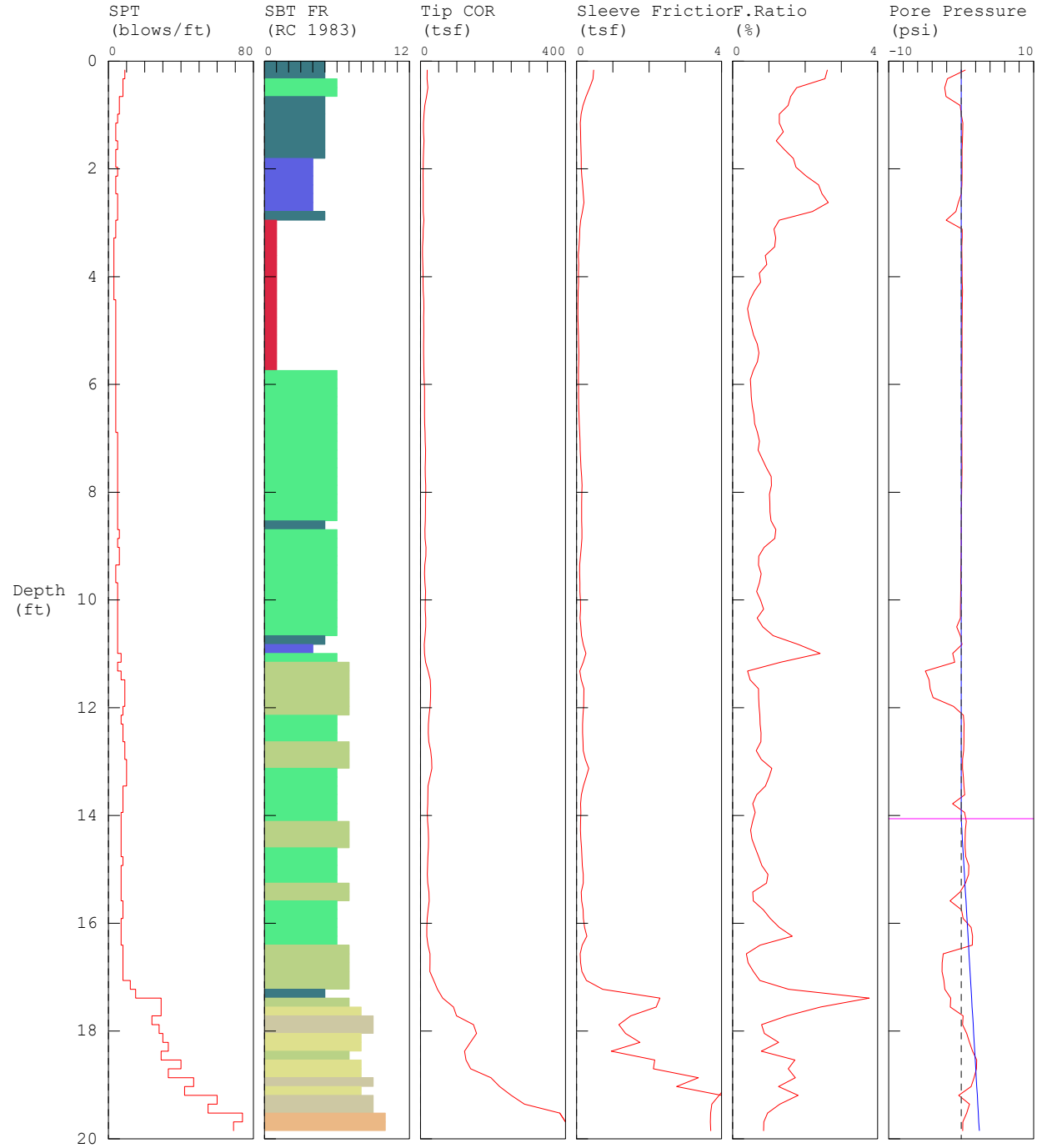
COMMENT: GeoDesign / CPT-2 / SW Larson Lane Castle Rock

TEST DATE: 1/13/2020 12:14:29 PM



GeoDesign / CPT-3 / SW Larson Lane Castle Rock

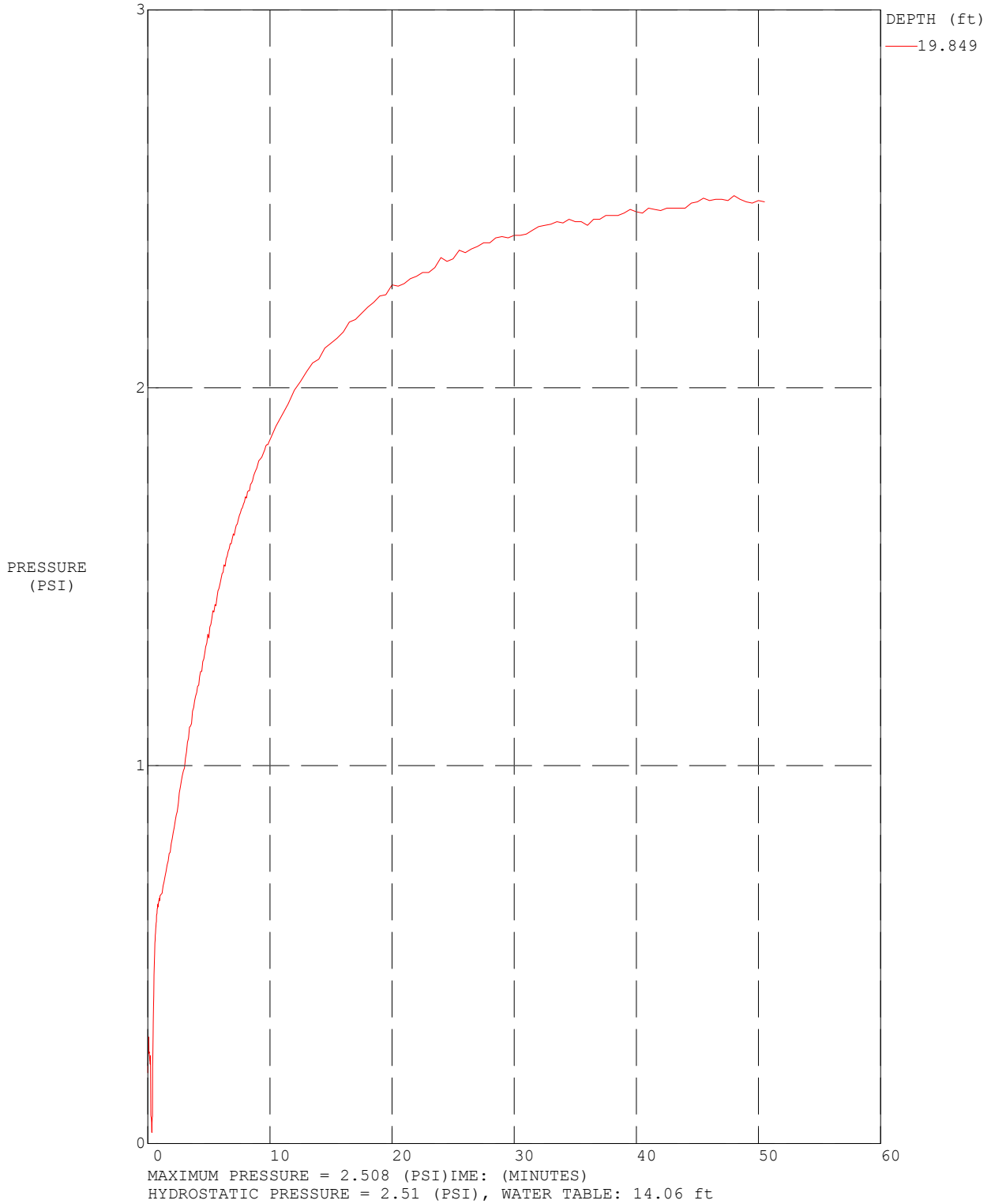
OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-3
TEST DATE: 1/13/2020 1:40:18 PM
TOTAL DEPTH: 19.849 ft



*SBT/SPT CORRELATION: UBC-1983

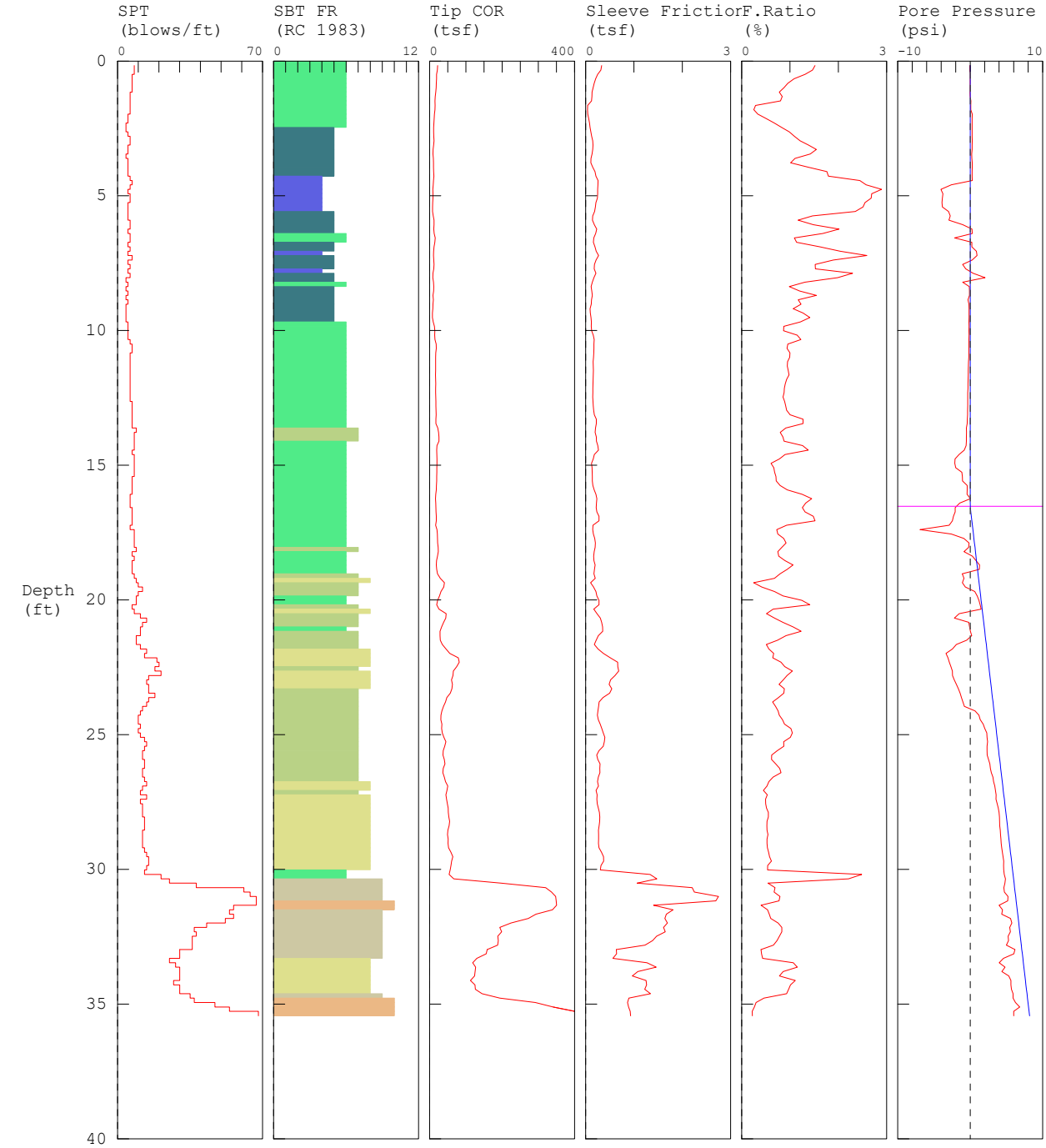
COMMENT: GeoDesign / CPT-3 / SW Larson Lane Castle Rock

TEST DATE: 1/13/2020 10:33:34 AM



GeoDesign / CPT-4 / SW Larson Lane Castle Rock

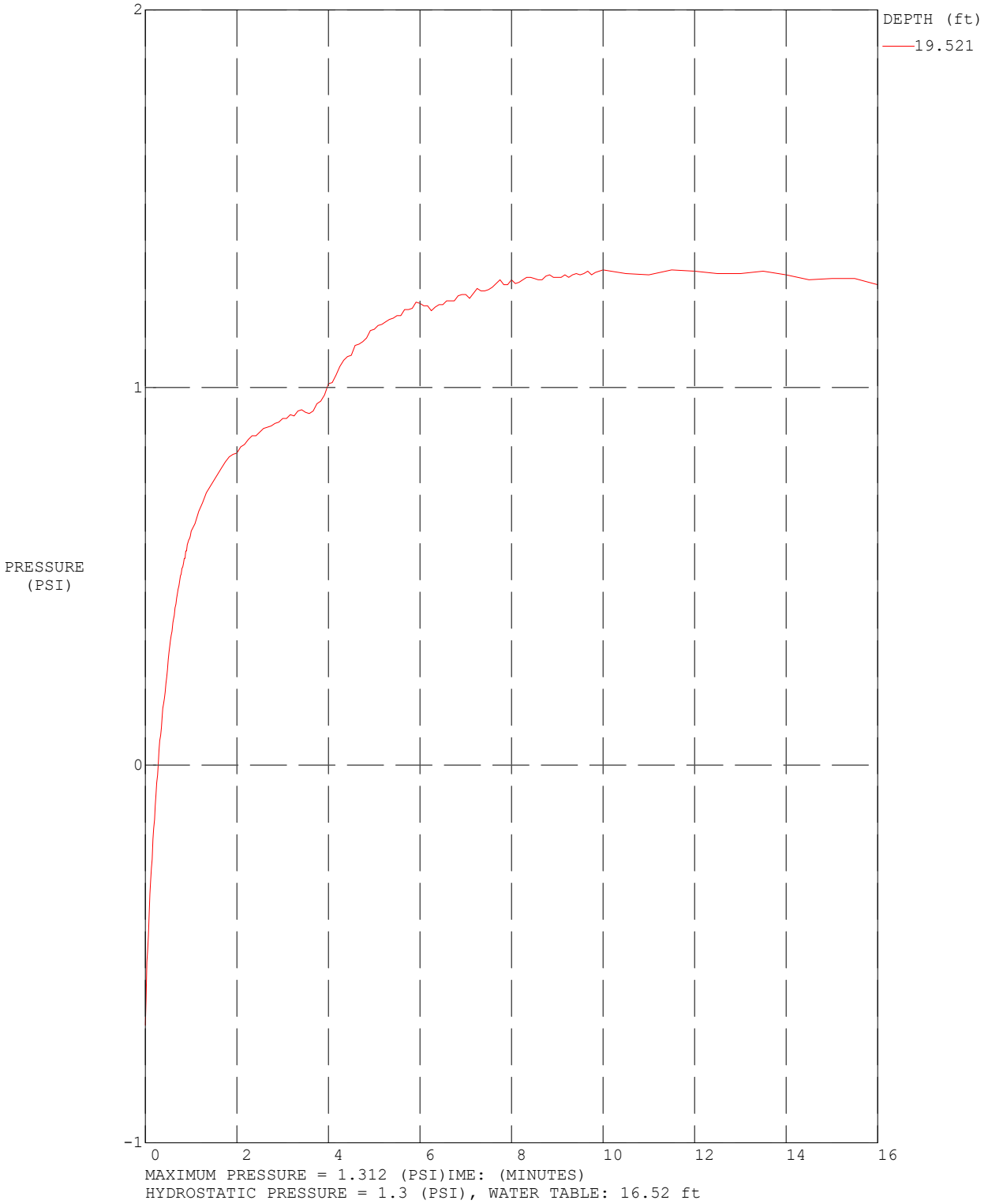
OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-4
TEST DATE: 1/13/2020 3:11:15 PM
TOTAL DEPTH: 35.433 ft



*SBT/SPT CORRELATION: UBC-1983

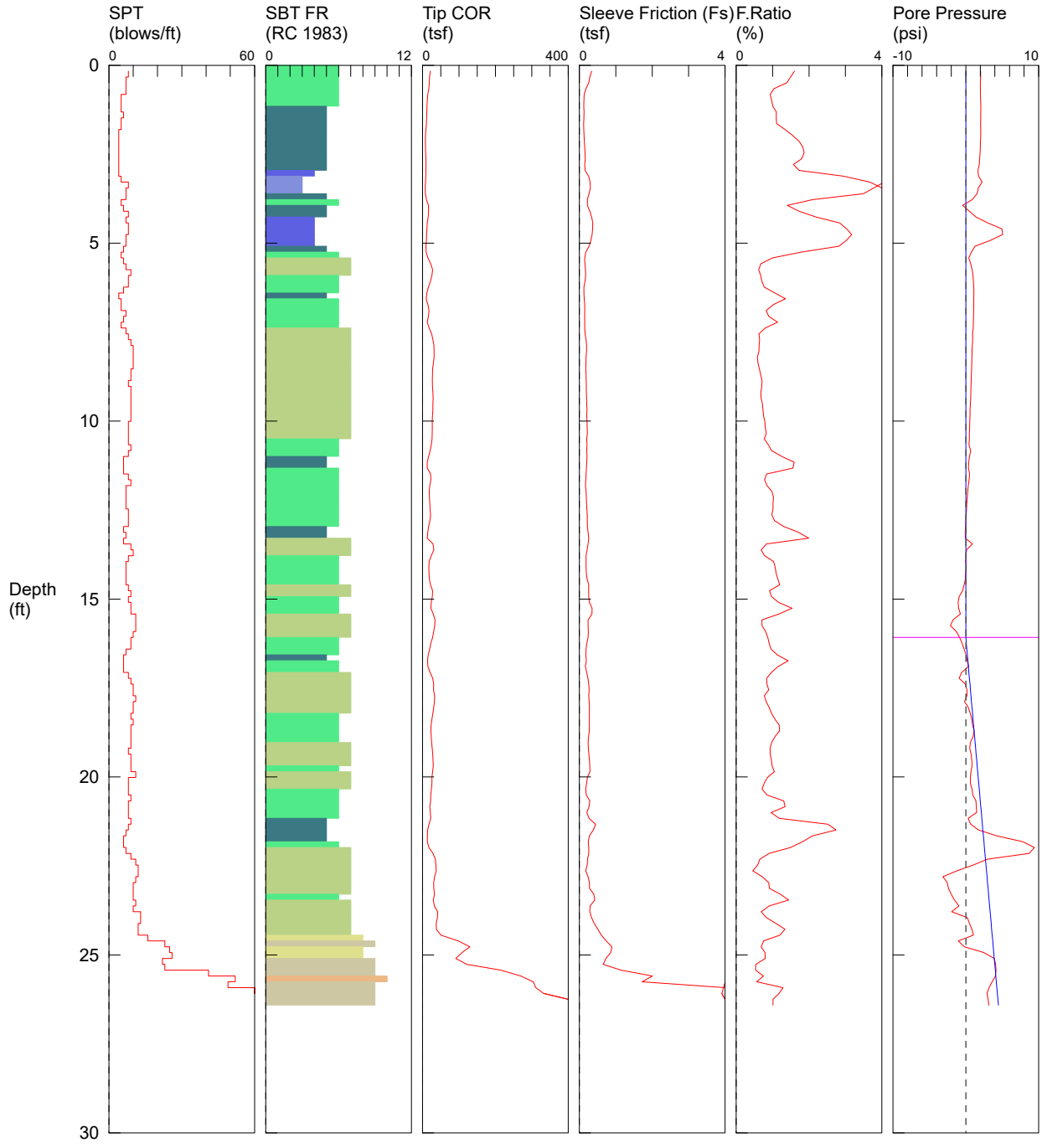
COMMENT: GeoDesign / CPT-4 / SW Larson Lane Castle Rock

TEST DATE: 1/13/2020 3:11:15 PM



GeoDesign / CPT-5 / SW Larson Lane Castle Rock

OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-5
TEST DATE: 1/14/2020 8:44:26 AM
TOTAL DEPTH: 26.411 ft

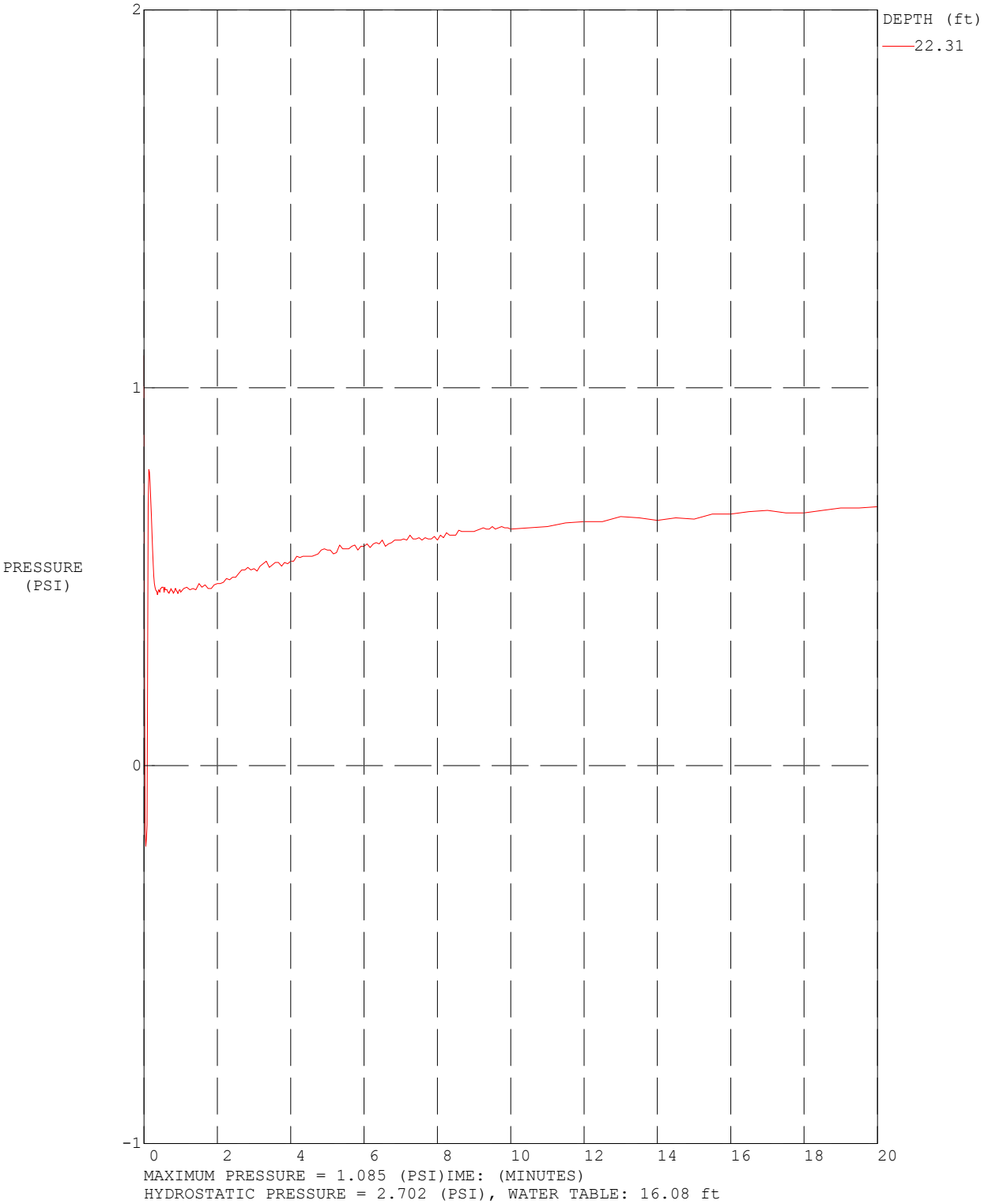


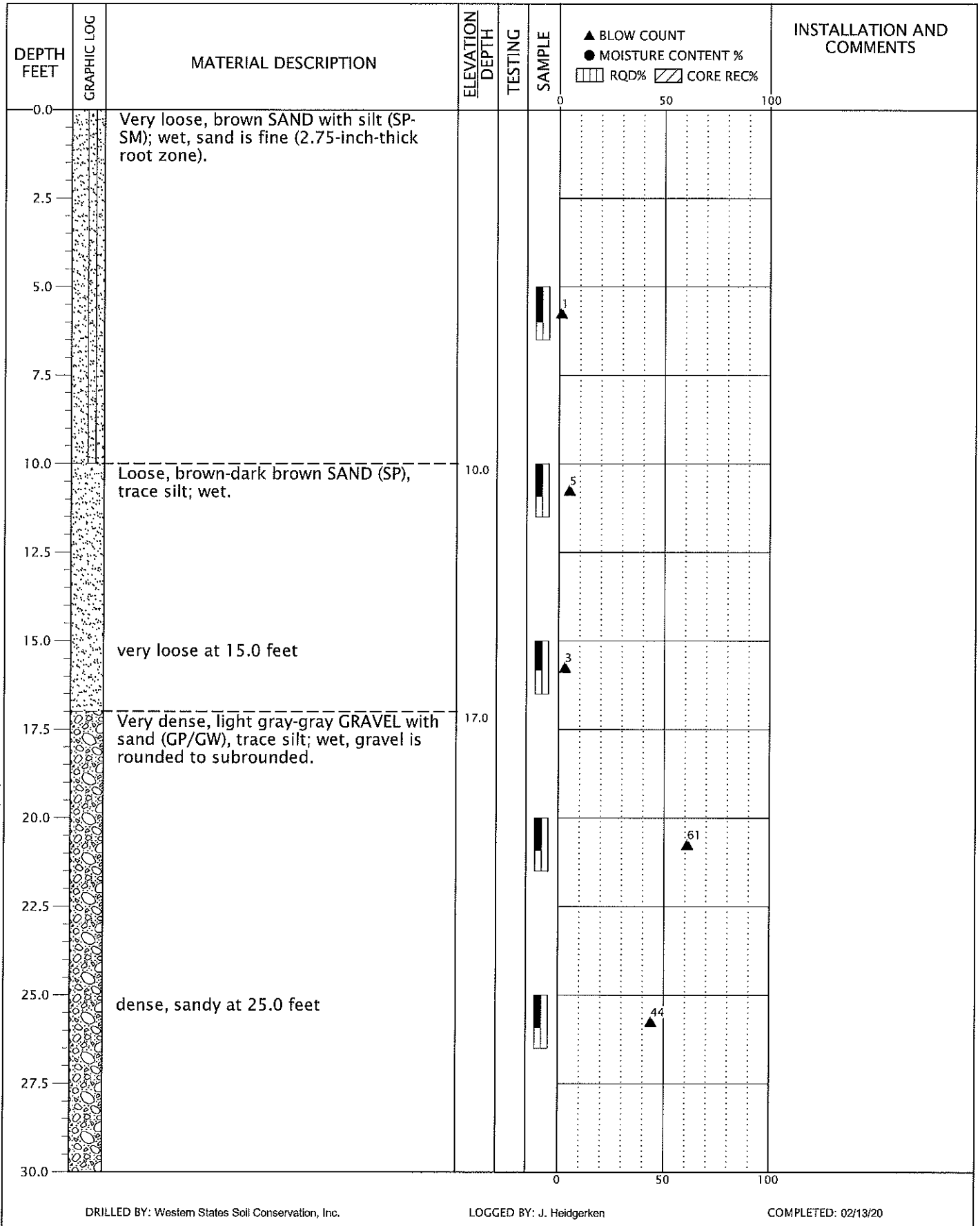
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

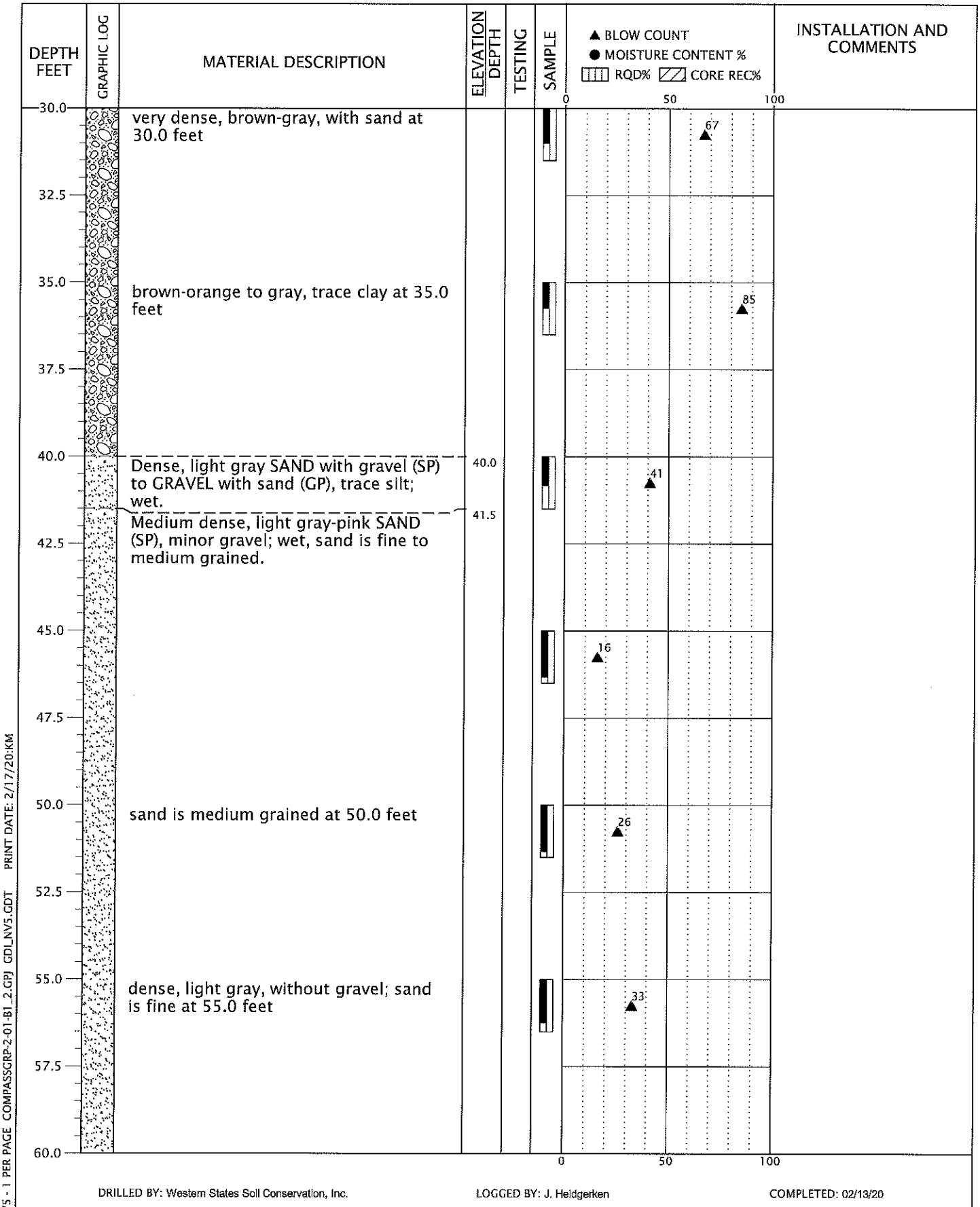
*SBT/SPT CORRELATION: UBC-1983

COMMENT: GeoDesign / CPT-5 / SW Larson Lane Castle Rock

TEST DATE: 1/14/2020 8:44:26 AM




DEPTH FEET
GRAPHIC LOG
MATERIAL DESCRIPTION
ELEVATION DEPTH
TESTING
SAMPLE
▲ BLOW COUNT
● MOISTURE CONTENT %
RQD% CORE REC%
0
50
100
INSTALLATION AND COMMENTS
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
22.5
25.0
27.5
30.0
Very loose, brown SAND with silt (SP-SM); wet, sand is fine (2.75-inch-thick root zone).
Loose, brown-dark brown SAND (SP), trace silt; wet.
10.0
very loose at 15.0 feet
Very dense, light gray-gray GRAVEL with sand (GP/GW), trace silt; wet, gravel is rounded to subrounded.
17.0
dense, sandy at 25.0 feet
1
5
3
61
44
DRILLED BY: Western States Soil Conservation, Inc.
LOGGED BY: J. Heidgerken
COMPLETED: 02/13/20
BORING METHOD: mud rotary (see document text)
BORING BIT DIAMETER: 4 7/8 inches
GEODESIGN INC
AN NV5 COMPANY
COMPASSGRP-2-01
BORING B-1
FEBRUARY 2020
LARSON LANE SITE
CASTLE ROCK, WA
FIGURE A-1
BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM



DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: J. Heldgerken COMPLETED: 02/13/20

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER: 4 7/8 inches

BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM

GEODESIGN INC AN NV5 COMPANY

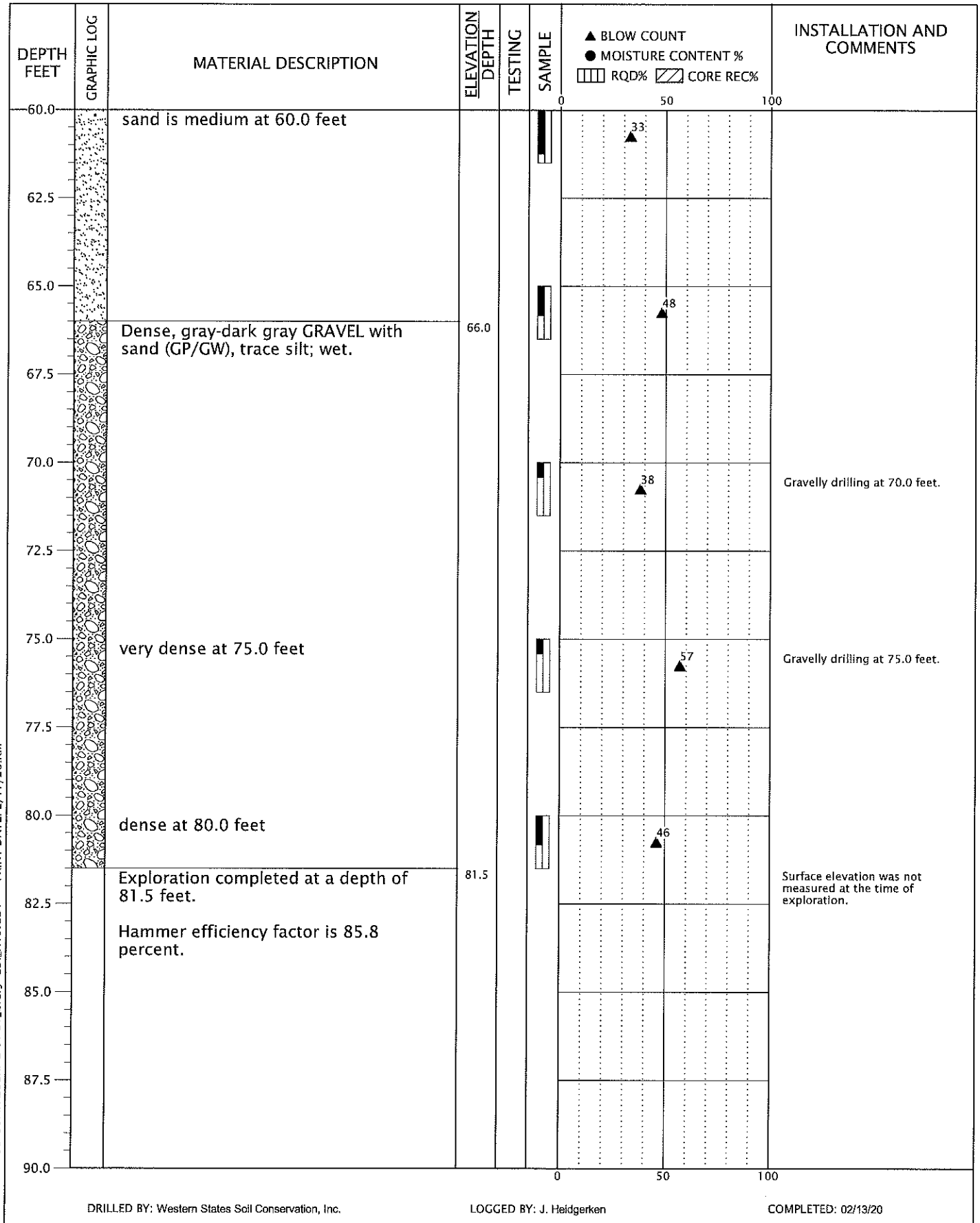
COMPASSGRP-2-01

BORING B-1
(continued)

FEBRUARY 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-1



DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: J. Heidgerken COMPLETED: 02/13/20

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER: 4 7/8 inches

GEODESIGN INC
AN NV5 COMPANY

COMPASSGRP-2-01

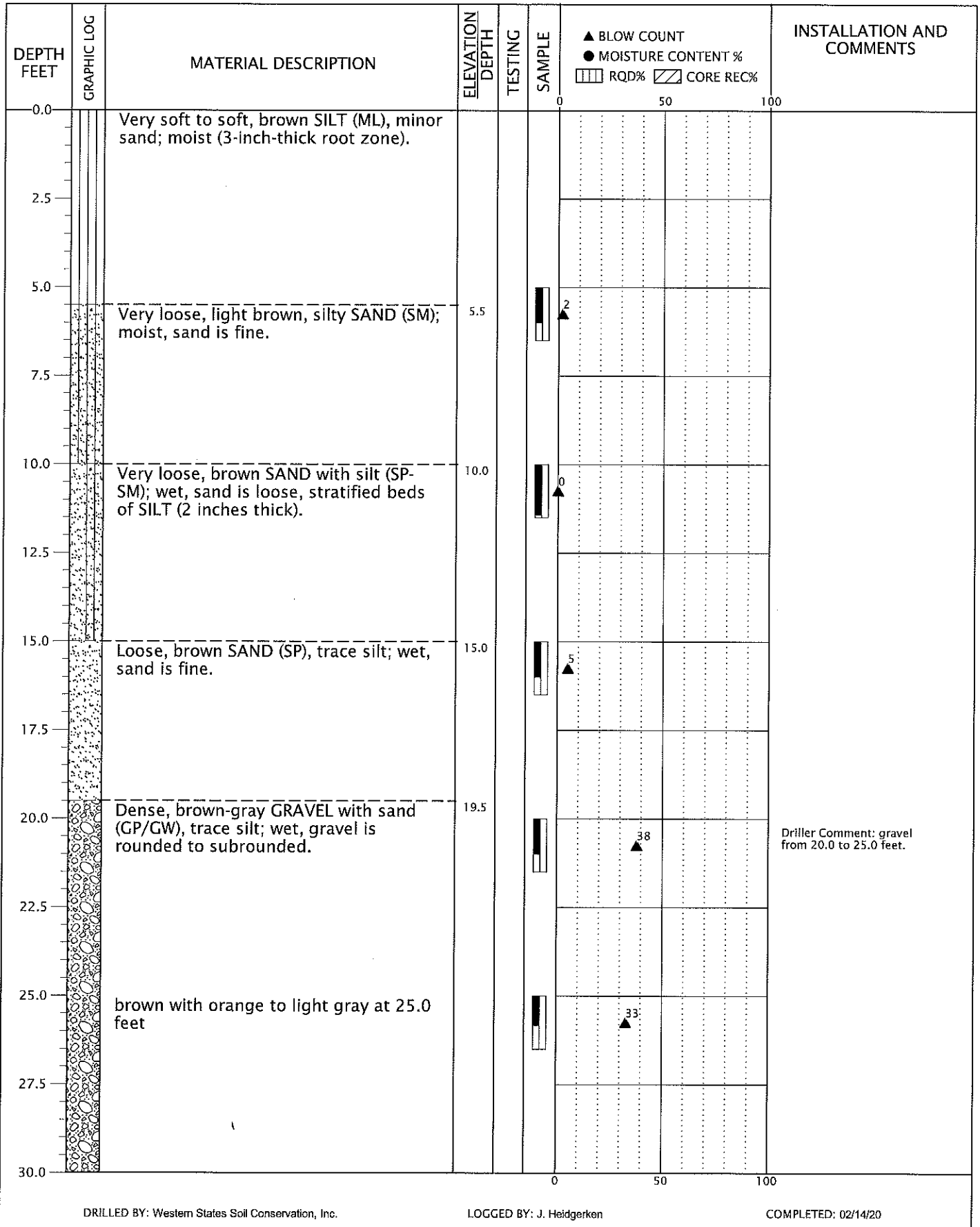
FEBRUARY 2020

BORING B-1
(continued)

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-1

BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM



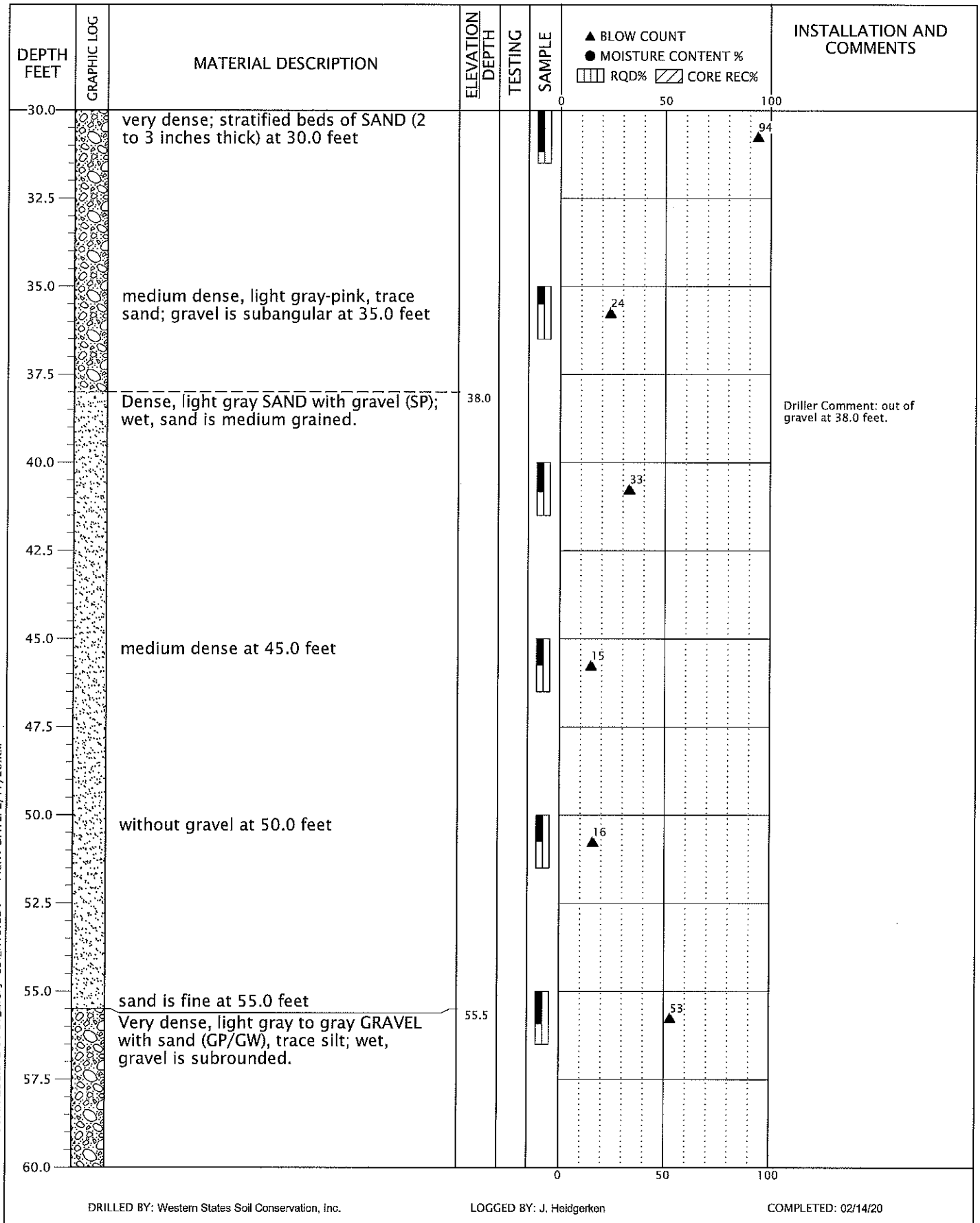
DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: J. Heidgerken COMPLETED: 02/14/20

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER: 4 7/8 inches

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01	**BORING B-2**	
FEBRUARY 2020	LARSON LANE SITE CASTLE ROCK, WA	**FIGURE A-2**

BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM



DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: J. Heidgerken COMPLETED: 02/14/20

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER: 4 7/8 inches

GeoDesign Inc
AN NV5 COMPANY

COMPASSGRP-2-01

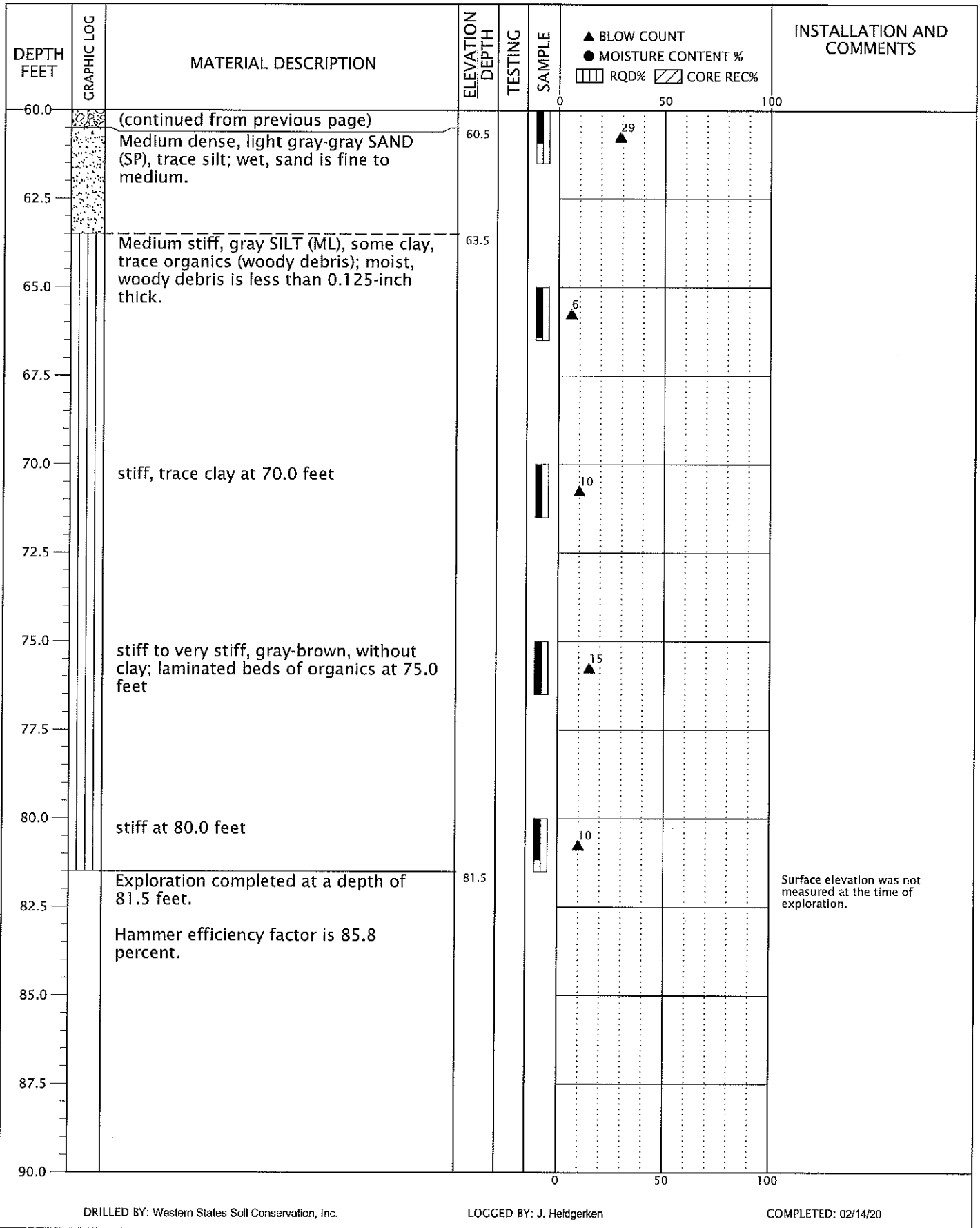
BORING B-2
(continued)

FEBRUARY 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-2

BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM



DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: J. Heidgerken COMPLETED: 02/14/20

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER: 4 7/8 inches

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01

FEBRUARY 2020

BORING B-2
(continued)

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-2

BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Loose, dark brown, silty SAND (SM), trace organics; moist to wet, sand is fine (3-inch-thick root zone).					
			0.8				
		Loose, brown SAND with silt (SP-SM), trace organics; moist, sand is fine. without organics at 1.5 feet					
2.5							
5.0							
7.5							
							Severe caving observed at 9.5 feet.
10.0		Loose, brown SAND (SP), trace silt; wet, sand is medium.	10.0				Rapid groundwater seepage observed at 10.5 feet.
12.5		Exploration completed at a depth of 12.5 feet.	12.5				Surface elevation was not measured at the time of exploration.
15.0							
17.5							
20.0						0 50 100	

EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20

EXCAVATION METHOD: mini excavator (see document text)

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01

TEST PIT TP-1

MARCH 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-3

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Loose, dark brown, silty SAND (SM), trace organics; moist, sand is fine (3-inch-thick root zone).			☒		
		Loose, light brown SAND with silt (SP-SM), trace organics; moist, sand is fine.	1.5				
2.5		without organics at 2.5 feet			☒		
5.0							
7.5							Severe caving observed at 8.2 feet.
10.0							
		Loose, brown SAND (SP), trace silt; moist, sand is medium.	11.5		☒		
12.5		Exploration completed at a depth of 13.0 feet.	13.0				No groundwater seepage observed to the depth explored. Surface elevation was not measured at the time of exploration.
15.0							
17.5							
20.0							

EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20

EXCAVATION METHOD: mini excavator (see document text)

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01	TEST PIT TP-2	
MARCH 2020	LARSON LANE SITE CASTLE ROCK, WA	FIGURE A-4

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Medium dense, dark brown SAND with silt (SP-SM), trace gravel and organics; moist to wet, sand is fine to coarse, gravel is fine and subrounded (4-inch-thick root zone).			☒		Minor caving observed between 1.0 and 4.0 feet.
2.5		gray-brown, minor gravel; sand is medium to coarse at 0.4 foot without organics at 1.5 feet			☒		
5.0		gray at 5.5 feet			☒		
7.5					☒		Slow groundwater seepage observed at 9.0 feet.
10.0					☒		
		Stiff, dark brown, sandy SILT (MH), trace organics; moist, silt has medium plasticity, sand is fine.	10.5				
		Exploration completed at a depth of 11.5 feet.	11.5				Surface elevation was not measured at the time of exploration.
12.5							
15.0							
17.5							
20.0						0 50 100	

EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20

EXCAVATION METHOD: mini excavator (see document text)

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01

TEST PIT TP-3

MARCH 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-5

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Very loose to loose, gray-brown SAND with silt (SP-SM), minor gravel, trace organics; moist to wet, sand is medium to coarse.					Severe caving observed from 0.0 to 10.5 feet.
		without organics at 1.5 feet			☒		
2.5							
5.0							
7.5							
		gray at 9.5 feet			☒		Slow groundwater seepage observed at 10.0 feet.
10.0		Medium stiff, dark brown, sandy SILT (MH), trace organics; moist, silt has medium plasticity, sand is fine.	10.5		☒		
12.5		Exploration completed at a depth of 12.0 feet.	12.0				Surface elevation was not measured at the time of exploration.
15.0							
17.5							
20.0						0 50 100	

EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20

EXCAVATION METHOD: mini excavator (see document text)

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01

TEST PIT TP-4

MARCH 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-6

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Loose, gray-brown SAND with silt (SP-SM), minor gravel, trace organics; moist to wet, sand is fine to coarse, gravel is fine to coarse and subrounded (4-inch-thick root zone).					Severe caving observed from 0.0 to 8.0 feet.
		without organics at 1.5 feet			☒		
7.5		Soft to very soft, dark brown, sandy SILT (MH), trace organics; moist, silt has medium plasticity, sand is fine.	7.5		☒		Numerous sticks and roots from 8.0 to 9.0 feet.
12.5							Moderate groundwater seepage observed at 12.0 feet.
		Exploration completed at a depth of 13.0 feet.	13.0				Surface elevation was not measured at the time of exploration.
20.0							

EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20

EXCAVATION METHOD: mini excavator (see document text)

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01

TEST PIT TP-5

MARCH 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-7

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Medium dense to dense, gray-brown SAND with silt (SP-SM), minor gravel, trace organics; moist to wet, sand is fine to coarse, gravel is fine to coarse and subrounded.					Severe caving observed from 0.0 to 11.0 feet.
2.5		brown, without gravel and organics; sand is fine at 3.0 feet			☒		
5.0					☒		
7.5							
10.0		Loose, dark brown SAND (SP), trace silt; wet, sand is medium.	10.0		☒		Rapid groundwater seepage observed at 10.0 feet.
		Exploration terminated at a depth of 11.0 feet due to caving.	11.0				Surface elevation was not measured at the time of exploration.
12.5							
15.0							
17.5							
20.0							

EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20

EXCAVATION METHOD: mini excavator (see document text)

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01

TEST PIT TP-6

MARCH 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-8

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

APPENDIX D
REPORT LIMITATIONS AND IMPORTANT INFORMATION

Date: March 30, 2023
Project: Landing on the Cowlitz
Castle Rock, Washington

Geotechnical and Environmental Report Limitations and Important Information

Report Purpose, Use, and Standard of Care

This report has been prepared in accordance with standard fundamental principles and practices of geotechnical engineering and/or environmental consulting, and in a manner consistent with the level of care and skill typical of currently practicing local engineers and consultants. This report has been prepared to meet the specific needs of specific individuals for the indicated site. It may not be adequate for use by other consultants, contractors, or engineers, or if change in project ownership has occurred. It should not be used for any other reason than its stated purpose without prior consultation with Columbia West Engineering, Inc. (Columbia West). It is a unique report and not applicable for any other site or project. If site conditions are altered, or if modifications to the project description or proposed plans are made after the date of this report, it may not be valid. Columbia West cannot accept responsibility for use of this report by other individuals for unauthorized purposes, or if problems occur resulting from changes in site conditions for which Columbia West was not aware or informed.

Report Conclusions and Preliminary Nature

This geotechnical or environmental report should be considered preliminary and summary in nature. The recommendations contained herein have been established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. The exploration and associated laboratory analysis of collected representative samples identifies soil conditions at specific discreet locations. It is assumed that these conditions are indicative of actual conditions throughout the subject property. However, soil conditions may differ between tested locations at different seasonal times of the year, either by natural causes or human activity. Distinction between soil types may be more abrupt or gradual than indicated on the soil logs. This report is not intended to stand alone without understanding of concomitant instructions, correspondence, communication, or potential supplemental reports that may have been provided to the client.

Because this report is based upon observations obtained at the time of exploration, its adequacy may be compromised with time. This is particularly relevant in the case of natural disasters, earthquakes, floods, or other significant events. Report conclusions or interpretations may also be subject to revision if significant development or other manmade impacts occur within or in proximity to the subject property. Groundwater conditions, if presented in this report, reflect observed conditions at the time of investigation. These conditions may change annually, seasonally or as a result of adjacent development.

Additional Investigation and Construction QA/QC

Columbia West should be consulted prior to construction to assess whether additional investigation above and beyond that presented in this report is necessary. Even slight variations in soil or site conditions may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent QA/QC construction observation and testing to verify soil conditions do not differ materially or significantly from the interpreted conditions utilized for preparation of this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Actual subsurface conditions are more readily observed and discerned during the earthwork phase of construction when soils are exposed. Columbia West cannot accept responsibility for deviations from recommendations described in this report or future

performance of structural facilities if another consultant is retained during the construction phase or Columbia West is not engaged to provide construction observation to the full extent recommended.

Collected Samples

Uncontaminated samples of soil or rock collected in connection with this report will be retained for thirty days. Retention of such samples beyond thirty days will occur only at client's request and in return for payment of storage charges incurred. All contaminated or environmentally impacted materials or samples are the sole property of the client. Client maintains responsibility for proper disposal.

Report Contents

This geotechnical or environmental report should not be copied or duplicated unless in full, and even then only under prior written consent by Columbia West, as indicated in further detail in the following text section entitled *Report Ownership*. The recommendations, interpretations, and suggestions presented in this report are only understandable in context of reference to the whole report. Under no circumstances should the soil boring or test pit excavation logs, monitor well logs, or laboratory analytical reports be separated from the remainder of the report. The logs or reports should not be redrawn or summarized by other entities for inclusion in architectural or civil drawings, or other relevant applications.

Report Limitations for Contractors

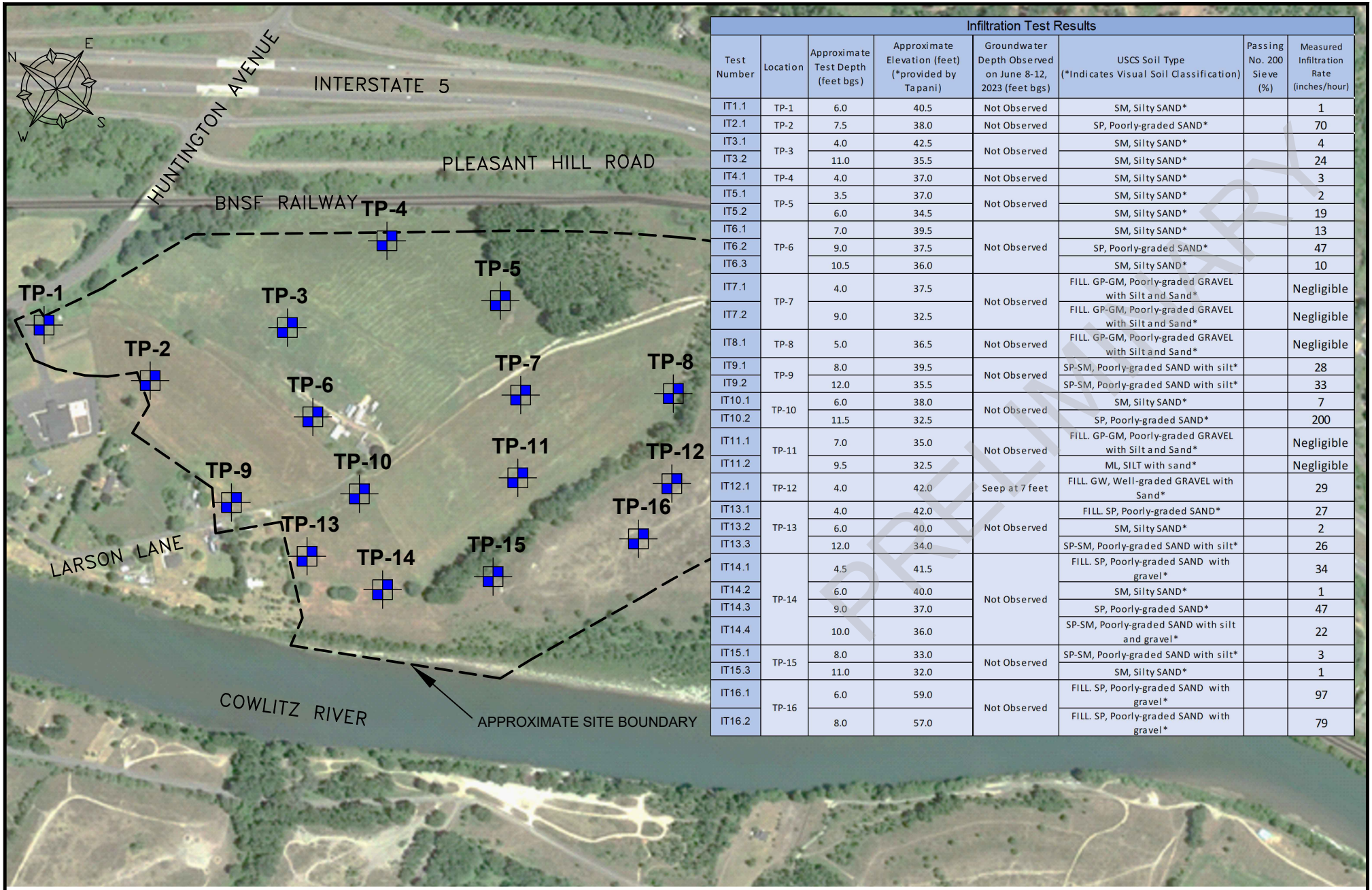
Geotechnical or environmental reports, unless otherwise specifically noted, are not prepared for the purpose of developing cost estimates or bids by contractors. The extent of exploration or investigation conducted as part of this report is usually less than that necessary for contractor's needs. Contractors should be advised of these report limitations, particularly as they relate to development of cost estimates. Contractors may gain valuable information from this report, but should rely upon their own interpretations as to how subsurface conditions may affect cost, feasibility, accessibility and other components of the project work. If believed necessary or relevant, contractors should conduct additional exploratory investigation to obtain satisfactory data for the purposes of developing adequate cost estimates. Clients or developers cannot insulate themselves from attendant liability by disclaiming accuracy for subsurface ground conditions without advising contractors appropriately and providing the best information possible to limit potential for cost overruns, construction problems, or misunderstandings.

Report Ownership

Columbia West retains the ownership and copyright property rights to this entire report and its contents, which may include, but may not be limited to, figures, text, logs, electronic media, drawings, laboratory reports, and appendices. This report was prepared solely for the client, and other relevant approved users or parties, and its distribution must be contingent upon prior express written consent by Columbia West. Furthermore, client or approved users may not use, lend, sell, copy, or distribute this document without express written consent by Columbia West. Client does not own nor have rights to electronic media files that constitute this report, and under no circumstances should said electronic files be distributed or copied. Electronic media is susceptible to unauthorized manipulation or modification, and may not be reliable.

Consultant Responsibility

Geotechnical and environmental engineering and consulting is much less exact than other scientific or engineering disciplines, and relies heavily upon experience, judgment, interpretation, and opinion often based upon media (soils) that are variable, anisotropic, and non-homogenous. This often results in unrealistic expectations, unwarranted claims, and uninformed disputes against a geotechnical or environmental consultant. To reduce potential for these problems and assist relevant parties in better understanding of risk, liability, and responsibility, geotechnical and environmental reports often provide definitive statements or clauses defining and outlining consultant responsibility. The client is encouraged to read these statements carefully and request additional information from Columbia West if necessary.



Infiltration Test Results

Test Number	Location	Approximate Test Depth (feet bgs)	Approximate Elevation (feet) (*provided by Tapani)	Groundwater Depth Observed on June 8-12, 2023 (feet bgs)	USCS Soil Type (*Indicates Visual Soil Classification)	Passing No. 200 Sieve (%)	Measured Infiltration Rate (inches/hour)
IT1.1	TP-1	6.0	40.5	Not Observed	SM, Silty SAND*		1
IT2.1	TP-2	7.5	38.0	Not Observed	SP, Poorly-graded SAND*		70
IT3.1	TP-3	4.0	42.5	Not Observed	SM, Silty SAND*		4
IT3.2		11.0	35.5		SM, Silty SAND*		24
IT4.1	TP-4	4.0	37.0	Not Observed	SM, Silty SAND*		3
IT5.1	TP-5	3.5	37.0	Not Observed	SM, Silty SAND*		2
IT5.2		6.0	34.5		SM, Silty SAND*		19
IT6.1	TP-6	7.0	39.5	Not Observed	SM, Silty SAND*		13
IT6.2		9.0	37.5		SP, Poorly-graded SAND*		47
IT6.3		10.5	36.0		SM, Silty SAND*		10
IT7.1	TP-7	4.0	37.5	Not Observed	FILL. GP-GM, Poorly-graded GRAVEL with Silt and Sand*		Negligible
IT7.2		9.0	32.5		FILL. GP-GM, Poorly-graded GRAVEL with Silt and Sand*		Negligible
IT8.1	TP-8	5.0	36.5	Not Observed	FILL. GP-GM, Poorly-graded GRAVEL with Silt and Sand*		Negligible
IT9.1	TP-9	8.0	39.5	Not Observed	SP-SM, Poorly-graded SAND with silt*		28
IT9.2		12.0	35.5		SP-SM, Poorly-graded SAND with silt*		33
IT10.1	TP-10	6.0	38.0	Not Observed	SM, Silty SAND*		7
IT10.2		11.5	32.5		SP, Poorly-graded SAND*		200
IT11.1	TP-11	7.0	35.0	Not Observed	FILL. GP-GM, Poorly-graded GRAVEL with Silt and Sand*		Negligible
IT11.2		9.5	32.5		ML, SILT with sand*		Negligible
IT12.1	TP-12	4.0	42.0	Seep at 7 feet	FILL. GW, Well-graded GRAVEL with Sand*		29
IT13.1	TP-13	4.0	42.0	Not Observed	FILL. SP, Poorly-graded SAND*		27
IT13.2		6.0	40.0		SM, Silty SAND*		2
IT13.3		12.0	34.0		SP-SM, Poorly-graded SAND with silt*		26
IT14.1	TP-14	4.5	41.5	Not Observed	FILL. SP, Poorly-graded SAND with gravel*		34
IT14.2		6.0	40.0		SM, Silty SAND*		1
IT14.3		9.0	37.0		SP, Poorly-graded SAND*		47
IT14.4		10.0	36.0		SP-SM, Poorly-graded SAND with silt and gravel*		22
IT15.1	TP-15	8.0	33.0	Not Observed	SP-SM, Poorly-graded SAND with silt*		3
IT15.3		11.0	32.0		SM, Silty SAND*		1
IT16.1	TP-16	6.0	59.0	Not Observed	FILL. SP, Poorly-graded SAND with gravel*		97
IT16.2		8.0	57.0		FILL. SP, Poorly-graded SAND with gravel*		79

PRELIMINARY

TEST PIT WITH INFILTRATION TESTING

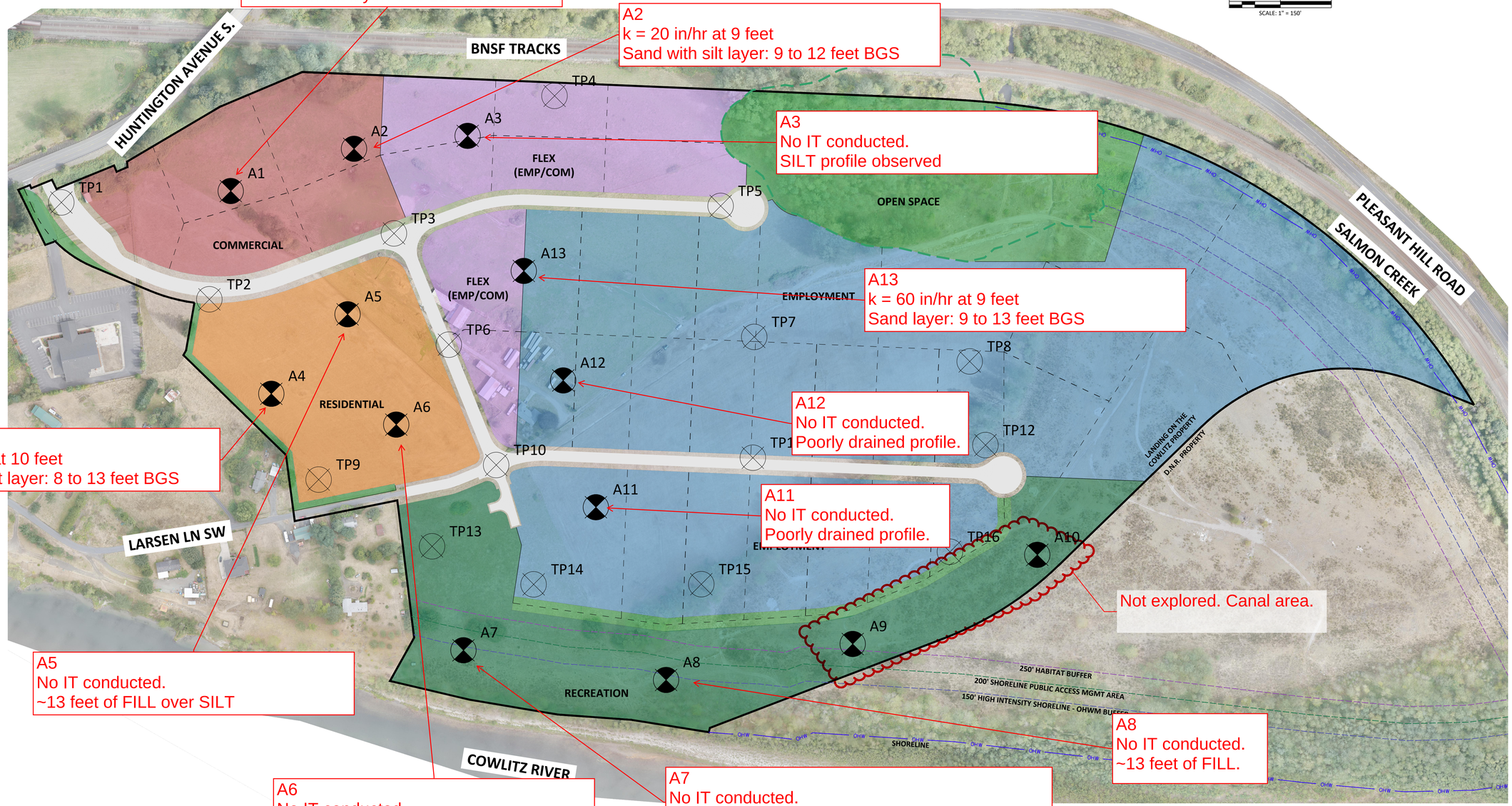
Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

Project: 22310
Date: 06/20/23
Drawn: MAC
Checked: GLW

EXPLORATION LOCATION MAP
LANDING ON THE COWLITZ

NOTES:
1. SITE LOCATION: 2542 SW LARSON LANE, CASTLE ROCK, WASHINGTON.
2. SITE CONSISTS OF PORTIONS OF TAX PARCEL NOS. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031 TOTALING APPROXIMATELY 118.2 ACRES.
3. DRAWING IS NOT TO SCALE.
4. BASE MAP OBTAINED FROM GOOGLE EARTH, 2023.
5. EXPLORATION LOCATIONS ARE APPROXIMATE AND NOT SURVEYED.
6. TEST PITS BACKFILLED LOOSELY WITH ONSITE SOILS ON JUNE 8, JUNE 9, AND JUNE 12, 2023.

FIGURE
2



LEGEND

- PROPERTY TESTED LOCATION
- PROPOSED LOCATION

PRELIMINARY RESULTS FROM TESTING CONDUCTED ON MARCH 13, 2024

811 Know what's below. Call before you dig.

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

LANDING ON THE COWLITZ
CASTLE ROCK, COWLITZ

INFILTRATION TEST LOCATIONS

REVISIONS:

JOB NO.:	23-463
DATE:	MARCH 2024
SCALE:	1" = 150'
DESIGNED BY:	MDR
DRAWN BY:	MDR
CHECKED BY:	TAW

EX1.0

FILE: W:\17783 CASTLE ROCK ENVIRO AND FILL PERMITS\500 DESIGN\502 DRAWINGS\EXHIBITS\2024-03-06 ADDITIONAL INFILTRATION TEST LOCATIONS.DWG

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-17
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	0800	0905

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
				ML		Orange-tan sandy SILT, moist to wet, medium dense, sand is fine.					
5	TP17.1			SP-SM		Light brown poorly-graded SAND with silt, moist, loose, sand is medium-grained and subangular.					
10						Bottom of test pit at 12 feet bgs. Groundwater not encountered on 3/13/24.					
15						**Preliminary** 03/20/2024 3:58:36 PM					

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-18
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	0905	0935

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
				ML		Gray SILT with sand, moist, soft, sand is fine.					
				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-to medium-grained and subangular.					
5											
				SP-SM		Light brown poorly-graded SAND with silt, moist, loose, sand is medium-grained and subangular.					
10	TP18.1										
						Bottom of test pit at 12 feet bgs. Groundwater not encountered on 3/13/24.					
15											

Preliminary
03/20/2024 3:58:48 PM

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-19
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1010	1040

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						Organic strippings.					
				ML		Brown SILT, moist, soft, low to medium plasticity.					
5				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
10											
15						Bottom of test pit at 14.5 feet bgs. Groundwater not encountered on 3/13/24.					

Preliminary
03/20/2024 3:58:48 PM

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-20
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	0935	1010

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
5				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
	TP20.1			SP-SM		Gray and brown poorly-graded SAND with silt, moist, loose, sand is medium-grained and subangular.					
10											
						Bottom of test pit at 13 feet bgs. Groundwater not encountered on 3/13/24.					
15											

Preliminary
03/20/2024 3:58:48 PM

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-21
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1040	1105

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
5						FILL. Light gray, poorly-graded GRAVEL with silt and sand, moist, very dense dense.					
10						FILL. Gray poorly-graded SAND and gravel, dense.					
				OH		Black organic SILT, moist, soft.					
15						Bottom of test pit at 14.5 feet bgs. Groundwater not encountered on 3/13/24.					

Preliminary
03/20/2024 3:58:49 PM

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-22
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1105	1130

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
5						FILL. Light gray, poorly-graded GRAVEL with silt and sand, moist, very dense dense.					
10						FILL. Gray poorly-graded SAND and gravel, dense.					
				OH		Black organic SILT, moist, soft.					
15						Bottom of test pit at 13 feet bgs. Groundwater not encountered on 3/13/24.					

Preliminary
03/20/2024 3:58:49 PM

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-23
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Observed at 11 feet BGS	1330	1500

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						3 inch root zone contained in 10 inches of sandy silt topsoil.					
						FILL. Light gray, poorly-graded GRAVEL with silt and sand, moist, very dense dense.					
5											
10						Becomes wet.					▼
						Bottom of test pit at 11 feet bgs. Groundwater encountered at 11 feet on 3/13/24.					
15											

Preliminary
03/20/2024 3:58:49 PM

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-24
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1500	1555

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						3 inch root zone contained in 10 inches of sandy silt topsoil.					
						FILL. Light gray, poorly-graded GRAVEL with silt and sand, moist, very dense dense.					
5											
10											
						Bottom of test pit at 13 feet bgs. Groundwater not encountered on 3/13/24.					
15											

Preliminary
03/20/2024 3:58:49 PM

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-25
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1130	1215

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
5											
10						Bottom of test pit at 12 feet bgs. Groundwater not encountered on 3/13/24.					
15											

Preliminary
03/20/2024 3:58:49 PM

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-26
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1245	1330

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
5											
10											
						Bottom of test pit at 14.5 feet bgs. Groundwater not encountered on 3/13/24.					
15											

Preliminary
03/20/2024 3:58:49 PM

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

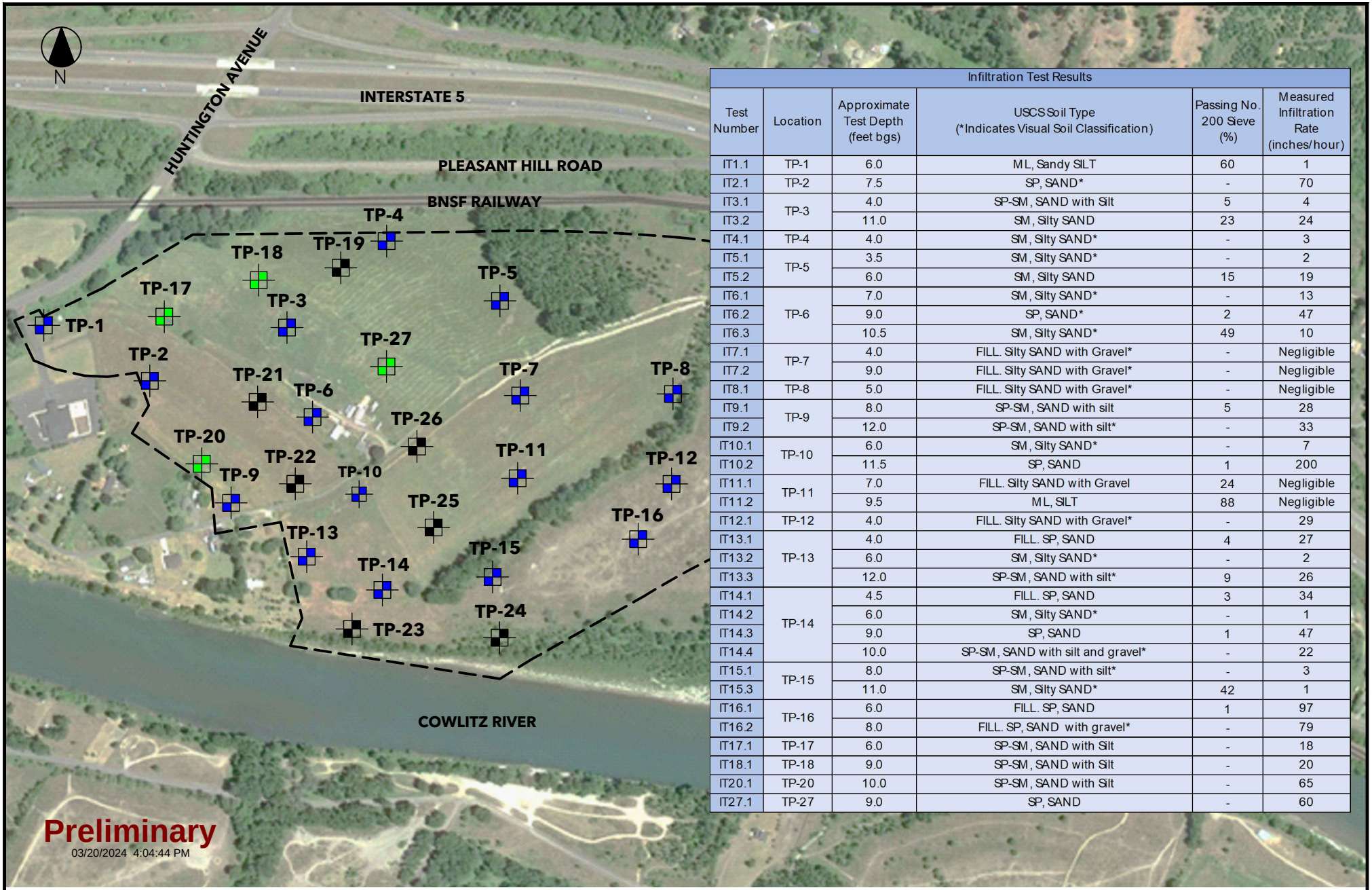
Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-27
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1215	1245

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
				ML		Orange-tan sandy SILT, moist to wet, medium dense, sand is fine.					
5				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
	TP27.1										
10				SP-SM		Gray and brown poorly-graded SAND with silt, moist, loose, sand is medium-grained and subangular.					
						Bottom of test pit at 13 feet bgs. Groundwater not encountered on 3/13/24.					
15											

Preliminary
03/20/2024 3:58:49 PM



Infiltration Test Results

Test Number	Location	Approximate Test Depth (feet bgs)	USCS Soil Type (*Indicates Visual Soil Classification)	Passing No. 200 Sieve (%)	Measured Infiltration Rate (inches/hour)
IT1.1	TP-1	6.0	ML, Sandy SILT	60	1
IT2.1	TP-2	7.5	SP, SAND*	-	70
IT3.1	TP-3	4.0	SP-SM, SAND with Silt	5	4
IT3.2		11.0	SM, Silty SAND	23	24
IT4.1	TP-4	4.0	SM, Silty SAND*	-	3
IT5.1	TP-5	3.5	SM, Silty SAND*	-	2
IT5.2		6.0	SM, Silty SAND	15	19
IT6.1	TP-6	7.0	SM, Silty SAND*	-	13
IT6.2		9.0	SP, SAND*	2	47
IT6.3		10.5	SM, Silty SAND*	49	10
IT7.1	TP-7	4.0	FILL. Silty SAND with Gravel*	-	Negligible
IT7.2		9.0	FILL. Silty SAND with Gravel*	-	Negligible
IT8.1	TP-8	5.0	FILL. Silty SAND with Gravel*	-	Negligible
IT9.1	TP-9	8.0	SP-SM, SAND with silt	5	28
IT9.2		12.0	SP-SM, SAND with silt*	-	33
IT10.1	TP-10	6.0	SM, Silty SAND*	-	7
IT10.2		11.5	SP, SAND	1	200
IT11.1	TP-11	7.0	FILL. Silty SAND with Gravel	24	Negligible
IT11.2		9.5	ML, SILT	88	Negligible
IT12.1	TP-12	4.0	FILL. Silty SAND with Gravel*	-	29
IT13.1	TP-13	4.0	FILL. SP, SAND	4	27
IT13.2		6.0	SM, Silty SAND*	-	2
IT13.3		12.0	SP-SM, SAND with silt*	9	26
IT14.1	TP-14	4.5	FILL. SP, SAND	3	34
IT14.2		6.0	SM, Silty SAND*	-	1
IT14.3		9.0	SP, SAND	1	47
IT14.4		10.0	SP-SM, SAND with silt and gravel*	-	22
IT15.1	TP-15	8.0	SP-SM, SAND with silt*	-	3
IT15.3		11.0	SM, Silty SAND*	42	1
IT16.1	TP-16	6.0	FILL. SP, SAND	1	97
IT16.2		8.0	FILL. SP, SAND with gravel*	-	79
IT17.1	TP-17	6.0	SP-SM, SAND with Silt	-	18
IT18.1	TP-18	9.0	SP-SM, SAND with Silt	-	20
IT20.1	TP-20	10.0	SP-SM, SAND with Silt	-	65
IT27.1	TP-27	9.0	SP, SAND	-	60

SITE BOUNDARY | TEST PIT WITH INFILTRATION TEST (2023) | TEST PIT WITH INFILTRATION TEST (2024) | TEST PIT (2024)

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

PROJECT: 22310
DATE: 03-20-24
DRAWN: GLW
CHECKED: NNP

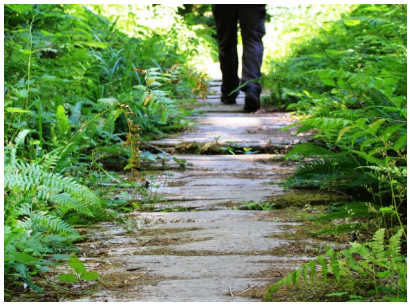
EXPLORATION MAP
LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

NOTES:
1. SITE LOCATION: 2542 SW LARSON LANE, CASTLE ROCK, WASHINGTON.
2. SITE CONSISTS OF PORTIONS OF TAX PARCEL NOS. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031 TOTALING APPROXIMATELY 118.2 ACRES.
3. DRAWING IS NOT TO SCALE.
4. BASE MAP OBTAINED FROM GOOGLE EARTH, 2023.
5. EXPLORATION LOCATIONS ARE APPROXIMATE AND NOT SURVEYED.
6. TEST PITS TP-1 TO TP-16 BACKFILLED LOOSELY WITH ONSITE SOILS ON JUNE 8, JUNE 9, AND JUNE 12, 2023.
7. TEST PITS TP-17 TO TP-27 BACKFILLED LOOSELY WITH ONSITE SOILS ON MARCH 13, 2024.

FIGURE
2

HABITAT MANAGEMENT, MITIGATION AND MONITORING PLAN

February 19, 2025



Castle Rock Business Park Permitting Outfall

Castle Rock, Washington

Prepared for

CT6
PO Box 1419
Battle Ground, Washington 98604
(360) 687-1148

Prepared by

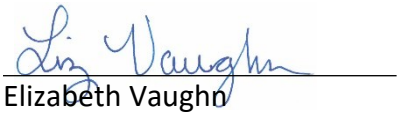
Ecological Land Services

1157 3rd Avenue, Suite 220A • Longview, WA 98632

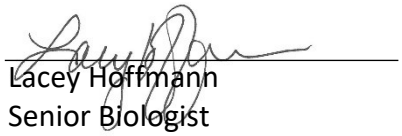
(360) 578-1371 • Project Number 1098.11

SIGNATURE PAGE

The information in this report was compiled and prepared under the supervision and direction of the undersigned.



Elizabeth Vaughn
Biologist II



Lacey Hoffmann
Senior Biologist

TABLE OF CONTENTS

INTRODUCTION **1**

PROJECT HISTORY, STUDY AREA, AND PHASE 1A DESCRIPTION **1**

METHODOLOGY **2**

PROJECT DESCRIPTION **2**

CONSTRUCTION METHODS 4

IMPACT AVOIDANCE AND MINIMIZATION MEASURES 4

PROJECT IMPACT SUMMARY 5

ONSITE MITIGATION 6

LISTED SPECIES AND PRIORITY HABITATS IN THE PROJECT VICINITY **7**

Suitable Habitat for Fish and Wildlife 7

MANAGEMENT RECOMMENDATIONS **8**

HABITAT MANAGEMENT PLAN **10**

CRMC 18.10.130(D) – Development Performance Standards 11

ONSITE ENHANCEMENT AND RESTORATION PLAN **13**

Shoreline Buffer Mitigation (Area 1) 14

Habitat Features (Area 1) 15

Shoreline Buffer Restoration (Area 2) 16

Shoreline Buffer Mitigation (Area 3) 16

Shoreline Jurisdiction of the Cowlitz River Mitigation 17

Specifications for Phase 1a Preparation, Planting, and Maintenance 18

GOALS, OBJECTIVES, AND PERFORMANCE STANDARDS **20**

Non-Native, Invasive Species Removal 20

Habitat Structure 20

Vegetative Structure 20

Long-Term Site Protection 21

MONITORING, MAINTENANCE, AND CONTINGENCY METHODS **21**

Monitoring Plots 22

Maintenance 23

Contingency Measures 23

LIMITATIONS **24**

REFERENCES **25**

TABLES (IN TEXT)

Table 1. Stormwater Outfall Impact Summary 6
Table 2.Proposed Outfall Onsite Mitigation Summary 7
Table 3.Endangered, Threatened, Candidate, and Sensitive Species and Priority Habitat that have Primary Habitat or Association with/on or Adjacent to the Project Site 8
Table 4.Summary of Shoreline Buffer and Shoreline Jurisdiction Impacts to the Cowlitz River .. 14
Table 5. Onsite Restoration and Enhancement Summary 14
Table 6.Planting Specifications and Native Upland Seed Mixture (Area 1) 15
Table 7.Habitat Feature Specifications (Area 1) 16
Table 8.Native Upland Seed Mixture (Area 2) 16
Table 9.Planting Specifications and Native Upland Seed Mixture (Area 3) 17
Table 10.Native Upland Seed Mixture (Shoreline Jurisdiction of the Cowlitz River) 17
Table 11.Performance Standards for Vegetation by Monitoring Year 21

FIGURES

Figure 1 Vicinity Map
Figure 2 Existing Conditions
Figure 3 Proposed Conditions Overview
Figure 4 Stormwater Outfall Detail
Figure 5 48 Inch Stormwater Outfall – Cross Section
Figure 6 30 Inch Stormwater Outfall – Cross Section
Figure 7 Mitigation Plan

INTRODUCTION

CT6, LLC has contracted Ecological Land Services, Inc. (ELS) to prepare a Habitat Management and Mitigation Plan for impacts associated with the development of a proposed stormwater outfall within the Phase 1a boundary of infrastructure included in the Landing on the Cowlitz Master Plan (Phase 1). Phase 1a boundary consists of a portion of Cowlitz County parcel numbers 308640100, 6143802, and 30864 which are presently subject to a boundary line adjustment (City Application No. CR-BLA-24-01). Phase 1a boundary is located south of 2542 South West Larsen Lane in Castle Rock, Washington within a portion of Section 23, Township 9 North, and Range 2 West of the Willamette Meridian (Figure 1). This report has been prepared in accordance with the *City of Castle Rock Municipal Code* (CRMC) *Chapter 18.10.130, Fish and Wildlife Habitat Conservation Areas* (CMC 2024), and the City of Castle Rock, Washington Shoreline Master Program (SMP)(SMP 2022).

PROJECT HISTORY, STUDY AREA, AND PHASE 1A DESCRIPTION

A SEPA Threshold Determination Staff Report was released on July 28, 2021 for a master planned, mixed-use development known as, the LOTC Master Plan. ELS was contracted to assess all critical areas including wetlands and fish and wildlife habitats within the study area and within 300 feet of the study area for the LOTC project. An amended report summarizing methodology and critical areas known as, *Castle Rock Business Park Amended Critical Areas Report* (ELS 2022) was prepared by ELS and submitted to Mr. James Carsner of the U.S. Army Corps of Engineers (Corps) and to the appropriate Washington Department of Ecology (Ecology) staff for the purpose of a formal wetland boundary verification and verification of the ordinary high water mark (OHWM) flagging on the Cowlitz River and Salmon Creek. Wetland and stream boundaries and the OHWM of the Cowlitz River were verified by Ecology via email on August 25, 2022 and by Corps on September 16, 2022 (Corps Reference Number NWS-2022-557). An additional study area visit was conducted with Ecology on August 29, 2024 to revise the OHWM within the Phase 1a boundary. Ecology verified the proposed changes via email the same day. A memorandum reflecting the verified changes to the OHWM of the Cowlitz River within the updated Phase 1a boundary known as, *Castle Rock Business Park Memorandum* (ELS 2024) was prepared by ELS and submitted to the client and to the City of Castle Rock.

The approximate 18-acre study area is located on the eastern bank of the Cowlitz River, Type S (shoreline) of the state, and can be accessed from an existing gravel road off Huntington Avenue S (Figure 2). Most of Phase 1a consists of dredged mudflow deposits from the 1980 Mt. St. Helens eruption. Vegetation is limited to mainly sporadic deciduous native trees, herbaceous grasses and weeds, and non-native, invasive species including scotch broom (*Cytisus scoparius*) and Himalayan blackberry (*Rubus armeniacus*). A maintained drainage ditch, known as Ditch 4, is present along the northeast portion of the Phase 1a boundary. Ditch 4 conveys surface runoff from upslope areas and Laren Lane SW in a southwesterly direction along the northern boundary of Phase 1a. Additionally, it conveys runoff from upslope areas along the western boundary of Phase 1a in a northerly direction. All parcels within the Phase 1a boundary are zoned Industrial.

A small portion of forested vegetation is present along the western portion of Phase 1a bordering the eastern bank of the Cowlitz River. The OHWM of the Cowlitz River is well-defined along the western portion of the Phase 1a boundary, with cut banks and the presence of large woody material and wrack deposits. The proposed project is located in the Shoreline Environmental Designation (SED) High-Intensity and is within a portion of the 100-year floodplain and regulatory floodway of the Cowlitz River.

According to the SMP and *RCW 90.58*, shoreline jurisdiction includes all shorelands and waters within the City of Castle Rock that fall under this statute. This jurisdiction encompasses lands extending 200 feet landward in all directions from the OHWM of the Cowlitz River, as measured on a horizontal plane. Additionally, it includes floodways, contiguous floodplain areas landward 200 feet from such floodways, associated wetlands, critical areas with their respective buffer zones, and river deltas associated with streams subject to the program

Within Phase 1a, the Cowlitz River is classified under Code Reach Number CR-01, with a High-Intensity SED. Based on SMP *Table 8: Shoreline Reach Based RHA[1] Buffers*, the shoreline buffer for the Cowlitz River within the Phase 1a boundary is defined as 150 feet measured landward from the OHWM (Figure 2). Furthermore, SMP *Section 3.1.A* specifies Type S waters, including the Cowlitz River, fall under the jurisdiction of *RCW 90.58*, affirming shoreline jurisdiction within the Phase 1a boundary extends 200 feet from the OHWM, as well as floodways and contiguous floodplain areas (Figure 2).

METHODOLOGY

The ordinary high water mark (OHWM) delineation of the Cowlitz River was conducted following *RCW 90.58.030 and Determining the Ordinary High Water Mark for Shoreline Management Act Compliance in Washington State* (Ecology 2016). The OHWM along the east bank of the Cowlitz River was recorded using a hand-held GPS unit capable of sub-meter accuracy. The OHWM was then surveyed by Mackay Sposito on September 5, 2024.

PROJECT DESCRIPTION

Phase 1a of the LOTC Master Plan consists of installing a stormwater outfall within a portion of the Cowlitz River's shoreline buffer and shoreline jurisdiction. Installation of a temporary gravel road, positioned outside all critical areas and shorelines, is proposed to provide access to the project footprint; the gravel will be removed upon completion of the proposed outfall installation and mitigation efforts. Stormwater will be conveyed to the outfall through one 30-inch corrugated polypropylene pipe (CPP) within Ditch 4, one 42-inch high-density polyethylene (HDPE) pipe east of Ditch 4 which widens to 48-inch CPP west of Ditch 4, and one 30-inch CPP pipe west of Ditch 4 (Figures 3 and 4). Details of the 30-inch CPP west of Ditch 4 and the 42-to 48-inch HDPE and CPP outfall profiles can be seen on Figures 5 and 6, respectively. The primary

[1]With respect to Type S Waters, the term riparian habitat area (RHA) is interchangeable with the term "shoreline buffer" used in the City of Castle Rock's SMP.

outfall is designated as the centralized discharge point for all stormwater within the project scope. Runoff intercepted from roadway surfaces will undergo preliminary water quality treatment through bioretention planters positioned along the roadways. For each individual phase of the LOTC Master Plan, final treatment methodologies will be specified at the development stage integrating bioretention systems and mechanical filtration via catch basins to achieve regulatory compliance. The treated stormwater will be directed into an onsite conveyance system, channeling flows towards the outfall and facilitating discharge into the shoreline buffer of the Cowlitz River. Additionally, an integrated infiltration strategy will be implemented at each capture point, optimizing upland infiltration and minimizing runoff volumes entering the conveyance system.

Stormwater infrastructure will be installed primarily through trenching for accurate pipeline placement. All onsite runoff will receive treatment though roadside bioretention rain gardens before discharge. Outfall construction will be completed with landward-based excavation, beginning at the OHWM of the Cowlitz River and moving progressively away from the river. Biodegradable jute erosion matting will be placed within the proposed restoration and enhancement area to stabilize soils prior to habitat features such as rootwads and rootwad logs are installed reducing the need for further equipment access for final planting. Construction traffic will use the existing gravel road northeast of the Phase 1a boundary which can be accessed from Huntington Avenue S, avoiding access from Larson Lane SW.

A portion of the Phase 1a boundary currently lies within the regulatory floodway and the 100-year floodplain of the Cowlitz River. The proposed outfall will require 121 cubic yards of cut and 113 cubic yards of fill, resulting in a net export of 8 cubic yards in the regulatory floodway. This comparison is based on existing versus proposed surface levels and does not include additional materials from trenching, planting, or gabion wall construction. Grading quantities within and outside the floodplain are approximately balanced.

Stormwater Treatment

No stormwater treatment facility is proposed within the shoreline buffer or shoreline jurisdiction of the Cowlitz River. The primary point of discharge for the project will be the outfall, which will serve as the terminal conveyance for stormwater runoff across the entirety of the Phase 1a boundary. Runoff from roadways will be treated through bioretention planters designed to filter and treat stormwater before discharge. For the individual future phases of the LOTC Master Plan, stormwater treatment methods will be determined during the development phase, with anticipated approaches including bioretention systems or mechanical filtration via treatment catch basins. A centralized stormwater system will capture and convey treated runoff from these areas to the outfall for discharge into the shoreline buffer of the Cowlitz River. Additionally, infiltration measures will be implemented to maximize onsite infiltration of runoff at the point of capture, reducing the volume of stormwater conveyed to the river system. All components of the proposed project will be sized and designed per the *Stormwater Management Manual for the Puget Sound Basin* (Ecology 1992) and the *Stormwater Management Manual for Western Washington Volume V – Chapter 5* standards (Ecology 2024).

Cut and Fill

The proposed grading within the project area will involve approximately 113 cubic yards of fill, balanced by 121 cubic yards of cut, resulting in only 8 cubic yards of net cut within shoreline jurisdiction. Temporary stockpile areas will be designated outside of shoreline jurisdiction onsite and will be surrounded with silt fencing and covered with plastic sheeting as necessary, ensuring compliance with WSDOT standards. All steep slopes (3:1 or greater) will be stabilized using jute matting, while gentler slopes will be treated with native upland seeding and certified weed-free straw. If sediment tracking from the Phase 1a boundary becomes an issue, a wheel wash will be installed at the construction entrance to minimize offsite sediment transport.

Construction Methods

To construct the proposed stormwater outfall conveyance system, equipment to be used may include, but is not limited to, excavators, bull dozers, dump trucks, concrete trucks, compacting equipment, and hand tools. All staging and stockpile areas will be located outside of critical areas and buffers, and all project construction is proposed to be completed in a single phase during the dry season. All plant installation will be conducted during the appropriate planting windows as specified in this report.

The following details the general construction sequence:

1. All work limits will be clearly demarcated with silt fencing or construction fencing.
2. All appropriate best management practices (BMPs) will be installed.
3. Topsoil will be cleared and grubbed.
4. Infiltration areas will be marked to avoid heavy equipment from compacting soils and affecting infiltration.
5. Stormwater outfall will be graded to designed elevations.
6. Install signage prohibiting access to mitigation area.
7. Install biodegradable erosion control jute matting.
8. Install habitat features in shoreline jurisdiction.
9. Install riparian habitat and shoreline vegetation enhancement and restoration plantings.

Impact Avoidance and Minimization Measures

The project has been designed to avoid impacts to the shoreline buffer and shoreline jurisdiction to the greatest extent practicable. Due to the landscape position of the Phase 1a boundary and the water-related/water orientated nature of the stormwater outfall, complete avoidance of impacts to shorelines was not possible. Permanent impacts from the proposed gabion wall are limited to 0.002 acres (108 sq. ft.) and will be offset with a 2:1 onsite mitigation ratio. Additionally, permanent impacts from grading and installation of the outfall system within the shoreline buffer necessitates the proposed removal of three black cottonwood (*Populus trichocarpa*) trees. Neither of these permanent impacts could be avoided to accommodate project design. Alternative locations for the outfall would result in the same amount of vegetation removal or more.

Vegetation in the proposed impact areas consists of deciduous trees, grasses, weedy forbs and non-native, invasive vegetation. Temporary physical impacts to native shoreline vegetation due to grading and installation of the dual stormwater outfall pipe was limited to 0.257 acres (11,191 square feet) in the shoreline buffer and shoreline jurisdiction.

The following BMPs will be utilized during construction and operation to further minimize impacts to habitat:

Construction BMPs

1. Construction will occur mainly during the dry season (May-October) as feasible.
2. Native vegetation will be retained to the greatest extent possible within shoreline jurisdiction where improvements are not proposed.
3. Only three trees within the project area will be removed to accommodate the installation of the outfall system.
4. Clearly demarcate the job site and critical areas that must be avoided prior to ground disturbing activities.
5. Install silt fencing on the waterward side of land disturbing activities in shoreline jurisdiction.
6. No equipment will enter below the OHWM of the Cowlitz River.
7. Vehicle and equipment maintenance, repair, and/or service will be performed at designated repair facilities whenever possible.
8. All equipment will be maintained or fueled up, a minimum of 200 feet from the Cowlitz River.
9. All bare soils within shoreline jurisdiction will be mulched with certified weed-free straw after ground disturbing activities.
10. Signage will be installed along the boundary of Area 1 and Area 3 to notify the public of mitigation locations and access restrictions (Figure 7).
11. Install large woody material rootwads and horizontal logs to deter entrance from the public to the stormwater outfall.

PROJECT IMPACT SUMMARY

All impacts have been minimized to the greatest extent possible. All mitigation for impacts to the shoreline buffer and shoreline jurisdiction of the Cowlitz River is proposed onsite (Figure 7). Most project impacts come from the proposed grading and fill, and the installation of the proposed dual outfall piping system. Proposed impacts to critical areas onsite are included in Table 1.

Table 1. Stormwater Outfall Impact Summary

Shoreline Buffer Impacts		
Habitat Area	**Proposed Impact**	**Size of Impact**
Shoreline Buffer for Cowlitz River (RHA)	Permanent Shoreline Buffer Impact	0.002 acres/108 square feet
	Temporary Shoreline Buffer Impact	0.217 acres/9,444 square feet
Shoreline Impacts		
Habitat Area	**Proposed Impact**	**Size of Impact**
Shoreline Jurisdiction for the Cowlitz River (outside of RHAs)	Temporary Shoreline Jurisdiction Impact	0.014 acres/629 square feet

ONSITE MITIGATION

The applicant is proposing project impacts be compensated for through onsite, in-kind mitigation (Figure 7). The goal of onsite mitigation is to ensure no net loss of ecological functions and meet vegetation conservation standards established in the SMP. The generally accepted mitigation ratio for permanent impacts and temporary impacts to shoreline buffers and shoreline jurisdiction impacts, in ELS experience, has been generally accepted at 1:1 mitigation ratio. CT6, LLC proposes a comprehensive onsite mitigation plan to address project impacts within the shoreline buffer and shoreline jurisdiction of the Cowlitz River. The plan includes:

- Permanent Impacts**:** Mitigation at a 2:1 ratio for permanent impacts to the shoreline buffer resulting from the installation of a gabion wall.
- Temporary Impacts: Mitigation at a 1:1 ratio for temporary impacts to the shoreline buffer and shoreline jurisdiction caused by grading and the installation of an outfall pipe system.
- Tree Removal: Mitigation at a 4:1 stem count ratio for the removal of three black cottonwood trees within the shoreline buffer to accommodate the outfall system installation.

Mitigation includes a combination of restoration and enhancement with an upland native grass seed application and installing native trees and shrubs. In addition to these measures, CT6, LLC will install habitat features within the shoreline buffer of the Cowlitz River to ensure no net loss of ecological function. Performance standards, monitoring, maintenance, and contingency methods will be discussed in subsequent sections of this report to ensure the mitigation areas are successful.

Table 2.Proposed Outfall Onsite Mitigation Summary

Impact Area	Impact Amount	Proposed Impact Type and Area	Proposed Mitigation	Mitigation Ratio	Total Mitigation Proposed	Total Enhancement per Area
Shoreline Buffer	0.002 ac. (108 sq. ft.)	Permanent Impacts (Area 1)	Restore & Enhance	2:1	0.050 ac. (216 sq. ft.)	**Area 1** 0.172 ac. (7,487 sq. ft.)
	0.217 ac. (9,444 sq. ft.)	Temporary Impacts (Area 2)	Restore & Enhance	1:1	0.217 ac. (9,444 sq. ft.)	**Area 2** 0.050 ac. (2,173 sq. ft.)
	3 Black Cottonwood Trees	Permanent Vegetation Impacts (Area 1)	Stem Replacement & Enhance	4.67:1 Stem Replacement	0.032 ac. (1,400 sq. ft.)	**Area 3** 0.032 ac. (1,400 sq. ft.)
Shorelines Jurisdiction (outside of buffer)	0.014 ac. 629 sq. ft.	Temporary Impacts	Restore & Enhance	1:1	0.014 ac. (629 sq. ft.)	**Shoreline Jurisdiction** 0.014 ac. (629 sq. ft.)
					Total Onsite Mitigation and Restoration:	**0.268 ac. (11,689 sq. ft.)**

LISTED SPECIES AND PRIORITY HABITATS IN THE PROJECT VICINITY

This fish and wildlife habitat management will address the species and habitats present within and adjacent to the project area according to *CRMC Table 7 Fish and Wildlife Conservation Area Classifications*, which lists ten classifications of fish and wildlife habitat. The project vicinity has Classification 1 (areas with which federal or state designated endangered, threatened, or sensitive species have a primary association), Classification 2 (state priority habitats and areas associated with state priority species), Classification 7 (Waters of the State, which includes Type S water), and Classification 8 (rivers planted with game fish by a governmental or tribal entity) All of the other classifications listed in the table are not present and will not be discussed further in this assessment (Classifications 3, 4, 5, 6, 9, and 10).

SUITABLE HABITAT FOR FISH AND WILDLIFE

The following table includes state priority habitats and federally listed or state-listed species as well as state sensitive species that have a primary association with habitat or suitable habitat within 300 feet of disturbance areas. The table was compiled using the most recent state and federal species lists (WDFW 2024, 2025a, 2025b; WDNR 2025a and 2025b; NMFS 2025; and USFWS 2025). The following table lists the species that have suitable habitat in the project vicinity.

Table 3.Endangered, Threatened, Candidate, and Sensitive Species and Priority Habitat that have Primary Habitat or Association with/on or Adjacent to the Project Site

Species or State Priority Habitat	State Status	Federal Status	Designated Critical Habitat in Project Vicinity?
Fish			
Bull Trout (*Salvelinus confluentus*)			
Columbia River DPS	Candidate	Threatened	No
Chum Salmon *(Oncorhynchus keta)*			
Columbia River Chum Salmon ESU	--	Threatened	Designated
Chinook Salmon *(Oncorhynchus tshawytscha)*			
Lower Columbia River Chinook ESU	--	Threatened	Designated
Coho Salmon *(Oncorhynchus kisutch)*			
Lower Columbia River Coho Salmon ESU	--	Threatened	Designated
Steelhead (*Oncorhynchus mykiss)*			
Lower Columbia River Steelhead DPS	Candidate	Threatened	Designated
Eulachon (Columbia River Smelt) *(Thaleichthys pacificus)*			
Eulachon Southern DPS	--	Threatened	Designated
Plants			
Western Wahoo (*Euonymus occidentalis var. occidentalis*)	Sensitive	--	--
Soft-leaved willow *(Salix sessilifolia)*	Sensitive	--	--
Priority Habitats			
Riverine	Priority Habitat	--	--

Although critical habitat is designated for some listed fish species in the project vicinity, suitable habitat for fish species is not present within the project footprint and all permanent and temporary project impacts will occur landward of the OHWM of the Cowlitz River. All permanent and temporary shoreline buffer impacts to the Cowlitz River will be mitigated using enhancement and restoration; therefore, the proposed project will avoid impacts to critical and suitable habitat for listed fish.

ELS recorded observations of surrounding topography, wildlife use, and habitat functions in Phase 1a boundary according to *CRMC Appendix 18.10F*. The listed plant species in Table 3 could occur within the project vicinity because they have suitable habitat provided by riparian areas.

MANAGEMENT RECOMMENDATIONS

Effects to species are generally avoided or minimized if the project meets management recommendations discussed below. Species detailed in Table 3 that do not have state or federal management recommendations will not be discussed.

Bull Trout

Federal

Federal management recommendations are not explicit, but state that for the Olympic Management Unit, recovery of bull trout includes protecting, restoring, and maintaining suitable habitat conditions and water quality with actions such as removing fish-passage barriers, maintaining and improving water quality, and improving habitat conditions in and along mainstem rivers (USFWS 2004).

State

WDFW (Rodrick and Milner 1991) advises the following management recommendations for streams that contain bull trout and steelhead: 1) maintain buffer zones along stream banks of at least the width of the height of the tallest tree or 50 feet, whichever is wider, 2) avoid road construction and maintenance activities, and 3) avoid in-stream structures, such as bridges, trestles, boat ramps, or culverts, that impede the natural movements of fish.

The proposed project will limit tree removal to three trees in the shoreline buffer and shoreline jurisdiction of the Cowlitz River. These trees will be replaced at a 4:1 ratio for stem count. Permanent and temporary impacts within the project area will be fully mitigated onsite through enhancement and restoration of the shoreline buffer and shoreline jurisdiction of the Cowlitz River. Mitigation onsite will result in an overall functional lift of riparian habitat when compared to current conditions. All other proposed impacts are placed outside of the shoreline buffer and shoreline jurisdiction to avoid any impacts to the Cowlitz River and its associated listed species. The project, as designed, is consistent with both federal and state management recommendations.

Salmon and Steelhead

Federal

The Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan (LCFRB 2010) is being used as a recovery plan for salmon and steelhead by the National Marine Fisheries Service. This plan gives the following key recovery priorities in the lower Cowlitz subbasin to attain recovery of listed salmon and steelhead:

1. Manage regulated stream flows through the hydropower system.
2. Restore floodplain function, riparian function, and stream habitat diversity.
3. Protect intact forest in headwater basins.
4. Manage growth and development to protect watershed processes and habitat conditions.
5. Address immediate risks with short-term habitat fixes.
6. Manage forest lands to protect and restore watershed processes.
7. Restore passage at culverts and other artificial barriers.
8. Align hatchery priorities consistent with conservation objectives.
9. Manage fishery impacts so they do not impede progress toward recovery.
10. Reduce out-of-subbasin impacts so that the benefits of in-basin actions can be realized.

State

WDFW does not have specific documents that have a short list of management recommendations for salmon; however, they do provide them for rainbow trout/steelhead (Rodrick and Milner 1991). Steelhead and salmon have similar life histories and habitat needs, so they are expected to be similar, if not identical. The following are management recommendations for steelhead:

1. Buffer zones of at least the width of the height of the tallest tree should be maintained along stream banks, which provide rainbow trout and steelhead habitat, and any other stream which directly or indirectly influences rainbow trout and steelhead habitat.
2. Road construction and maintenance activities should be avoided adjacent to streams which provide rainbow trout and steelhead habitat.
3. Instream structures, such as bridges, piers, boat ramps, or culverts must not impede the natural movements of rainbow trout and steelhead.
4. Waters inhabited by steelhead parr should not be treated with metal-based herbicides during the period March 1 through June 15.

The proposed project will limit tree removal to three trees in the shoreline buffer and shoreline jurisdiction of the Cowlitz River. These trees will be replaced at a 4:1 ratio for stem count. The project is proposing to offset permanent and temporary impacts within the project area by fully mitigating impacts onsite within the shoreline buffer and shoreline jurisdiction of the Cowlitz River. Mitigation onsite will result in an overall functional lift of riparian habitat when compared to current conditions. All other proposed impacts are placed outside of the shoreline buffer and shoreline jurisdiction to avoid any impacts to the Cowlitz River and its associated listed species. The project, as designed, is consistent with both federal and state management recommendations. The project, as designed, is consistent with both federal and state management recommendations.

Riparian Habitat

The WDFW management recommendation for riparian habitat (Knutson and Naef 1997) is to "protect riparian habitat areas". Standard recommended buffer widths for areas with typed and non-typed streams are somewhat different than widths required in the CRMC and further in the SMP. This project has been designed to avoid and minimize impacts to the shoreline buffer of the Cowlitz River within the Phase 1a boundary to the greatest extent possible, and where impacts to the shoreline buffer could not be avoided, onsite mitigation will be performed. Onsite mitigation will include the removal of non-native, invasive species, excluding reed canarygrass (*Phalaris arundinacea*), installation of geotextile erosion control fabric, installation of large woody material for habitat enhancement and riparian bank stabilization, installation of native shrubs, and spreading native seed mix, resulting in no net loss of ecological function.

HABITAT MANAGEMENT PLAN

This project requires a Habitat Management Plan in accordance with *CRMC.18.10.130.E*. because the project proposes impacts within 250 feet of a Classification 1, 2, 7, and 8 habitat area, which

includes species management recommendations (above) and development performance standards that are included below.

CRMC 18.10.130(D) – DEVELOPMENT PERFORMANCE STANDARDS

The following are development standards applicable to this project (in *italics*) as listed in *CRMC 18.10.130(D),* followed by a discussion of how they are met (in regular font).

1. *Best available science shall be used to conduct any biological assessments of fish and wildlife habitats and to propose mitigation steps required for specific developments.*

   Best available science and the most recent available data were used in preparing this document and the mitigation plan.

2. *Locate buildings and structures in a manner that preserves the habitat or minimizes adverse impact.*

   No permanent buildings are proposed within the shoreline buffer or shoreline jurisdiction of the Cowlitz River. The proposed outfall structure will be located landward of the OHWM and will be limited to 108 square feet of permanent impacts. Both permanent and temporary impacts associated with the outfall installation will be fully mitigated onsite through enhancement and restoration to maintain existing habitat quality. Mitigation measures will also focus on enhancing the ecological function of the area, preserving habitat integrity while contributing to overall ecological improvement.

3. *Consolidate habitat and vegetated open space in contiguous blocks, and where possible locate habitat contiguous to other habitat, open space or landscaped areas to contribute to a continuous system or corridor that provides connections to adjacent habitat areas.*

   All proposed impacts within the shoreline buffer and shoreline jurisdiction of the Cowlitz River will be fully mitigated, restored, or enhanced, with no access-related disturbance to critical areas. This approach will ensure the continuity and integrity of the habitat, preserving essential ecological functions.

4. *Use native species in any landscaping of disturbed or undeveloped areas and in any enhancement of habitat or buffers. Emphasize diversity in selection of plant materials and structure of landscaping.*

   Mitigation plantings and upland seed mix proposed for critical habitats onsite will consist of native species tailored to the specific hydrological regime of the area.

5. *Remove and/or control any noxious or undesirable species of plants as identified by the Cowlitz County weed control board.*

A mitigation and monitoring plan will be implemented to identify, remove, and control non-native, invasive species excluding reed canarygrass as designated by the Cowlitz County weed control board. Regular monitoring will be conducted to assess the effectiveness of these measures and address any resurgence of problematic species. See the section titled *Goals, Objectives, and Performance Standards* for specific information regarding noxious species.

6. *Demonstrate how existing trees will be preserved, preferably in groves.*

   Only three trees are proposed to be removed within the shoreline buffer of the Cowlitz River. The removal of these trees will be mitigated within the shoreline buffer of the Cowlitz River at a 4:1 stem count ratio.

7. *Preserve and introduce native plant species which serve as a food source for wildlife; provide shelter from climatic extremes and predators; provide structure and cover for reproduction and rearing of young.*

   The proposed mitigation trees and shrubs are known to produce cones, fruits, and leaves that serve as a food source for various wildlife species, including birds and insects. The trees and shrubs will provide dense growth for habitat and the large woody material placed throughout the mitigation area will provide nesting opportunities. The proposed native trees, shrubs, and herbaceous species will create a multi-layered canopy that provides various microhabitats to support species through their lifecycle.

8. *Preserve the natural hydraulic and ecological functions of drainage systems.*

   The proposed stormwater outfall system will be installed landward of the OHWM of the Cowlitz River to preserve the natural hydraulic and ecological functions of the drainage system. Runoff from upslope areas will be managed by regulating flow through native vegetation in the enhancement and restoration area, Area 1, which will allow for infiltration into the uplands of the shoreline buffer. This process will help prevent excessive erosion and sedimentation from entering the Cowlitz River. Upland infiltration of stormwater runoff will capture sediments, nutrients, and pollutants, supporting water quality and recharging groundwater.

9. *Preserve critical fish and wildlife habitat areas through maintenance of stable channels, adequate low flows, management of stormwater runoff, erosion, and sedimentation.*

   The project will preserve critical fish and wildlife habitats by maintaining stable channels, managing stormwater runoff, and minimizing erosion and sedimentation. Geotextile fabric and large woody material placed in the enhancement and restoration area will stabilize the bank and create habitat complexity, benefiting fish and other aquatic species. Native vegetation will further aid in filtering runoff and reducing sediment flow into the Cowlitz River, supporting habitat health.

10. *Manage access to critical fish and wildlife habitat areas to protect species which are sensitive to human disturbance.*

    Access to critical fish and wildlife habitat areas will be managed to protect species sensitive to human disturbance. Signage will be installed along the boundary of Area 1 and Area 3 to reduce access to the mitigation area and minimize human impact to critical fish and wildlife habitat areas (Figure 7).

11. *Maintain or enhance water quality through control of runoff and use of best management practices.*

Water quality will be maintained and enhanced by minimizing the removal of trees within the shoreline buffer of the Cowlitz River and mitigating onsite within the shoreline buffer of the Cowlitz River at a 4:1 stem count ratio. The project heavily focuses on removing all non-native, invasive species excluding reed canarygrass. Mitigation and enhancement plantings, all located landward of the OHWM of the Cowlitz River, will help reduce erosion and prevent sediment from entering the river. No fill will be placed below the OHWM. Additionally, biodegradable erosion control jute matting and willow cuttings in the enhancement and restoration area will reduce erosion and filter runoff, promoting infiltration within the upland riparian habitat. Mitigation proposed will result in no net loss of ecological functions provided by shoreline buffer, as well as within shoreline jurisdiction of the Cowlitz River.

ONSITE ENHANCEMENT AND RESTORATION PLAN

To determine how mitigation measures should be applied to ensure no net loss of ecological function, ELS biologists first considered the location of impact should be at least functionally equivalent to the location where mitigation takes place. The goal of onsite mitigation is to result in an overall lift of ecological function when compared to existing riparian and shoreline habitat functions. Proposed project impacts are from permanent and temporary loss of habitat due to removing native vegetation. A total of 0.002 acres (108 square feet) of permanent impacts and 0.271 acres (9,444 square feet) of temporary impacts to the shoreline buffer landward of the OHWM of the Cowlitz River are proposed. Additionally, 0.014 acres (629 square feet) of temporary impacts to shoreline jurisdiction of the Cowlitz River is proposed. Temporary impacts are due to trenching and grading for the installation of a stormwater conveyance system and permanent impacts result from the installation of a gabion wall for the outfall. These shoreline vegetation impacts include the permanent and temporary loss of habitat availability within the shoreline buffer and shoreline jurisdiction. All permanent and temporary impacts will be mitigated onsite through removal of non-native, invasive species, excluding reed canarygrass, placing large woody material within the project area, planting native trees and shrubs, and seeding all proposed mitigation areas to provide no net loss of ecological function. Table 4 summarizes proposed project impacts, and Table 5 summarizes proposed onsite mitigation through restoration and enhancement.

Table 4.Summary of Shoreline Buffer and Shoreline Jurisdiction Impacts to the Cowlitz River

Shoreline Buffer Impacts		
Habitat Area	**Proposed Impact**	**Size of Impact**
Shoreline Buffer (Cowlitz River RHA)	Permanent	0.002 ac. (108 sq. ft.)
	Temporary	0.217 ac (9,444 sq. ft.)
Shoreline Jurisdiction impacts		
Habitat Area	**Proposed Impact**	**Size of Impact**
Shoreline Jurisdiction (Cowlitz River)	Temporary	0.014 ac. (629 sq. ft.)

Table 5. Onsite Restoration and Enhancement Summary

Impact Area	Impact Amount	Proposed Impact Type and Area	Proposed Mitigation	Mitigation Ratio	Total Mitigation Proposed	Total Enhancement per Area
Shoreline Buffer	0.002 ac. (108 sq. ft.)	Permanent Impacts (Area 1)	Restore & Enhance	2:1	0.050 ac. (216 sq. ft.)	**Area 1** 0.172 ac. (7,487 sq. ft.)
	0.217 ac. (9,444 sq. ft.)	Temporary Impacts (Area 2)	Restore & Enhance	1:1	0.217 ac. (9,444 sq. ft.)	**Area 2** 0.050 ac. (2,173 sq. ft.)
	3 Black Cottonwood Trees	Permanent Vegetation Impacts (Area 1)	Stem Replacement & Enhance	4.67:1 Stem Replacement	0.032 ac. (1,400 sq. ft.)	**Area 3** 0.032 ac. (1,400 sq. ft.)
Shorelines Jurisdiction (outside of buffer)	0.014 ac. 629 sq. ft.	Temporary Impacts	Restore & Enhance	1:1	0.014ac. (629 sq. ft.)	**Shoreline Jurisdiction** 0.014 ac. (629 sq. ft.)
					Total Onsite Mitigation and Restoration:	**0.268 ac. (11,689 sq. ft.)**

SHORELINE BUFFER MITIGATION (AREA 1)

Permanent impacts to the shoreline buffer of the Cowlitz River due to the installation of a gabion wall for the stormwater outfall conveyance system are proposed to be mitigated at a 2:1 ratio and temporary impacts to the shoreline buffer of the Cowlitz River due to grading within Area 1 are proposed to be mitigated at a 1:1 ratio. Mitigation will include removal of all non-native, invasive species, excluding reed canarygrass, installation of biodegradable erosion control jute matting, placement of large woody material as habitat structures, installation of shrubs, seeding with a native upland seed mix, and mulching Area 1 with certified weed-free straw. Permanent and temporary shoreline buffer impacts due to the installation of the gabion wall will occur where vegetation almost completely consists of non-native, invasive species. Existing functions in Area 1 are reduced because of the presence of scotch broom and Himalayan blackberry. For this reason, mitigation will create a native vegetated area resulting in a lift of ecological functions in the shoreline buffer. Mitigation plantings will promote infiltration to remove pollutants in surface runoff, and protective signage will deter human access to critical shoreline habitat. Habitat

features including at least two logs and five rootwads will be installed in Area 1 to provide valuable wildlife habitat for birds and small mammals for nesting and roosting. Dense shoreline plantings in Area 1 will result in a functional lift of ecological functions through slowing surface runoff and promoting infiltration and establishing a native seed source that can spread throughout shoreline and riparian habitat areas.

Prior to installation of mitigation plantings, all non-native, invasive species, excluding reed canarygrass will be removed and compacted soils in Area 1 will be ripped or tilled to allow plants to better establish root systems, and biodegradable jute erosion control matting and habitat features including downed logs and rootwads will be placed within Area 1. Table 5 details mitigation ratios and Table 6 details shrub and seed specifications for Area 1.

Table 6.Planting Specifications and Native Upland Seed Mixture (Area 1)

Shoreline Buffer Planting Area 1-Mitigation of 0.172-acres/7,487 square feet			
Species	**Spacing** (on-center)	**Stock**	**Quantity**
Shrubs			
Scouler's willow (*Salix scouleriana*, FAC)	4-feet	Cutting Stock	200
Dune willow (*Salix hookeriana*, FACW)			135
Sitka willow (*Salix sitchensis*, FACW)			135
		Total	**470**

Shoreline Buffer Planting Area 1-Mitigation of 0.172-acres/7,487 square feet			
Upland Disturbance Areas – Sunmark Seeds Stream Bank Plus			
Species	**Composition**	**Rate**	**Quantity**
Native red fescue (*Festuca rubra*, FAC)	50%	1lb/1,000 sq. ft.	Approximately 7.5 lbs
California brome (*Bromus carinatus*, NI)	20%		
Blue wildrye (*Elymus glaucus,* FACU)	20%		
Large leaf lupine (*Lupinus polyphyllus*, FAC)	10%		
Total	100%		

HABITAT FEATURES (AREA 1)

Prior to installing plants, habitat features including downed logs and rootwads will be placed within Area 1 (Figure 7). These features will be a maximum of 20 feet apart, and a minimum of two logs with attached rootwads and five rootwads will be placed within Area 1. Actual locations will be determined in the field with consideration to the listed spacing and density to produce the most natural appearance possible. All rootwads will be a minimum of 6 feet in diameter and will be placed on its side so lateral roots can provide habitat and roosting opportunities for birds. Downed logs with rootwads will be a minimum of 20 feet long and will have a minimum diameter of 20-inches at the small end with branches retained as much as possible. Downed logs will be placed so they do not roll downhill towards the public or the Cowlitz River. Specifications for habitat features within Area 1 are detailed in Table 7.

Table 7.Habitat Feature Specifications (Area 1)

Habitat Feature Type	Specifications	Location	Quantity to be Installed
Rootwads	>6' in diameter Clean roots of soils prior to transportation Retain lateral roots as much as possible Place on its side so roots can provide perching	Along the waterward side of the proposed gabion wall (Area 1)	Minimum of 5
Downed Logs with Rootwads	20" in diameter on the small end >20 feet in length Retain branches as much as possible Place logs so they do not roll downhill towards the river		Minimum of 2

SHORELINE BUFFER RESTORATION (AREA 2)

Area 2 as shown on Figure 7 is also within the shoreline buffer of the Cowlitz River. Only temporary impacts to herbaceous vegetation are proposed within Area 2 to accommodate grading and the installation of stormwater outfall piping. Restoration within Area 2 will be restored at a 1:1 ratio by removing non-native, invasive species, excluding reed canarygrass prior to construction. Post construction mitigation will include seeding with a native upland seed mix and mulching with a certified weed-free straw. Existing functions in Area 2 are reduced because of the presence of scotch broom and Himalayan blackberry. For this reason, restoration will create a native vegetated area that will result in a lift of ecological functions in the shoreline buffer. All restoration specifications for Area 2 are detailed in Table 5 and specifications for native upland seed mix are detailed in Table 8.

Table 8.Native Upland Seed Mixture (Area 2)

Shoreline Buffer Planting Area 2- Mitigation of 0.050-acres/2,173 square feet			
Upland Disturbance Areas – Sunmark Seeds Stream Bank Plus			
Species	**Composition**	**Rate**	**Quantity**
Native red fescue (*Festuca rubra*, FAC)	50%	1lb/1,000 sq. ft.	Approximately 2.2 lbs
California brome (*Bromus carinatus*, NI)	20%		
Blue wildrye (*Elymus glaucus,* FACU)	20%		
Large leaf lupine (*Lupinus polyphyllus*, FAC)	10%		
Total	100%		

SHORELINE BUFFER MITIGATION (AREA 3)

Permanent impacts due to tree removal within the shoreline buffer of the Cowlitz River will be mitigated within Area 3 (Figure 7). Mitigation in Area 3 includes removing non-native, invasive vegetation, excluding reed canarygrass, planting native trees at a 4.67:1 stem replacement ratio, seeding with a native upland seed mix and mulching Area 3 with certified weed-free straw. Mitigation within Area 3 will compensate for the removal of three native black cottonwood (*Populus trichocarpa*) trees in Area 1, which is necessary for grading and installation of the proposed stormwater outfall conveyance system. Removing invasive species and establishing native vegetation will improve ecological functions, including pollutant removal, reducing human disturbance, slowing surface runoff, promoting infiltration, and providing a native seed source that can spread throughout the shoreline buffer.

Prior to installation of mitigation plantings, all non-native, invasive vegetation, excluding reed canarygrass will be removed and compacted soils in Area 3 will be ripped or tilled to allow plants to better establish root systems. All mitigation specifications for Area 3 are detailed in Table 5 and Table 9 details native tree installation and native upland seed mix specifications for Area 3.

Table 9.Planting Specifications and Native Upland Seed Mixture (Area 3)

Shoreline Buffer Planting Area 3-Mitigation of 0.032-acres/1,400 square feet			
Species	**Spacing** (on-center)	**Stock**	**Quantity**
Trees			
Lodgepole Pine (*Pinus contorta*)	10-feet	1-gallon potted	14

Shoreline Buffer Planting Area 1-Mitigation of 0.172-acres/7,487 square feet			
Upland Disturbance Areas – Sunmark Seeds Stream Bank Plus			
Species	**Composition**	**Rate**	**Quantity**
Native red fescue (*Festuca rubra*, FAC)	50%	1lb/1,000 sq. ft.	Approximately 1.4 lbs
California brome (*Bromus carinatus*, NI)	20%		
Blue wildrye (*Elymus glaucus,* FACU)	20%		
Large leaf lupine (*Lupinus polyphyllus*, FAC)	10%		
Total	100%		

SHORELINE JURISDICTION OF THE COWLITZ RIVER MITIGATION

All temporary impacts to shoreline jurisdiction of the Cowlitz River are proposed to be mitigated at a 1:1 ratio by removing all removing non-native, invasive vegetation, excluding reed canarygrass prior to construction. Post construction mitigation will include seeding with a native upland seed mix and mulching with a certified weed-free straw over 1,747 square feet of the temporarily impacted shoreline jurisdiction. Existing functions of the impacted area within shoreline jurisdiction of the Cowlitz River outside of the shoreline buffer are minimal due to scotch broom and Himalayan blackberry. The restoration of this area will provide an overall ecological functional lift by eliminating non-native, invasive vegetation, excluding reed canarygrass and restoring the impacted areas with native vegetation providing habitat, and foraging opportunities. All mitigation specifications for shoreline jurisdiction of the Cowlitz River are detailed in Table 5 and Table 10 details native upland seed mix specifications.

Table 10.Native Upland Seed Mixture (Shoreline Jurisdiction of the Cowlitz River)

Shoreline Jurisdiction of the Cowlitz River-Restoration of 0.014-acres/629 square feet			
Upland Disturbance Areas – Sunmark Seeds Stream Bank Plus			
Species	**Composition**	**Rate**	**Quantity**
Native red fescue (*Festuca rubra*, FAC)	50%	1lb/1,000 sq. ft.	Approximately 0.63 lbs
California brome (*Bromus carinatus*, NI)	20%		
Blue wildrye (*Elymus glaucus,* FACU)	20%		
Large leaf lupine (*Lupinus polyphyllus*, FAC)	10%		
Total	100%		

Specifications for Phase 1a Preparation, Planting, and Maintenance

The following specifications will be used to protect existing critical areas, set boundaries for mitigation, provide direction for installing vegetation and habitat features, and provide maintenance requirements for the 5-year monitoring and maintenance period.

Prepare Mitigation Areas

1. Install appropriate BMPs along the mitigation area boundaries.
2. Stake or flag the mitigation area waterward of shorelines jurisdiction.
3. Install temporary construction fencing along the boundary of the mitigation areas onsite to prevent equipment access.
4. Rip or till soils in planting locations as needed to loosen compact soils in mitigation areas.
5. Remove all non-native, invasive vegetation, excluding reed canarygrass within the proposed mitigation areas.
6. Install riparian bank stabilizing biodegradable jute matting within Area 1.

Install Habitat Features within Area 1

1. Install a minimum of seven pieces of habitat features including downed logs or rootwads according to the specifications in Table 7.
2. Habitat features will be located within Area 1 west of the proposed gabion wall within the shoreline buffer of the Cowlitz River, landward of the OHWM.
3. Place habitat features a maximum of 20 feet apart.
4. Place rootwads on their side.
5. Place downed logs so they will not roll downhill.

Install Cutting Stock in Area 1, Bare root Stock in Area 3, and Native Upland Seed Mixture in all Mitigation Areas

1. Plant native 1-gallon potted trees and cuttings during the late fall to early spring (October-March) at spacing identified in Table 6 and Table 9, respectively.
2. 1-gallon potted trees will be purchased from a native plant nursery.
3. Cuttings will be collected within the Phase 1a boundary, where possible. Any remaining cuttings will be salvaged from local offsite sources or purchased from a native plant nursery. Onsite or local offsite cutting material will be used as much as possible because these plants are best adapted to the local microclimate.
4. Cuttings will be a minimum of 3 feet long and between ¼ to ½ inches in diameter.
5. One-gallon potted trees and cuttings will be protected until installation by being refrigerated, covered in damp burlap, placed in moist sand or peat, or other method of keeping cool and moist.
6. Cuttings will be installed within 1 to 2 days of harvesting.
7. Unused cuttings must be properly stored at the end of each planting day to prevent drying out.
8. Spread appropriate amount of native upland seed mix within all mitigation areas.

9. Install a minimum of 3-inch depth mulch layer within all mitigation areas. The mulch will be comprised of certified weed-free straw. Avoid placing mulch directly against plant stems.
10. Irrigate all newly installed 1-gallon potted trees, cuttings, and seeded areas as the Phase 1a boundary and weather conditions warrant.

Install Habitat Signs

Install durable, enamel coated metal critical area signs at a minimum of 100-foot intervals on metal or wood posts bordering mitigation Area 1 and Area 3.

Maintain Enhancement and Restoration Areas

The planted 1-gallon potted trees and shrub cuttings will be maintained as often as necessary to ensure that the specified performance standards are met. The maintenance includes the following:

1. Inspect the plantings at least once annually, or more often as appropriate, and maintain to achieve the performance standards specified in the subsection titled "*Goals, Objectives, & Performance Standards*."
2. Irrigate planted 1-gallon potted trees and shrubs during the dry season for the first 2 to 3 years after planting. Water should be delivered at a minimum rate of 1 gallon every 4 weeks. Adjust as necessary based on site and weather conditions.
3. Remove competing vegetation from around the base of plant species during first 2 to 3 years after planting and as needed thereafter.
4. Replace mulch as needed to suppress competing vegetation.
5. Replace dead or failed 1-gallon potted trees or cuttings to meet the minimum annual performance standards (Table 11). Replaced plants will be installed as described for the original installation.

Minor corrective actions will be undertaken as necessary as a part of routine maintenance and will be documented in the subsequent monitoring report. Corrective actions include, but are not limited to, the following:

1. Replant 1-gallon potted trees.
2. Replant shrub cuttings.
3. Implement a fertilizing schedule.
4. Repair damaged limbs or prune dead branches.
5. Substitute the anti-herbivore device, such as painting lower stems with sanded latex paint, or spraying herbivore deterrent.

Goals, Objectives, and Performance Standards

The goal of this mitigation plan is to establish a multi strata riparian habitat buffer and shoreline vegetation screening to compensate for impacts to the shoreline buffer and to shoreline jurisdiction of the Cowlitz River from grading and installation of a stormwater outfall conveyance system. The proposed mitigation will enhance and restore vegetative structure, habitat, and water quality functions. To accomplish this goal, the following goals, objectives, and performance standards have been established.

Non-Native, Invasive Species Removal

Objective 1: Remove all non-native, invasive plants, excluding reed canarygrass within enhancement and restoration areas to improve habitat and ecological function within the shoreline buffer and shoreline jurisdiction of the Cowlitz River.

Performance Standard 1a: Manually or mechanically remove all non-native, invasive plants, excluding reed canarygrass within the enhancement and restoration areas prior to installation of habitat features, plantings, seeding, and mulching. This performance standard is complete when all non-native, invasive plants, excluding reed canarygrass are removed and documented in the as-built report.

Performance Standard 1b: Inspect all mitigation areas and remove all non-native, invasive plants, excluding reed canarygrass. Non-native, invasive plants, excluding reed canarygrass will not exceed 10 percent cover in all mitigation areas for the duration of monitoring. This performance standard is completed when documented in all annual monitoring reports.

Habitat Structure

Objective 2: Install habitat features to favor small mammals and birds to improve riparian habitat functions. Habitat features will also deter public presence near active operations.

Performance Standard 2a: A minimum of seven habitat features including rootwads or downed logs will be placed within Area 1. The performance standard is completed when the habitat features are installed and documented in the as-built report.

Vegetative Structure

Objective 3: Establish a multi strata riparian habitat buffer and shoreline jurisdiction herbaceous vegetation screening to compensate for impacts to the shoreline buffer and to shoreline jurisdiction of the Cowlitz River, and to enhance vegetative structure, habitat, and water quality functions.

Performance Standard 1a: Install all native 1-gallon potted trees, native shrub cuttings, and mulch and seed mitigation areas as described in Tables 6, and 8-10. The performance standard is completed when plants are installed and documented in the as-built report.

Performance Standard 1b: By Year 1, native trees and shrubs will achieve at least 90 percent survival. Dead plants will be replaced if this performance standard is not met.

Performance Standard 1c: By Year 2, native trees and shrubs will achieve at least 80 percent survival. Dead plants will be replaced if this performance standard is not met.

Performance Standard 1d: By Year 3, native trees and shrubs will achieve at least 75 percent survival. Dead plants will be replaced if this performance standard is not met.

Performance Standard 1e: By Year 5, native trees and native shrubs will have a minimum 25 percent cover. Dead plants will be replaced if this performance standard is not met.

Table 11.Performance Standards for Vegetation by Monitoring Year

	Percent Survival and Cover			
	Year 1	**Year 2**	**Year 3**	**Year 5**
Tree & Shrub Strata				
Survival	≥90%	≥80%	≥75%	--
Cover	--	--	--	≥25%
Non-native, invasive vegetation, excluding reed canarygrass				
Cover of non-native, invasive species	<10%	<10%	<10%	<10%

LONG-TERM SITE PROTECTION

Objective 4: Establish long term protection mechanism for Area 1 and Area 3.

Performance Standard 4a: Record a conservation covenant with the City of Castle Rock protecting Area 1 and Area 3 in perpetuity. This performance standard will be met when a conversation covenant is recorded at the city and a copy is included in the as-built report.

Performance Standard 4b: Critical areas signage with verbiage approved by the responsible official made of enamel coated metal attached to a durable metal or wood posts shall be installed at a maximum of 100 feet apart along the perimeter Area 1 and Area 3. Signage shall be maintained in perpetuity. This performance standard will be met when all installed signs are documented in the final monitoring report. Additional signage may be required during additional development phases.

MONITORING, MAINTENANCE, AND CONTINGENCY METHODS

The shoreline buffer and shoreline jurisdiction mitigation areas will be monitored for a five-year period following project construction in Year 0 (as-built), 1, 2, 3, and 5. Monitoring reports will

be submitted to the City of Castle Rock by December 31st of each monitoring year. The goal of monitoring is to determine if previously stated performance standards are being met. All mitigation areas will be monitored once during the growing season, preferably during the same two-week period each year to better compare data.

Monitoring of the mitigation areas will follow the requirements of established performance standards. Monitoring plots will be established within the shoreline buffer and shoreline jurisdiction of the Cowlitz River. A minimum of four monitoring plots will be established to document if the Phase 1a boundary is meeting performance standards. At least one photostation will be established per monitoring plot to document changes over time. Additional photostations may be established outside of monitoring plots as needed. Photostations and monitoring plot locations will be established in the as-built report.

MONITORING PLOTS

During the first annual monitoring event, a minimum of four monitoring plots will be established, with at least two monitoring plots in Area 1 and two monitoring plots within Area 3. The monitoring plots will be staked with metal t-posts and identification tags. Their locations will be identified by GPS and placed on an as-built Phase 1a boundary map that will accompany the monitoring reports. Permanent photo points will be established at each monitoring plot and directions documented on Phase 1a boundary map.

Vegetation

To assess the status of the vegetation within the mitigation areas, the vegetation monitoring will measure the following:

- Total stem count of trees and shrubs (to determine survival rate) within Area 1 and Area 3.
- Percent aerial cover of planted and naturally recruiting native trees and shrubs within a 15-foot radius from the metal t-post.
- Percent aerial cover of naturally occurring herbaceous plants within a 5-foot radius from the metal t-post.
- Percent aerial cover of non-native, invasive species, excluding reed canarygrass within a 15-foot radius from the metal t-post.
- Change in the plant community over time (documented at each designated photo point).

Fauna

To assess the development of wildlife habitat within shoreline jurisdiction, wildlife monitoring will document the following regarding use of the downed logs or rootwads, and overall plant condition:

- Insect use
- Amphibian/reptile use
- Bird use
- Mammal use

- Level of herbivory

Soils and Hydrology

If the planted species show poor or failed growth, soil moisture and soil nutrients may also be monitored during the growing season. If necessary, soil moisture will be monitored monthly during the growing season and soil nutrients will be assessed annually during the growing season. Corrective actions will be taken as appropriate based on the soil moisture and soil nutrient data. These actions include, but are not limited to, a revised irrigation schedule and a fertilization schedule.

At minimum the following items will be included in annual monitoring reports:

- Location, map, and as-built drawing including any changes.
- Historic description of the project, including dates of plant installation, current year of monitoring, and remedial actions taken (if necessary).
- Description of monitoring methods.
- Documentation of vegetative performance standards and overall development.
- Assessment of non-native, invasive species, excluding reed canarygrass and recommendations for continued management.
- Photographs from established photostations.
- Observations of wildlife including amphibians, invertebrates, reptiles, birds, and mammals. If photographs are taken, they will be included.
- Summary of maintenance and contingency measures completed for the past year and proposed for the next year.

MAINTENANCE

Maintenance will occur during the growing season and will include the following:

- Irrigating mitigation areas as needed during the dry season for the first three years. Taper watering in Years 2-3.
- Remove competing non-native, invasive species excluding reed canarygrass as needed within a 3-foot radius of planted species, re-apply mulch as needed.
- Replace dead or failed plants as described for the original installation to meet the minimum performance standards.

CONTINGENCY MEASURES

If performance standards are not met by Year 5, steps will be taken to correct the situation in a timely manner. The following steps will be implemented when an area is identified as failing or potentially failing:

- Identify the cause(s) of failure or potential failure.
- Identify the extent of failure of potential failure.
- Implement corrective actions such as irrigating, fertilizing, or replanting.
- Document activities and include this data in annual monitoring reports.

- If routine corrective action will not correct the problem, immediately consult with the appropriate agencies.
- Evaluate recommendations from resource agency staff and implement recommendations in a timely manner.

Funding for corrective actions will be the responsibility of the applicant.

LIMITATIONS

ELS bases this report's determinations on standard scientific methodology and best professional judgment. In our opinion, local, state, and federal regulatory agencies should agree with our determinations; however, the information contained in this report should be considered preliminary and used at your own risk until it has been approved in writing by the appropriate regulatory agencies. ELS is not responsible for the impacts of any changes in environmental standards, practices, or regulations after the date of this report.

REFERENCES

Castle Rock Municipal Code (CRMC). 2024. *Castle Rock Title 18 Environmental Protection, Chapter 18.08 Shoreline Master Program and Chapter 18.10, Critical Areas*. City of Castle Rock, Washington.

Ecological Land Services. 2022. *Castle Rock Business Park Amended Critical Areas Report* (ELS 2022).

Ecological Land Services. 2024. *Castle Rock Business Park Memorandum | Update to the Ordinary High Water Mark of the Cowlitz River |* Castle Rock, Cowlitz County, Washington (ELS 2024).

Lower Columbia Fish Recovery Board (LCFRB). 2010. *Washington Lower Columbia Salmon Recover and Fish and Wildlife Subbasin Plan. Final*. May 28.

Knutson and Naef. 1997. *WDFW Management Recommendations for Riparian Habitat.*

National Marine Fisheries Service (NMFS). 2025. *Species Directory.* Internet site accessed February 2025: https://www.fisheries.noaa.gov/species-directory/threatened-endangered?title=&species_category=any&species_status=any&regions=1000001126&items_per_page=all&sort=.

Rodrick, E. and R. Milner, eds. 1991. *Management Recommendations for Washington's Priority Habitats and Species.* Washington Department of Wildlife, Wildlife Management, Fish Management, and Habitat Management Divisions, Olympia, Washington. May 24.

Shoreline Master Program, City of Castle Rock (SMP). 2022. *City of Castle Rock, Washington Shoreline Master Program Ordinance No. 2022-03*. May 9, 2022.

U.S. Fish and Wildlife Service (USFWS). 2004. Draft Recovery Plan for the Coastal-Puget Sound Distinct Population Segment of Bull Trout (Salvelinus confluentus). Volume II of (II): Olympic Peninsula Management Unit. Region 1. Portland, Oregon. July.

U.S. Fish and Wildlife Service (USFWS). 2025. *Information for Planning and Consultation* (IPaC). Internet site accessed February 2025: USFWS Western Washington Fish and Wildlife Office. https://ecos.fws.gov/ipac/location/index.

Washington Department of Ecology (Ecology). 1992. *Stormwater Management Manual for the Puget Sound Basin*. *February 1992.* Publication No.91-75.

Washington Department of Ecology (Ecology). 2024. *Stormwater Management Manual for Western Washington. July 2024 Update.* Publication No. 24-10-013.

Washington Department of Ecology (Ecology). 2016. *Determining the Ordinary High Water Mark for Shoreline Management Act Compliance in Washington State. Final Review*. Publication No. 16-06-029.

Washington Department of Fish and Wildlife (WDFW). Revised March, 2024. *State Listed Species.* Accessed February 2025: https://wdfw.wa.gov/sites/default/files/2024-03/wa-state-listed-and-candidate-species-list.pdf

Washington Department of Fish and Wildlife (WDFW). 2025a. *PHS on the Web*. Internet site accessed February 2025: https://geodataservices.wdfw.wa.gov/hp/phs/.

Washington Department of Fish and Wildlife (WDFW). 2025b. *Statewide Washington Integrated Fish Distribution*. Internet site accessed February 2025: https://geo.nwifc.org/swifd/.

Washington Department of Natural Resources (WDNR). 2025a. *Forest Practices Information Mapping Tool*. Internet site accessed February 2025: https://fpamt.dnr.wa.gov/default.aspx.

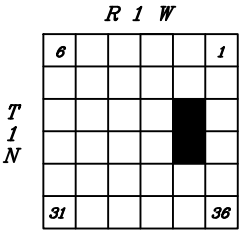
Washington Department of Natural Resources (WDNR). 2025b. *Washington Natural Heritage Program Element Occurrences – Current*. Internet site accessed February 2025. https://datawadnr.opendata.arcgis.com/datasets/34fb23d474d14a55bfbf670d065209c3_2/explore?location=46.044895%2C-122.777861%2C13.61.

FIGURES

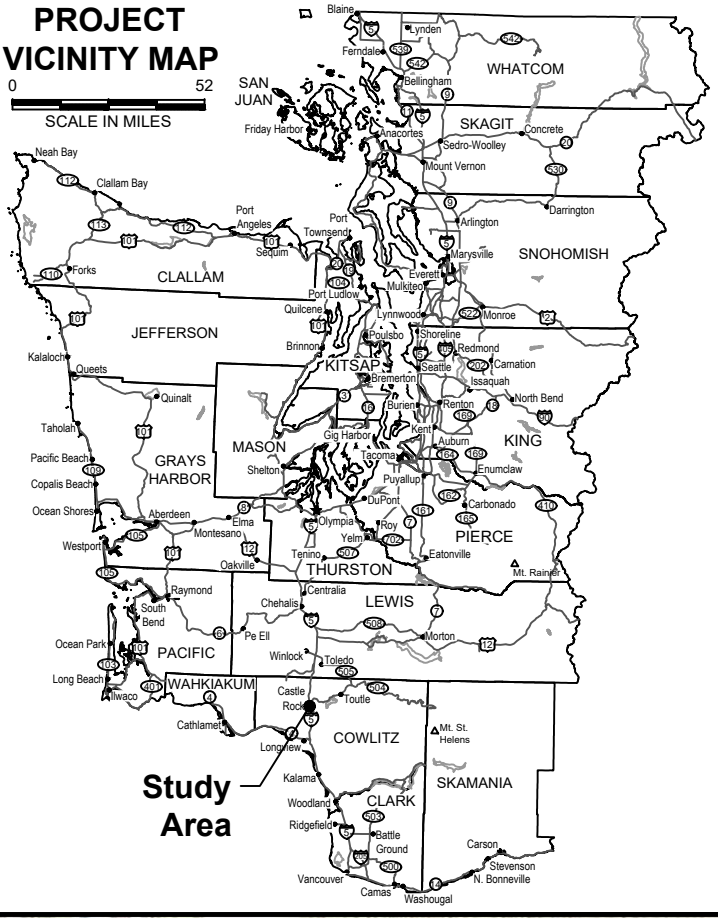
WASHINGTON

Latitude: 46.2552°
Longitude: -122.8900°

LOCATION MAP



PROJECT VICINITY MAP



NOTE:
Quadrangle topographic map from USGS.

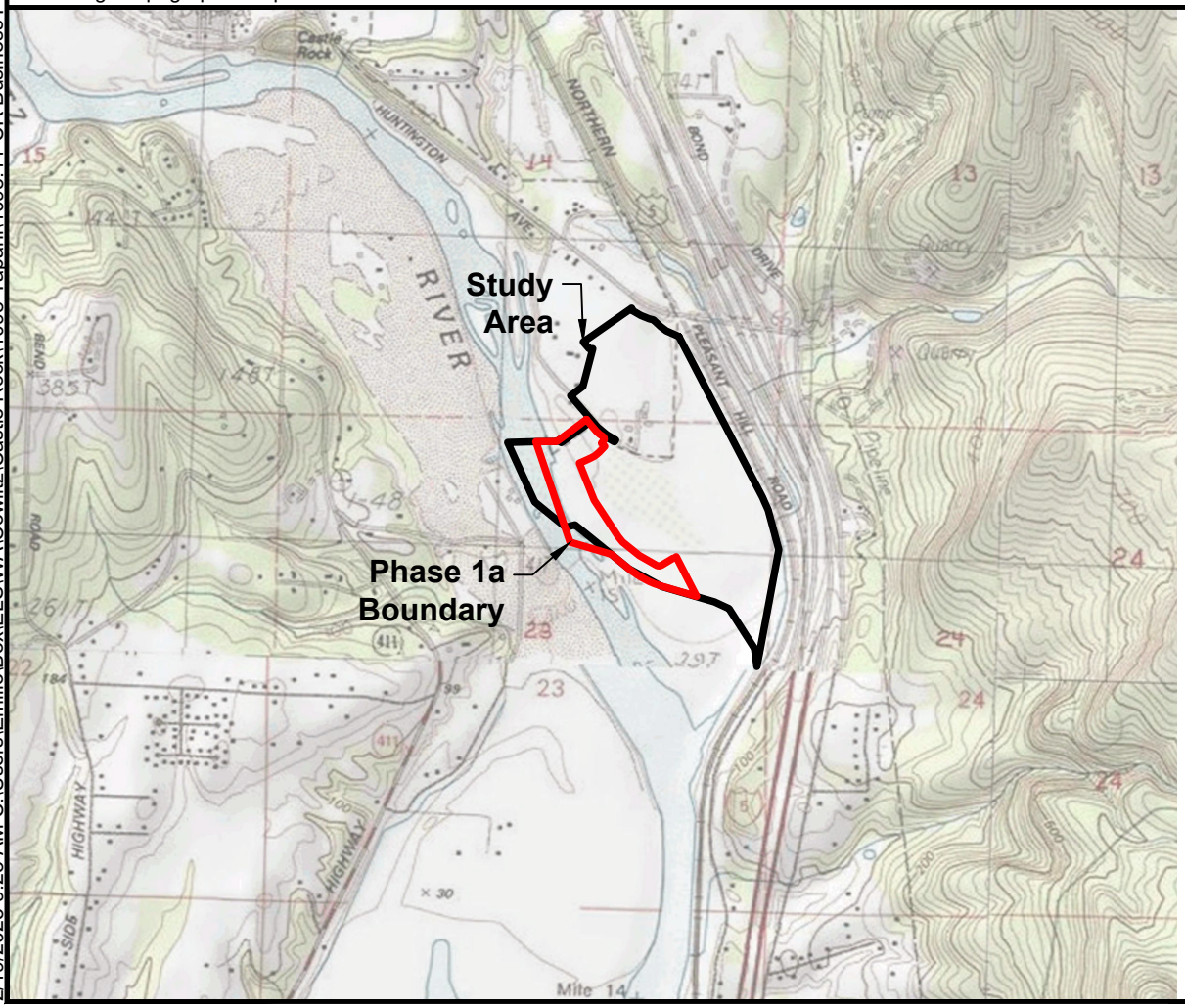


Figure 1
VICINITY MAP
Castle Rock Buisness Park Permitting Outfall
CT6, LLC
Castle Rock, Cowlitz County, WA
Section 14,23, Township 9N, Range 2W, W.M.

DATE: 2/19/25
DWN: EF
REQ. BY: EV
PRJ. MGR: EV
CHK: GB
PROJECT NO: 1098.11

1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371
Fax: (360) 414-9305
www.eco-land.com
Ecological Land Services

0 2000 4000
SCALE IN FEET

N W E S

2/19/2025 9:23 AM C:\Users\Emilio\Box\ELS\WA\Cowlitz\Castle Rock\1098-Tapani\1098.11-CR Business Park Permitting\1098.11-Figures\1098.11 PHASE1.dwg Emilio

Parcel #: 30813

Parcel #: 30812

Parcel #: 6143802

Parcel #: 30864

Larson Ln SW

Ditch #4

Ditch #1

Ditch #1A

Ditch #3

Ditch #4

Wetland B
Depressional
Category III
Emergent
Seasonally Flooded
Saturated Only
(0.13 ac./5,717 sq. ft.)

150'

200'

45'

40'

50'

40'

Cowlitz River
(Type S)

TP-2
TP-5
TP-15
TP-16
TP-17
TP-18
TP-19
TP-20
TP-21
TP-22
TP-23
TP-24
TP-29
TP-30
TP-31
TP-12
TP-13
TP-14

LEGEND:

- Study Area
- Phase 1a Boundary (18.31 ac.)
- Parcel Boundary
- Wetland Boundary
- Wetland Buffer
- Ditch with Flow Direction
- OHWM
- 150' Shoreline Buffer
- Shoreline Jurisdiction
- FEMA Floodway
- 100-Year Floodplain
- Existing Gravel Road
- TP-1 Test Plot Location
- 5' Contours
- Tree (3)

NOTE(S):

1. Aerial from Google Earth™.
2. Wetlands and test plots were mapped by an ELS biologist using a hand-held GPS unit with submeter accuracy.
3. OHWM and contours were surveyed by MacKay and Sposito.
4. Trees were surveyed by Tapani.

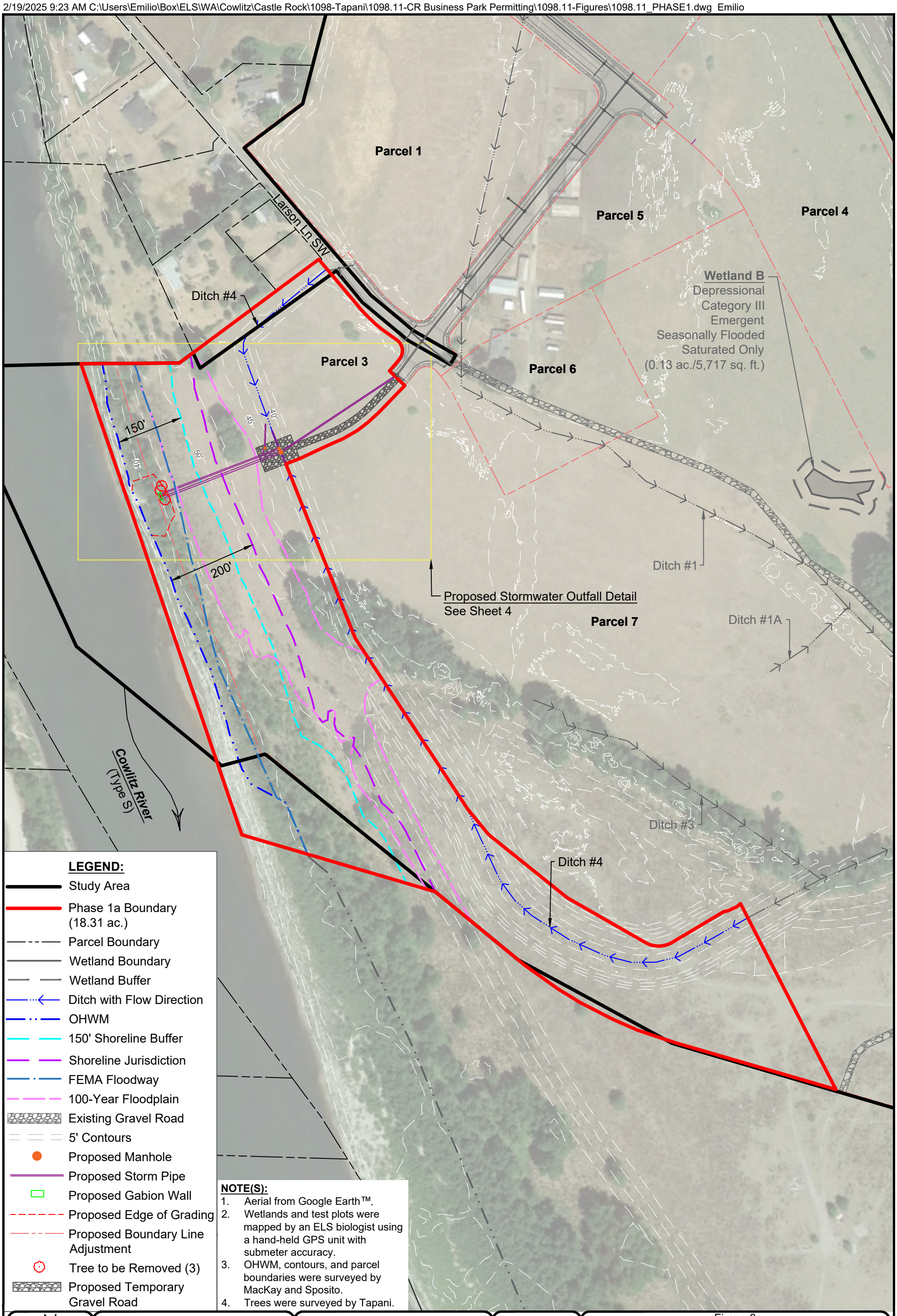
N W E S

0 200 400
SCALE IN FEET

Ecological Land Services
1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371
Fax: (360) 414-9305
www.eco-land.com

DATE: 2/19/25
DWN: EF
REQ. BY: EV
PRJ. MGR: EV
CHK: GB
PROJECT NO: 1098.11

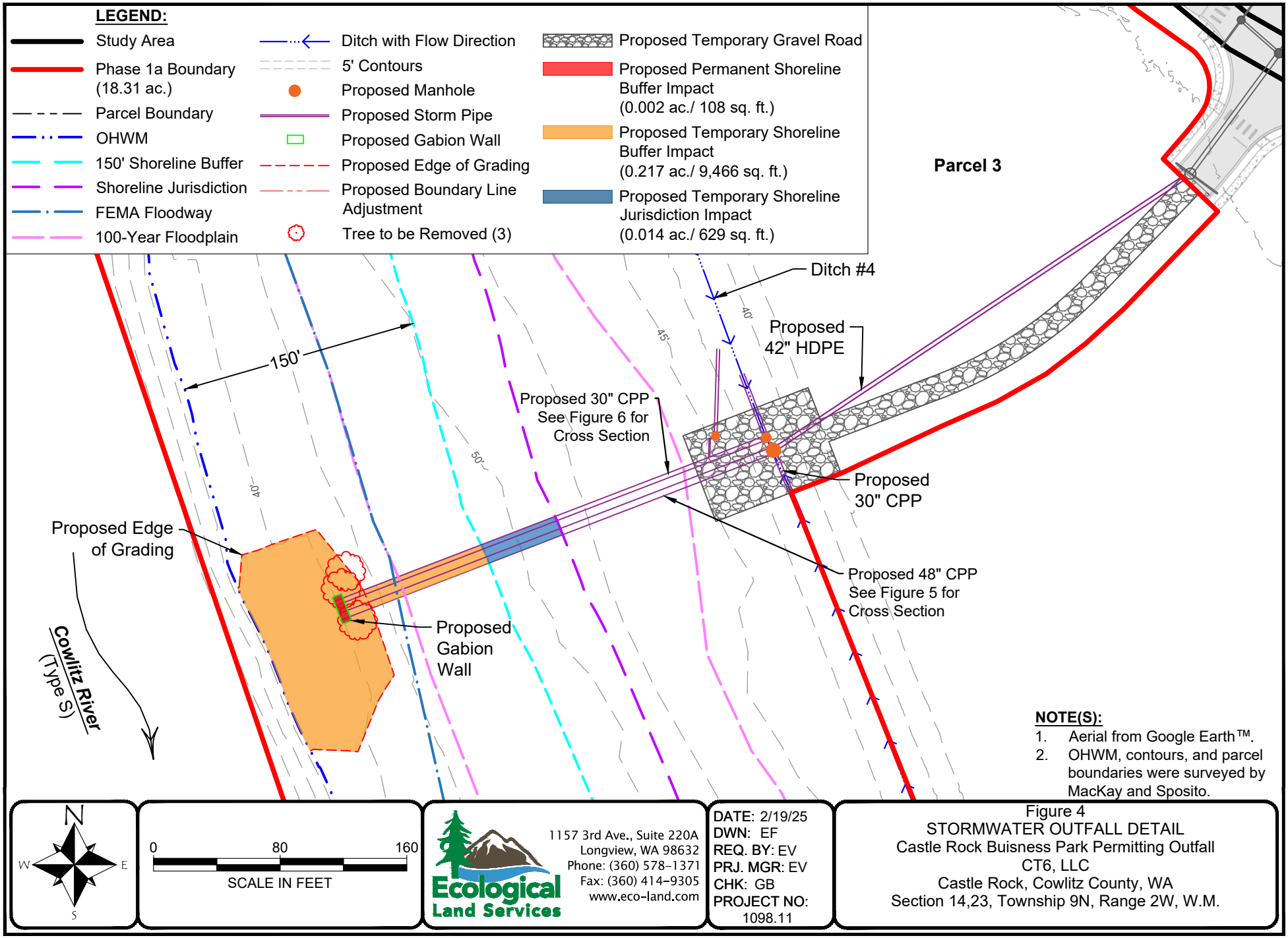
Figure 2
EXISTING CONDITIONS
Castle Rock Buisness Park Permitting Outfall
CT6, LLC
Castle Rock, Cowlitz County, WA
Section 14,23, Township 9N, Range 2W, W.M.



Ecological Land Services
1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371
Fax: (360) 414-9305
www.eco-land.com

DATE: 2/19/25
DWN: EF
REQ. BY: EV
PRJ. MGR: EV
CHK: GB
PROJECT NO: 1098.11

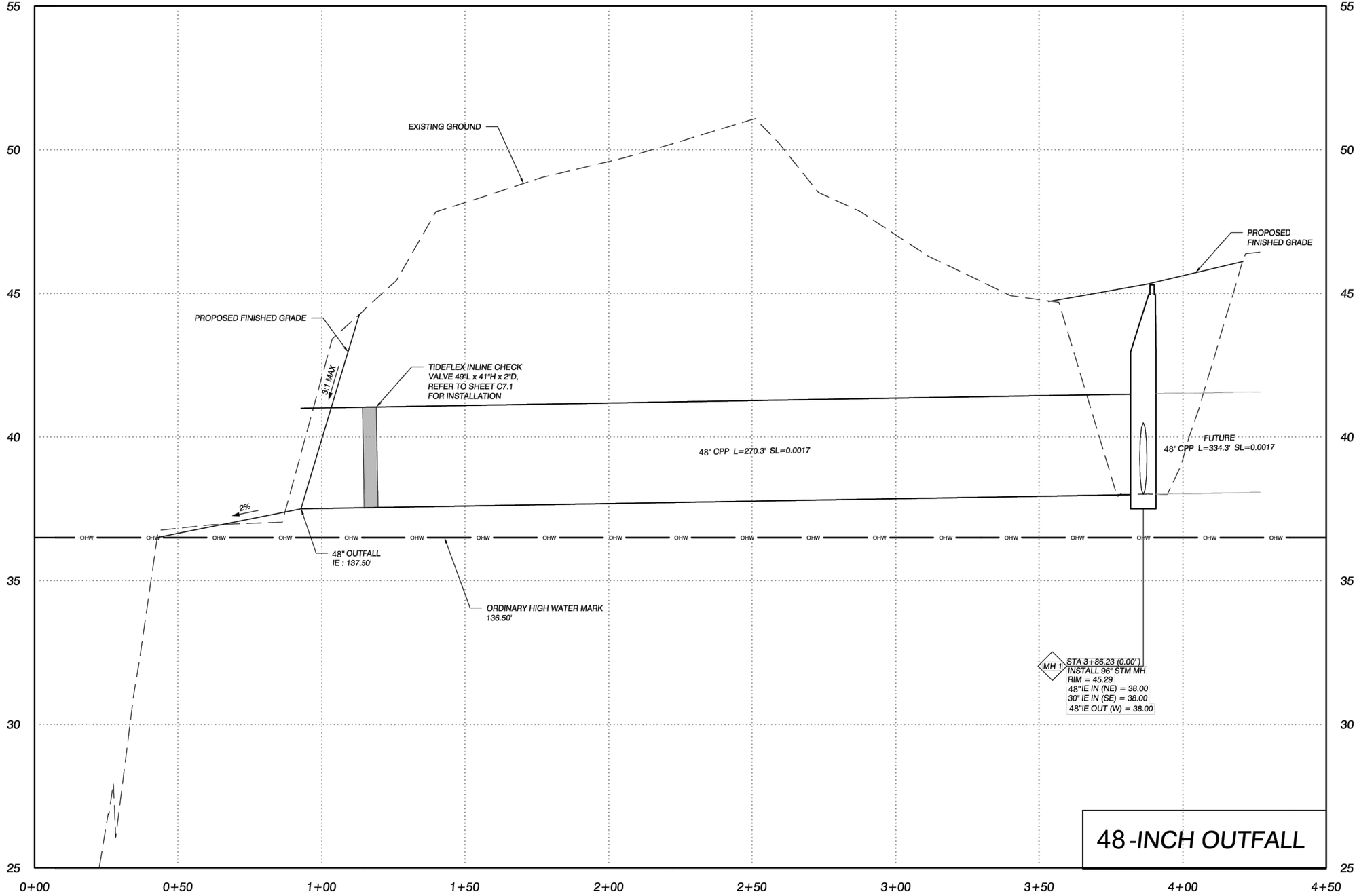
Figure 3
PROPOSED CONDITIONS OVERVIEW
Castle Rock Buisness Park Permitting Outfall
CT6, LLC
Castle Rock, Cowlitz County, WA
Section 14,23, Township 9N, Range 2W, W.M.



Ecological Land Services
1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371
Fax: (360) 414-9305
www.eco-land.com

DATE: 2/19/25
DWN: EF
REQ. BY: EV
PRJ. MGR: EV
CHK: GB
PROJECT NO: 1098.11

Figure 4
STORMWATER OUTFALL DETAIL
Castle Rock Buisness Park Permitting Outfall
CT6, LLC
Castle Rock, Cowlitz County, WA
Section 14,23, Township 9N, Range 2W, W.M.



48 -INCH STORMWATER OUTFALL PROFILE

Figure 5
48 INCH STORMWATER OUTFALL - CROSS SECTION
Castle Rock Buisness Park Permitting Outfall
CT6, LLC
Castle Rock, Cowlitz County, WA
Section 14,23, Township 9N, Range 2W, W.M.

DATE: 2/19/25
DWN: EF
REQ. BY: EV
PRJ. MGR: EV
CHK: GB
PROJECT NO: 1098.11

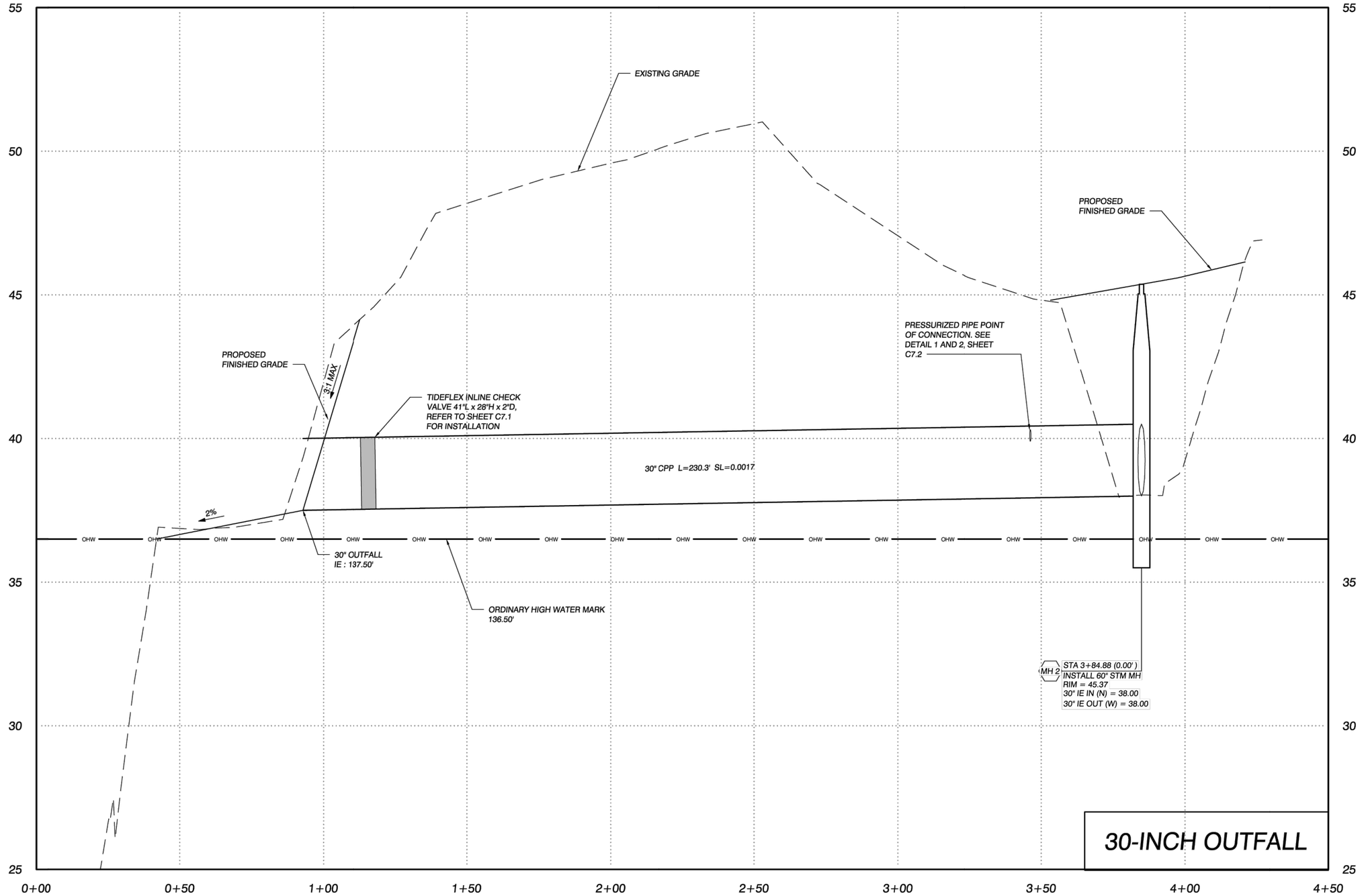
11157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371
Fax: (360) 414-9305
www.eco-land.com
Ecological Land Services

NOT TO SCALE

N
W
E
S

2/19/2025 9:23 AM C:\Users\Emilio\Box\ELS\WA\Cowlitz\Castle Rock\1098-Tapani\1098.11-CR Business Park Permitting\1098.11-Figures\1098.11_PHASE1.dwg Emilio

2/19/2025 9:23 AM C:\Users\Emilio\Box\ELS\WA\Cowlitz\Castle Rock\1098-Tapani\1098.11-CR Business Park Permitting\1098.11-Figures\1098.11_PHASE1.dwg Emilio



30-INCH STORMWATER OUTFALL PROFILE

Figure 6
30 INCH STORMWATER OUTFALL - CROSS SECTION
Castle Rock Buisness Park Permitting Outfall
CT6, LLC
Castle Rock, Cowlitz County, WA
Section 14,23, Township 9N, Range 2W, W.M.

DATE: 2/19/25
DWN: EF
REQ. BY: EV
PRJ. MGR: EV
CHK: GB
PROJECT NO: 1098.11

1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371
Fax: (360) 414-9305
www.eco-land.com
Ecological Land Services

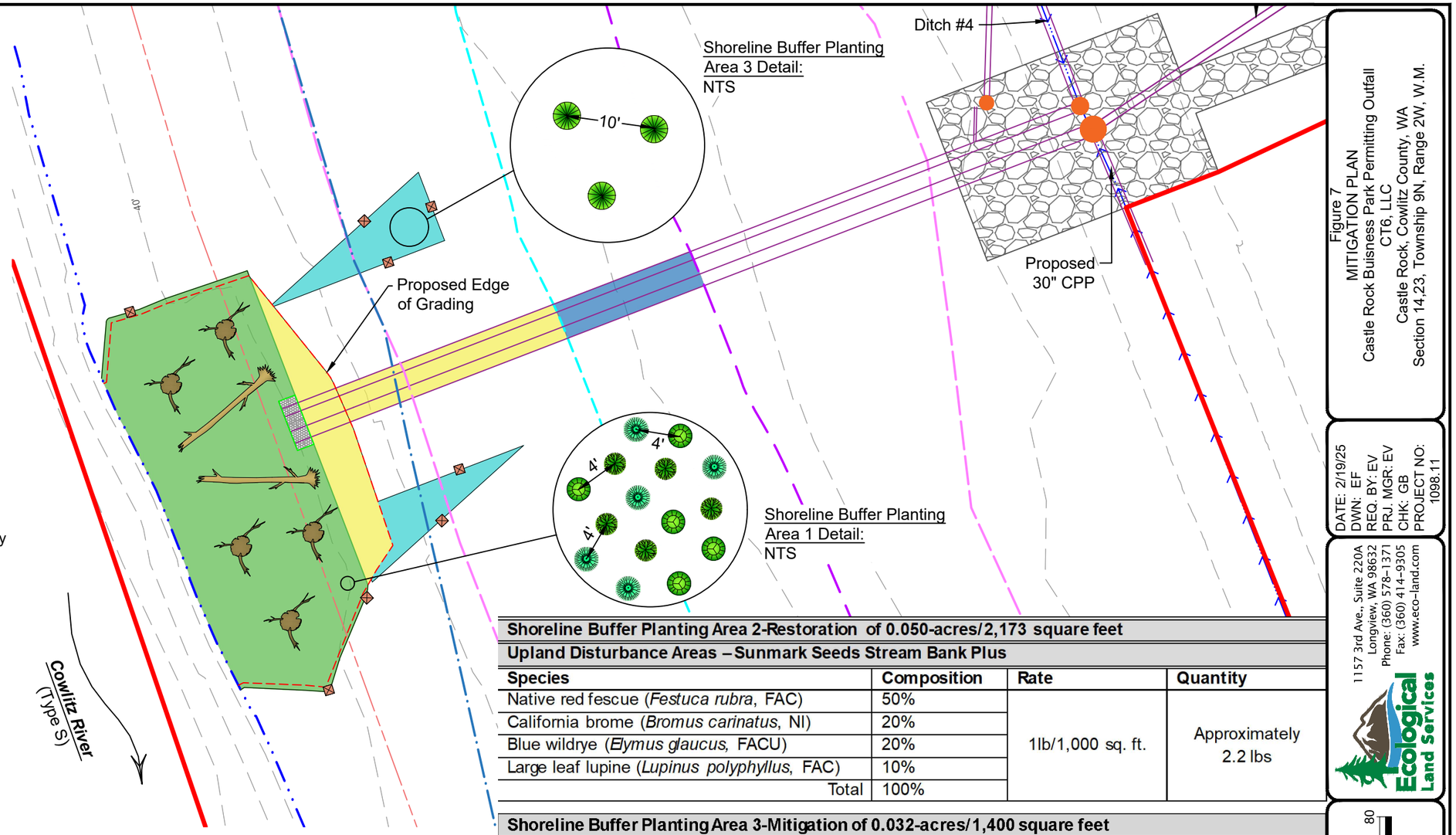
NOT TO SCALE

LEGEND:

- Phase 1a Boundary (18.31 ac.)
- Parcel Boundary
- OHWM
- 150' Shoreline Buffer
- Shoreline Jurisdiction
- FEMA Floodway
- 100-Year Floodplain
- Ditch with Flow Direction
- 5' Contours
- Proposed Manhole
- Proposed Storm Pipe
- Proposed Gabion Wall
- Proposed Edge of Grading
- Proposed Boundary Line Adjustment
- Proposed Temporary Gravel Road
- Shoreline Buffer Planting Area 1 (0.172 ac./7,487 sq. ft.)
- Shoreline Buffer Planting Area 2 - Seeded Only (0.050 ac./2,195 sq. ft.)
- Shoreline Buffer Planting Area 3 (0.032 ac./1,400 sq. ft.)
- Shoreline Jurisdiction Planting Area - Seeded Only (0.014 ac./629 sq. ft.)
- Proposed Rootwad (5)
- Proposed Rootwad Log (2)
- Mitigation Area Signage

NOTE(S):

1. Aerial from Google Earth™.
2. OHWM, contours, and parcel boundaries were surveyed by MacKay and Sposito.
3. Mitigation areas will have biodegrable jute erosion fabric anchored down by proposed willow stakes and large rootwads.
4. Plants, rootwads, and rootwad logs are not to scale and locations are approximate as shown. Actual locations will be determined in the field, with consideration to the listed spacing and density to produce the most natural appearance possible.



Shoreline Buffer Planting Area 1-Mitigation of 0.172-acres/7,487 square feet

Species	Spacing (on-center)	Stock	Quantity
Shrubs			
Scouler's willow (*Salix scouleriana*, FAC)	4-feet	cutting	200
Dune willow (*Salix hookeriana*, FACW)			135
Sitka willow (*Salix sitchensis*, FACW)			135
		Total	**470**

Shoreline Buffer Planting Area 1-Mitigation of 0.172-acres/7,487 square feet
Upland Disturbance Areas – Sunmark Seeds Stream Bank Plus

Species	Composition	Rate	Quantity
Native red fescue (*Festuca rubra*, FAC)	50%	1lb/1,000 sq. ft.	Approximately 7.5 lbs
California brome (*Bromus carinatus*, NI)	20%		
Blue wildrye (*Elymus glaucus*, FACU)	20%		
Large leaf lupine (*Lupinus polyphyllus*, FAC)	10%		
Total	100%		

Shoreline Buffer Planting Area 2-Restoration of 0.050-acres/2,173 square feet
Upland Disturbance Areas – Sunmark Seeds Stream Bank Plus

Species	Composition	Rate	Quantity
Native red fescue (*Festuca rubra*, FAC)	50%	1lb/1,000 sq. ft.	Approximately 2.2 lbs
California brome (*Bromus carinatus*, NI)	20%		
Blue wildrye (*Elymus glaucus*, FACU)	20%		
Large leaf lupine (*Lupinus polyphyllus*, FAC)	10%		
Total	100%		

Shoreline Buffer Planting Area 3-Mitigation of 0.032-acres/1,400 square feet

Species	Spacing (on-center)	Stock	Quantity
Trees			
Lodgepole Pine (*Pinus contorta*, FAC)	10-feet	1-gallon potted	14
		Total	**14**

Shoreline Buffer Planting Area 3-Mitigation of 0.032-acres/1,400 square feet
Upland Disturbance Areas – Sunmark Seeds Stream Bank Plus

Species	Composition	Rate	Quantity
Native red fescue (*Festuca rubra*, FAC)	50%	1lb/1,000 sq. ft.	Approximately 1.4 lbs
California brome (*Bromus carinatus*, NI)	20%		
Blue wildrye (*Elymus glaucus*, FACU)	20%		
Large leaf lupine (*Lupinus polyphyllus*, FAC)	10%		
Total	100%		

Figure 7
MITIGATION PLAN
Castle Rock Buisness Park Permitting Outfall
CT6, LLC
Castle Rock, Cowlitz County, WA
Section 14,23, Township 9N, Range 2W, W.M.

DATE: 2/19/25
DWN: EF
REQ. BY: EV
PRJ. MGR: EV
CHK: GB
PROJECT NO: 1098.11

1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371
Fax: (360) 414-9305
www.eco-land.com
Ecological Land Services

0 40 80
SCALE IN FEET

N W E S

2/19/2025 9:23 AM C:\Users\Emilio\Box\ELS\WA\Cowlitz\Castle Rock\1098-Tapani\1098.11-CR Business Park Permitting\1098.11-Figures\1098.11_PHASE1.dwg Emilio

Ecological Land Services

December 4, 2024

CT6, LLC
Attn: Mr. Shane Tapani
PO Box 1419
Battle Ground, Washington 98604

Subject: Castle Rock Business Park Memorandum | Update to the Ordinary High Water Mark of the Cowlitz River | Castle Rock, Cowlitz County, Washington

Mr. Tapani,

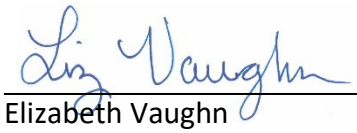
Ecological Land Services, Inc. (ELS) assessed Cowlitz County Parcel Numbers 6143802, 30864, 308640200, 30813, 30812, and a portion of Department of Natural Resources (DNR) property, for critical areas on August 23, 2021 and March 23, 2022 in preparation for future development of the study area. The study area is located in Castle Rock, Washington within Section 23, Township 9 north, and Range 2 west of the Willamette Meridian (Figure 1). ELS has completed further field work regarding the ordinary high water mark (OHWM) of the Cowlitz River. This letter contains details regarding updates to the location of the OHWM in Phase 1a and 1b boundary.

An amended report summarizing methodology and critical areas, *Castle Rock Business Park Amended Critical Areas Report* (ELS 2022), was prepared by ELS and submitted to Mr. James Carsner of the U.S. Army Corps of Engineers (Corps) and to the appropriate Washington Department of Ecology (Ecology) staff for the purpose of a formal wetland boundary verification and verification of the OHWM flagging on the Cowlitz River and Salmon Creek in 2022. Wetland and stream boundaries and the OHWM of the Cowlitz River were verified by Ecology via email on August 25, 2022 and by Corps on September 16, 2022 (Corps Reference Number NWS-2022-557).

An additional study area visit was conducted to revise the OHWM boundary with Ecology on August 29, 2024 and verified via email the same day. Additionally, the boundary of future proposed development of a stormwater outfall conveyance system has been added (Phase 1a) and the boundary of future proposed development of a recreational RV park (Phase 1b). The Phase 1a and 1b boundary and verified changes to the OHWM of the Cowlitz River are shown on Figure 2.

If you have any questions please contact Elizabeth Vaughn at elizabeth@eco-land.com, or Francis Naglich at francis@eco-land.com, or by phone at (360) 578-1371.

Sincerely,



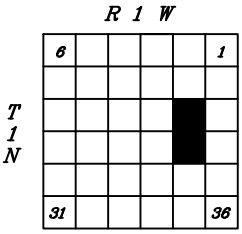
Elizabeth Vaughn
Wetlands Biologist I

Francis Naglich
Principal/Sr. Wetland Biologist

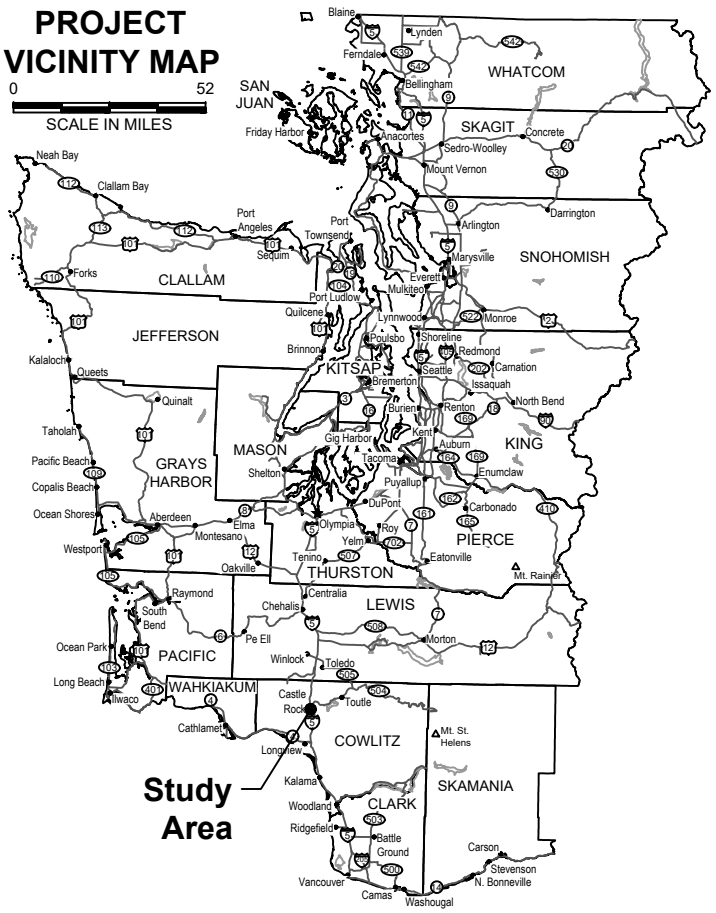
WASHINGTON

Latitude: 46.2552°
Longitude: -122.8900°

LOCATION MAP



PROJECT VICINITY MAP



NOTE:
Quadrangle topographic map from USGS.

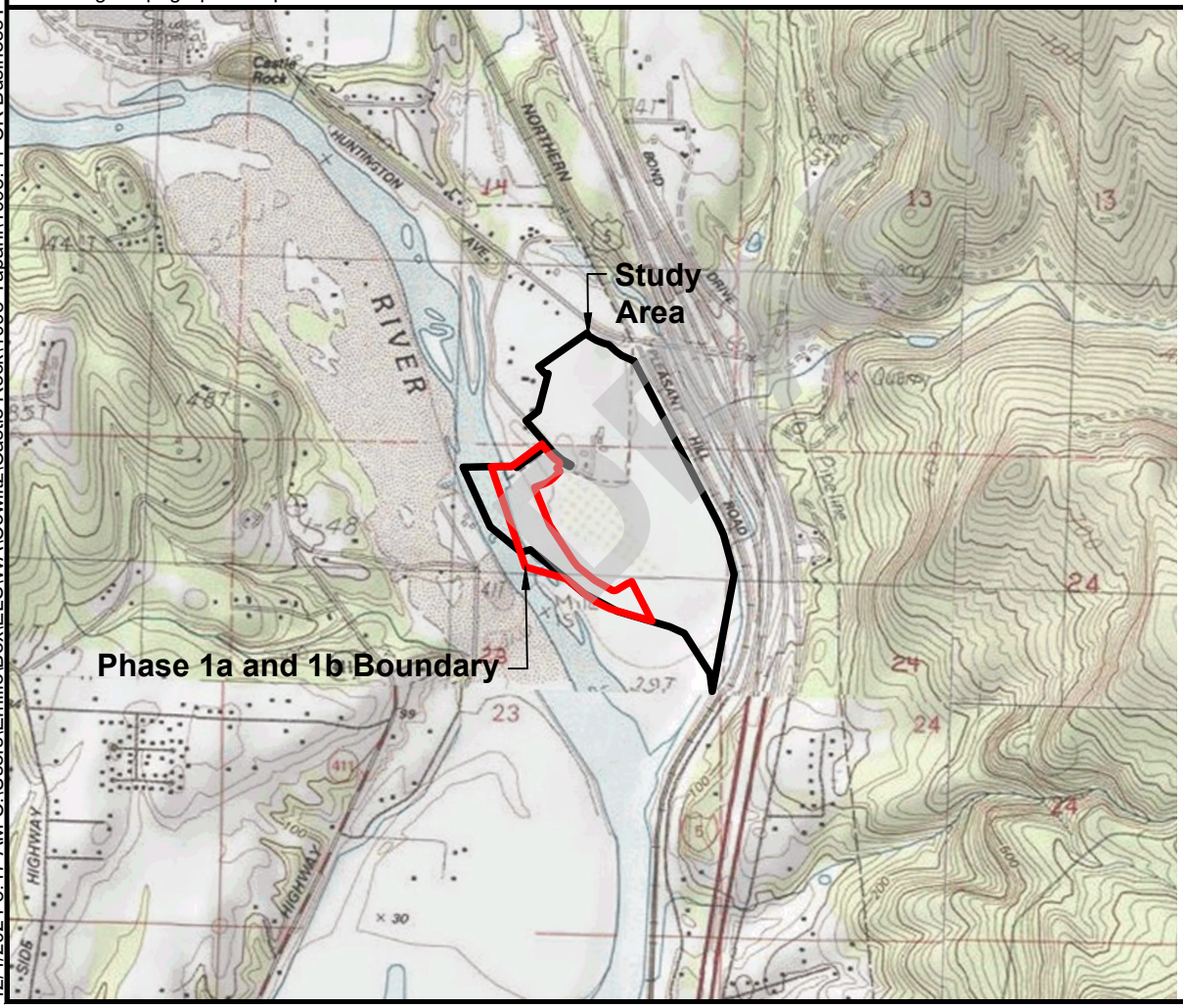


Figure 1
VICINITY MAP
Castle Rock Buisness Park Permitting Memo
CT6, LLC
Castle Rock, Cowlitz County, WA
Section 14,23, Township 9N, Range 2W, W.M.

DATE: 12/4/24
DWN: EF
REQ. BY: EV
PRJ. MGR: EV
CHK: GB
PROJECT NO: 1098.11

1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371
Fax: (360) 414-9305
www.eco-land.com
Ecological Land Services

0 2000 4000
SCALE IN FEET

N
W E
S

12/4/2024 8:47 AM C:\Users\Emilio\Box\ELS\WA\Cowlitz\Castle Rock\1098-Tapani\1098.11-CR Business Park Permitting\1098.11-Figures\1098.11 PHASE1 DL.dwg Emilio

52 BNSF Seattle Subdivision

Huntington Ave S

Larson Ln SW

Interstate 5

Bond Rd

Kalmbach Rd

Pleasant Hill Rd

Bonner Dr

Parcel #: 30813

Parcel #: 30812

Parcel #: 6143802

Parcel #: 30864

Parcel #: 308640200

Wetland B
Depressional
Category III
Emergent
Seasonally Flooded
Saturated Only
(0.13 ac./5,717 sq. ft.)

Wetland A
Slope
Category III
Forested
Emergent
Saturated Only
(4.14 ac./
180,521 sq. ft. onsite)

Wetland C
Depressional
Category III
Emergent
Seasonally Flooded
Saturated Only
(0.17 ac./7,414 sq.ft.)

Ditch #1

Ditch #1A

Ditch #3

Ditch #4

200'

150'

Cowlitz River
(Type S)

Salmon Creek
(Type S)

DNR Property Boundary

DRAFT

LEGEND:

- Study Area
- Phase 1a and 1b Boundary
- Parcel Boundary
- OHWM
- Stream Buffer
- 200' Shoreline Jurisdiction
- FEMA Floodway
- 100-Year Floodplain

NOTE(S):

1. Aerial from Google Earth™.
2. Wetland and stream boundaries were verified by Ecology on 8/25/22 and Corps on 9/16/24. The OHWM of the Cowlitz River was updated and verified by Ecology on 8/29/24.
3. Wetland boundaries and OHWM of the Cowlitz River and Salmon Creek were surveyed by MacKay and Sposito 9/5/24.

N W E S

0 400 800
SCALE IN FEET

Ecological Land Services
1157 3rd Ave., Suite 220A
Longview, WA 98632
Phone: (360) 578-1371
Fax: (360) 414-9305
www.eco-land.com

DATE: 12/4/24
DWN: EF
REQ. BY: EV
PRJ. MGR: EV
CHK: GB
PROJECT NO: 1098.11

Figure 2
EXISTING CONDITIONS
Castle Rock Buisness Park Permitting Memo
CT6, LLC
Castle Rock, Cowlitz County, WA
Section 14,23, Township 9N, Range 2W, W.M.

City of Castle Rock

Building & Planning Department

141 A St SW / PO Box 370
Castle Rock, WA 98611
Phone: (360) 274-8181
finance@ci.castle-rock.wa.us
kakesson@ci.castlerock.wa.us

Excavation and Grading

Supplemental Addendum

Permits Required Except as specified below, no person shall do any grading without first having obtained a grading permit from the building official.

Exempted Work A grading permit is not required for the following:

1. When approved by the building official, grading in an isolated, self-contained area if there is no danger to private or public property.
2. An excavation below finished grade for basements and footings of a building, retaining wall or other structure authorized by a valid building permit. This shall not exempt any fill made with the material from such excavation or exempt any excavation having an unsupported height greater than 5 feet (1524 mm) after the completion of such structure.
3. Cemetery graves.
4. Refuse disposal sites controlled by other regulations.
5. Excavations for wells, tunnels or utilities.
6. Mining, quarrying, excavating, processing or stockpiling of rock, sand, gravel, aggregate or clay where established and provided for by law, provided such operations do not affect the lateral support or increase the stresses in or pressure upon any adjacent or contiguous property.
7. Exploratory excavations under the direction of soil engineers or engineering geologists.
8. An excavation that (1) is less than 2 feet (610 mm) in depth or (2) does not create a cut slope greater than 5 feet (1524 mm) in height and steeper than I unit vertical in 1 ½ units horizontal (66.7% slope).
9. A fill less than 1 foot (305 mm) in depth and placed on natural terrain with a slope flatter than 1 unit vertical in 5 units horizontal (20% slope), or less than 3 feet (914 mm) in depth, not intended to support structures, that does not exceed 50 cubic yards (38.3 M3) on any one lot and does not obstruct a drainage course. Exemption from a permit shall not be deemed to grant authorization for any work to be done in any manner in violation of the provisions of the International Building Code or any other laws or ordinances of this jurisdiction.

If you feel your project is exempt from permit; please circle the appropriate items above. Even if you feel your project is exempt from permits, please provide the drawings required on page two (2) and the following information:

How much total volume of material is involved in the excavation and grading activity? Be sure to include cuts, Fills and/or road building. (27 cubic feet = 1 cubic yard) 1,098 CY

Indicate the type of excavation and/or grading activity (CIRCLE ALL THAT APPLY):

Cut Fill Grading Foundation Excavation Road building

Placing Culverts/Utilities* Retaining Wall Landscaping

Excavation and Grading
Supplemental Addendum

Provide the following Information for CUTS:
No. Cubic Yards: 121 CY
Finished Slope of Cut: 0% - 33%
Slope Prior to Cutting: 0% - 50%

Provide the following information for FILLS:
No. Cubic Yards: 977 CY
Slope Prior to Filling: 0% - 50%
Maximum Depth of Fill: 7.5'
Finished Slope of Fill: 0% - 33%
Material Used for Fill: On-Site Borrow

What type of material is involved in the excavation and grading activity (Including Cuts and Fills)?

	Amount in Cubic Yards	Percentage of Total Amount
Dirt/Soil	1,098 CY	100%
Large Rock 12"+		
Pit Run 4"-12"		
Fines Less Than 4"		
Concrete over 12"		
Concrete Less Than 12"		
Other (State Type)		

Will the proposed excavation and/or grading cause one of the following (Circle YES or NO).

YES	(NO)	Create runoff
YES	(NO)	Will runoff impact neighboring property
(YES)	NO	Will finish grading retain runoff on property
(YES)	NO	Will the effects of the runoff be negligible
(YES)	NO	Will runoff be contained within an approved drainage system

Describe impacts of runoff after filling and/or finish grading (If you answered YES to any of the above Items, please explain):

Runoff from the proposed grading will be controlled to contain sedimentation and prevent runoff onto properties adjacent to the project site. The effects of the runoff will be negligible, as BMPs will be put in place to mitigate any impacts from runoff. Flow paths and runoffs will utilize the existing drainage channels and outfall after sedimentation removal.

What measures will be implanted for erosion control?
BMPs from the 2019 Stormwater Management Manual for Western Washington will be implemented including the following: BMP C105, C120, C130, C201, C233

If your excavation/grading activity meets one or more of the following criteria, you may be deemed exempt From SEPA review. (CHECK applicable spaces below):

_____ Activity involves less than 100 cubic yards
_____ Is for septic system installation
_____ Is for foundation excavation or associated backfill
_____ Is for Landscaping

A SEPA Review was previously completed for this area with the mass grading permit

***NOTE:** Some projects may require additional information, plans or permits upon our review.

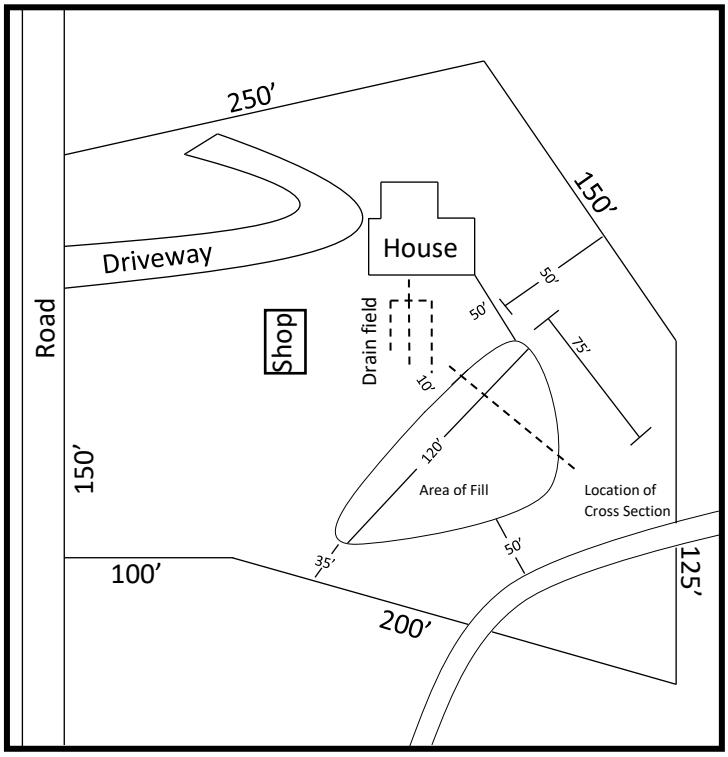
Signature: _____ Date: _____

Excavation and Grading
Supplemental Addendum

SITE PLAN MUST SHOW:

1. Lot dimensions and property lines.
2. Directional arrow indicating north.
3. Any existing or proposed roads or driveways.
4. Any existing structures and their distances to each other, to property lines, to the centerline of the road and to ascending and descending slopes.
5. Location of drain fields, slope of land, wells, and their distances o proposed or existing structures or projects.
6. Location and dimensions of any excavation or grading.
7. Bodies of water, natural and manmade (streams, creeks, rivers, ditches, etc.), and distance to proposed structures or developments.
8. All easements (utility, access, etc.)
9. Adjacent property addresses and uses.
10. Location of retaining walls.

EXAMPLE SITE PLAN:



APPLICANT'S SITE PLAN:

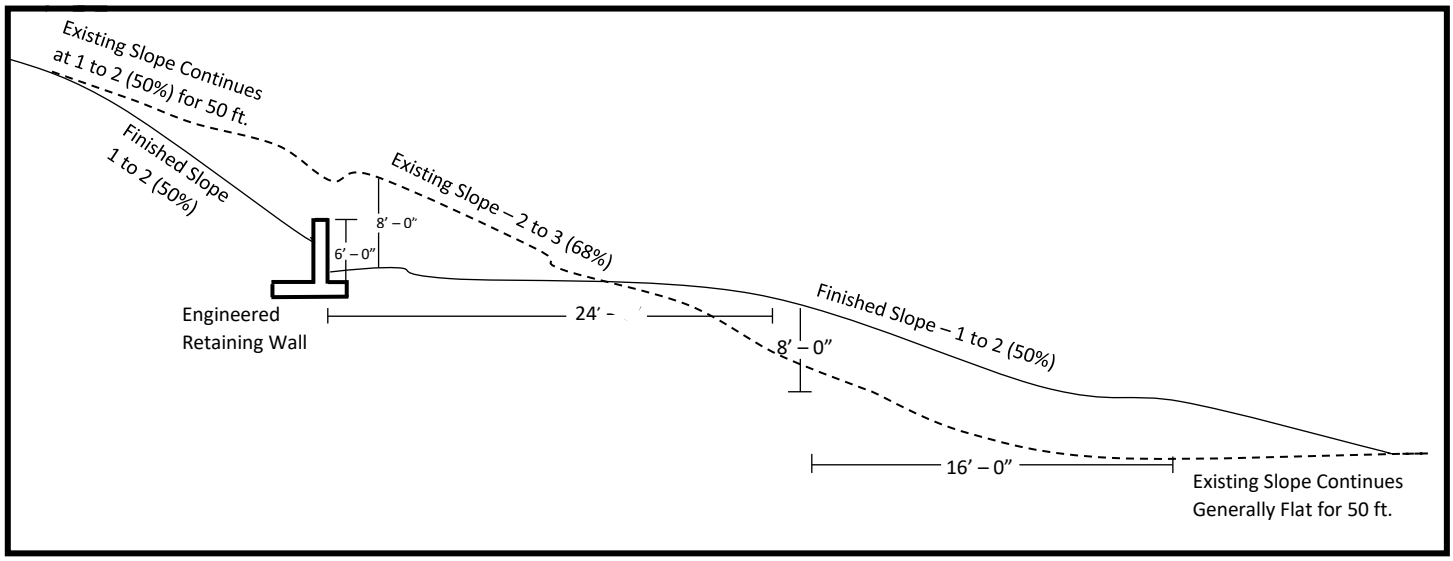
see attached

Excavation and Grading
Supplemental Addendum

CROSS SECTION MUST SHOW:

1. Maximum depth of fill and maximum height of cut.
2. Buildings and their setbacks to ascending and descending slopes.
3. Existing grade (before any work is done) to extend a minimum 20’ beyond scope of work.
4. Finished grade of cuts and fills to extend a minimum of 20’ beyond scope of work.
5. Retaining walls.
6. Grade of all existing cut and fill areas (ex. 2 units horizontal to 1 unit vertical).

EXAMPLE CROSS SECTIONS:



APPLICANT’S CROSS SECTION:

see attached

City of Castle Rock
PO Box 370
Castle Rock, WA 98611
(360) 274-7478

Letter of Completeness

CT6, LLC
Ingrid Friedberg,
Special Projects Manager
PO Box 1419, Battle Ground, WA 98604

RE: Landing on the Cowlitz Stormwater Outfall: Substantial Shoreline Development Permit (SSDP) and SEPA Checklist

Ms. Friedberg,

Thank you for submitting a Substantial Shoreline Development Permit (SSDP) and SEPA Checklist to the City of Castle Rock to construct the stormwater outfall in order to support the first phase of development within the approved Landing on the Cowlitz (LOTC) Master Plan. The site is located within the Recreation designated portion of the approved LOTC Master Plan and recently approved Boundary Line Adjustment (CR-BLA-24-01) Parcel 3 and Parcel #308110100.

The city has received the following application materials:

1. Application Submittal Overview
2. Signed Master Application Form
3. Narrative
4. SEPA Checklist
5. Habitat Management, Mitigation and Monitoring Plan dated February 19, 2025, by Ecological Land Services
6. Ordinary High-Water Mark Memo dated December 4, 2024, by Ecological Land Services
7. Check in the amount of $1,500.00 and a check in the amount of $300 made payable to the City of Castle Rock

This letter acts as a letter of completeness for materials received related to the Substantial Shoreline Development Permit (SSDP) and SEPA Checklist. Please keep in mind that during the technical review the city can request clarification, revisions or additional information.

The Shoreline Substantial Development Permit and SEPA will be integrated into the current engineering review for Phase 1 Access & Utilities and the Stormwater Outfall, and all public meetings will be consolidated to streamline the permitting process.

Please reach out if you have any questions.

Sincerely,

Rachel Granrath, Contract Planner

Cc: Karlene Akesson, Deputy Clerk

Exhibit B: Noticing Materials

THE DAILY NEWS

AFFIDAVIT OF PUBLICATION

Longview Daily News
770 11th Ave
(360) 577-2525

State of Florida, County of Broward, ss:

Rachel Cozart, being first duly sworn, deposes and says: That (s)he is a duly authorized signatory of Column Software, PBC, duly authorized agent of Longview Daily News, published in Cowlitz county, has been approved as a Legal newspaper by order of the Superior court of the State of Washington of Cowlitz County, and that the Annexed printed copy is a true copy of the notice in the above entitled matter as it was printed in the regular entire issue of said paper and online at www.tdn.com , for publication dates as listed below, and that said newspaper was regularly distributed to its subscribers during all of said period, and that said notice was published in said paper and not in a supplement form. That the full amount of the fee charged for said forgoing publication is as listed below, and is $3.50 per line for the first insertion and $3.00 per line for each subsequent insertion. There is also an additional charge of $10.00 for every additional affidavit copy over two copies.

PUBLICATION DATES: May. 27 2025

NOTICE ID: cOHx7zvUzI18HHJGlFFH
PUBLISHER ID: COL-WA-100925
NOTICE NAME: CR-25-007/008 - SSDP/SEPA - LOTC Stormwater
Publication Fee: $363.10

Rachel Cozart
(Signed)_____

SHERI SMITH
Notary Public - State of Florida
Commission # HH269383
Expires on May 31, 2026

VERIFICATION

State of Florida
County of Broward

Subscribed in my presence and sworn to before me on this: 06/02/2025

S Smith
_____
Notary Public
Notarized remotely online using communication technology via Proof.

PUBLIC NOTICE
Notice of SEPA Mitigated Determination of NonSignificance (MDNS), Substantial Shoreline Development Permit, and Public Hearing
Phase 1: Stormwater Outfall Landing on the Cowlitz Master Planned Development

Lead Agency: City of Castle Rock, WA
Proponent: CT6, LLC
Location: Landing on the Cowlitz (LOTC) Master Plan, formally Parcel 3 (#6143802), adjusted per Boundary Line Adjustment (CR-BLA-24-01 – AFN#3762029)

Description of proposal: The applicant has submitted a Substantial Shoreline Development Permit (SSDP) and SEPA Checklist to the City of Castle Rock to construct the stormwater outfall in order to support the first phase of development within the approved Landing on the Cowlitz (LOTC) Master Plan.

Mitigated Determination of Non-Significance (MDNS): The City of Castle Rock has determined that this proposal will not have a probable significant adverse impact on the environment. Pursuant to WAC 197-11-350(3), the proposal has been clarified, changed, and conditioned to include necessary mitigation measures to avoid, minimize or compensate for probable significant impacts. Materials are available at the City's website www.ci.castle-rock.wa.us or available to the public on request at: 141 "A" Street SW, Castle Rock, WA 98611.

Notice of Public Hearing of the Planning Commission:
Date: June 17, 2025
Time : 6:00 pm
Location : Castle Rock Senior Center 222 2nd Ave SW, Castle Rock, WA 98611
Purpose: To review the proposed Substantial Shoreline Development permit and SEPA MDNS to construct a stormwater outfall with the first phase of development.

This MDNS is issued under WAC 197-11-350 and the comment period will end on June 10, 2025.

Agency Contact: City Contract Planner Rachel Granrath, Submit written comments to: Karlene Akesson, Deputy Clerk, City of Castle Rock, PO Box 370, Castle Rock, WA 98611 or to kakesson@ci.castle-rock.wa.us

Signature: Rachel Granrath, May 20, 2025

Appeal: Castle Rock Municipal Code (CRMC) 18.04.210 and 18.04.220 (E)
5/27 COL-WA-100925

Notice of SEPA MDNS, Substantial Shoreline Development Permit, and Public Hearing

1 message

Karlene Akesson <kakesson@ci.castle-rock.wa.us> Tue, May 27, 2025 at 8:15 AM
To: Carie Cuttonaro <ccuttonaro@ci.castle-rock.wa.us>, Jason Lugo <jason.lugo@wsdot.wa.gov>, "Mendoza,Jennifer" <mendozaj@cowlitzwa.gov>, sepaunit@ecy.wa.gov, Chris Fritsch <cfritsch@crschools.org>, Taylor Aalvik <taylor.a@cowlitz.org>, SEPA@dahp.wa.gov, "McCoy, Catherine (COM)" <catherine.mccoy@commerce.wa.gov>, Mike Moss <mossm@co.cowlitz.wa.us>, Kessina Lee <TeamRidgefield@dfw.wa.gov>, David Vorse <crpwd@ci.castle-rock.wa.us>, TDN Front Door <frontdoor@tdn.com>, Bill Fashing <bfashing@cwcog.org>, Laurie Lebowsky <laurie.lebowsky@wsdot.wa.gov>, pacific-cascade.region@dnr.wa.gov, Andrea Yoho <yohoa@cowlitzwa.gov>, NRD-Cowlitz Indian Tribe <NRDpermit@cowlitz.org>, Christina Hallock <Tina@swcleanair.org>, sepacenter@dnr.wa.gov, Christian Cordova <Christian.Cordova@wsdot.wa.gov>, Bill LeMonds <chief@cowlitz6fire.org>, Rudy Salakory <Rsalakory@cowlitz.org>, Lorie Clark <lclark@lcfrb.gen.wa.us>, Rachel Granrath <Rachel.Granrath@kimley-horn.com>, Charles Worley <cworley@crpolice.org>, Department of Fish and Wildlife Southwest - Region 5 <R5.planning@dfw.wa.gov>, Duane Johnson <Duane@swcleanair.org>, Jeff Barsness <jeff.barsness@wsdot.wa.gov>
Cc: Karlene Akesson <kakesson@ci.castle-rock.wa.us>

Good morning,

Please see the attached NOTICE of SEPA Mitigated Determination of Nonsignificance (MDNS), Substantial Shoreline Development Permit (SSDP), and Public Hearing for the proposed construction of the stormwater outfall in order to support the first phase of development within the approved Landing on the Cowlitz (LOTC) Master Plan.

Materials are available to be viewed online at:
https://ci.castle-rock.wa.us/notices.htm

Sincerely,
Karlene Akesson
Deputy Clerk
City of Castle Rock
PO Box 370
Castle Rock, WA 98611
Phone: 360-274-8181

City Hall Hours Effective January 2, 2024:

Monday through Thursday, 7:30 AM – 5:00 PM

CLOSED Friday and legal holidays

Public Notice SEPA MDNS SSDP Stormwater Outfall with Map.pdf
303K

City of Castle Rock
PO Box 370
Castle Rock, WA 98611
(360) 274-7478

PUBLIC NOTICE

Notice of SEPA Mitigated Determination of NonSignificance (MDNS), Substantial Shoreline Development Permit, and Public Hearing

Phase 1: Stormwater Outfall Landing on the Cowlitz Master Planned Development

---

Lead Agency: City of Castle Rock, WA
Proponent: CT6, LLC
Location: Landing on the Cowlitz (LOTC) Master Plan, formally Parcel 3 (#6143802), adjusted per Boundary Line Adjustment (CR-BLA-24-01 – AFN#3762029)

Description of proposal: The applicant has submitted a Substantial Shoreline Development Permit (SSDP) and SEPA Checklist to the City of Castle Rock to construct the stormwater outfall in order to support the first phase of development within the approved Landing on the Cowlitz (LOTC) Master Plan.

Mitigated Determination of Non-Significance (MDNS): The City of Castle Rock has determined that this proposal will not have a probable significant adverse impact on the environment. Pursuant to WAC 197-11-350(3), the proposal has been clarified, changed, and conditioned to include necessary mitigation measures to avoid, minimize or compensate for probable significant impacts. Materials are available at the City's website www.ci.castle-rock.wa.us or available to the public on request at: 141 "A" Street SW, Castle Rock, WA 98611.

Notice of Public Hearing of the Planning Commission:

Date: June 17, 2025
Time: 6:00 pm
Location: Castle Rock Senior Center 222 2nd Ave SW, Castle Rock, WA 98611
Purpose: To review the proposed Substantial Shoreline Development permit and SEPA MDNS to construct a stormwater outfall with the first phase of development.

This MDNS is issued under WAC 197-11-350 and the comment period will end on June 10, 2025.

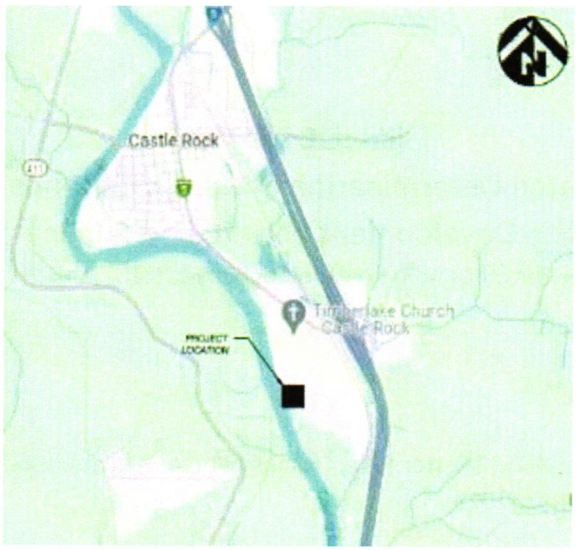
Agency Contact: City Contract Planner Rachel Granrath,
Submit written comments to: Karlene Akesson, Deputy Clerk, City of Castle Rock, PO Box 370, Castle Rock, WA 98611 or to kakesson@ci.castle-rock.wa.us

Signature: Rachel Granrath, May 20, 2025

Appeal: Castle Rock Municipal Code (CRMC) 18.04.210 and 18.04.220 (E)

Parcel #6143802

#CR- BLA-24-01, Parcel 3



AKA Parcel #308120500

Posted at: City Hall, CR Post Office, CR Library on 05/27/2025
Mailed on: 05/27/2025
Notice + Materials Posted on Website: 05/27/2025

Larson lane

2 messages

Brice Anshutz <banshutz@ci.castle-rock.wa.us> Tue, May 27, 2025 at 8:05 AM
To: Karlene Akesson <kakesson@ci.castle-rock.wa.us>

Brice Anshutz <banshutz@ci.castle-rock.wa.us> Tue, May 27, 2025 at 8:10 AM
To: Karlene Akesson <kakesson@ci.castle-rock.wa.us>

On Tue, May 27, 2025, 8:05 AM Brice Anshutz <banshutz@ci.castle-rock.wa.us> wrote:

Posted on site: 05/27/2025

Posted on site: 05/27/2025

Exhibit C: SEPA MDNS

City of Castle Rock
PO Box 370
Castle Rock, WA 98611
(360) 274-7478

STATE ENVIRONMENTAL POLICY ACT
Mitigated Determination of NonSignificance

May 20, 2025

Lead Agency: City of Castle Rock, Washington
Agency Contact: City Contract Planner Rachel Granrath,
Comments submitted to Karlene Akesson, Deputy Clerk, City of Castle Rock, PO Box 370, Castle Rock, WA 98611 or to kakesson@ci.castle-rock.wa.us

Project Description: The applicant has submitted a Substantial Shoreline Development Permit (SSDP) and SEPA Checklist to the City of Castle Rock to construct the stormwater outfall in order to support the first phase of development within the approved Landing on the Cowlitz (LOTC) Master Plan.

Project Location: The site is located within the Recreation designated portion of the approved LOTC Master Plan, formally Parcel 3 (#6143802), adjusted per Boundary Line Adjustment (CR-BLA-24-01 – AFN#3762029). The Castle Rock Landing on the Cowlitz Master Planned Mixed Use Development site is accessed from I-5 from Exit #48 and is located on the south side of Huntington Avenue S, approximately 4 mile west of the exit. The site is located within the Recreation designated portion of the approved Landing on the Cowlitz Master Plan.

Proponent: CT6, LLC
Project Representative: Ingrid Friedberg, Special Projects Manager
Mailing Address: PO Box 1419, Battle Ground, WA 98604
Telephone: (360) 553-9144
Email: ingridf@tapani.com

The City of Castle Rock has determined that this proposal will not have a probable significant adverse impact on the environment. Pursuant to WAC 197-11-350(3), the proposal has been clarified, changed, and conditioned to include necessary mitigation measures to avoid, minimize or compensate for probable significant impacts. An environmental impact statement (EIS) is not required under RCW 43.21C.030. The necessary mitigation measures are listed below, the Environmental Checklist is attached and associated materials are available at the City's website www.ci.castle-rock.wa.us

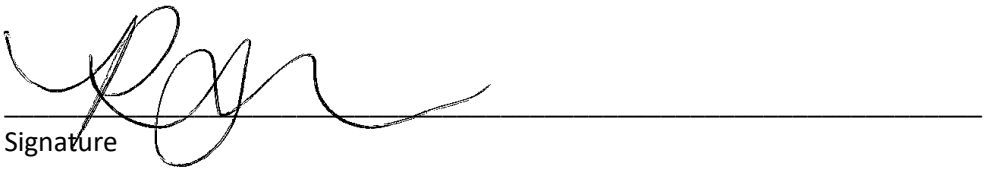
This determination is based on the following mitigation measures, findings and conclusions:

- **Dedication of Improvements**: Upon completion of construction, all site improvements and associated rights-of-way shall be dedicated to the City.
- **Storm Event Mitigation:** Due to the location of the improvements, the applicant shall implement mitigation measures to address impacts during peak storm events and periods of high water as required by stormwater regulations, standards, codes and subject to approval by the City.
- **General Construction Stormwater Permit Compliance**: The applicant shall either amend the existing General Construction Stormwater Permit (GCSP) for the mass grading project or obtain a new permit to cover construction activities related to site access, utilities, and the stormwater outfall. Compliance with this requirement may be included as a condition of the Mitigated Determination of Nonsignificance (MDNS).
- In the event of inadvertent discovery of archaeological resources during site disturbance, all work shall cease in the vicinity of the find and the City shall be notified immediately for further direction.
- The applicant will remain compliant with the Master Planned Development Agreement and conditions associated.
- The applicant will obtain a substantial shoreline development permit and processed as a Type VIII Permit in CRMC 17.77.040 (8).

This MDNS is issued under WAC 197-11-350 and the comment period will end on June 10, 2025.

Responsible Official:

Agency Contact: City Contract Planner Rachel Granrath,
Submit written comments to: Karlene Akesson, Deputy Clerk, City of Castle Rock, PO Box 370, Castle Rock, WA 98611 or to kakesson@ci.castle-rock.wa.us
Telephone: (360) 274-7478.



Signature

May 20, 2025

Appeal process: Castle Rock Municipal Code (CRMC) 18.04.210 and 18.04.220 (E)

Exhibit D: Comments Received

Gmail

Karlene Akesson <kakesson@ci.castle-rock.wa.us>

Larsen lane -CT6, LLC Tapani, 6 brothers!, hidden 6.

2 messages

sheryl adams <sheryladams2012@yahoo.com> Sun, Jun 1, 2025 at 9:02 PM
To: kakesson@ci.castle-rock.wa.us

Well , sounds like I was right about Larsen lane 3 years ago ! No one wants to be sold out to tapani and there lies about our road. We were promised no outlet or public access to river , we were promised from the city of castle rock, not to be used!!! City said and tapani said Larsen lane we not be allowed for traffic and be opened for access to development! Also we want our eagles to nest and our beavers not to be bothered also we have geese out with there babies. The wildlife will be impacted on this despicable act done by you the city of castle rock! I was told that our road wasn't going to be touched! See if you keep your word or you sold us out for a pile of cement. And the tax payers are paying for the new water project! . Has the city checked the levels of lead in town at school's pipes! I think that's more important than a development . Don't sell Larsen lane out for tapani and there pile of concrete! It's not right!!! Also the road sign says comments by 10 of June ! Letters are different than what you send . You need to post all letters on road!!!

sheryl adams <sheryladams2012@yahoo.com> Sun, Jun 1, 2025 at 9:24 PM
To: kakesson@ci.castle-rock.wa.us

Sent from my

> On Jun 1, 2025, at 9:02 PM, sheryl adams <sheryladams2012@yahoo.com> wrote:
>
> Well , sounds like I was right about Larsen lane 3 years ago ! No one wants to be sold out to tapani and there lies about our road. We were promised no outlet or public access to river , we were promised from the city of castle rock, not to be used!!! City said and tapani said Larsen lane we not be allowed for traffic and be opened for access to development! Also we want our eagles to nest and our beavers not to be bothered also we have geese out with there babies. The wildlife will be impacted on this despicable act done by you the city of castle rock! I was told that our road wasn't going to be touched! See if you keep your word or you sold us out for a pile of cement. And the tax payers are paying for the new water project! . Has the city checked the levels of lead in town at school's pipes! I think that's more important than a development . Don't sell Larsen lane out for tapani and there pile of concrete! It's not right!!! Also the road sign says comments by 10 of June ! Letters are different than what you send . You need to post all letters on road!!!
>
>

5 attachments

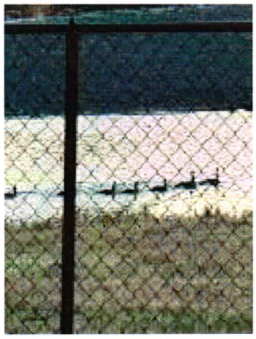


image0.jpeg
2925K

SEPA Record# 202502192
CR-24-051 - CRP-25-007/008

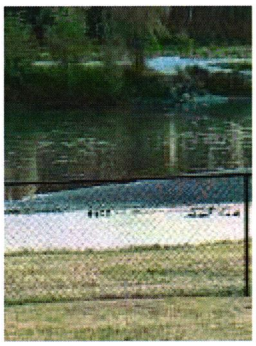


image1.jpeg
3748K

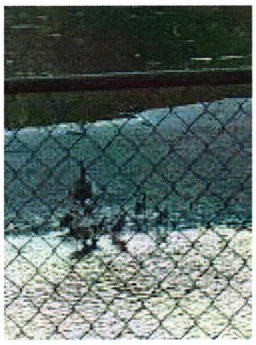


image2.jpeg
2512K

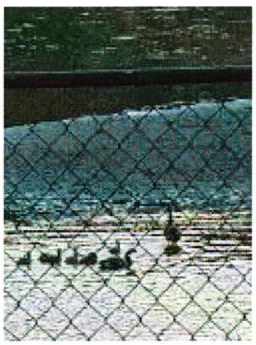


image3.jpeg
2567K

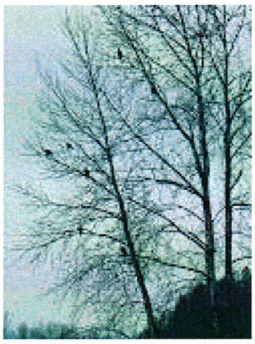


image4.jpeg
3047K

Gmail

Karlene Akesson <kakesson@ci.castle-rock.wa.us>

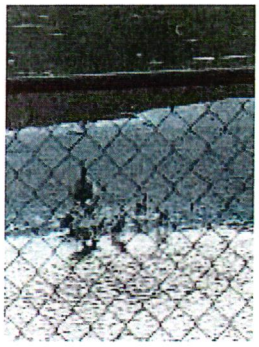
Castle rock , tapani construction are back yard to Cowlitz. Babies geese

1 message

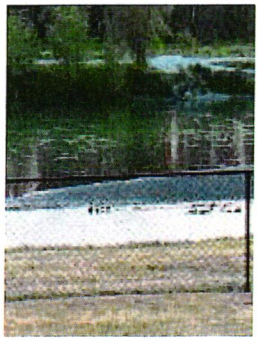
sheryl adams <sheryladams2012@yahoo.com> Mon, Jun 2, 2025 at 7:04 PM
To: kakesson@ci.castle-rock.wa.us

Sent from my iPhone

5 attachments



IMG_0534.jpg
2512K

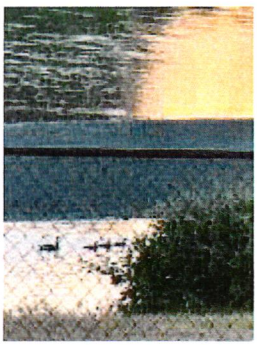


IMG_0533.jpg
3748K

SEPA Record # 20250292
OR-24-051-CRP -25-007/008

IMG_0530.jpg
2925K

IMG_0529.jpg
2458K



IMG_0527.jpg
2992K

This proposed outflow is the harbinger of issues to come and so must bear this present scrutiny not only in design but in its overall purpose. The construction of this outfall raises questions that must begin to be answered at this point in development since an outfall is pointless unless it is attached to some body of water.

1)WOTUS and Setbacks
There is a lack of consensus among the courts as to whether drainage ditches can be considered WOTUS. Please see included documentation from Somach Simmons & Dunn, attorneys at law.

Courts Apply New WOTUS Rule to Ditches and Canal

In the face of this uncertainty it is incumbent upon the applicant to provide for any neighboring property the maximum EPA/governmental agencies setbacks required now or in a future caused by this development. The applicant has created "new drainage features" with the creation of their drainage ditch and should be required to insure that said ditch will NEVER encroach on neighboring property's ability to build or develop, ie setbacks from waterways or other environmental requirements. To fail to do so would constitute the unlawful use of eminent domain by a corporation.

2) Using the "new drainage ditch" to drain stormwater from Timberlake Church and the properties surrounding them, opens the issue of a previously closed infiltration system (that was totally contained on those properties and did not overflow onto the Hornstra, now Tappani property) to the uncertainties of a WOTUS declaration by the EPA or other agencies and potential loss of development use to the properties it drains. (Please see historical data and brief explanation included.)
It is incumbent upon the developers to a) create a closed infiltration system for these properties similar to the closed system in use before the applicant's destruction of that system so they could hookup to their "new ditch" or b) insure in perpetuity that their mitigations include all properties that drain stormwater into the "new drainage ditch" and are free from future stormwater related encumbrances to development.

The above stated concerns are relevant at this stage of planning because the applicant is proposing an outflow that directly discharges in a WOTUS River, the Cowlitz, thus forcing a discussion and decision by EPA and other agencies as to whether "the new ditch" including all waters discharged by this outfall and the ditch supplying the outfall will be declared WOTUS and subject to setback and environmental requirements of WOTUS.

Additionally: at present there are no apparent wetlands or environmentally sensitive areas that "the new ditch" drains, but as the ditch ages, wetlands grasses ie wire grass, cattails, and other determinate plants will grow as well as it providing homes for wetland birds and animals. This will create the potential for future EPA and other agencies designation of "the new ditch" (which is drained by this proposed outflow) as an environmentally sensitive area, requiring setbacks and mitigation to development on adjacent properties.

RECEIVED 6/2/2025

Finally, I am adamantly opposed to transferring responsibility for maintenance of the infiltration/ overflow system to the church. It must remain Tappani's or the city's responsibility to avoid the same scenario as is presently the case where the city approved, privately engineered design, fails to eliminate the stormwater successfully and leaves the landowners holding the bag for remediation. At minimum a 20 year performance bond must guarantee the proper functioning of this system.

This outflow consequently becomes the harbinger of issues to come and so must bear this present scrutiny as part of this decision making process.

Roy Henson
2278 LARSEN LN SW
1933 HUNTINGTON AVE S
2335 LARSEN LN SW

RECEIVED
6/2/2025

SOMACH SIMMONS & DUNN

ATTORNEYS AT LAW

Subscribe to our eAlerts

October 15, 2024 | Written by Ellen M. Moskal

Lack of Consensus Emerges as Courts Apply New WOTUS Rule to Ditches and Canals

The limits to federal jurisdiction over "waters of the United States" (WOTUS) have continued to develop following the Supreme Court's landmark decision in *Sackett v. Environmental Protection Agency*, as federal district courts begin to vary in determining federal Clean Water Act jurisdiction over manmade ditches and canals.

A critical question, subject to extensive rulemaking and litigation over past decades, involves the extent to which manmade ditches and canals qualify as waters of the United States subject to federal regulation. In 2001, in *Headwaters Inc. v. Talent Irrigation District*, the Ninth Circuit Court of Appeal recognized manmade irrigation canals as WOTUS if water flowed, at least occasionally, through such features into natural streams. The United States Environmental Protection Agency (EPA) took a consistent view, defining WOTUS to include drainage ditches, even with only intermittent flow, provided that they were tributary to a water of the United States and had perceptible ordinary high water marks.

RECEIVED 6/2/2025

The landscape changed with the Supreme Court's 2006 decision in *Rapanos v. United States* and *Carabell v. United States* (collectively referred to as *Rapanos*), in which the plurality opinion instituted the "relatively permanent" test ("relatively permanent, standing or continuously flowing bodies of water" that are connected to traditional navigable waters, plus wetlands with a "continuous surface connection" to such relatively permanent water bodies, are WOTUS) while a concurrence relied on the "significant nexus" test (WOTUS include wetlands that possess a "significant nexus" to waters that are or were navigable in fact or that could reasonably be so made). The EPA and Army Corps of Engineers issued guidance in 2008, advising that waters that satisfied either test qualified as WOTUS. The Trump and Biden Administrations subsequently adopted competing definitions of WOTUS within the confines of the *Rapanos* decision.

Then, in May 2023, the Supreme Court decided *Sackett*. The court upheld the "relatively permanent" test to the exclusion of the "significant nexus" test, finding that WOTUS include "only those relatively permanent, standing or continuously flowing bodies of water 'forming geographic[al] features' that are described in ordinary parlance as 'streams, oceans, rivers, and lakes.' " Some interpreted this holding as supporting the position that canals and ditches would not qualify as WOTUS because they are not ordinarily described as streams, oceans, rivers, or lakes. The EPA subsequently adopted a revised definition of WOTUS to comport with the *Sackett* decision, expressly excluding, in relevant part, "Ditches (including roadside ditches) excavated wholly in and draining only dry land and that do not carry a relatively permanent flow of water." The revised definition became effective in September 2023. Notably, this definition does not clearly align with *Sackett*, as it does not address the Supreme Court's expression of the limitation to relatively permanent bodies of water that are ordinarily described as streams, oceans, rivers, and lakes.

Over the last year, United States district courts have begun to apply *Sackett* to determine whether canals and ditches qualify as WOTUS. While a consensus has begun to emerge, it has not been consistently interpreted. In the first case decided after *Sackett*, *San Francisco Baykeeper v. City of Sunnyvale* (*Baykeeper*), the District Court for the Northern District of California reconsidered and upheld its pre-*Sackett* holding that a manmade channel qualified as WOTUS. The channel at issue conveys stormwater, irrigation water runoff, and groundwater to traditional WOTUS. The court held that it qualified under *Sackett* because, though it flowed seasonally, "it flows continuously during certain times of the year" and "more than in direct response to precipitation." The court also rejected the "argument that *Sackett* calls into question whether manmade channels with continuous seasonal flows such as this can be [WOTUS] merely because they are manmade." It did not, however, explain why its holding is consistent with *Sackett's* language limiting WOTUS to those "described in ordinary parlance as 'streams, oceans, rivers, and lakes.' " Similarly, the District Court for the Western District of Washington indicated, in *Waste Action Project v. Girard Res. and Recycling, LLC*, that a ditch flowing into a creek could be grounds for qualification as WOTUS, but did not decide the issue.

RECEIVED 6/2/2025

In contrast, other district courts have recognized or applied stricter limitations on manmade ditches. Following *Sackett*, the plaintiff in *Ragsdale v. JLM Construction Services, Inc.* (*Ragsdale*), which was decided in the District Court for the Western District of Texas, abandoned his claims that the defendant violated the Clean Water Act by discharging into manmade features, conceding "that the stock pond, drainage ditches, culverts, and trenches are not covered under the [Clean Water Act]." Similarly, in *United States v. Sharfi* (*Sharfi*), the District Court for the Southern District of Florida in 2024 held that seasonal drainage ditches with varying flow throughout the year were not WOTUS under *Sackett*, focusing on the fact that ditches are not ordinarily described as streams, oceans, rivers, or lakes, and that flow was intermittent. Notably, the *Ragsdale* and *Sharfi* courts both cited *Baykeeper* for the general history of the WOTUS rule leading up to *Sackett*, but did not explain or otherwise acknowledge the inconsistencies between their respective analyses.

The developing split among district courts warrants caution in determining whether manmade canals and ditches qualify as WOTUS under the current regulatory regime, particularly within the Northern District of California, which covers Alameda, Contra Costa, Del Norte, Humboldt, Lake, Marin, Mendocino, Monterey, Napa and San Benito, San Francisco, San Mateo, Sunnyvale, and Santa Cruz counties. Moreover, there is a potential for litigation challenging the regulatory exemption for ditches given its inconsistency with the *Sackett* decision. Pursuant to the Supreme Court's recent decision in *Loper Bright Enterprises, et al. v. Raimondo, Secretary of Commerce, et al.*, courts must review the definition of WOTUS using their independent judgment, rather than deferring to the EPA's interpretation of its statutory authority, increasing the chances for successful challenges to the regulation in light of *Sackett's* definition of WOTUS.

For inquiries or additional information, please contact:

- Ellen M. Moskal, emoskal@somachlaw.com
- Kelley M. Taber, ktaber@somachlaw.com

Somach Simmons & Dunn provides the information in its Environmental Law & Policy Alerts and on its website for informational purposes only. This general information is not a substitute for legal advice, and users should consult with legal counsel for specific advice. In addition, using this information or sending electronic mail to Somach Simmons & Dunn or its attorneys does not create an attorney-client relationship with Somach Simmons & Dunn.

Read more news and alerts »

Meet Our Team »

RECEIVED 6/2/2025

Historical Recap:

The permit for me to short plat and sell the property in 1995 to Cowlitz Valley Christian Center now Timberlake Church, was conditioned by city attorney, city engineer, and city council on the fact that no water would flow across the property line of the Sam Hornstra property per a letter from Odine Husemoen, Sam's attorney. The as built stormwater retention system used 3 French drain/ drywells on my property (1933 and 1955 Huntington, 1955 was subsequently sold for this development) The drywell system functioned successfully as designed. With the construction of the church, the city approved a new stormwater system that included the 3 drywells, berm, and the current bioswale system on the former Timberlake property, now belonging to Tappani. ALL water was contained and perked on site and no stormwater crossed into the Hornstra, now Tappani property. It was a closed system with NO WOTUS potential. Although the berm prevented water from flowing onto the Hornstra property, the churches newly engineered bioswale system backed water onto my property because of what I believe was insufficient sizing for the church runoff.

Currently Tappani destroyed and filled in the third drywell and French drain on my former property and connected the stormwater from Lowe's, now Partridge property, and other northern properties that flows across my property (1933 Huntington) to their drainage system that crosses over the old Hornstra property line. This direct connection of stormwater to their ditch creates a potential WOTUS situation and requires an answer to the original WOTUS question.

RECEIVED
6/2/2025

CR-24-051 -CRP-25-007/008
CRP-25-009

Walstead, Mertsching Husemoen, Donaldson & Barlow P.S. **Attorneys at Law**

FOUNDING PARTNERS
Howard J. Atwell 1880-1962
Ronald Moore 1897-1968
Jerome Walstead 1913-1981

Michael J. Baldwin
John A. Barlow
Mark S. Brumbaugh
Barry J. Dahl
Norman C. Dick
D.L. Donaldson
Timothy J. Hayes
Odine H. Husemoen
Scott M. Kilpatrick
Charles T. Mertsching
Stephen L. Wanderer
Craig W. Weston

January 13, 1995

City Engineer
City of Castle Rock
141 A Street, SW
Castle Rock, WA 98611

RE: South Castle Rock Drainage

Dear Sir or Madam:

Some time ago I wrote you on behalf of Sam Hornstra and his wife about a concern he had over potential drainage problems near his property in south Castle Rock. The purpose of this letter is again to alert you to that concern.

Mr. and Mrs. Hornstra want you to be assured that they have no particular problem with any development or growth in Castle Rock. Their concern centers around a potential problem which seems obvious to him. The area around his home has surface water drainage problems now, and any new construction will add to that particular problem. Therefore, it is suggested that your attention to be addressed to storm and surface water drainage.

If there is to be construction in the area of the Hornstra property, we believe that all those problems could be resolved if sufficient drainage is installed at the time of any new construction. If you are already alerted to this problem, then you may disregard this letter, but if not, please take into consideration this problem as any development could have an adverse affect on the Hornstra property.

Thank you in advance for your courtesy and attention to this letter.

Very truly yours,

Odine H. Husemoen

Odine H. Husemoen

OHH:clm
cc: Mr. and Mrs. Hornstra

1000 Twelfth Avenue, Suite 2 • P.O. Box 1549 • Longview, Washington 98632-7934
Longview (206) 423-5220 • Woodland (206) 225-6339 • Vancouver (206) 694-0606 • Fax No. (206) 423-1478

RECEIVED 6/2/2025

June 9, 1995

Mayor Gene Frymire
City of Castle Rock
P.O. Box 370
Castle Rock, WA 98611

Dear Mayor Frymire:

I wish to inform you that Mr. Roy Henson has agreed to put a berm around his improved property, adequate enough to retain any water runoff from coming onto my property. This is in addition to the drainage system he has already proposed to the council.

If these two measures are done, and the systems are maintained in working order, my concerns regarding the runoff problem from this property will be satisfied.

It is my hope that any further development in the Larsen lane area will be approved with similar conditions to keep any water runoff from draining onto my property.

Sincerely,

Sam Hornstra

Sam Hornstra, Owner
Larsen Lane SW

RECEIVED
6/2/2025

1995

Description of Project: A portion of the subject property is an old river channel of centuries past. During the eruption of Mt. St. Helens in 1980, this channel was filled by the mud flow. This mud flow hardened forming a less permeable surface which now stands water until it slowly percolates and evaporates. (See cross section)

Scope of Project: The plan is two fold. (1) Drain the existing standing water estimated at 4000 cubic feet. (2) Provide a permanent solution in the form of access from the mud flow to the original sandy loam soil. This is accomplished by a series of trenches and dry-wells. (See plan) Since all property in this area drains in a Southerly direction, this property owner was required to provide drainage for all neighboring property lying to the North of the subject property. This is the purpose of dry-well #1. Dry-wells #2 and #3 provide drainage for the subject property.

Details and Specifications: Dry-wells; 3 @ 800 cubic feet each
capable of draining 50 cu.ft\ hr each
total capability is 1200 cu.ft\ day

Trenches; 2 ft. width, tapered depth to 2ft.

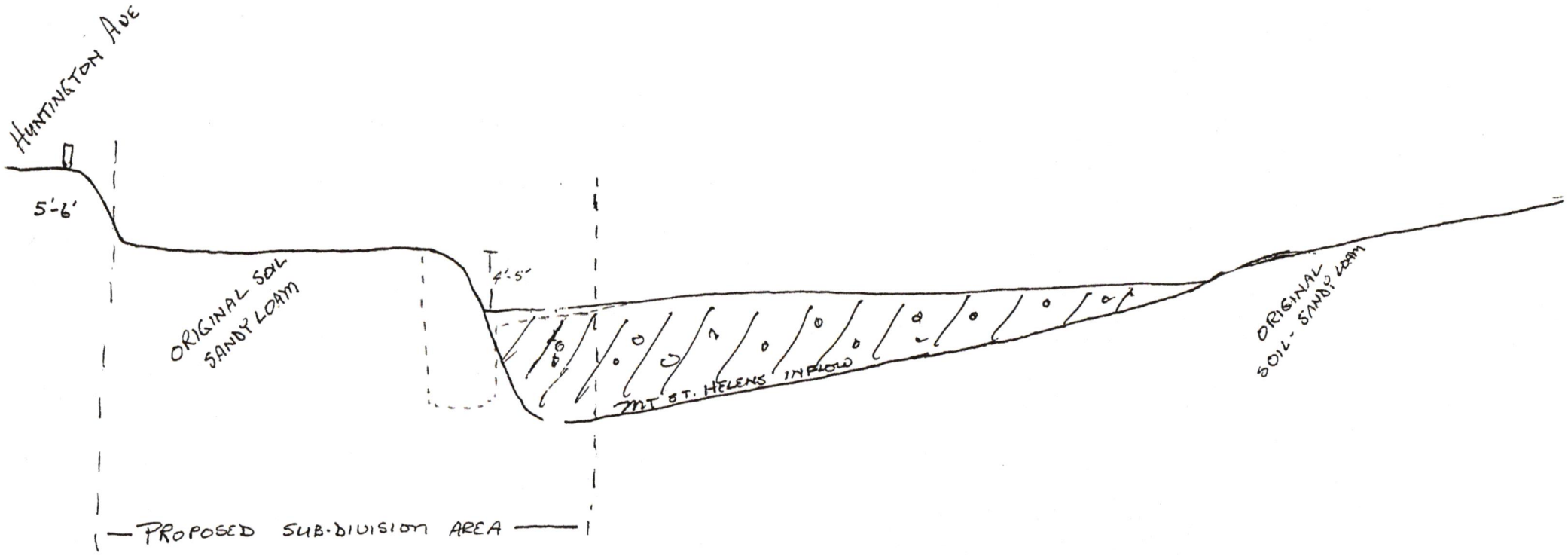
Natural Vegetation; trees planted every 4 ft. along perimeter of property. Young trees will respire 12 gal. water per day. Mature trees 100 gals \day

Rainfall; 1 inch of rain on subject area equals 200 cu.ft

Conclusion: Even in the severest of weather the system has worked. No surface water is flowing onto neighboring properties. Water no longer stands on mud flow area. It is immediately drained away to appropriate dry-well . Video tape of before and after is available as evidence.

RECEIVED
6/2/2025

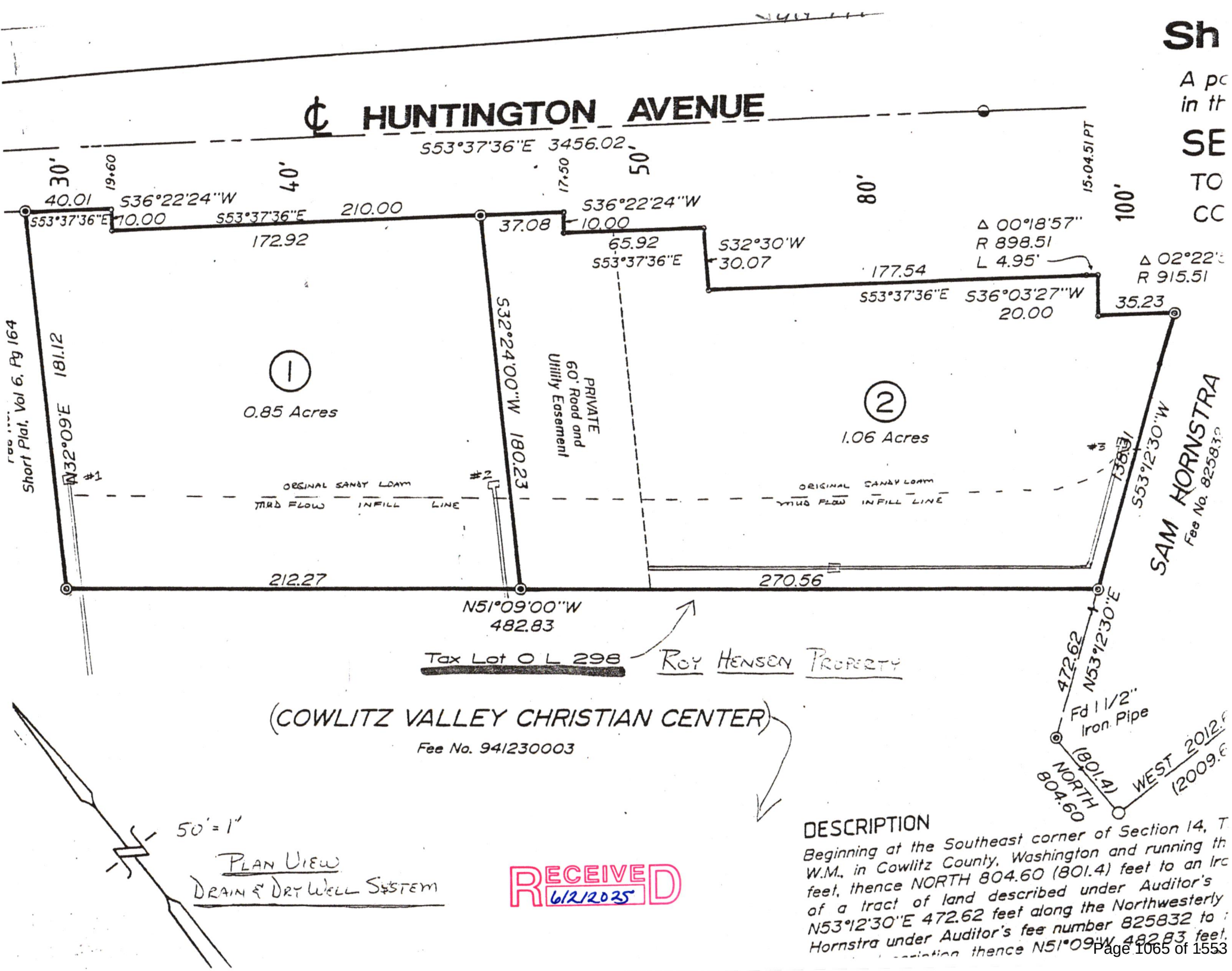
1995



CROSS SECTION LOOKING SOUTH

NOT TO SCALE

RECEIVED 6/2/2025


℄ HUNTINGTON AVENUE
S53°37'36"E 3456.02'
30'
19.60
40'
17.50
50'
80'
15.04.51 PT
100'
40.01
S36°22'24"W
10.00
S53°37'36"E
210.00
172.92
37.08
S36°22'24"W
10.00
65.92
S53°37'36"E
S32°30'W
30.07
177.54
S53°37'36"E
Δ 00°18'57"
R 898.51
L 4.95'
Δ 02°22'
R 915.51
S36°03'27"W
20.00
35.23
Short Plat, Vol 6, Pg 164
181.12
N32°09'E
S32°24'00"W 180.23
PRIVATE
60' Road and
Utility Easement
1
0.85 Acres
2
1.06 Acres
#1
#2
#3
ORGINAL SANDY LOAM
MUD FLOW INFILL LINE
ORIGINAL SANDY LOAM
MUD FLOW INFILL LINE
138.31
S53°12'30"W
SAM HORNSTRA
Fee No. 825832
212.27
270.56
N51°09'00"W
482.83
Tax Lot O L 298
ROY HENSEN PROPERTY
(COWLITZ VALLEY CHRISTIAN CENTER)
Fee No. 941230003
472.62
N53°12'30"E
Fd 1 1/2"
Iron Pipe
(801.4)
NORTH
804.60
WEST 2012
(2009.
50' = 1"
PLAN VIEW
DRAIN & DRY WELL SYSTEM
RECEIVED
6/12/2025
DESCRIPTION
Beginning at the Southeast corner of Section 14, T
W.M., in Cowlitz County, Washington and running th
feet, thence NORTH 804.60 (801.4) feet to an Iro
of a tract of land described under Auditor's
N53°12'30"E 472.62 feet along the Northwesterly
Hornstra under Auditor's fee number 825832 to
thence N51°09'W 482.83 feet.
1995

City of Castle Rock
PO Box 370
Castle Rock, WA 98611

City of Castle Rock

STAFF REPORT

Preliminary Plat

Rivers Edge at the Landing Subdivision

To: Members of the City of Castle Rock Planning Commission
From: Rachel Granrath, Contract Planner
Date: June 12, 2025
Subject: *Public Hearing*: Rivers Edge at the Landing Subdivision

---

Summary of Request and Recommendation

The applicant has submitted a Preliminary Plat for a 45 single family residential unit subdivision located in the 8.93 acre residential designated portion of the Landing on the Cowlitz (LOTC) Master Plan. The development will be accessed by a single residential local access roadway connecting to the Standard Collector Road. Potential for a future connection to Larsen Lane SW may be obtained depending on agreements with neighboring property owners and feasibility. The Planning Commission is holding a public hearing and shall act in accordance with CRMC 16.12.070 to make findings of fact and provide a recommendation to the city council that this application be approved, disapproved, or approved with conditions.

Staff Recommendation: Staff recommends approval of this application, with conditions.

General Information

Location: 0 Larsen Lane SW (Parcel 308120300) adjusted per Boundary Line Adjustment (CR-BLA-24-01 – AFN#3762029), focused on approximately 8.93 acres of the residential designated portion of the approved Landing on the Cowlitz Master Plan.
Proponent: CT6, LLC
Project Representative: Ingrid Friedberg, Special Projects Manager
Project Name: Rivers Edge at the Landing

Site Overview

Site/Proposal Description	Details
Total gross area	8.93 acres
Net area	7.82 acres
Right of way dedication	1.63 acres
Park and Open Space	48,162 SF (±1.11 AC)
Total proposed lots	45 single family lots

Vicinity Map

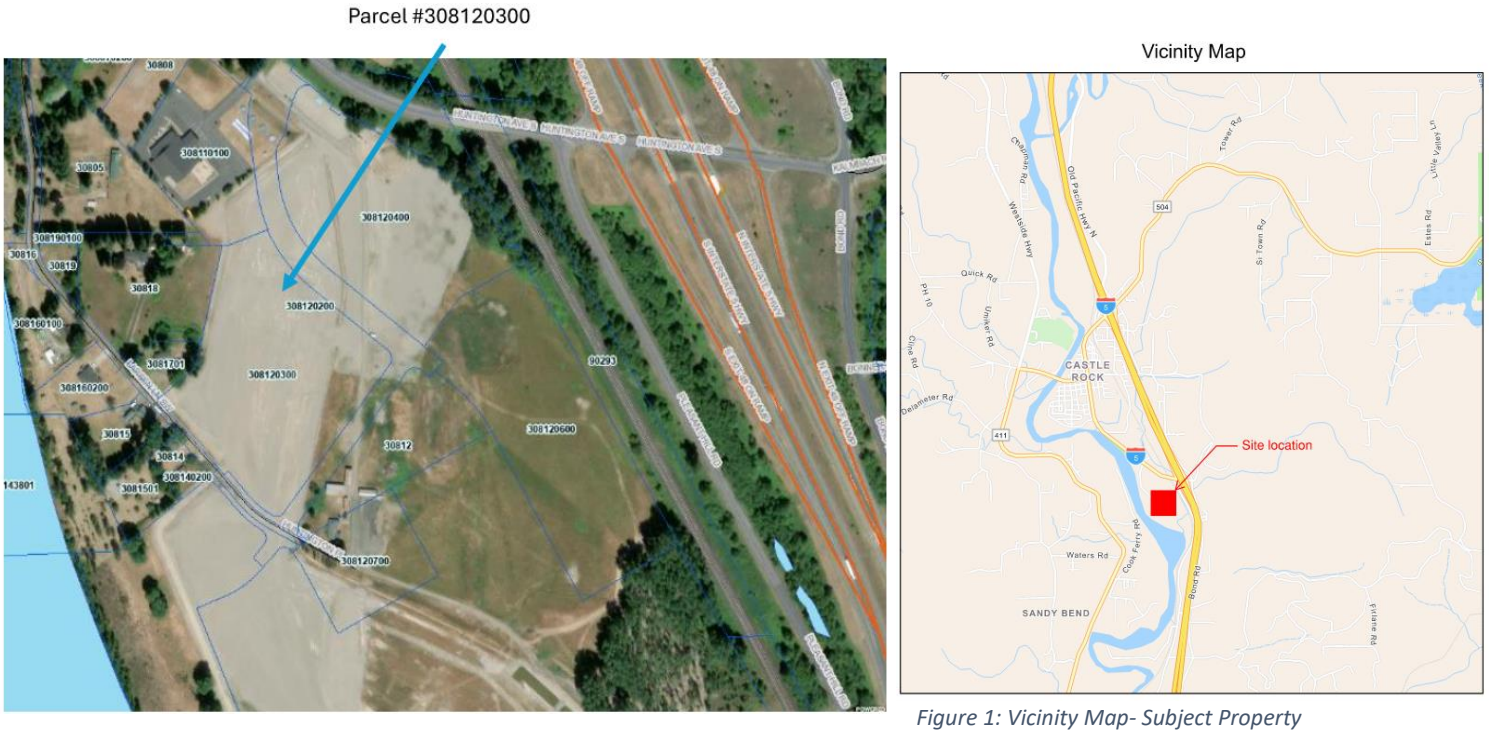


Figure 1: Vicinity Map- Subject Property

Figure 2: Phased Development for the Landing on the Cowlitz - Subject Property in Orange

Development Standards

Development activities in the Residential Land Use Area shall comply with the provisions of the High Density Residential (R-2) zoning district except as modified by these conditions of approval with the Landing on the Cowlitz Development Agreement and Master Plan, which was approved in 2021 and amended January 18, 2024. The following table outlines the applicable zoning district standards within the R-2 district as well for taking into

account the Master Planned Development requirements and the vested development, subdivision and zoning codes that were in effect on November 8, 2021.

Table 2: Development and Zoning Standard Requirement

Standard	Site Design	Reference Requirement	Requirement Met
Minimum lot area	4,500 sf	3,500 sf minimum lot per DA Section 6.1.1	Yes
Lot width	45 ft minimum	Per DA	Yes
Lot depth	100 ft minimum	Per DA	Yes
Front yard setback	20 ft	16.20.260 Minimum yards and 17.32.070	Yes
Side yard setback	5 ft	16.20.260 Minimum yards and 17.32.070	Yes
Rear yard setback	20 ft	16.20.260 Minimum yards and 17.32.070	Yes
Buffering for lots abutting Master Plan development	Landscape buffer - 20 ft Storm easement – 10 ft	17.32.080 and development agreement	Yes
Parking standards (on-site)	2 garage and 2 in driveway	16.20.150 Parking requirements requires 2 off street parking stalls 17.32.090 Off-street parking.	Yes, as conditioned
Parking standards (street)	21 on-street spaces available	17.52.020 Parking standards.	Yes, as conditioned
Sidewalks	Detached with landscape utility easement buffer 4.5 ft and a 5 ft sidewalk	Chapter 16.20 Design and Layout Standards	Yes
Streetlights	16’ high acorn LED pole	Streetlight illumination level for Collector - 16.20.140 Street lighting, per DA	Yes, as conditioned
Park/Playground	Tract D (18,396 sf) Park elements include preschool play and primary play as well as a pavilion structure	16.20.200 Public open spaces. And development agreement.	Yes, as conditioned
Open space	Tract E (4,250 sf) & F (29,766 sf)	16.20.200 Public open spaces., and development agreement	Yes, as conditioned
Monument signage area	Tract G (1,182 sf)	Development agreement	Yes, as conditioned
Critical Areas	Project involves fill and dirt work to remove portions of the site from the 100-year floodplain	Chapter 15.24 Flood Damage Prevention	Yes, as conditioned
Homeowners Association (HOA)	Draft HOA covenants	To maintain private driveway and access roads, stormwater, monument, open space and parks.	Yes, as conditioned
SEPA	SEPA Checklist was submitted	A SEPA MDNS was issued in with mitigation conditions	Yes, as conditioned

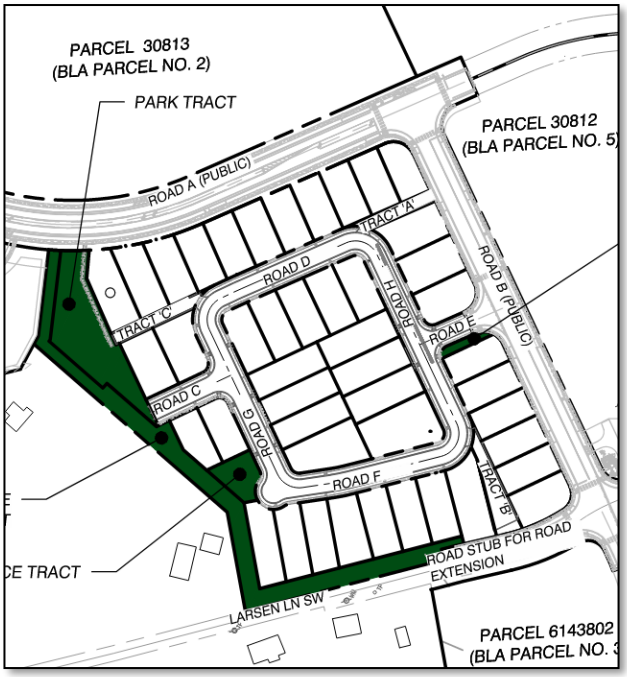
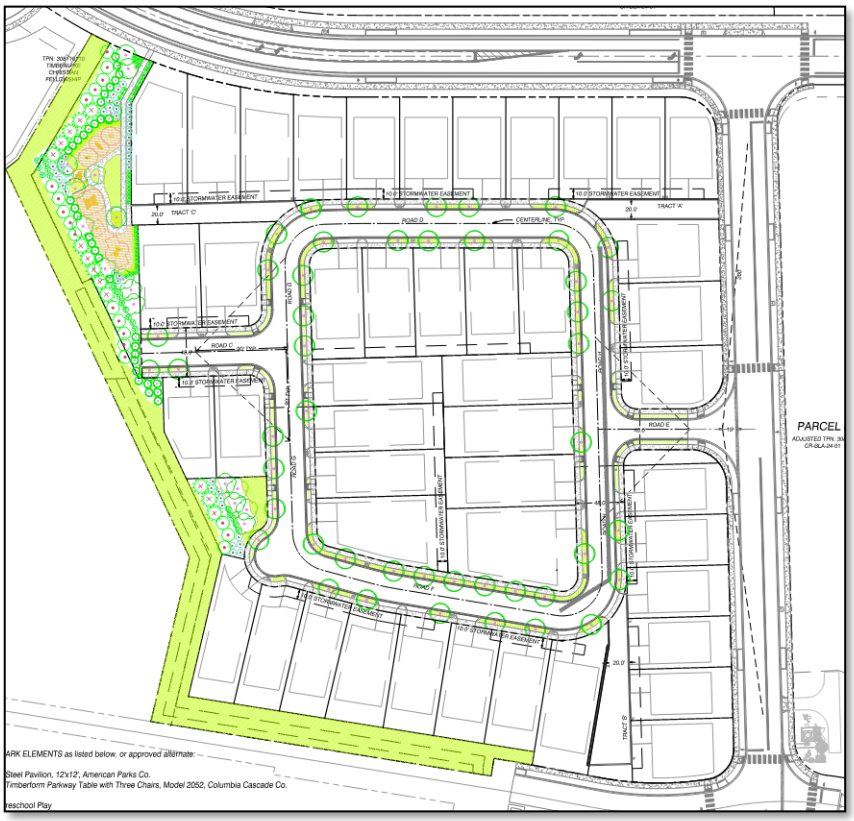


Figure 3: Park Dedication and Landscape Overview



Comprehensive Plan Consistency

Castle Rock Comprehensive Plan designates this property as Industrial on the future land use map. Neighboring uses include heavy commercial and light industrial, and commercial designations. However, the current land uses in place are lower density such as residential and religious institutions. As stated previously in this report, there is a governing Master Planned Development in place, which allocates a mixture of uses. For the purposes of this staff report and consideration we are only discussing the residential portion. As conditioned in this staff report, the following goals and policies illustrate the development's consistency with the Castle Rock Comprehensive Plan.

Land Development/Subdivision Goals and Policies:

Goal 1: Ensure that subdivisions and necessary public facilities are designed and constructed to meet existing and future needs.

Goal 2: Encourage innovative techniques to residential and commercial land development that will be beneficial to the community and reflect sound planning.

Goal 5: Incorporate the following principals into subdivision design; a sense of place, walkable, mixed transportation and housing, and affordability.

Policy 1: If a preliminary subdivision plat represents a phase of a potentially larger development, the city should require that a master plan showing all phases of the development be submitted concurrently.

Policy 3: Subdivisions should be site designed and constructed to preserve and enhance natural features and be compatible with aesthetic values of the area.

Policy 5: Vehicle and pedestrian circulation patterns should be considered in the design of the subdivision for future connections.

Procedural Requirements

The process is outlined by the following steps in accordance with the Castle Rock Municipal Code (CRMC) 16.12 and 17.77.040 (6). The process is currently at the Public Hearing in the process.

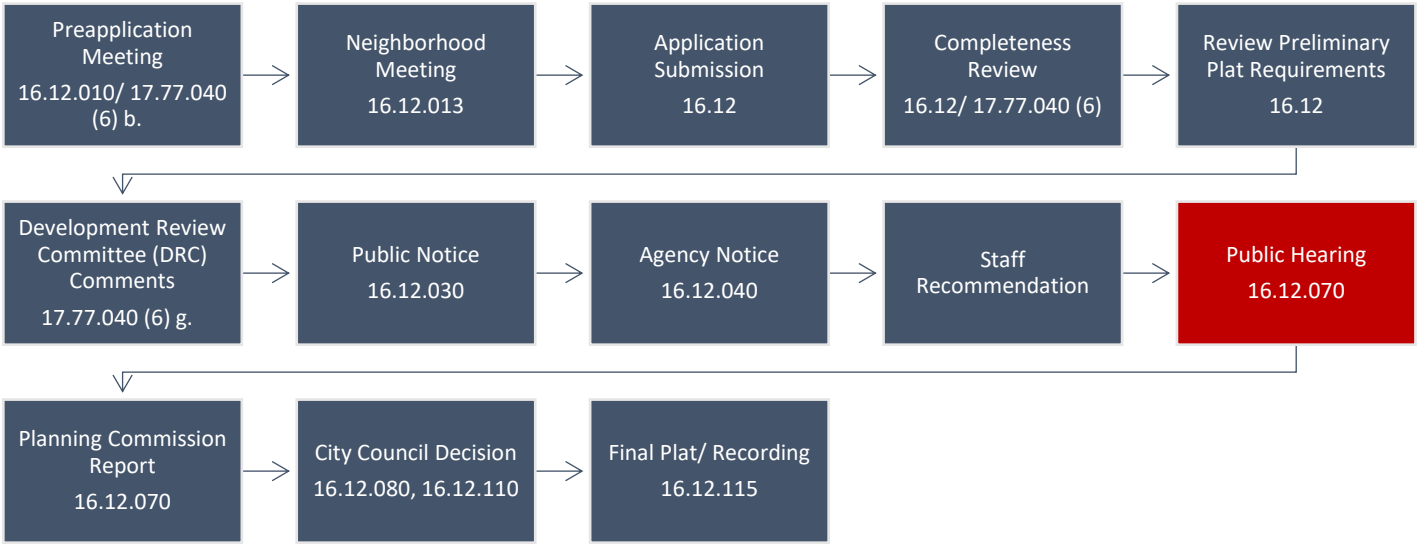


Table 3: Subdivision Procedure: Key Dates and Milestones

Procedure Action Item	Date
Pre-Application Meeting	November 6, 2024
Application Submittal	March 31, 2025
Letter of Complete	April 28, 2025
Development Review Committee (DRC)	April 28 – May 10, 2025
Agency Notice	May 21, 2025
Agency Comment Period	May 21 – June 6, 2025
SEPA/Public Notice	Issued June 3, 2025 – Comment period ends June 17
Public Hearing	Tuesday, June 17, 2025

Agency and Public Comment

The Development Review Committee reviewed the application materials and received detailed comments from Tom Gower, City Engineer. The comments are summarized below and included in the conditions of approval.
Agency comment was issued on May 21st, no comments were received.
Public comment was issued on June 3rd and comment period ends the date of the public hearing. At the time of this report, staff has received two public comments, summarized below.

Table 4: Public and Agency Comments Received

Commenter	Nature of Comment(s)
Tom Gower, Gibbs & Olson – City Engineer	Redlined comments to the plat. Phasing of utilities with Phase 1 & 2. Comments on parks and bollard with capped roadways.

Sheryl Adams – Public Comment	Concern on Larsen Lane use and traffic through existing development. Concern on public access to river and impact to wildlife.
Roy Henson – Public Comment	Concerns about drainage and stormwater flow with subdivision and outfall

Conclusions

Staff finds that the application materials have met the requirements outlined in CRMC 16.12.045, CRMC 16.12.050 Preliminary Plat Decision Criteria, and as conditioned Chapter 16.20 Design and Layout Standards and Castle Rock Engineering Standards for Public Works Construction.

Planning Commission Action

CRMC 16.12.070 (below), states that the Planning Commission will review, make findings of fact and a recommendation to City Council that the preliminary plat be approved, disapproved or approved with conditions. In the following pages, staff provides recommended findings of fact and conditions of approval. The City Planner will take the recommendations, findings of fact and conditions from the Planning Commission discussion and submit a formal recommendation report to City Council within 14 days of this public hearing.

> **16.12.070 Preliminary plat – Planning commission action.**
> *The planning commission shall review all proposed subdivisions and make recommendations thereon to the city council. Such review shall be made to ensure conformance of the proposed subdivision to the general purposes of the comprehensive plan and the planning standards and specifications as adopted by the city. The planning commission will review the preliminary plat application, make findings of fact and make recommendation to the city council that the preliminary plat be approved, disapproved or approved with conditions. The planning commission, if it finds the preliminary plat application to be incomplete, may return same to the applicant and request additional information. When the planning commission has considered the preliminary plat application, it shall within 14 days after taking its action submit its recommendation to the city council. Written notice of the planning commission's recommendations shall be provided to the subdivider applicant within the same 14 days. The report and recommendations of the planning commission shall be advisory only.*

Recommendation

As conditioned below, the application does not appear to be detrimental to the general public health, safety or welfare and meets the basic intent and criteria in Castle Rock Municipal Code, City Engineering and Public Works Standards, and the Master Planned Development Agreement.

Recommended Findings of Fact

1. CT6, LLC submitted an application for a 45-lot preliminary plat (subdivision) on one (1) parcel totaling 8.93 acres of land.

2. The Comprehensive Plan land use designation is Industrial for the subject property.

3. The subject property is zoned Industrial.

4. The property includes an approved Mixed-Use Master Planned Development, approved by Ordinance No. 2021-10, as well as the associated Development Agreement amended in February 20, 2024. The property is vested under the November 8, 2021, City Ordinances. The subject property is within the Residential land use designated area of the approved Landing on the Cowlitz Master Plan.

5. A Preliminary Plat application was submitted to the City of Castle Rock Building and Planning Department on March 31, 2025. The application was deemed complete on April 28, 2025. The Development Review Committee pursuant to CRMC 17.77.040 (6) g reviewed and commented on the application, comments were due May 10, 2025. Agency Notice was sent out on May 21 and ended June 6, 2025. Public Notice along with SEPA MDNS issuance was published on June 3, 2025, and the comment period ends the date of this public hearing on June 17, 2025.

6. SEPA review was conducted and an MDNS was issued on June 3, 2025.

7. The proposal is consistent with the goals and policies of the City of Castle Rock Comprehensive Plan. The proposed subdivision as conditioned will have adequate services.

8. This proposal, as conditioned, is consistent with Title 17 CRMC Zoning, CRMC 16.12 Subdivision and CRMC 16.20 Design and Layout.

9. This proposal, as conditioned, will meet Standards and Castle Rock Engineering Standards for Public Works Construction.

Recommended Conditions of Approval

1. **Parks and Open Space:**
    a. Recommend consolidating all open space and park tracts to be more centrally located and accessible, unless applicant provides a reasonable explanation on the current design and location of the primary park. There shall not be sidewalk access to the park from Minor arterial Road A.
    b. Lighting shall be included in the park.

2. **Transportation:**
    a. **SR-411 Intersection Mitigation:** At 70% build-out of the Landing Master Plan Development, the intersection of SR411/Westside Highway and PH10, is projected to fall below the designated Level of Service (LOS) "C". To address the impacts of this and other incremental development on the site, the applicant shall be responsible for funding and implementing mitigation improvements—either at 70% build-out or when LOS falls below “C,” whichever occurs first. All mitigation measures must be approved by the City of Castle Rock and WSDOT.
    b. **Larsen Lane:** Per the Castle Rock Landing on the Cowlitz Conditions of Master Site Plan Approval, Item #13: The City may install reasonable measures to prevent the use of Larsen Lane SW in its existing condition to access the Master Planer Development. This may include, but is not limited to, signage, a gate or bollards with a lockbox, and a cul-de-sac or turnaround for vehicles attempting to enter the Master Planned Development.
    c. Tract A, B and C are private roads, the minimum width for access roads shall be 25 feet, with a 5’ sidewalk and 20’ drive aisle, and no parking shall be allowed within these Tracts.
    d. All stubbed streets shall have a gate, bollards, or turnaround for vehicles.

e. All roads within the subdivision shall be named and addressed in accordance with the City's addressing and road naming standards, subject to approval by the appropriate addressing authority prior to final plat approval.

3. **Cultural Resources**: Should ground disturbing or other activities related to the proposed subdivision result in the inadvertent discovery of cultural resources or archaeological materials, work shall be stopped in the immediate area and contact be made with the Washington State Department of Archaeology and Historic Preservation (DAHP) and the Cowlitz Indian Tribe. Work shall remain suspended until the findings are assessed, and appropriate consultation is conducted. Should human remains be inadvertently discovered, as dictated by Washington State RCW 27.44.055, work shall be immediately halted in the area and contact made with the coroner and local law enforcement in the most expeditious manner possible.

4. **Frequently Flooded Areas:** Due to the proposed site fill and grading, the site will be raised to 50.3 feet which is above the base flood elevation (BFE) of 48 for the site. As proposed by the applicant all structures shall be required to be raised one- (1) foot above the BFE. This proposal has been designed to facilitate the inclusion of building pads at 51.8 feet. All structures shall be a minimum of 1-foot above the BFE. Applicant shall submit a flood elevation certificate at the conclusion of grading and fill work. All building applications shall submit an elevation certificate illustrating compliance with FEMA regulations and Building Codes.

5. **HOA Covenants:**
    a. The City has approved a reduced street width for this subdivision, contingent upon each lot providing a minimum of four (4) off-street parking spaces. To ensure ongoing compliance, the following restriction shall be clearly stated on the final plat and HOA Covenants and within the deed for each lot: the garage shall not be converted to living space and must remain available for the parking of vehicles.
    b. Prior to final plat approval, the applicant shall amend the draft Covenants, Conditions, and Restrictions (CC&Rs) to clearly identify the ownership and maintenance responsibilities of the Homeowners Association. The amended CC&Rs shall align with the final plat and specifically detail each tract, buffer, parks, open space, easement, and beautification element (including but not limited to streetlights and monument signs) within the development. As an example, the HOA shall maintain and filter the treatment catch basins.

6. **Signage Plan:** The plat denotes a monument sign, as conditioned in the Master Site Plan Approval, condition 17 states the project sponsor shall prepare and submit a Master Signage Plan to guide the design and locations of the signs throughout the site. This is a condition that shall be addressed prior to submittal of final plat.

7. Comments from Tom Gower, Gibbon & Olson– City Engineer, dated May 7, 2025, on the "River's Edge at the Landing Subdivision Preliminary Land Use Plans" dated 3/27/2025 consisting of 23 drawings and the "River's Edge at the Landing Preliminary Technical Information Report" dated March 26, 2025 consisting of 241 pages shall be addressed in revised preliminary plat design, exhibits, and the preliminary technical information report.

8. The applicant is responsible for compliance with all applicable local, state, and federal rules and regulations, and must obtain all appropriate permits and approvals.

9. All conditions of the SEPA MDNS issued on June 3, 2025, shall be met.

Exhibits:

Exhibit A: Application Materials

1. Subdivision Application Submittals Overview
2. Signed Master Application Forms
3. Application Narrative
4. SEPA Checklist
5. Preliminary Plat Application Plan Set
6. Preliminary Stormwater Drainage Report
7. Transportation Compliance Letter
8. SR-411 & Westside Hwy Mitigation Memorandum dated January 14, 2025
9. Draft Master Plan Conditions, Covenant and Restrictions (CC&Rs)
10. Title Report (Guarantee/Certificate Number: 622-173054)
11. Neighborhood Meeting Materials
12. Pre-Application Notes (CR-PA-24-06)
13. Traffic Analysis Clarification for Pre-Application (CR-PA-24-06)

Exhibit B: Noticing Materials

Exhibit C: SEPA MDNS

Exhibit D: Comments Received

Exhibit A: Application Materials

1. Subdivision Application Submittals Overview
2. Signed Master Application Forms
3. Application Narrative
4. SEPA Checklist
5. Preliminary Plat Application Plan Set
6. Preliminary Stormwater Drainage Report
7. Transportation Compliance Letter
8. SR-411 & Westside Hwy Mitigation Memorandum dated January 14, 2025
9. Draft Master Plan Conditions, Covenant and Restrictions (CC&Rs)
10. Title Report (Guarantee/Certificate Number: 622-173054)
11. Neighborhood Meeting Materials
12. Pre-Application Notes (CR-PA-24-06)
13. Traffic Analysis Clarification for Pre-Application (CR-PA-24-06)

SUBMITTAL OVERVIEW

CT6, LLC

DATE: March 27, 2025

PROJECT NO.: 163.3
CITY PROJECT NO.:
RECEIVED BY:

SUBMITTAL TITLE: River's Edge at the Landing Subdivision Application

SUBMITTED BY: Ingrid Friedberg, Special Projects Manager
CT6, LLC
P.O. Box 1419
Battle Ground, WA 98604

SUBMITTED VIA: Online Share Drive | One Full-Size Plans Delivered to City Hall

SUBMITTED TO: **City of Castle Rock**
Attn. Karlene Akesson, Building/Planning Clerk
P.O. Box 370
Castle Rock, WA 98611

SUBMITTAL CONTENTS: In conformance with City of Castle Rock Municipal Code §16.12.045, this application contains the required application contents as itemized below.

ITEM NO.	DESCRIPTION	RECEIVED
1.	**Subdivision Application Submittals Overview**	☐
2.	**Signed Master Application Forms**	☐
3.	**Application Narrative**	☐
4.	**SEPA Checklist**	☐
5.	**Preliminary Plat Application Plan Set (one digital and one full-size copy)**	☐
	Cover Sheet	☐
	Sheet Index Plan	☐
	Existing Conditions	☐
	Preliminary Plat	☐
	Grading and Erosion Control Plan (Phase 1)	☐
	Grading and Erosion Control Plan (Phase 2)	☐
	Street and Storm Plan (Phase 1)	☐
	Street and Storm Plan (Phase 2)	☐
	Street Sections	☐
	Main Circulation Street and Storm Profile	☐
	Road C and Road E Street and Storm Profiles	☐
	Sewer and Water Plan (Phase 1)	☐
	Sewer and Water Plan (Phase 2)	☐
	Main Circulation Sewer Profile	☐
	Road C and Road E Sewer Profiles	☐
	Preliminary Master Phasing Plan	☐
	Preliminary Master Signage Plan	☐
	Preliminary Master Parks, Recreation, and Open Space Plan	☐
	Landscape Planting Plan	☐
	Planting Specifications and Details	☐
	Irrigation Specifications	☐
	Street Photometrics	☐
	Fixture Specifications	☐

SUBMITTAL OVERVIEW

CT6, LLC

SUBMITTAL CONTENTS CONTINUED:

6.	**Preliminary Stormwater Drainage Report**	☐
7.	**Transportation Compliance Letter**	☐
8.	**SR-411 & Westside Hwy Mitigation Memorandum dated January 14, 2025**	☐
9.	**Draft Master Plan Conditions, Covenant and Restrictions (CC&Rs)**	☐
10.	**Title Report (Guarantee/Certificate Number: 622-173054)**	☐
11.	**Neighborhood Meeting Materials**	☐
12.	**Pre-Application Notes (CR-PA-24-06)**	☐
13.	**Traffic Analysis Clarification for Pre-Application (CR-PA-24-06)**	☐
14.	**Application Fee in the amount of $14,050 made payable to the City of Castle Rock**	☐

Docusign Envelope ID: 738A2F55-4B9A-483F-9262-EAE01C99D650

City of Castle Rock
Department Of Building and Planning
City Hall, PO Box 370 / 141 'A' St SW, Castle Rock, WA 98611
Phone: 360.274.8181 / Email: finance@ci.castle-rock.wa.us

CR _____

PLEASE PRINT IN INK OR TYPE

MASTER APPLICATION

PROPERTY INFORMATION

Project Address: _____ City: Castle Rock Parcel #: 308120300

Short Plat/Subdivision: River's Edge at the Landing Block: _____ Lot: _____

OWNER/APPLICANT INFORMATION

Applicant/Authorized Agent: Shane Tapani on behalf of CT6, LLC Phone: 360.687.1148

Mailing Address: PO Box 1419 City: Battle Ground State: WA Zip: 98604

Property Owner: Same as Applicant. Phone: _____

Mailing Address: Same as Applicant. City: Same as Applicant. State: Same as Applicant. Zip: Same as Applicant.

Contractor: Tapani Inc. Lic #: TAPANI*883OE Phone: _____

Mailing Address: PO Box 1900 City: Battle Ground State: WA Zip: 98604

Lender Name: N/A Phone: _____

Lender's Address: _____

PROJECT INFORMATION

Building/Construction
- ☐ Building Permit
- ☐ Excavation & Grading Permit
- ☐ Manufactured/Structure Placement
- ☐ Mechanical Permit
- ☐ Plumbing Permit
- ☐ Roofing Permit
- ☐ Signage Permit
- ☐ Other _____

Planning
- ☐ Critical Areas
- ☐ Flood Plain
- ☐ Master Plan
- ☐ Mobile Home Park
- ■ Plat (Preliminary)
- ☐ Plat (Final)
- ☐ Short Plat
- ☐ Site Plan (Preliminary)
- ☐ Site Plan (Final)

Environmental
- ☐ Critical Areas
- ☐ Flood Plain Permits
- ■ SEPA
- ☐ Surface Mining
- ☐ Other _____

PROJECT DESCRIPTION

Occupancy Group: N/A **Type of Construction:** N/A **Sq. Ft.** N/A **No. of Stories:** N/A **No. of Bedrooms:** N/A

Is there any grading, filling, or excavation associated with this project? Yes Quantity (cubic yards): _____

(Including grading for road construction, site preparation, and landscaping.) ***NO SITE WORK MAY BE DONE PRIOR TO CRITICAL AREAS DETERMINATION.***

Water Supply: Public **Sewage Disposal:** Public **Type of Heat:** _____ **Fair Market Value:** _____

Does project involve Asbestos? ☐ YES ■ NO

PLEASE PROVIDE A BASIC DESCRIPTION OF THE PROPOSED PROJECT:

This proposal involves the construction of a 45 detached single-family residential subdivision within the residential land use area of the approved Landing on the Cowlitz Master Plan.

I hereby certify that I am the owner or duly authorized agent of the owner for the purposes of this application. Further, I grant permission from the owner to any and all employees and representatives of the City of Castle Rock and other governmental agencies to enter upon and inspect said property as reasonably necessary to process this application. I further certify that I have read and examined this application and know the same to be true and correct. If any of the information provided on this application is incorrect, the permit or approval may be revoked.

APPLICANT'S SIGNATURE: DocuSigned by: Shane Tapani 8ADCF0136D1B439... DATE: 3/13/2025 | 2:10 PM PDT

APPLICATION ACCEPTED BY: _____ DATE: _____

APPLICATION APPROVED BY: _____ DATE: _____

PERMIT NUMBER
CR _____

Docusign Envelope ID: 738A2F55-4B9A-483F-9262-EAE01C99D650

City of Castle Rock

Building & Planning Department

141 A St SW / PO Box 370
Castle Rock, WA 98611
Phone: (360) 274-8181
finance@ci.castle-rock.wa.us

General Land Use Application

OFFICIAL USE ONLY

Case # _____ Related File # CR-PA-24-06 Received By: _____

One or more of the following **Supplements** must be attached to this **General Land Use Application**:

TITLE 16 SUBDIVISIONS

- ☐ Binding Site Plan
- ☐ Boundary Line Adjustment
- ☐ Condominium Subdivision
- ☐ Final Plat (Subdivision)
- ☐ Final Short Plat
- ■ Preliminary Plat (Subdivision)
- ☐ Preliminary Short Plat

TITLE 18 ENVIRONMENTAL PROTECTION

- ☐ Critical Areas Determination
- ☐ Critical Areas Permit
- ☐ Environmental Questionnaire
- ■ SEPA Checklist
- ☐ Shorelines Conditional Use
- ☐ Shorelines Substantial Development
- ☐ Shorelines Variance

TITLE 17 ZONING

- ☐ Annexation
- ☐ Bed & Breakfast – (CUP)
- ☐ Comprehensive Plan Amendment
- ☐ Conditional Use Permit = (CUP)
- ☐ Home Occupancy Business License
- ☐ Home Occupancy in an Accessory Building – (CUP)
- ☐ Manufactured Home Park
- ☐ Recreational Vehicle Park – (CUP)
- ☐ Request for Clarification
- ☐ Rezone
- ☐ Similar Use Authorization
- ☐ Special Use Permit
- ☐ Variance

OTHER

- ☐ Request for Pre-Application Meeting
- ☐ Wireless Communications Facilities - (CUP)
- ☐ Other _____

Project Name: River's Edge at the Landing Subdivision

Project Address: 2542 Larsen Lane SW
Castle Rock, WA 98611

Applicant: CT6, LLC
Phone : (360) 687-1148
E-mail Address: shanet@tapani.com | ingridf@tapani.com

Mailing Address: PO Box 1519, Battle Ground WA 98604

Owner: Same as Applicant.
(If other than applicant)
Phone : _____
E-mail Address: _____

Mailing Address: Same as Applicant.

Docusign Envelope ID: 738A2F55-4B9A-483F-9262-EAE01C99D650

Other Authorized Representative (if any): N/A

Mailing Address:

Phone:

E-mail Address:

Project Description: This proposal involves the construction of a 45 detached single-family residential subdivision within the residential land use area of the approved Landing on the Cowlitz Master Plan.

Size of Project Site: ±8.93 acres

Assessor Tax Parcel Number(s): 308120300

Full Legal Description of Subject Property (Attached ■):

Zoning: City: Industrial | Land Use Designated Area of the Landing on the Cowlitz Master Plan: Residential

Special Areas On or Near Site (show areas on site plan):

☐ Creek, Stream or River (name):

☐ Wetland ■ Flood Hazard Area

☐ Steep Slopes/Draw/Gully/Ravine ☐ None

Water Service

Existing pipe size and material:

Proposed pipe size and material: 8" C900 PVC

Sewage Disposal

Existing:

Proposed: Each lot will have a 4" PVC sewer lateral leading to an 8" gravity sewer main within the subdivision parcel. The system will connect to a an 8" stub at the entrance to the subdivision that leads to the LOTC sewer pump station.

Access

Name of Street(s) from which access will be gained:

Owner's Consent and Authorization

I affirm that I am the owner of the subject site and all answers, statements, and information submitted with this application are correct and accurate to the best of my knowledge. Further, I grant permission from the owner to any and all employees and representatives of the City of Castle Rock and other governmental agencies to enter upon and inspect said property as reasonably necessary to process this application.

I agree to pay all fees of the City that apply to this application.

Shane Tapani on behalf of CT6, LLC
Owner's Name (Print Name)

DocuSigned by: Shane Tapani 8ADCF0130D1B439...
Owner's Signature

3/13/2025 | 2:10 PM PDT
Date

Docusign Envelope ID: 738A2F55-4B9A-483F-9262-EAE01C99D650

ISSUING OFFICE:
Title Officer: James R. Copeland Chicago Title Company of Washington 655 W. Columbia Way, Suite 200 Vancouver, WA 98660 Phone: 360-601-4370 Fax: 877-334-2993 Main Phone: (360)696-0551 Email: James.Copeland@ctt.com

SCHEDULE A

Liability	Premium	Tax
$1,000.00	$350.00	$30.10

Effective Date: January 22, 2025 at 08:00 AM

The assurances referred to on the face page are:

That, according to those public records which, under the recording laws, impart constructive notice of matter relative to the following described property:

For APN/Parcel ID(s): 308120300

A PARCEL OF PROPERTY LOCATED IN A PORTION OF THE BENJAMIN HUNTINGTON D.L.C. AND THE SOUTH HALF OF SECTION 14, AND THE NORTH HALF OF SECTION 23, TOWNSHIP 9 NORTH, RANGE 2 WEST OF THE WILLAMETTE MERIDIAN IN THE CITY OF CASTLE ROCK, COWLITZ COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

COMMENCING AT THE CORNER COMMON TO SECTION 13, 14, 23 AND 24, TOWNSHIP 9 NORTH, RANGE 2 WEST, AS SHOWN ON RECORD-OF-SURVEY RECORDED IN VOLUME 43, PAGES 120-121 OF THE WILLAMETTE MERIDIAN, COWLITZ COUNTY, WASHINGTON;

THENCE NORTH 01°42'22" EAST, ALONG THE EAST LINE OF THE SOUTHEAST QUARTER OF SAID SECTION 14, A DISTANCE OF 742.50 FEET TO THE NORTH LINE OF THE SOUTH HALF OF THE BENJAMIN HUNTINGTON DONATION LAND CLAIM;

THENCE NORTH 88°18'14" WEST, ALONG SAID NORTH LINE, 1915.35 FEET;

THENCE SOUTH 01°33'06" WEST 26.70 FEET TO THE NORTHWEST CORNER OF "PARCEL I" AS CONVEYED TO CT6, LLC BY DEED RECORDED UNDER AUDITOR'S FILE NUMBER 3682681, COWLITZ COUNTY RECORDS AND THE TRUE POINT OF BEGINNING;

THENCE SOUTH 88°09'15" EAST ALONG THE NORTH LINE OF SAID PARCEL I, A DISTANCE OF 88.61 FEET;

THENCE NORTH 68°26'31" EAST ALONG THE NORTH LINE OF SAID PARCEL I, A DISTANCE OF 93.90 FEET TO A NON-TANGENT 530.00 FOOT RADIUS CURVE TO THE LEFT, FROM WHICH THE RADIUS POINT BEARS NORTH 67°48'33" EAST;

THENCE ALONG SAID 530.00 FOOT NON-TANGENT CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 22°53'04" (LONG CHORD BEARS SOUTH 38°40'15" WEST 210.28 FEET) AN ARC DISTANCE OF 211.69 FEET;

THENCE SOUTH 50°06'47" EAST 328.61 FEET TO A 35.00 FOOT RADIUS CURVE TO THE RIGHT;

THENCE ALONG SAID 35.00 FOOT RADIUS CURVE TO THE RIGHT, THROUGH A CENTRAL ANGLE OF 88°23'02" AN ARC DISTANCE OF 53.99 FEET;

Docusign Envelope ID: 738A2F55-4B9A-483F-9262-EAE01C99D650

SCHEDULE A
(continued)

THENCE SOUTH 38°16'16" WEST 604.48 FEET TO A 30.00 FOOT RADIUS CURVE TO THE RIGHT;

THENCE ALONG SAID 30.00 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 82°46'20" AN ARC DISTANCE OF 43.34 FEET TO A POINT 30.00 FEET NORTHERLY OF, WHEN MEASURED RADIALLY TO, THE CENTERLINE OF LARSEN LANE AS SHOWN ON SAID RECORD OF SURVEY, VOLUME 43, PAGES 120-121 AND A 313.53 FOOT RADIUS COMPOUND CURVE TO THE RIGHT;

THENCE PARALLEL WITH SAID LARSEN LANE CENTERLINE AND ALONG SAID 313.53 FOOT RADIUS CURVE TO THE RIGHT, THROUGH A CENTRAL ANGLE OF 19°31'25", AN ARC DISTANCE OF 106.94 FEET:

THENCE NORTH 39°25'59" WEST, PARALLEL WITH SAID CENTERLINE 82.70 FEET;
THENCE NORTH 41°01'19" WEST, PARALLEL WITH SAID CENTERLINE 22.20 FEET;
THENCE SOUTH 48°56'17" WEST 17.50 FEET TO THE NORTH RIGHT-OF-WAY LINE OF SAID LARSEN LANE, SAID NORTH RIGHT OF WAY LINE BEING 12.50 FEET NORTHERLY OF, WHEN MEASURED PERPENDICULAR TO, SAID CENTERLINE;

THENCE NORTH 41°01'19" WEST, ALONG SAID NORTHERLY RIGHT-OF-WAY LINE 337.54 FEET TO THE WEST LINE OF "PARCEL I" AS CONVEYED TO CT6, LLC BY DEED RECORDED UNDER AUDITOR'S FILE NUMBER 3682681, COWLITZ COUNTY RECORDS;

THENCE NORTH 53°08'46" EAST, LEAVING SAID NORTHERLY RIGHT-OF-WAY LINE AND ALONG THE WEST LINE OF SAID "PARCEL I" A DISTANCE OF 165.33 FEET;

THENCE NORTH 14°33'38" EAST, ALONG SAID WEST LINE 393.71 FEET TO THE TRUE POINT OF BEGINNING.

Title to said real property is vested in:

CT6, LLC, a Washington limited liability company

subject to the matters shown below under Exceptions, which Exceptions are not necessarily shown in the order of their priority.

END OF SCHEDULE A

RIVER'S EDGE AT THE LANDING SUBDIVISION

APPLICATION NARRATIVE

CITY OF CASTLE ROCK

March 27, 2025

PROPERTY OWNER & APPLICANT:

CT6, LLC
P.O. Box 1419
Battle Ground, WA 98604-1419
Contact: Ingrid Friedberg, Special Projects Manager
Email: ingridf@tapani.com
Phone: 360.553.9144

APPLICATION ENGINEERING AND SURVEY CONSULTANT:

MacKay Sposito
18405 SE Mill Plain Blvd., Suite 100
Vancouver, WA 98683
Contact: Taylor Wilson, PE
Email: twilson@mackaysposito.com
Phone: 360.695.3411

CT6, LLC.

TABLE OF CONTENTS

I. DEVELOPMENT SUMMARY INFORMATION....1

II. PROPOSED DEVELOPMENT....2

III. EXISTING CONDITIONS....2

IV. CONFORMANCE WITH CITY OF CASTLE ROCK SUBDIVISION APPROVAL CRITERIA....2

TITLE 16 SUBDIVISIONS....3
TITLE 17 ZONING....10
TITLE 15 BUILDINGS AND CONSTRUCTION....17
TITLE 18 ENVIRONMENTAL PROTECTION....18

V. CONFORMANCE WITH MITIGATION MEASURES AS OUTLINED IN THE MODIFIED MDNS....19

VI. CONCLUSION....23

I. DEVELOPMENT SUMMARY INFORMATION

Property Owner & Applicant:	CT6, LLC P.O. Box 1419 Battle Ground, WA 98604-1419 Contact: Ingrid Friedberg, Special Projects Manager Email: ingridf@tapani.com Phone: 360.553.9144
Applicant's Engineering & Surveying Consultant:	MacKay Sposito 18405 SE Mill Plain Blvd., Suite 100 Vancouver, WA 98683 Contact: Taylor Wilson, PE Email: twilson@mackaysposito.com Phone: 360.695.3411
Request:	Approval of a 45-lot detached single-family residential subdivision within the approved Landing on the Cowlitz Master Plan (LOTC)
Parcel ID:	308640100
Area:	± 8.93 acres (±388,991 square feet)
Zoning Designation:	Industrial
LOTC Land Use **Designation:**	**Residential**

II. PROPOSED DEVELOPMENT

The Applicant, CT6, LLC, wishes to subdivide an approximately 8.93-acre property into forty-five (45) single-family detached residential lots within property which shall be associated with 2542 Larsen Lane SW (Parcel 308640100) of the approved Landing on the Cowlitz (LOTC) Master Plan and subsequent minor modification (Ordinance No. 2021-10 and Resolution No. 2024-03) (Master Plan). This proposal also includes the provision of private park/open space areas, individual residential driveways, Residential Local Access roads and private driveway tracts. A single Residential Local Access roadway intersection is included in this proposal serving as the connection to the Standard Collector road included in Phase 1 of the Master Plan infrastructure.

The roadway stub included in this proposal may serve as an extension for a potential future connection to Larsen Lane SW. However, that extension is contingent upon the successful entry into contract agreements with neighboring property owners and completion of a feasibility analysis. There is the potential that the roadway stub will never be extended.

III. EXISTING CONDITIONS

The existing Parcel 308640100 is 8.93 acres and is zoned Industrial (I) within the City of Castle Rock (City) and is located within the residential land use designated area of the approved Landing on the Cowlitz (LOTC) Master Plan. The site was recently subject to a boundary line adjustment (ref. CR-BLA-24-01).The recently adjusted Parcel 308640100 is bounded by the Phase 1 road, Timberlake Church (Parcel 308110100), Parcel 30818, Parcel 3081701 and Larsen Lane SW. The site is subject to conformance with the development standards applicable to the High Density Residential (R-2) except as amended by the Master Plan Conditions of Approval.

Infrastructure necessary for initial site use is anticipated to be completed prior to the issuance of final engineering approval for the River's Edge at the Landing Subdivision. Separate Development Engineering applications are presently under second review by the City for the approval of the Phase 1 roadway and stormwater system, and for the sewer pump lift station. An application for new commercial service is under review at the Cowlitz County Public Utilities District for the proposed Phase 1 infrastructure and the sewer pump station. All Phase 1 infrastructure has been designed to service the proposed subdivision.

The future site of the subdivision was historically subject to farming, and it is presently vacant. The site recently underwent the initial phase of mass grading pursuant to the approved Phase 1 Mass Grading Plan (ref. CR22023). Further mass grading efforts will occur in conjunction with the proposed Phase 1 roadway construction. A temporary private access gravel roadway off Huntington Avenue S. serves the Master Plan. No public roadways presently serve the site.

IV. CONFORMANCE WITH CITY OF CASTLE ROCK SUBDIVISION APPROVAL CRITERIA

Under the provisions of the City of Castle Rock Municipal Code, the applicable approval criteria must be met for subdivision application submittals which includes demonstrating that the threshold requirements are met, payment of required City application fees required and corroboration that the proposal is consistent with the relevant development standards' provisions of the Code except where

amended by the Developer's Agreement for the Landing on the Cowlitz Master Plan. This application has been prepared in conformance with the Code and Developer's Agreement requirements for a Preliminary Plat approval. The subsequent narrative addresses this proposals' compliance with all applicable approval criteria.

TITLE 16 SUBDIVISIONS
Chapter 16.12 Subdivisions
Procedural Requirements
[…]

Response: This subdivision application follows a pre-application conference which was held on November 6, 2024, in conformance with §16.12.010. In addition, a notification was mailed to neighboring property owners within three hundred (300) feet of the property preceding the neighborhood meeting, which was held on November 25, 2024, in conformance with §16.12.013. A copy of the notices with a list of addresses is included in this application submittal along with a Neighborhood Meeting sign in sheet.

Application Requirements
[…]

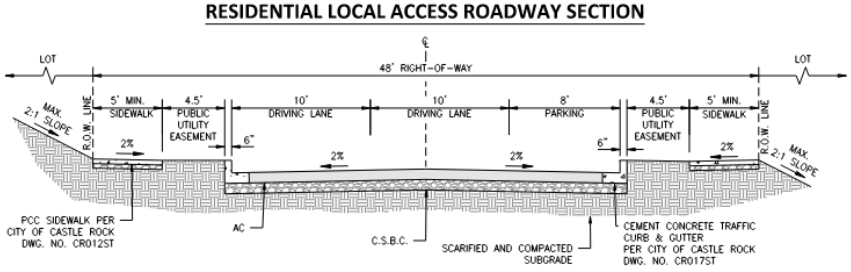
Response: Pursuant to the City of Castle Rock Municipal Code (CRMC) Section 16.12.045, an overview of all required submittal items is evidenced in the *1. Subdivision Application Submittal*, as included in the subdivision application submittal. The Preliminary Plat is included in this application package which meets the requirements of CRMC Section 16.12.050.

Chapter 16.20 Design and Layout Standards
[…]

16.20.040 Streets – Conformance with street plan.

The location of all streets and roads shall conform to the official street plan adopted or in preparation by the city. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 509 § 5.03(A), 1980].

Response: The Applicant has provided a subdivision which conforms with the applicable design and layout standards contained within the City of Castle Rock Municipal Code (CRMC) and the City's Engineering Design Standards except where modified within Section 6 of the Landing on the Cowlitz Master Plan (LOTC) Developer's Agreement. This proposal includes the modified urban residential local access road:



Ref. Landing on the Cowlitz Roadway Sections, Exhibit C

Streets internal to the subdivision have been designed in conformance with the Residential Local Access which was modified with the Development Agreement to include a forty-eight- (48) foot right-of-way , five- (5) foot sidewalks and a four and a half (4.5) foot public utility easement on both sides of the street. The functional classification of the internal subdivision roadway is appropriate for the intended use of the site for forty-five (45) lots pursuant to the City City Engineering Design Standard 4.03.d. which requires this for roadway for service of up to sixty-four (64) lots. The intersection spacing of the streets internal to the subdivision have been designed to meet the minimum one-hundred and twenty-five (125) feet intersection spacing required by the City Engineering Design Standard Chapter 4.02.B.10., for local access roadways.

The subdivision has been designed to include a connection to the Phase 1 LOTC Road B (Standard Collector), the intersection for which is spaced approximately 366 feet between the nearest intersections of Larsen Lane SW and the future Phase 2 meeting the 300-foot minimum spacing requirement for Standard Collectors.

The two private driveway access tracts included in this proposal feature 20 feet of paved width, which meets Fire Marshal access requirements.

16.20.050 Arterial streets.

Arterial streets will be designed to move vehicles through the city and between various areas of the city. Direct driveway access to arterial streets shall be avoided except where no other access is available. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006].

Response: Not applicable. This proposal does not include the provision of or connection to arterial streets.

16.20.050 Access streets.

Access streets will be designed primarily to provide access to abutting properties only and shall be designed to discourage through traffic. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 509 §5.03(B), 1980].

Response: This proposal has been designed to include access streets which discourage through traffic to abutting properties and will instead facilitate access to the Phase 1 Road B.

In addition, this proposal has been designed without the provision of direct emergency access to Larsen Lane SW. Proposed finished site grades will inhibit the connection of emergency access for the River's Edge at the Landing Subdivision. twenty- (20) foot wide tract. In conformance with the Master Plan Conditions of Approval, Item 12.a(2), an alternative location for emergency access is required if the required emergency access cannot be provided within the existing Larsen Lane SW right-of-way. This proposal has been designed to include an emergency access spaced two-hundred and seventeen (217) feet apart from the primary subdivision access road and is included via a twenty- (20) foot wide Tract 'A.' The emergency access connection to the Phase 1 Standard Collector included in this subdivision extends less than one hundred and twenty (120) feet. The placement of bollards or other acceptable barrier at the end of the tract shall inhibit the everyday use of the emergency access road and allow emergency access use by the Cowlitz County Fire District 6.

16.20.060 Cul-de-sac streets.

"Cul-de-sacs," defined in CRMC 17.16.685, are required for roads longer than 150 feet, but they cannot exceed 400 feet in length. Please refer to the "City of Castle Rock Engineering Standards for Public Works Construction" for design specifications. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 2003-05 § 2, 2003].

Response: This proposal does not include roads that are longer than one-hundred and fifty (150) feet that do not intersect with another street. As such, cul-de-sacs are not included in this proposal.

16.20.100 Right-of-way and roadbed widths.

The minimum street right-of-way and roadbed widths shall be in "City of Castle Rock Engineering Standards for Public Works Construction" and are adopted by this reference. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 509 § 5.03(G), 1980].

Response: The road included in this proposal adhere to the modified forty-eight- (48) foot wide street right-of-way and eighteen- (180) foot roadbed width standards pursuant to the approved Landing on the Cowlitz.

16.20.110 Street frontage improvements.
Except where deemed impractical by the city council, all plats, subdivisions, short subdivisions, condominiums, and binding site plans shall install street frontage improvements at the time of construction as required by "City of Castle Rock Engineering Standards for Public Works Construction." Such improvements may include curb and gutter, sidewalk, bus stops, street storm drainage, street lighting system, traffic signal modification, relocation or installation, utility relocation, landscaping and irrigation, and street widening all per these standards. Plans shall be prepared and signed by a licensed civil engineer registered in the state of Washington. All frontage improvements shall be made across full frontage of property from centerline to right-of-way line. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 509 § 5.03(H), 1980].

Response: This proposal is not subject to any frontage improvements for existing roadways abutting the site. The roadway improvements for a portion of Larsen Lane SW are included in the Phase 1 Access and Utilities (CR-24-052).

16.20.120 Half streets.

A street lying along the boundary of a subdivision may be dedicated one-half of the required width if it is practical to require the dedication of the other half when the adjoining property is subdivided. Whenever there exists a dedicated half street of an adjoining subdivision next to a proposed subdivision, the other half shall be dedicated on the proposed subdivision to make the street complete. To ensure that this occurs, a one-foot conditional dedication shall be required on the subdivision boundary along the street for the purpose of withholding access from the unsubdivided property to said street until such time as a complete street is constructed. This same procedure will also be required when a street dead-ends at the boundary of any subdivision. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 509 § 5.03(I), 1980].

Response: This proposal does not include the provision of a half-width street. A one (1) foot conditional dedication shall be included for Road C which dead ends at the boundary of the proposed River's Edge at the Landing Subdivision.

16.20.140 Street lighting.

Street lighting shall be included in the development of all future platting and/or subdivisions. Street lights shall be placed at all streets per the "City of Castle Rock Engineering Standards for Public Works Construction." [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 509 § 5.03(K), 1980].

Response: The Preliminary Lighting Plan depicts street lighting spaced in conformance with the two-hundred- (200) feet maximum spacing requirement pursuant to *CRMC 16.20.140*.). Final locations of street lighting are subject to change during final engineering but shall be required to conform with the City Engineering Standards, Chapter 4.22.K., local roadways which include twenty-eight (28) feet wide pavement, staggered or one (1) side system every two hundred (200) feet. This proposal has been designed to include the modified Residential Local Access roadway segments varying in length.

16.20.150 Parking requirements.
When a plat or subdivision is included in an area where off-street parking is required, such off- street parking shall be as required by CRMC Title 17. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 509 § 5.03(L), 1980].

Response: This proposal is subject to off-street parking requirements pursuant to the City of Castle Rock Municipal Code (CRMC) 17.52.020.A.1. which necessitates two (2) spaces for each dwelling unit. This proposal has been designed to facilitate the inclusion of two- (2) car garages and two- (2) car carports/driveways.

16.20.160 Railway crossings.

[…]

Response: Not applicable. This proposal is not situated at a site in which a railway grade crossing is involved.

16.20.170 Alleys – Required when.

Alleys should be provided at the rear of all lots intended for commercial or industrial uses. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 509 § 5.04(A), 1980].

Response: Not applicable. This proposal does not involve lots intended for any non-residential use.

16.20.180 Alleys – Specifications.

Dead-end alleys shall be avoided whenever possible, but, if unavoidable, shall be provided with turnaround facilities. Alley intersections and sharp changes in direction shall be avoided, but where they are necessary, corners shall be rounded sufficiently to permit safe vehicular movement. Except as otherwise provided in this title, alleys shall follow the general development standards governing streets. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 509 § 5.04(B), 1980].

Response: Not applicable. This proposal does not include alleys therefore the specifications pertaining to those do not apply.

CRMC §16.20.190 Easements – Required when.

A. Except where alleys of not less than 20 feet are provided for that purpose, the city council may require easements not exceeding 10 feet on each side of all rear lot lines, and on side lot lines where necessary or, in the opinion of the city council, advisable, for poles, wires, conduits, storm and sanitary sewers, gas, water and heat mains or other utility lines or across lines where necessary for the extension of existing or planned utilities.

Response: This proposal has been designed to include a ten- (10) foot stormwater easement within portions of the site pursuant to the requirements of the approved Landing on the Cowlitz Master Plan.

B. If, in the opinion of the city council, the most suitable and reasonable locations for any of the utilities, such as sewers, storm drains, water and gas pipes and electric pole lines and conduits, which are likely to be required within a subdivision, either for the service thereof or for service of areas in the surrounding territory, do not wholly lie within the streets, including alleys, if any, shown upon the plat, the city council may require, as far as reasonable, provisions to be made for the location of such utilities on routes elsewhere than within said streets, either by dedication of public easements for the same as part of the plat or by the filing of supplementary instruments which will adequately protect public interest in the proper location of said utilities. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 509 § 5.05(A), 1980].

Response: This proposal has been designed to include a ten- (10) foot stormwater easement, where applicable, along the perimeter of the property abutting privately owned non-LOTC Master Plan property and for Lots 12-19 abutting Larsen Lane SW.

16.20.200 Public open spaces.

All residential single-family subdivision (including manufactured home parks/subdivision) and multifamily development proponents shall be required to dedicate land for park areas prior to receiving any occupancy permit. Upon finding that there is cause for a variation in accordance with Chapter 16.36 CRMC, or if the proponent demonstrates that off-site improvements associated with projects identified in the park and recreation plan are of greater benefit to the city than an on-site land dedication, the city council may accept off-site improvements or a fee in lieu of land dedication; provided, that the off-site improvements are completed or the fee in lieu of land dedication will be collected in full prior to final plat approval.

All mitigation measures are to be based on specific impacts based on population increase caused by the development as determined in the city's park and recreation plan adopted via Resolution No. 2005-02, or amended thereafter. Said dedication shall be based on an assessment of demand and need along with established park standards set forth within the adopted park and recreation plan. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 509 § 5.05(B), 1980].

Response: This proposal has been designed to include park space that is approximately 18,396 square feet in size and shall be dedicated to the City of Castle Rock upon completion of construction and prior to issuance of final certificate of occupancy for the subdivision. The exact amount of park area may be subject to change during final engineering but shall be designed in conformance with the applicable requirements.

In anticipation of a potential 183 future site residents (factoring in a potential three (3) residents per lot), a minimum of one-hundred and seventy four (174) square feet per lot is required pursuant to the approved Landing on the Cowlitz Master Plan (LOTC) Developer's Agreement, Item No. 6.1.4.

16.20.210 Watercourse easements.

Where a subdivision is traversed by a watercourse, drainageway, wasteway, channel or stream, there shall be provided a stormwater easement or drainage right-of-way conforming substantially to the line of such watercourse, drainageway, wasteway, channel, or stream, and of such width for construction, maintenance, and control as will be required for such purposes. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 509 § 5.05(C), 1980].

Response: This proposal includes an existing drainageway along the perimeter abutting privately owned property not included in the approved Landing on the Cowlitz Master Plan (LOTC) which has been designed to be undergrounded with a ten- (10) foot stormwater easement. In addition, stormwater piping is included along the rear of Lots 12-19 abutting Larsen Lane SW for which a ten- (10) foot stormwater easement.

16.20.220 Blocks – Length.

Intersecting streets shall be laid out so that blocks between street lines shall be provided in accordance with the "City of Castle Rock Engineering Standards for Public Works Construction," except that where, in the opinion of the city council, extraordinary conditions unquestionably justify departure from this maximum, the city council may require or permit greater distances between street lines. The city council may require, at or near the middle of the block, a public pedestrian way not less than 15 feet in width for foot traffic. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 509 § 5.06(A), 1980].

Response: This proposal has been designed to include streets that meet the City Engineering Design Standard Chapter 4.10.C., which requires a minimum centerline offset of one hundred and fifty (150) feet from the intersection with Road B, a Standard Collector modified by the LOTC Developer's Agreement. In addition, the intersection spacing of the streets internal to the subdivision have been designed to meet the minimum one-hundred and twenty-five (125) feet intersection spacing required by the City.

16.20.240 Blocks – widths.

The width of blocks shall be such as to allow two rows of lots, of the size specified in this chapter, unless exceptional conditions are, in the opinion of the city council, such as to render this requirement impracticable. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 509 § 5.06(B), 1980].

Response: This proposal has been designed to include a maximum of two (2) rows of lots.

16.20.240 Lots – Access.

Each lot shall be provided with satisfactory access by means of a public street connecting to existing and developed highways or by some other legally sufficient right of access which is permanent and inseparable from the lot to be served. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 509 §5.07(A), 1980].

Response: Direct roadway connection for each lot included in this subdivision is facilitated via the internal public asphalt LOTC modified Urban Local Access roads or private tracts included in the River's Edge at the Landing Subdivision.

16.20.250 Lots – Arrangement.

In all quadrangular lots and, so far as practicable, all other lots, the side line shall be at right angles to straight street lines or radial or curved street lines. An arrangement placing adjacent lots at right angles to one another shall be avoided where practicable. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 509 § 5.07(B), 1980].

Response: Each quadrangular lot has been included in this subdivision with right angles to abutting roadways and tracts which provide access to the lots.

16.20.260 Lot – Minimum size.

Minimum lot sizes and lot dimensions of any subdivision shall be as required by CRMC Title 17. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 518 § 1, 1980; Ord. 509 § 5.07(C), 1980].

Response: Pursuant to the approved Landing on the Cowlitz Master Plan (LOTC) Condition of Approval, Item 5.a., there are no minimum lot size or width requirements provided that applicable lot coverage, parking, loading, stormwater management, and landscaping requirements as well as the provisions of the International Building Codes, as adopted and implemented by the City are met. The Developer's Agreement Item 6.1.1., requires that single-family lots must be a minimum of 3,500 square feet in size. This proposal has been designed to include single-family lots which are 3,500 square feet or larger.

16.20.260 Minimum yards.

The minimum front, side or rear yard within a subdivision shall be as required by the zoning ordinance then in effect. [Ord. 2010-01 Att. A, 2010; Ord. 2006-09 Att. A, 2006; Ord. 509 § 5.07(D), 1980].

Response: Each lot included in this subdivision has been designed in this subdivision to include the required setbacks. privately-owned property not included in the master plan. The LOTC Developer's Agreement requires that the residential land use portion of the Master Plan must comply with the following minimum setback requirements of the R-2 high density residential district:

- 20 feet for front yards with garages;
- 15 feet for front yards and corner lot/side yard in width along the flanking or street side;
- 20 feet for rear yards, and;
- 5 feet for side yards for lots that include single-family dwellings.
- 35 feet building setback abutting privately-owned properties not included in the LOTC master plan (twenty- (20) foot landscape buffer, ten- (10) foot drainage easement and additional five- (5) foot building setback).
- Corner lots must comply with the minimum sight distance requirements included in Section 4.12 of the City Engineering Design Standards. This standard is met as demonstrated on the Landscape Planting Plan, Sheet L1.0

  This proposal also includes additional setback requirements in conformance with the approved Landing on the Cowlitz Master Plan (LOTC) Condition of Approval, Item 5.b.:
  Condition of Approval, Item 5.b.:

There are no minimum front, side, or rear yard building setbacks, within the interior of the master planned development, provided that:

(1) There shall be a minimum landscape buffer of 20' along the external boundary of the master planned development that abuts privately owned properties not a part of the Master Planned Development. This requirement may be modified by mutual written agreement of the adjoining property owners and subject to City review and approval.

(2) All buildings must be setback at least 5' from the required 20' landscaped buffer.

(3) All buildings shall comply with the provisions of the International Building Codes as adopted and implemented by the City.

This proposal has been designed to include a twenty- (20) foot landscape buffer along portions of the property that abut privately owned property not included in the approved Master Plan, i.e., Parcel 3081101100, Parcel 30818 and Parcel 3081701. In addition, this proposal has been designed to include a ten- (10) foot drainage easement within which no development is allowed, and a five- (5) foot building setback (ref. Lots 14 and 16). As such, a total of thirty-five (35) feet of setback included in the design for proposed lots within the Landing on the Cowlitz (LOTC) Master Plan that abut privately owned property.

Lots 9-14 abut Larsen Lane SW and have been designed to include a ten- (10) foot drainage easement within which no development is allowed and a twenty- (20) foot building setback.

TITLE 17 ZONING
Chapter 17.32 High Density Residential District

17.32.040 Building heights.

The maximum building height in the R-2 district shall be four stories or 40 feet, except that building heights greater than four stories or 40 feet may be allowed by special permit. [Ord. 2018-02 § 2 (Exh. A), 2018].

Response: This preliminary plat does not include proposed structures, however, demonstrate that this standard has been met will be required with the building permit applications.

17.32.050 Building site dimensions.

A. In the R-2 district, the following shall be considered as a minimum lot area; however, no dwelling shall be constructed upon a lot which has a width of less than 60 feet or less than the following square footage:

1 Single-family dwellings, 6,000 square feet;

2. Single-family attached dwellings, 3,750 square feet;

3. Duplexes, 7,500 square feet;

4. Multiple-family dwellings, 7,500 square feet for the first two dwelling units, plus 1,000 square feet for each additional dwelling unit.

Response: While this site is subject to the requirements of the R-2 district, this proposal has been designed to meet the minimum lot sizing as modified by the approved Landing on the Cowlitz Master Plan which includes 3,500 square foot single-family residential lots.

B. Provided, that these regulations shall not prohibit the erection of one single-family dwelling upon any lot of record prior to March 1, 1975, because such lot is of less area or width than required by these regulations. [Ord. 2018-02 §2 (Exh. A), 2018].

Response: Not applicable. This proposal involves the subdivision and development of property which shall be devoid of any structures.

17.32.060 Street frontage.

Every principal structure, except bungalow courts, shall front upon a public street without any other building intervening between it and the street upon which it fronts. [Ord. 2018-02 § 2 (Exh. A), 2018].

Response: This proposal has been designed to include lots which front upon and have direct access to a public street or private tract. Subsequent building permit applications submitted after preliminary land use approval shall be required to demonstrate that no buildings shall be allowed to intervene between the principal structure and the street for which each lot has access to.

17.32.070 Minimum yard requirements.

The minimum yard requirements in the R-2 district are as follows:

A. Front yard: not less than 15 feet from the front property line.

Response: This proposal has been designed to include twenty- (20) foot front yard setbacks as each lot has been designed with the intention to be front loaded.

B. Garage entrance: set back a minimum of 20 feet from the front property line.

Response: All lots included in this proposal have been designed to include a twenty- (20) foot setback from the front property line.

C. Rear yard: not less than 20 feet in depth. The rear yard may be reduced by the development review committee to five feet if provisions are made for off-street parking and the property abuts an alley. The development review committee can include conditions necessary to maintain the residential character of the neighborhood.

Response: Rear lot setbacks included in this proposal are twenty (20) feet. None of the lots included in this proposal abut an alley as an urban local access roadway and private tracts are the only road types included in this subdivision.

D. Side yard: not less than five feet in width on sides of dwelling. For two-family dwellings (duplex), each side yard shall be a minimum of eight feet in width. The side yard for every building shall be increased by one additional foot in width for each story of the structure above two stories in height.

Response: This proposal involves a detached single-family residential subdivision and as such, five- (5) foot side yard setbacks are included. With a maximum building height of forty (40) feet, it is not anticipated that additional building setback area will be necessary for side yards.

E. Corner lot/side yard: 15 feet in width along the flanking or side street line. [Ord. 2018-02 § 2 (Exh. A), 2018].

Response: Corner lots included in this proposal feature a fifteen (15) foot setback along the flanking or street line.

17.32.080 Screening, landscaping and critical area buffering requirements.

The objectives of the screening, landscaping and buffering requirements are threefold. The first objective is to develop a multiple-family residential area which is attractive; the second is to buffer adjacent single-family residential areas from the effects of neighboring high density residential uses; and the third is the protection of property and life from damages resulting from locating too close to a critical area, while providing protection from human encroachment for endangered and local wildlife species. Prior to or as part of applying for a building permit to expand existing or construct a new building in the R-2 residential zone, the following screening, landscaping and buffering requirements shall be met:

A. A site plan with detailed landscaping and screening must be submitted for city review for consideration of the following requirements: A perimeter hedge or landscaped berm or landscaped areas at least three feet deep shall be installed and maintained adjacent to each property line, except where a permanent structure, driveway or sidewalk is in this area. The landscaping must conform with the street visibility standards contained in CRMC 17.48.020.

Response: This preliminary application submittal includes a landscaping and screening plan which depicts the proposed landscaping on sheets L1.0, L1.1 and L1.2.

B. Landscaping of Surface Parking and Loading Areas. In addition to the general required landscaping, the following screening and landscaping is required on surface parking areas:

1. *Additional interior landscaping of two percent or more of the site area shall be required when the site, exclusive of building areas, is 5,000 or more square feet. The interior landscaping shall be placed within a parking area in a way which visually reduces the barren effect of the open surfaced area. Berms and other landscaped areas provided to meet screening requirements may not be counted as part of this additional interior landscaped area.*

   Response: Not applicable. This proposal does not include surface parking or loading areas therefore these standards to do apply.

2. *One tree or medium sized (four feet tall or larger) evergreen shrub shall be planted and maintained for every 20 parking spaces. Each tree or shrub shall be three feet away from any curb of a landscaped area or edge of the parking area.*

   Response: This proposal has been designed to include trees sized and spaced in accordance with this requirement and is depicted in the proposed landscaping on sheets L1.0, L1.1 and L1.2.

C. Screening of Surface Parking Areas and Other Outdoor Use Areas Abutting a Single-Family Residential Area.

[...]

Response: Not applicable. This proposal involves residential use only.

D. Screening of Blank Facades. A five-foot-deep landscaped area with trees or medium sized (four feet tall or larger) evergreen shrubs shall be planted and maintained between street property lines and a blank building facade which exceeds 50 feet in width.

Response: This proposal does not include the provision of structures. This will be addressed with the building permit application submittal.

E. Permitted Breaks in Landscaping or Screening. Pedestrian walkways and vehicular driveways through required landscaping or screening are permitted. Breaks in required landscaping or screening for vehicular access shall not exceed the width of permitted curbcuts.

Response: This proposal does not at this time include breaks in landscaping or screening to facilitate vehicular driveways or walkways that exceed the width of permitted curbcuts.

F. Screening. Wherever six-foot-high screening is required, it may be either:

1. *A fence or wall six feet in height; or*
2. *A landscaped berm at least four feet in height or a hedge which will achieve a height of five feet within three years of planting and is at least two feet high at the time of planting.*

Response: This proposal has been designed to include screening as appropriate.

G. Grade Separation Exceptions. Where grade difference of 10 or more feet occurs within 10 feet of the lot line, the required screen may be replaced with a landscaped area five feet deep or 150 percent of the required landscaped area, whichever is more.

Response: Not applicable. The site is flat and devoid of grade differences of ten (10) feet or more.

H. Required Planting. Areas or berms required to be landscaped shall be planted with trees, shrubs and evergreen ground cover, in a manner which covers the required setback, excluding driveways, within three years of the date of the issuance of the permit. Features such as walkways, decorative paving, sculptures or foundations may cover a maximum of 30 percent of each required landscaped area or berm. Trees shall be selected from the city's recommended list for tree planting.

Response: This proposal has been designed to include landscaping which covers the required setback, excluding driveways.

I. Buffering Requirements Adjacent to Critical Areas. Prior to or as part of applying for a building permit to expand existing or construct a new multiple-family building in the R-2 zone adjacent to any identified critical area, an approved critical area permit must be submitted which clearly shows that adequate buffering has been (or soon will be) provided in accordance with Chapter 18.10 CRMC, Critical Areas, as applicable to the subject site. [Ord. 2018-02 § 2 (Exh. A), 2018].

Response: Not applicable. This proposal does not abut critical areas.

17.32.090 Off-street parking.

Off-street parking shall be provided in accordance with the requirements of Chapter 17.52 CRMC and CRMC 17.48.110. [Ord. 2018-02 § 2 (Exh. A), 2018].

Response: This proposal has been designed to facilitate the inclusion of the required parking quantity and configuration pursuant to the requirements of Chapter 17.52 CRMC. CRMC 17.48.110 pertains to quasi-public building yard and as such does not apply to this proposal which involves a single-family residential subdivision. Narrative addressing the requirements contained within 17.52 is included in response to those chapters below.

17.32.100 Permitted signs.

Signs allowed in the R-1 district shall be allowed in the R-2 district in accordance with Chapter 17.82 CRMC. [Ord. 2018-02 § 2 (Exh. A), 2018].

Response: This proposal does not include the provision of signage. It is anticipated that monumentation signage may be contemplated as part of the subdivision building permitting process. Since a subdivision developer is not at this time engaged in the project, it remains unknown if entry signage will be pursued at a later date.

Chapter 17.52

OFF-STREET PARKING AND LOADING

17.52.010 Requirements.

In all use districts, space for the off-street storage and parking and loading and unloading of motor vehicles shall be reserved and improved for use when any building or structure is erected, or when any building or structure is enlarged or expanded in heights or ground coverage so as to increase the number of required parking spaces by 10 percent over the number required prior to the enlargement or expansion. Any on-street parking space immediately adjacent to a use may be counted toward fulfilling that use's parking requirements. [Ord. 2018-02 § 2 (Exh. A), 2018].

Response: This proposal includes the development of a subdivision. No uses have been developed within the approved Landing on the Cowlitz Master Plan (LOTC) therefore, required parking spaces may not be counted towards the minimum required for the subdivision.

17.52.020 Parking standards.

A. The minimum required parking spaces for the various uses shall be as follows:

1. Single-family dwelling: two spaces for each dwelling or living unit;

Response: This proposal has been designed to include eighteen- (18) foot wide driveways for each individual residential lot in order to accommodate two (2) off-street parking spaces in the driveway. Pursuant to the City's Street & Asphalt Concrete Paths and/or Bikeways Standards Section 4.11, page 4-15, for private driveways, individual lot sizes ranging from 30 to 50 feet are limited to twelve (12) feet or 30% of frontage. The Applicant requests a modification to the City's driveway standard in order to maximize the number of parking spaces available to future homeowners. This modification would allow the Applicant to maximize the number of lots available to the community.

2. Duplex: two spaces for each dwelling unit;

Response: Not applicable. This proposal involves a subdivision with single-family residential lots.

3. Multifamily dwelling: one and one-half spaces for each dwelling or living unit;

Response: Not applicable. This proposal does not involve a multifamily family use.

4. Church, mortuary, funeral home: one space for each four seats in the chapel or nave;

Response: Not applicable. This proposal involves a single-family residential subdivision.

5. *Bowling alleys: three spaces for each lane;*

   Response: Not applicable. This proposal involves a residential use and as such does not include a bowling alley.

6. *Hotels and motels: one space for each room or suite, plus one space for each employee and required spaces for any restaurant, assembly rooms, or other accessory use;*

   Response: Not applicable. This proposal involves a single-family residential subdivision.

7. *Hospitals, sanitariums, convalescent homes, nursing homes and rest homes: one space for every three patient beds, plus one additional space for each staff doctor and for every three employees;*

   Response: Not applicable. This proposal involves a single-family residential subdivision.

8. *Manufacturing or industrial uses: one space for each two employees on the shift of greatest employment, with a minimum of three spaces;*

   Response: Not applicable. This proposal involves a single-family residential subdivision.

9. *Restaurants with inside service: one space for each 100 square feet and restaurants with drive-thru, one space for each 200 square feet.*

   Response: Not applicable. This proposal involves a subdivision with single-family residential lots.

B. All parking spaces will be provided with adequate ingress and egress to allow maneuvering for the parking spaces.

Response: All parking spaces included in this subdivision have been designed to allow adequate ingress and egress.

C. All parking spaces will be located on the same lot as the use for which the parking spaces are needed.

Response: This proposal has been designed to include lots which can facilitate parking spaces and public streets internal to the subdivision. This proposal includes the provision of twenty-one (21) on-street parking spaces.

D. All other uses will provide one parking space for each 200 square feet of gross floor area.

Response: Not applicable. This proposal includes a single-family residential use for which the parking requirements are specified.

E. Parking Space Dimensions.

1. *The minimum size for large size vehicle parking (SUVs, pickup trucks, motor homes, etc.) is nine feet in width and 19 feet in length.*

   Response: This proposal includes lots that have been dimensioned to facilitate the inclusion of four (4) nine- (9) foot wide and nineteen (19) feet in length.
2. *The minimum size for medium size vehicle parking (four-door sedans, etc.) is eight and one-half feet in width and 17 feet in length.*

Response: This proposal has been designed to include on-street parking spaces to facilitate twenty-one (21) on-street parking spaces which have been sized to include eight- (8) foot wide by twenty- (20) foot long parking spaces.

3. *The minimum size for small size vehicle parking (VWs, Honda Civics, etc.) is eight feet in width and 15 feet in length.*

   Response: Not applicable. This proposal does not include small vehicle size parking spaces.

4. *Barrier-free parking space dimensions shall be provided as required by the Washington State Rules and Regulations for Barrier-Free Design. Unless more space is required under the Washington State Rules and Regulations, barrier-free parking spaces, accessible to disabled persons, shall be provided in every off-street parking facility with 10 or more parking spaces at the rate of one accessible parking space for every 30 standard parking spaces.*

   Response: Not applicable. This proposal has been designed to include twenty-one (21) on-street parking spaces. Since this proposal does not include thirty (30) standard parking spaces, the provision of the City's barrier-free (handicapped) parking space requirement does not apply.

F. Required Mixture of Various Sized Spaces. The required number of parking spaces of each size shall be determined by whether the parking is for residential or nonresidential use. In structures containing both residential and nonresidential uses, parking, which is clearly set aside and reserved for residential use, shall meet the standards of subsection (F)(1) of this section; otherwise, all parking for the structure shall meet the standards of subsection (F)(2) of this section.

1. *Residential Use.*

   a. *When five or fewer spaces are provided, a minimum required size for each parking space shall be for a medium sized car.*

      Response: Not applicable. This proposal involves the inclusion of greater than five (5) spaces.

   b. *When more than five spaces are provided, a minimum of 60 percent of the parking space shall be striped for medium sized vehicles, and one space or two percent, whichever is the greater, of parking spaces must meet the barrier-free (handicapped) design standards.*

      Response: This proposal includes the provision of more than five (5) spaces and the provision of on-street parking spaces which generally meet the criteria for the medium parking space.

2. Nonresidential Use.

[…]

Response: Not applicable. This proposal involves a residential use.

17.52.030 Mixed occupancies.

In the case of mixed uses, the total requirements for off-street parking facilities shall be the sum of the requirements for the various uses computed separately. Off-street parking facilities for one use shall not be considered as providing required facilities for any other use except as hereinafter specified for a joint use. [Ord. 2018-02 § 2 (Exh. A), 2018].

Response: Not applicable. This proposal involves a single use whereby which mixed occupancies shall be prohibited.

17.52.040 Layout plan.

Prior to the issuance of a building permit for any building or use requiring more than two parking spaces, a plan showing proposed and existing buildings and the layout, dimension, mixture of various size spaces, and the number of parking spaces shall be submitted to the development review committee as per Chapter 17.77 CRMC. [Ord. 2018-02 § 2 (Exh. A), 2018].

Response: The Applicant acknowledges this requirement must be met prior to the City's issuance of building permits.

17.52.050 Loading and unloading.

On every lot in a C-1, C-2 or I-1 district, and on any lot on which is conducted any public or semi-public use, there shall be space provided for the loading of goods and materials. Such spaces shall not be less than 10 feet in width nor 25 feet in length. Such space shall be provided with adequate access to a public right-of-way. [Ord. 2018-02 § 2 (Exh. A), 2018].

Response: Not applicable. This proposal involves a subdivision which requires adherence to standards required for a R-2 district.

17.52.060 Requirement compliance with state handicapped regulations.

Handicapped (barrier-free) parking shall be provided as stated in CRMC 17.52.020 and as defined in RCW 46.16.281. [Ord. 2018-02 § 2 (Exh. A), 2018].

Response: Regulations pursuant to CRMC 17.52.020 do not apply to this proposal as it involves the provision of fewer than thirty (30) on-street parking spaces.

17.52.070 Hard surfaces required for commercial and industrial parking.

"Hard surface" means asphalt, concrete, or cement. [Ord. 2018-02 § 2 (Exh. A), 2018].

Response: Not applicable. This pertains to commercial and industrial parking and this proposal includes a residential use.

TITLE 15 BUILDINGS AND CONSTRUCTION
Chapter 15.24 Flood Damage Prevention
[…]
15.24.240 Subdivision Proposals

A. All subdivision proposals shall be consistent with the need to minimize flood damage.

Response: This proposal includes the provision of site fill, with proposed site grading which shall result in raising the site to 50.3 feet which is above the base flood elevation (BFE) of 48 for the site. In addition, structures shall be required to be raised one- (1) foot above the BFE. This proposal has been designed to facilitate the inclusion of building pads at 51.8 feet.

B. All subdivision proposals shall have public utilities and facilities such as sewer, gas, electrical and water systems located and constructed to minimize flood damage.

Response: The road profiles included in this proposal have been designed to keep the roadways above the BFE ensuring that water meter boxes, gas meters, electric meters, etc. are all above flood elevations. In addition, this proposal has been designed to include building pad elevations well above the base flood plain (BFE).

C. All subdivision proposals shall have adequate drainage provided to reduce exposure to flood damage.

Response: This proposal has been designed in accordance the Landing on the Cowlitz Master Plan master drainage plan which is anticipated to receive approval within Q2 of 2025. in addition, each building pad elevation in this proposal is set well above the 100-year base flood plain elevation. Driveway grades have been designed to ensure positive drainage away from structures. For more information, refer to the Stormwater Master Plan for the LOTC about how the system will perform during flood events.

D. Where base flood elevation data has not been provided or is not available from another authoritative source, it shall be generated for subdivision proposals and other proposed developments which contain at least 50 lots or five acres (whichever is less). [Ord. 88-14 § 5.1-4, 1988].

Taylor, how would you describe how the proposed provision of utilities and facilities has been designed to minimize flood damage?

Response: Not applicable. Base flood elevation data is available for this site as derived from FEMA FIRMETTE Map No. 53015C0294G (Effective Date 12/16/2015).

TITLE 18 ENVIRONMENTAL PROTECTION

[…]

18.04.130 Environmental checklist.

A. A completed environmental checklist (or a copy), in the form provided in WAC 197-11-960, shall be filed at the same time as an application for a permit, license, certificate, or other approval not specifically exempted in this chapter; except, a checklist is not needed if the city and applicant agree an EIS is required, SEPA compliance has been completed, or SEPA compliance has been initiated by another agency. The city shall use the environmental checklist to determine the lead agency and, if the city is the lead agency, for making the threshold determination.

Response: This application submittal includes a completed SEPA Checklist.

B. For private proposals, the city will require the applicant to complete the environmental checklist, providing assistance as necessary. For city proposals, the department initiating the proposal shall complete the environmental checklist for that proposal. [Ord. 574 § 18A.12.040, 1984].

Response: While a SEPA Checklist was not specified in the Pre-Application Notes as a required submittal item, one is provided in the event the City of Castle Rock makes the determination one is needed.

V. CONFORMANCE WITH MITIGATION MEASURES AS OUTLINED IN THE MODIFIED MDNS DATED SEPTEMBER 8, 2021

This proposal has been designed in conformance with the City's requirement to avoid, minimize, and mitigate potential adverse impacts associated with the phased implementation of the Landing on the Cowlitz (LOTC) Master Plan over time. The subdivision application constitutes the first implementing phase of the LOTC Master Plan and as such requires the submittal of a State Environmental Protection Act (SEPA) Checklist which evaluates the following potential impacts associated with the subdivision against the anticipated impacts evaluated in the Modified Mitigated Determination of Non-Significance (MDNS) dated September 8, 2021, for the Landing on the Cowlitz (LOTC) Master Plan. The following mitigating measures have been met by this proposal:

1. *A SEPA Checklist will be submitted with the application to implement each phase of the approved master plan.*
   a. *The City may require additional mitigation and/or conditions of approval based on an analysis of these subsequent environmental documents.*

      Response: The application for the River's Edge at the Landing Subdivision includes a SEPA Checklist which demonstrates that all anticipated impacts associated with the subdivision were contemplated within the approved SEPA MDNS dated September 8, 2021.

2. *All subsequent project specific development activities shall comply with the applicable provisions of the Castle Rock Municipal Code unless modified by these conditions of approval.*

   Response: Pursuant to the Developer's Agreement (DA) dated February 20, 2024, Section 5, all subsequent project specific development activities are vested under the development standards in effect on November 8, 2021 except where modified by the DA. This proposal has been designed in conformance with all applicable development standards.

3. *There shall be no net loss of function or value of wetlands, streams, or rivers and associated habitats.*
   a. *A Critical Areas Report shall be submitted for all development activities that may impact environmentally sensitive areas on or near the site and a Critical Areas Permit or similar authorization shall be required for all non-exempt development activities.*

      Response: Not applicable. The site does not have indicators for wetlands, stream, or rivers and associated habitats. Therefore, a Critical Areas Report is not required for the proposed subdivision.

   b. *All critical areas and their buffers shall be delineated and placed in an open space tract.*

Response: This proposal shall involve site fill and certification for bringing above the floodplain. As such, the finished subdivision shall not include critical areas and shall not necessitate the inclusion of an open space tract.

c. *All development activities within 200' of a river or stream and their associated wetlands under the jurisdiction of the Washington State Shoreline Management Act shall comply with the provisions of the Castle Rock Shoreline Master Program.*

Response: The site is located outside of the two hundred (200) feet of a river or stream and their associated wetlands under the jurisdiction of the Washington State Shoreline Management Act.

4. *All development activities shall comply with the City Flood Hazard Prevention regulations including the elevation of buildings at least one foot above base flood elevations.*

Response: This proposal has been designed in conformance with the City of Castle Rock Municipal Code (CRMC) 15.24.240 and includes building pads at elevation 51.8 which is well over one- (1) foot about the base flood elevation of 48. For more information, see the narrative section above which addresses this.

5. *Prior to the initiation of any clearing and grading activities the Project Sponsor shall submit for City review and approval a Master Clearing, Fill, and Grading Plan that is integrated with a Master Stormwater Management Plan that includes an analysis of the impacts of the development to the adjacent properties and measures to ensure that stormwater or flood waters will not adversely affect neighboring properties.*

Response: This proposal post-dates the approved master grading plan (ref. City file no. CR22023)

6. *The primary route of ingress and egress shall be from Huntington Avenue South and a new access road in the immediate vicinity of the existing Timberlake Church access road. All access roads in this corridor shall be designed, built, and improved to City industrial road standards, except as modified by the Conditions of Master Plan approval, provided that:*

a. *With each application to implement a phase of development, the Project Sponsor shall submit an updated traffic report that identifies the number of trips to be generated, assesses existing conditions, identifies proposed mitigation measures to meet City standards, and that identifies when such mitigation measures are required.*

Response: Pursuant to the feedback provided by the City's traffic engineering consultant in a letter dated November 14, 2024, determined that the appropriate level of review required for the subdivision includes a trip accounting analysis.

7. *Larsen Lane SW is a public right-of-way and in its existing condition the use of Larsen Lane SW to access the Master Planned Development shall be limited to:*

a. *Emergency ingress and egress, provided that:*

(1) *The Project Sponsor shall be responsible for the design and construction of such improvements to Larsen Lane SW within the existing right-of-way from the site of the Master Planned Development to the intersection with Huntington Avenue South that may be*

required by the City to maintain emergency access to the Master Planned Development in accordance with the provisions of the International Fire Code as implemented and adopted by the City.

Response: This proposal has been designed without the provision of direct emergency access to Larsen Lane SW. Proposed finished site grades will inhibit the connection of emergency access for the River's Edge at the Landing Subdivision. As such, the Applicant is not subject to the provision of additional improvements to Larsen Lane SW right-of-way from the site of the Master Planned Development to the intersection with Huntington Avenue South.

(2) *It is understood by the parties that if the required emergency access cannot be provided within the existing right-of-way that a different route for emergency access may be required.*

Response: This proposal has been designed to include emergency access to the subdivision via a private access driveway tract located approximately two hundred and seventeen feet from the primary subdivision.

b. *Interim access by the Project Sponsor, and their employees, subcontractors, and suppliers pending the construction of a temporary access road at the primary access point from Huntington Avenue near the church driveway, provided that:*

(1) *The Project Sponsor shall provide the City with documentation of the existing condition of Larsen Lane SW and shall be responsible for the repair of any damages to the roadway during this interim period.*

Response: A temporary access road was established to the site in 2022 and as such, Larsen Lane SW is not used as an interim construction access road.

(2) *The City will require a bond or financial guarantee sufficient to restore Larsen Lane SW in its sole discretion.*

Response: Not applicable. This proposal does not include emergency or otherwise temporary use of Larsen Lane SW.

(3) *The Project Sponsor shall design and construct, subject to City review and approval, a temporary access road at the primary point of access from Huntington Avenue near the church driveway no later than June 30, 2022, provided that this deadline may be extended with cause by the City.*

Response: The temporary access road at the primary point of access from Huntington Avenue South near the church driveway was established in 2022 in conformance with City requirements.

(4) *The City will make a good faith effort to expedite the review and approval of this temporary access road.*

Response: Not applicable. The Applicant did not bear the responsibility of expediting reviews.

8. *The City may install reasonable measures to prevent the use of Larsen Lane SW to access the Master Planned Development. This may include, but is not limited to, signage, a gate or bollards with a lock box, and a cul-de-sac or turnaround for vehicles attempting to enter the Master Planned Development.*

   Response: Pursuant to the Pre-Application Meeting with the City of Castle Rock on November 6, 2022 (ref. CR-PA-24-06), the City indicated that they do not have plans limit access along Larsen Lane SW from the master planned development.

9. *The Project Sponsor may propose to use Larsen Lane SW to provide a second access route to the Master Planned Development if such is required in accordance with local, state, or federal standards. The Project Sponsor shall be responsible for the design, acquisition of right-of-way, and construction of any required improvements to Larsen Lane SW including the intersection with Huntington Avenue South in accordance with City standards. The proposed design and use of these improvements shall be subject to environmental review and mitigation.*

   Response: Not applicable. This proposal does not involve a second access route connection to Larsen Lane SW.

10. *The Project Sponsor shall prepare and submit with the first implementing application a Conceptual Master Plan to guide the development and use of pedestrian and bicycle facilities, parks, and open spaces open to the public. This Conceptual Master Plan shall include, but is not limited:*

    a. *The standards for the development of trails, sidewalks, bike paths and lanes.*

       Response: This proposal includes park area which shall be dedicated to the City of Castle Rock pursuant to the Developer's Agreement Item No. 6.1.4. Sidewalks included in this proposal are included with the roadways internal to the subdivision.

    b. *Potential areas to view and access shorelines.*

       Response: Not applicable. There are no scenic views observable from the site that could become obstructed by the proposed subdivision.

    c. *Areas to be maintained by a private management entity, homeowner's association, or the like.*

       Response: It is presently anticipated that the future Homeowner's Association shall be responsible for the areas within the subdivision such as the private driveway access tracts, i.e., Tract 'A' and Tract 'B,' mailboxes and the entrance area which may someday feature entrance signage/monumentation.

    d. *Areas proposed for dedication and maintenance by the City or other public agency, if any.*

       Response: This proposal includes roadways internal to the subdivision which shall be dedicated to the City of Caste Rock.

11. *The Project Sponsor shall be responsible for the design, construction, and maintenance of such improvements as may be required to connect to the City water system, unless otherwise agreed to by the parties. All new development shall be connected to the City water system, provided that plans for a separate irrigation system may be submitted for City review and approval.*

Response: This proposal involves connection to the proposed City water system within the Phase 1 roadway.

12. *The Project Sponsor shall be responsible for the design, construction, and maintenance of such improvements as may be required to connect to the City sewer system, unless otherwise agreed to by the parties.*

    Response: This proposal has been designed to connect to the City sewer system within the Phase 1 roadway.

13. *The City and the Project Sponsor shall jointly consult with the Cowlitz Indian Tribe to determine the scope of a cultural and archaeological survey that shall be conducted prior to initiating any clearing, grading, filling, or excavation activities.*

    […]

    Response: An inadvertent discovery plan was developed in conformance with these requirements as well as state and federal provisions. Adherence to these requirements shall be required in the event *any human remains, artifacts, or evidence of potential archaeological, historical, or cultural resources are encountered during construction activities.*

VI. CONCLUSION

This application has addressed all relevant City of Castle Rock approval criteria for a residential subdivision application within the approved Landing on the Cowlitz Master Plan, and as such, the Applicant respectfully requests the approval of this subdivision proposal.

City of Castle Rock

P.O. Box 370
CASTLE ROCK, WA 98611
(360) 274-8181

Gateway to Mt. St. Helens

SEPA ENVIRONMENTAL CHECKLIST

What is this for?

The City and other governmental agencies use this checklist to help determine whether the environmental impacts of your proposal are significant. This information will also help determine if it's possible to avoid, minimize, or compensate (mitigate) for the probable significant impacts; or whether an environmental impact statement needs to be prepared to further analyze the proposal.

***How to fill this out*:**

This environmental checklist asks you to describe some basic information about your proposal. Please answer each question accurately and carefully, to the best of your knowledge. You may need to consult with an agency specialist or private consultant for some questions. You may use "not applicable" or "does not apply" only when you can explain why it does not apply and not when the answer is unknown. You may also attach, excerpt, or refer to additional studies or reports. Complete and accurate answers to these questions often avoid delays with the SEPA process as well as later in the decisionmaking process.

The checklist questions apply to all parts of your proposal, even if you plan to do them over a period of time or on different parcels of land. Attach any additional information that will help describe your proposal or its environmental effects. The City or other agencies may ask you to explain your answers or provide additional information to determine if there may be a significant adverse impact.

If you're using this checklist for a nonproject proposal (such as an ordinance, regulations, plans, or programs), complete the applicable parts of Parts A and B plus the SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS (Part D). Please completely answer all questions that apply and note that the words "project," "applicant," and "property or site" should be read as "proposal," "proponent," and "affected geographic area," respectively. For nonproject actions, the lead agency may exclude questions in Part B that do not contribute meaningfully to the analysis of the proposal.

This form is set up as a Word table. Except for a few questions that ask for you to select options, each question is followed by a blank field in which you can type your answer. Type in the shaded box. Check boxes will fill in when you click them. Each field will expand to accommodate your text, and the overall form will expand to additional pages as you fill in answers.

A. BACKGROUND

1. Name of proposed project, if applicable:

   River's Edge at the Landing Subdivision

2. Name of applicant:

   CT6, LLC

3. Address and phone number of applicant or contact person:

   PO Box 1419, Battle Ground, WA 98604 | Ingrid Friedberg, Special Projects Manager

4. Date checklist prepared:

   3/27/2025

5. Agency requesting checklist:

   City of Castle Rock

6. Proposed timing or schedule (including phasing, if applicable):

   It is anticipated that construction will commence upon the receipt of the necessary permits and approvals.

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? ☐ Yes ☒ No
   If yes, explain.

   Insert text here.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.

   Specific to this subdivision, the following items have been prepared:

   Preliminary Technical Information Report | MacKay Sposito | March 26, 2025

   Transportation Compliance Letter | Lancaster Mobley | March 7, 2025
   SR-411 at Westside Highway - Mitigation Due Diligence Analysis Memorandum | Lancaster Mobley | January 14, 2025

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? ☒ Yes ☐ No
   If yes, explain.

   Phase 1 access and utilities (CR-24-052) and the outfall (CR-24-051) for the Landing on the Colwitz Master Plan are presently under review and affect the developability of the property covered by the proposal.

10. List any government approvals or permits that will be needed for your proposal, if known.

    Approvals or permits required for this proposal include: Preliminary Subdivision; Engineering Approval; Final Plat Approval; NPDES General Construction Stormwater Permit; Building Permits.

11. Give brief, complete description of your proposal, including the proposed uses and the size of the project and site. (There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers here.)

The Applicant, CT6, LLC, wishes to subdivide an approximately 8.93-acre property into forty-five (45) single-family detached residential lots within property associated with 2542 Larsen Lane SW (Parcel 308640100) of the approved Landing on the Cowlitz (LOTC) Master Plan and subsequent minor modification (Ordinance No. 2021-10 and Resolution No. 2024-03) (Master Plan). This proposal also includes the provision of private park/open space areas, individual residential driveways, residential local access roads and private driveway tracts. A single modified Residential Local Access roadway intersection is included in this proposal serving as the connection to the Standard Collector road included in Phase 1 of the Master Plan infrastructure.

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description and, if you haven't already done so with the permit application to which this checklist is related, a site plan, vicinity map, and topographic map, if reasonably available.

The site is included within the Residential designated portion of the approved LOTC Master Plan. It was recently adjusted (Parcel 308640100, BLA Parcel 1, ref. CR-BLA-24-01), and it is bounded by the Phase 1 public access roadway (also interchangeably referred herein as Phase 1), Timberlake Church (Parcel 308110100), Parcel 30818, Parcel 3081701 and Larsen Lane SW. The property is subject to the Master Plan area designated for residential use and is required to conform with the High Density Residential (R-2) except as amended by the Master Plan Conditions of Approval.

B. ENVIRONMENTAL ELEMENTS

1. Earth

a. General description of the site:

☒ Flat ☒ Rolling ☐ Hilly ☐ Steep slopes ☐ Mountainous

☐ Other (specify): Insert text here.

b. What is the steepest slope on the site (approximate percent slope)?

50%

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any agricultural land of long-term commercial significance and whether the proposal results in removing any of these soils.

The majority of the site (60.2%) is comprised of Carrolls loamy sand, 0 to 2 percent slopes. Other soils at the site

include Pilchuck loamy fine sand, 0 to 8 percent slopes (35.4%) and Newberg fine sandy loam, 0 to 3 percent slopes (4.5%). The site does not consist of soils designated for long-term commercial significance.

d. Are there surface indications or history of unstable soils in the immediate vicinity? ☐ Yes ☒ No
If so, describe.

Insert text here.

e. Describe the purpose, type, total area, and approximate quantities and total affected area of any filling, excavation, and grading proposed. Indicate source of fill.

It is anticipated that the preliminary grading and cross sections shall include an estimated week 2,000 cubic yards (cy) of cut and 15,000 cy of fill, with a net 13,000cy of fill. These quantities are in relation to the revised mass grading surface which is anticipated to be finalized prior to the initiation of earthwork activities for the subdivision. The source of the fill shall be the dredge material stockpiles on-site.

f. Could erosion occur as a result of clearing, construction, or use? ☒ Yes ☐ No
If so, generally describe.

As with any clearing or other types of earth-disturbing construction activity, there is potential for erosion to occur. Site-specific best management practices will be used to mitigate erosion during the construction of the proposal. Site-specific erosion control measures will be implemented per the approved Grading Plan. Further, all sediment and erosion control design work will be completed in accordance with the requirements of the NPDES Construction Stormwater General Permit and City standards.

g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?

It is currently anticipated that approximately forty-six (46) percent (±179,541 square feet) of the total site area (±388,991 square feet) will be covered with impervious surfaces.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any:

Proposed measures to reduce or control erosion, or other impacts to the earth include treating and detaining stormwater, as well as silt fencing and other erosion control best management practices. Stormwater and erosion control plans prepared by MacKay Sposito have been prepared in compliance with the City's regulatory requirements.

2. Air

a. What types of emissions to the air would result from the proposal during construction, operation, and maintenance when the project is completed? If any, generally describe and give approximate quantities if known:

During Construction, Operation, and Maintenance:
Equipment and vehicles required for construction activities will generate dust and particulate emissions during the construction period.

After Project Completion:
Delivery trucks, mail delivery, solid waste, recycling vehicles and residence's automobiles will generate some particulate emissions in the long-term. Other emission sources include those typical to residential areas, e.g. small power tools including, heating, air conditioning, fireplaces, gas appliances, small gas-powered equipment used for site and landscape maintenance and emissions that are typical of a residential area are anticipated.

b. Are there any off-site sources of emissions or odor that may affect your proposal? ☐ Yes ☒ No
If so, generally describe.

Insert text here.

c. Proposed measures to reduce or control emissions or other impacts to air, if any:

If necessary, water will be utilized for dust control as needed during construction of on- and off-site improvements. Emissions control measures for vehicles and equipment are regulated under the Washington State Department of Ecology and U.S. Environmental Protection Agency. It is anticipated that all construction vehicles and equipment will be in compliance with these regulations.

3. Water

a. Surface Water

1) Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? ☐ Yes ☒ No
If yes, describe type and provide names. If applicable, state what stream or river it flows into.

Insert text here.

2) Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? ☐ Yes ☒ No
If yes, please describe, and attach available plans.

Insert text here.

3) Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material.

None.

4) Will the proposal require surface water withdrawals or diversions? ☐ Yes ☒ No
Give general description, purpose, and approximate quantities if known.

None.

5) Does the proposal lie within a 100-year floodplain? ☒ Yes ☐ No
If so, note location on the site plan.

6) Does the proposal involve any discharges of waste materials to surface waters? ☐ Yes ☒ No
If so, describe the type of waste and anticipated volume of discharge.

Insert text here.

b. Ground Water

1) Will groundwater be withdrawn from a well for drinking water or other purposes? ☐ Yes ☒ No
If so, give a general description of the well, proposed uses, and approximate quantities withdrawn from the well.

Insert text here.

Will water be discharged to groundwater? ☐ Yes ☒ No
Give general description, purpose, and approximate quantities if known.

Click or tap here to enter text.

2) Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: domestic sewage; industrial, containing the following chemicals…; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.

Not applicable. No wastewater will be discharged into the ground.

c. Water runoff (including stormwater)

1) Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.

Surface runoff within the proposed roadways will be collected at catch basins (both standard and mechanical filter) before being conveyed into piping beneath the roadways. Lot drainage for impervious surfaces will be collected via area drains and gutters, then piped into the conveyance system bypassing any treatment. Runoff on open spaces, slopes, and park areas will be minimal as most areas will be pervious, but perimeter ditches will convey those flows to the off-site drainage system. Once runoff is captured by the conveyance system, a portion of the main will consist of infiltration trench to meet LID standards and reduce the amount of runoff leaving the site at the stub to the subdivision. Any runoff leaving the site through the stub will enter the LOTC on-site drainage system. The LOTC in-site drainage system features a large detention pond and a direct outfall to the Cowlitz River.

2) Could waste materials enter ground or surface waters? ☐ Yes ☒ No
If so, generally describe.

Insert text here.

3) Does the proposal alter or otherwise affect drainage patterns in the vicinity of the site?
☒ Yes ☐ No
If so, describe.

This proposal has been designed to enhance the site drainage by including mechanisms to control water quality and quantity.

d. Proposed measures to reduce or control surface, ground, and runoff water, and drainage pattern impacts, if any:

Measures included in this proposal have been designed specifically to control surface runoff and improve drainage patterns for the site.

4. Plants

a. Check the types of vegetation found on the site:

☐ alder ☐ maple ☐ aspen ☐ fir ☐ cedar ☐ pine ☐ other tree(s) (specify):

☐ shrubs ☒ grass ☐ pasture ☐ crop or grain ☐ orchards, vineyards or other permanent crops

☐ cattail ☐ buttercup ☐ bulrush ☐ skunk cabbage ☐ other wet soil plant(s) (specify): Insert text here.

☐ water lily ☐ eelgrass ☐ milfoil ☐ other water plant(s) (specify): Insert text here.

☒ other types of vegetation Scotch broom

b. What kind and amount of vegetation will be removed or altered?

All vegetation within the site will be removed. The site is presently sparsely vegetated.

c. List threatened and endangered species known to be on or near the site.

None.

d. List all noxious weeds and invasive species known to be on or near the site.

None.

5. Animals

a. Check any birds and other animals which have been observed on or near the site or are known to be on or near the site.

☐ hawk ☐ heron ☐ eagle ☒ songbirds, ☐ other bird(s) (specify): Insert text here.

☒ deer ☐ bear ☐ elk ☐ beaver ☐ other mammal(s) (specify): Insert text here.

☐ bass ☒ salmon ☒ trout ☐ herring ☐ shellfish ☐ other fish (specify): Insert text here.

b. List any threatened and endangered species known to be on or near the site.

The site is approximately less than 1,000 feet from the Cowlitz River and Salmon Creek, which according to the Washington Department of Fish and Wildlife Priority Habitats and Species list may contain:

Cutthroat - Candidate for Federal Status - Cowlitz River and Salmon Creek;

Steelhead - Threatened - Cowlitz River and Salmon Creek;

Coho - Threatened - Cowlitz River and Salmon Creek;

Chinook - Cowlitz River

c. Washington as whole lies within the Pacific Flyway. Is the site part of any other migration route?
☒ Yes ☐ No
If so, explain.

The site is located within what is commonly referred to as the Pacific Flyaway. This Flyaway is the general migratory route for various species of ducks, geese, and other migratory fowl. The Flyaway stretched from Alaska to Mexico and from the Pacific Ocean to the Rocky Mountains. Neotropical birds, such as Robins, may also seasonally utilize or be near the site.

d. Proposed measures to preserve or enhance wildlife, if any:

Landscaping included in the final condition of the finished subdivision may provide some habitat for wildlife typical for urban environments.

e. List any invasive animal species known to be on or near the site.

Scotch Broom which shall be cleared as part of the activities necessary to develop the site.

6. Energy and Natural Resources

a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.

The completed project's energy needs shall be met by electric and natural gas.

b. Would your project affect the potential use of solar energy by adjacent properties?
☐ Yes ☒ No
If so, generally describe.

Insert text here.

c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:

This proposal does not include the construction of buildings. Future building applications shall be required to demonstrate compliance with the State of Washington Energy Code and the adopted version of the International Building Code.

7. Environmental Health

a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste, that could occur as a result of this proposal?
☐ Yes ☒ No
If so, describe.

Insert text here.

1) Describe any known or possible contamination at the site from present or past uses.

Unknown.

2) Describe existing hazardous chemicals/conditions that might affect project development and design. This includes underground hazardous liquid and gas transmission pipelines located within the project area and in the vicinity.

There are no known existing hazardous chemicals/conditions that might affect the project development and design. The Applicant shall be required to comply with all applicable local, state and federal regulations during the construction of this proposal.

3) Describe any toxic or hazardous chemicals that might be stored, used, or produced during the project's development or construction, or at any time during the operating life of the project.

Construction equipment will require the use of various petroleum products for fuel, hydraulics and lubrication.

4) Describe special emergency services that might be required.

Special emergency services are not anticipated for this proposal. However, State-compliant protocol shall be followed should any unforeseen complications arise with the spillage of hazardous or otherwise toxic chemicals. A spill prevention and/or response plan shall be on site at all times during construction.

5) Proposed measures to reduce or control environmental health hazards, if any:

None.

b. Noise

1) What types of noise exist in the area which may affect your project (for example: traffic, equipment, operation, other)?

Some traffic noise from the Interstate 5 (I-5) Highway, may be heard currently at the site, but it not expected to adversely affect the proposal.

2) What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site.

Construction on the site will create short-term noise and shall not be allowed after 7 p.m. or before 7 a.m. Visitor, resident, mail and parcel deliveries, solid waste and recycling vehicles, and HVAC equipment will be associated on a long-term basis. Other long-term noise sources which may be created include small power tools associated with landscaping maintenance and upkeep typical to residential life.

3) Proposed measures to reduce or control noise impacts, if any:

Construction activities shall be limited between 7 a.m. and 7 p.m.

8. Land and Shoreline Use

a. What is the current use of the site and adjacent properties? Will the proposal affect current land uses on nearby or adjacent properties? ☐ Yes ☒ No
If so, describe.

The site is vacant with an existing uninhabited residential building and outbuildings. Surrounding area includes undeveloped Department of Natural Resources property, Timberlake Church and established single-family residential use.

b. Has the project site been used as working farmland or working forest land?
☒ Yes ☐ No
If so, describe.

The site has not been in active farmland use for several decades.

How much agricultural or forest land of long-term commercial significance will be converted to other uses as a result of the proposal, if any?

None.

If resource lands have not been designated, how many acres in farmland or forest land tax status will be converted to nonfarm or nonforest use?

Not applicable. The site does not consist of resource lands.

1) Will the proposal affect or be affected by surrounding working farm or forest land normal business operations, such as oversize equipment access, the application of pesticides, tilling, and harvesting? ☐ Yes ☒ No
If so, how?

Insert text here.

c. Describe any structures on the site.

The existing structures are dilapidated and require removal to facilitate the construction of the subdivision.

d. Will any structures be demolished? ☒ Yes ☐ No
If so, what?

The existing uninhabited residential building and outbuildings on site require demolition and removal.

e. What is the current zoning classification of the site?

The underlying zoning district of the site is Industrial and the land use designation pursuant to the approved Landing on the Cowlitz Master Plan is residential.

f. What is the current comprehensive plan designation of the site?

The current comprehensive plan designation for the site is Industrial.

g. If applicable, what is the current shoreline master program designation of the site?

The site is located outside of the jursidictional shoreline area.

h. Has any part of the site been classified as a critical area by the city or county?
☒ Yes ☐ No
If so, specify.

The site is currently located in a floodplain but shall be filled as part of this proposal, bringing all pad elevations above the base flood elevation (BFE). Portions

of the site have already been subject to mass grading activities as approved by the City of Castle Rock (ref. file no. CR2223).

i. Approximately how many people would reside or work in the completed project?

Based on the State of Washington Department of Ecology's (ECA) standard calculation for occupancy rates utilitzed in instances when the exact number not yet known, there will be approximately one hundred and twenty six (126) people residing in the complete project. The assumption was made based on the total number of residential dwelling units multiplied by 2.8 (persons per dwelling unit) per ECA's standard calculation.

j. Approximately how many people would the completed project displace?

None. The site is devoid of inhabitants.

k. Proposed measures to avoid or reduce displacement impacts, if any:

None.

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:

This proposal includes a residential use within the residential land use designated area of the approved Landing on the Cowlitz. Surrounding area use consists of existing single-family residential use, a church and undeveloped Department of Natural Resources property.

m. Proposed measures to reduce or control impacts to agricultural and forest lands of long-term commercial significance, if any:

None. This proposal is not located near lands designated for agricultural or forest use.

9. Housing

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.

This proposal includes the provision of forty-five (45) middle income housing units.

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.

One (1) uninhabited housing unit will be eliminated to facilitate the development of the subdivision.

c. Proposed measures to reduce or control housing impacts, if any:

None.

10. Aesthetics

a. What is the tallest height of any proposed structure(s), not including antennas? What is the principal exterior building material(s) proposed?

This proposal does not at this time include structures. However, once building permit applications are submitted at a later date, the tallest allowable building shall be forty (40) feet in conformance with the approved Landing on the Cowlitz Master Plan, Condition of Approval 5.c(3).

b. What views in the immediate vicinity would be altered or obstructed?

The site is devoid of designated scenic views. Once the subdivision has been constructed, housing, landscaping and roads shall be visible in the immediate vicinity.

c. Proposed measures to reduce or control aesthetic impacts, if any:

None.

11. Light and Glare

a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

Typical residential building and street lighting will be produced by the completed project and will be most visible during the nighttime hours.

b. Could light or glare from the finished project be a safety hazard or interfere with views?

The installation of illuminated materials will be done in such as was as to minimize dispersion off-site and not create a safety hazard.

c. What existing off-site sources of light or glare may affect your proposal?

It is not anticipated that existing off-site source of light or glare will affect this proposal.

d. Proposed measures to reduce or control light and glare impacts, if any:

This proposal has been designed to include the installation of lighting in order to meet safety and security criteria as set forth by the City of Castle Rock Municipal Code for a residential site development. Lighting included in this proposal shall include mitigation such as downward shielding of lighting fixtures so as to minimize dispersion and control for potential off-site impacts.

12. Recreation

a. What designated and informal recreational opportunities are in the immediate vicinity?

The nearest recreational opportunity to the site is the Lions Pride Park Cowlitz River Access which is located approximately 0.8 miles away from the proposed subdivision.

b. Would the proposed project displace any existing recreational uses? ☐ Yes ☒ No
If so, describe.

Insert text here.

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any:

This proposal does not include mitigation measures as none are needed. This proposal includes the provision of park area that will be dedicated to the City of Castle Rock.

13. Historic and cultural preservation

a. Are there any buildings, structures, or sites, located on or near the site that are over 45 years old listed in or eligible for listing in national, state, or local preservation registers ? ☐ Yes ☒ No

If so, specifically describe.

Insert text here.

b. Are there any landmarks, features, or other evidence of Indian or historic use or occupation? This may include human burials or old cemeteries. ☐ Yes ☒ No
Are there any material evidence, artifacts, or areas of cultural importance on or near the site? ☐ Yes ☒ No
Please list any professional studies conducted at the site to identify such resources.

An Archaeological Survey for the Castle Rock Landing on the Cowlitz Project was produced by Archaeological Investigations Northwest, Inc. on February 15, 2022 which evaluated area that encompassed the entire master plan.

c. Describe the methods used to assess the potential impacts to cultural and historic resources on or near the project site. Examples include consultation with local tribe(s) and the state Department of Archeology and Historic Preservation, archaeological surveys, historic maps, GIS data, etc.

The methods used to assess the potential impacts to cultural and historic resources included an evaluation of archaeological site distribution maps, site form files, historical maps, and literature pertaining to archaeological research conducted in the vicinity of the project area.

d. Proposed measures to avoid, minimize, or compensate for loss, changes to, and disturbance to resources. Please include plans for the above and any permits that may be required.

None. There are no known historic or cultural resources at the site.

14. Transportation

a. Identify public streets and highways serving the site or affected geographic area and describe proposed access to the existing street system. If any, show on site plan.

Generally, the site shall be accessible via Huntington Avenue South via the Phase 1 roadways. This proposal includes the provision of public street access to the subdivision via Road A and B included in the Phase 1 Access for the approved Landing on the Cowlitz Master Plan.

b. Is the site or affected geographic area currently served by public transit? ☐ Yes ☒ No
If so, generally describe. If not, what is the approximate distance to the nearest transit stop?

Insert text here.

c. How many additional parking spaces would the completed project or non-project proposal have? How many would the project or proposal eliminate?

None.

d. Will the proposal require any new or improvements to existing roads, streets, pedestrian, bicycle or state transportation facilities, not including driveways? ☒ Yes ☐ No
If so, generally describe (indicate whether public or private).

This proposal requires the inclusion of new public streets to service the subdivision.

e. Will the project or proposal use (or occur in the immediate vicinity of) water, rail, or air transportation? ☐ Yes ☒ No

If so, generally describe.

A railway line is located adjacent to the Landing on the Cowlitz Master Plan but is not within the immediate vicinity of the proposed subdivision. This proposal shall not involve the use of the railway line.

f. How many vehicle trips per day would be generated by the completed project or proposal? If known, indicate when peak volumes would occur and what percentage of the volume would be trucks (such as commercial and nonpassenger vehicles). What data or transportation models were used to make these estimates?

It is anticipated that the completed project shall result in a total of 368 external weekday trips.

g. Will the proposal interfere with, affect or be affected by the movement of agricultural and forest products on roads or streets in the area? ☐ Yes ☒ No
If so, generally describe.

Insert text here.

h. Proposed measures to reduce or control transportation impacts, if any:

No mitigation measures are required or included in this proposal as the anticipated impacts were evaluated and accounted for within the approved Landing on the Cowlitz Master Plan.

15. Public Services

a. Would the project result in an increased need for public services (for example: fire protection, police protection, public transit, health care, schools, other)? ☒ Yes ☐ No
If so, generally describe.

This proposal may result in an increased need for additional fire / emergency and police protection with the proposed development of forty-five (45) single-family residential lots.

b. Proposed measures to reduce or control direct impacts on public services, if any.

This proposal, as with any new construction, will include the provision of urban utilities and payment of development charges and impact fees.

16. Utilities

a. Check utilities currently available at the site:

☒ electricity ☒ natural gas ☒ potable water ☒ irrigation water ☒ refuse service ☒ telephone ☒ sanitary sewer ☒ septic system ☒ other (specify): internet

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity which might be needed.

This proposal includes the provision of public water, sewer, electric and natural gas. Utilities providers anticipated are as follows:

City of Castle Rock: Water and sewer

Cowlitz PUD: Electricity

Internet/Telephone: Xfinity

C. SIGNATURE

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

Signature:	Signed by: Ingrid Friedberg 8E83AE430A5A433... Manually sign above, print, & scan; or insert electronic signature here.
Name:	Ingrid Friedberg
Position:	Special Projects Manager
Agency/Organization:	CT6, LLC
Date Submitted:	March 27, 2025

D. SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS

(**Do NOT** use this sheet for project actions)

Because these questions are very general, it may be helpful to read them in conjunction with the list of the elements of the environment. When answering these questions, be aware of the extent the proposal, or the types of activities likely to result from the proposal, would affect the item at a greater intensity or at a faster rate than if the proposal were not implemented. Respond briefly and in general terms.

1. How would the proposal be likely to increase discharge to water; emissions to air; production, storage, or release of toxic or hazardous substances; or production of noise?

   Insert text here.

   Proposed measures to avoid or reduce such increases are:

   Insert text here.

2. How would the proposal be likely to affect plants, animals, fish, or marine life?

   Insert text here.

   Proposed measures to protect or conserve plants, animals, fish, or marine life are:

   Insert text here.

3. How would the proposal be likely to deplete energy or natural resources?

   Insert text here.

   Proposed measures to protect or conserve energy and natural resources are:

   Insert text here.

4. How would the proposal be likely to use or affect environmentally sensitive areas or areas designated (or eligible or under study) for governmental protection; such as parks, wilderness, wild and scenic rivers, threatened or endangered species' habitat, historic or cultural sites, wetlands, floodplains, or prime farmlands?

   Insert text here.

   Proposed measures to protect such resources or to avoid or reduce impacts are:

   Insert text heret.

5. How would the proposal be likely to affect land and shoreline use, including whether it would allow or encourage land or shoreline uses incompatible with existing plans?

   Insert text here.

   Proposed measures to avoid or reduce shoreline and land use impacts are:

   Insert text here.

6. How would the proposal be likely to increase demands on transportation or public services and utilities?

   Insert text here.

   Proposed measures to reduce or respond to such demand(s) are:

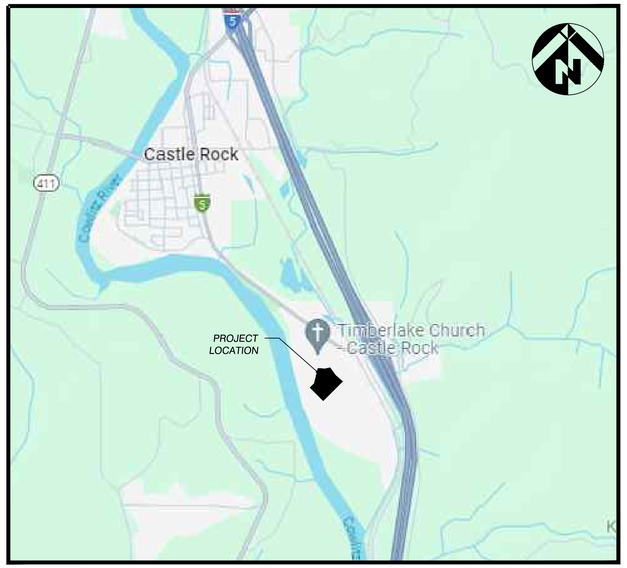
   Insert text here.

7. Identify, if possible, whether the proposal may conflict with local, state, or federal laws or requirements for the protection of the environment.

   Insert text here.

RIVER'S EDGE AT THE LANDING SUBDIVISION
PRELIMINARY LAND USE PLANS

NW QTR, SECTION 14
TOWNSHIP T9N, RANGE R2W W.M.



VICINITY MAP
N.T.S.

PROJECT PARCEL #308640100
PER BLA #CR-BLA-24-01 (AFN #3762029 AND AFN #3763318)

OWNER
CT6, LLC
SHANE TAPANI
PO BOX 1419
BATTLE GROUND ,WA 98604
PHONE: 360-687-1148

CONTRACTOR
TAPANI, INC.
1705 SE 9TH AVE
BATTLE GROUND, WA 98604
JEROME SARKINEN
PHONE: 360-907-7615

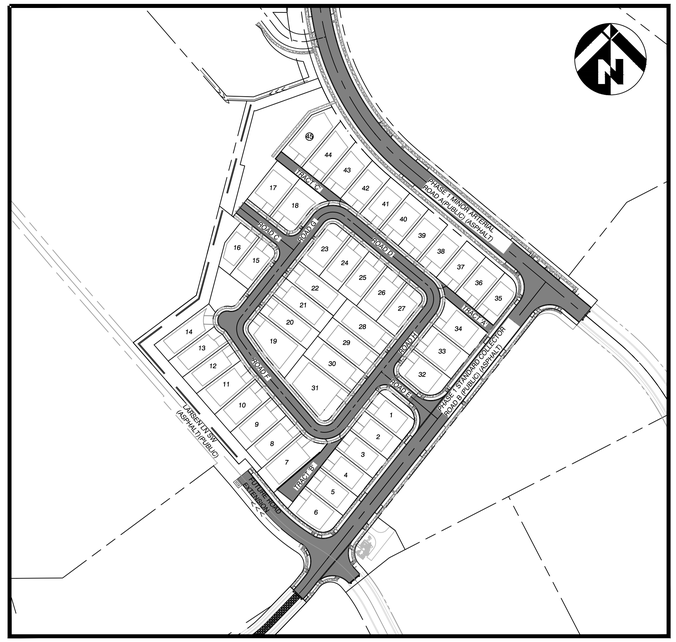
ENGINEER
MacKay Sposito
18405 SE MILL PLAIN BLVD, SUITE 100
VANCOUVER, WA 98683
C (714)732-8563
O (360)823-1244
www.mackaysposito.com
ENGINEER: TAYLOR WILSON, PE
TWILSON@MACKAYSPOSITO.COM

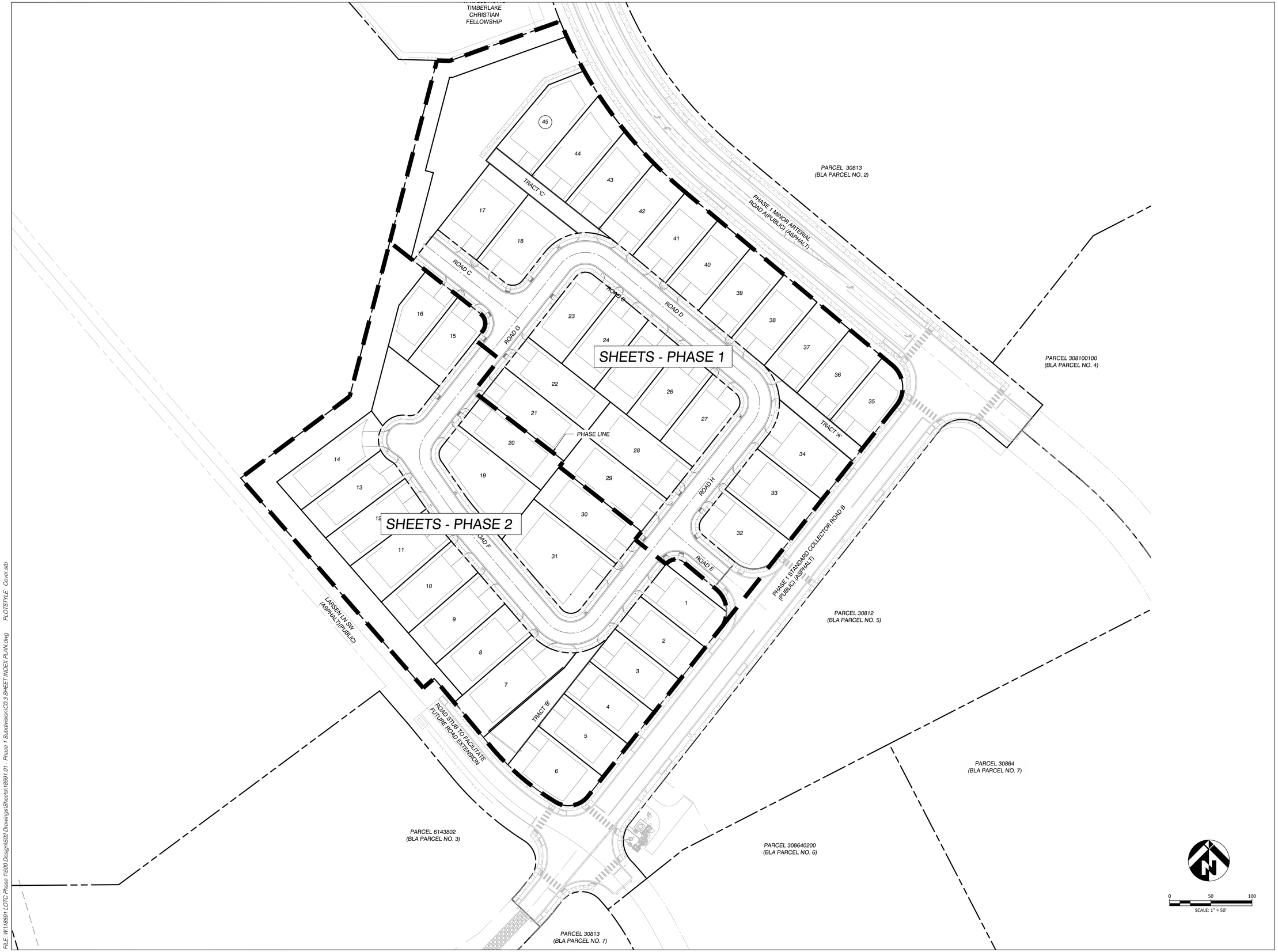
VERTICAL DATUM

THE ELEVATIONS SHOWN ON THIS MAP ARE BASED ON AN OPUS SOLUTION AT CP 1 WITH A DERIVED NAVD88 ORTHOMETRIC ELEVATION OF 46.26 FEET.

HORIZONTAL DATUM

WASHINGTON STATE PLANE COORDINATE SYSTEM, SOUTH ZONE (4602), NAD83(2011)(EPOCH: 2010.0000), US SURVEY FOOT. DISTANCES SHOWN HEREON ARE GROUND DISTANCES. TO CONVERT TO GRID MULTIPLY BY THE COMBINED SCALE FACTOR OF 0.9999321353 ABOUT CP1


WEST TAYLOR ROAD (GRAVEL)
WEST TAYLOR ROAD (ASPHALT)
TIMBERLAKE DRIVE (ASPHALT PUBLIC)
TIMBERLAKE DRIVE (ASPHALT PUBLIC)
TIMBERLAKE DRIVE (ASPHALT PUBLIC



FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 01 - Phase 1 Subdivision\C0.3 SHEET INDEX PLAN.dwg PLOTSTYLE: Cover.stb

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

TYLER ANDREW WILLIS
STATE OF WASHINGTON
22012357
REGISTERED
PROFESSIONAL ENGINEER

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

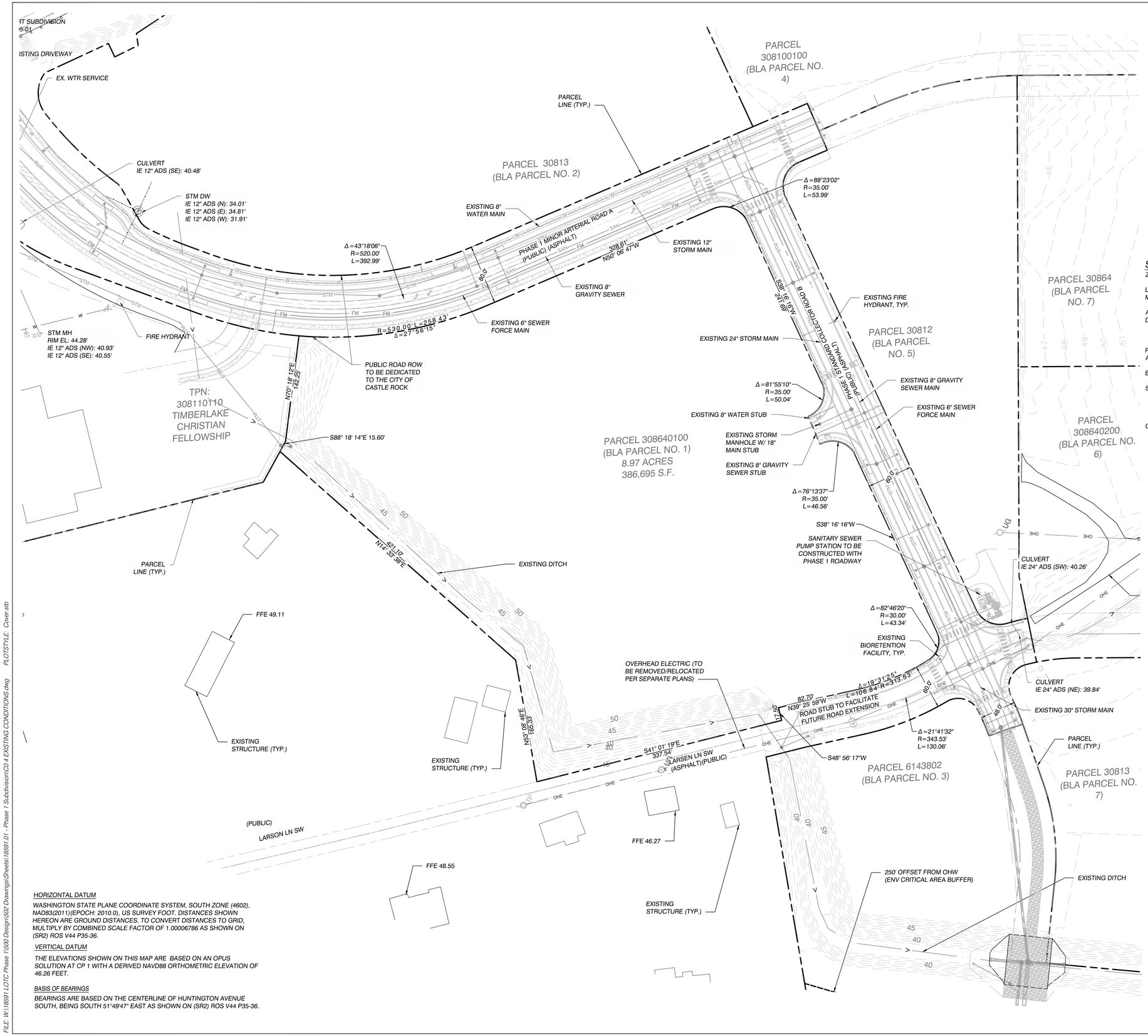
SHEET INDEX PLAN

REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1"= 50'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

C0.1



SITE STATISTICS

ZONING:	*INDUSTRIAL*
LANDING ON THE COWLITZ (LOTC): MASTER PLAN DESIGNATION	*RESIDENTIAL*
APPLICABLE ZONING : DISTRICT STANDARDS	*HIGH DENSITY RESIDENTIAL (R-2) (LANDING ON THE COWLITZ CONDITIONS OF MATER PLAN APPROVAL, ITEM 2.C.)*
RECENT LAND USE DECISIONS : AFFECTING THE PROPERTY	*LANDING ON THE COWLITZ MASTER PLAN*
EXISTING USE OF PROPERTY:	*VACANT AND UNDEVELOPED*
SURROUNDING USES:	*RESIDENTIAL (NORTH); CHURCH (NORTHEAST); DEPARTMENT OF NATURAL RESOURCES (SOUTHEAST)*
CRITICAL AREA:	*THE EXISTING SITE AT THE TIME OF PRELIMINARY SUBDIVISION APPLICATION IS LOCATED WITHIN THE FEMA 100-YEAR FLOODPLAIN. HOWEVER, THE SUBDIVISION HAS BEEN DESINGED TO BE ABOVE THE BASE FLOOD ELEVATION (BFE) AT 50.8.*

NOTES

1. *EXISTING CONDITIONS SHOWN IN THIS PLAN SHALL BE THE EXISTING CONDITIONS FOLLOWING THE CONSTRUCTION OF THE PHASE 1 ACCESS AND UTILITIES, AS WELL AS THE LOTC OUTFALL. THIS CONSTRUCTION WILL BE COMPLETED PRIOR TO THE CONSTRUCTION OF THE RIVER'S EDGE SUBDIVISION.*
2. *REFER TO AFN 3762029 AND AFN 3763318 FOR FULL LEGAL DESCRIPTIONS OF THE EXISTING PARCELS REFERENCED IN THIS EXISTING CONDITIONS PLAN.*
3. *PORTIONS OF THE SITE CURRENTLY LIE WITHIN THE FEMA 100-YEAR FLOOD PLAIN BUT BUILDING PADS WILL BE PROPOSED A MINIMUM OF 1' ABOVE THE BASE FLOOD ELEVATION OF 48 FEET.*

SURVEY NOTE

THE BOUNDARY AND THE SUSEQUENT MATHEMATICAL SOLUTIONS USED IN THE ADJUSTED LEGAL DESCRIPTIONS HEREON ARE BASED ON BOUNDARY LINE ADJUSTMENT SURVEY RECORDED UNDER AUDITOR'S FILE NUMBER 3597924 IN CONJUNCTION WITH RECORD OF SURVEY BY MACKAY SPOSITIO, RECORDED UNDER AUDITOR'S FILE NUMBER 3732400, 34620229, AND 3763318.

HORIZONTAL DATUM

WASHINGTON STATE PLANE COORDINATE SYSTEM, SOUTH ZONE (4602), NAD83(2011)(EPOCH: 2010.0), US SURVEY FOOT. DISTANCES SHOWN HEREON ARE GROUND DISTANCES. TO CONVERT DISTANCES TO GRID, MULTIPLY BY COMBINED SCALE FACTOR OF 1.00006786 AS SHOWN ON (SR2) ROS V44 P35-36.

VERTICAL DATUM

THE ELEVATIONS SHOWN ON THIS MAP ARE BASED ON AN OPUS SOLUTION AT CP 1 WITH A DERIVED NAVD88 ORTHOMETRIC ELEVATION OF 46.26 FEET.

BASIS OF BEARINGS

BEARINGS ARE BASED ON THE CENTERLINE OF HUNTINGTON AVENUE SOUTH, BEING SOUTH 51°49'47" EAST AS SHOWN ON (SR2) ROS V44 P35-36.

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

ALEXANDRE W. TAYLOR
STATE OF WASHINGTON
22012357
REGISTERED PROFESSIONAL ENGINEER

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

EXISTING CONDITIONS

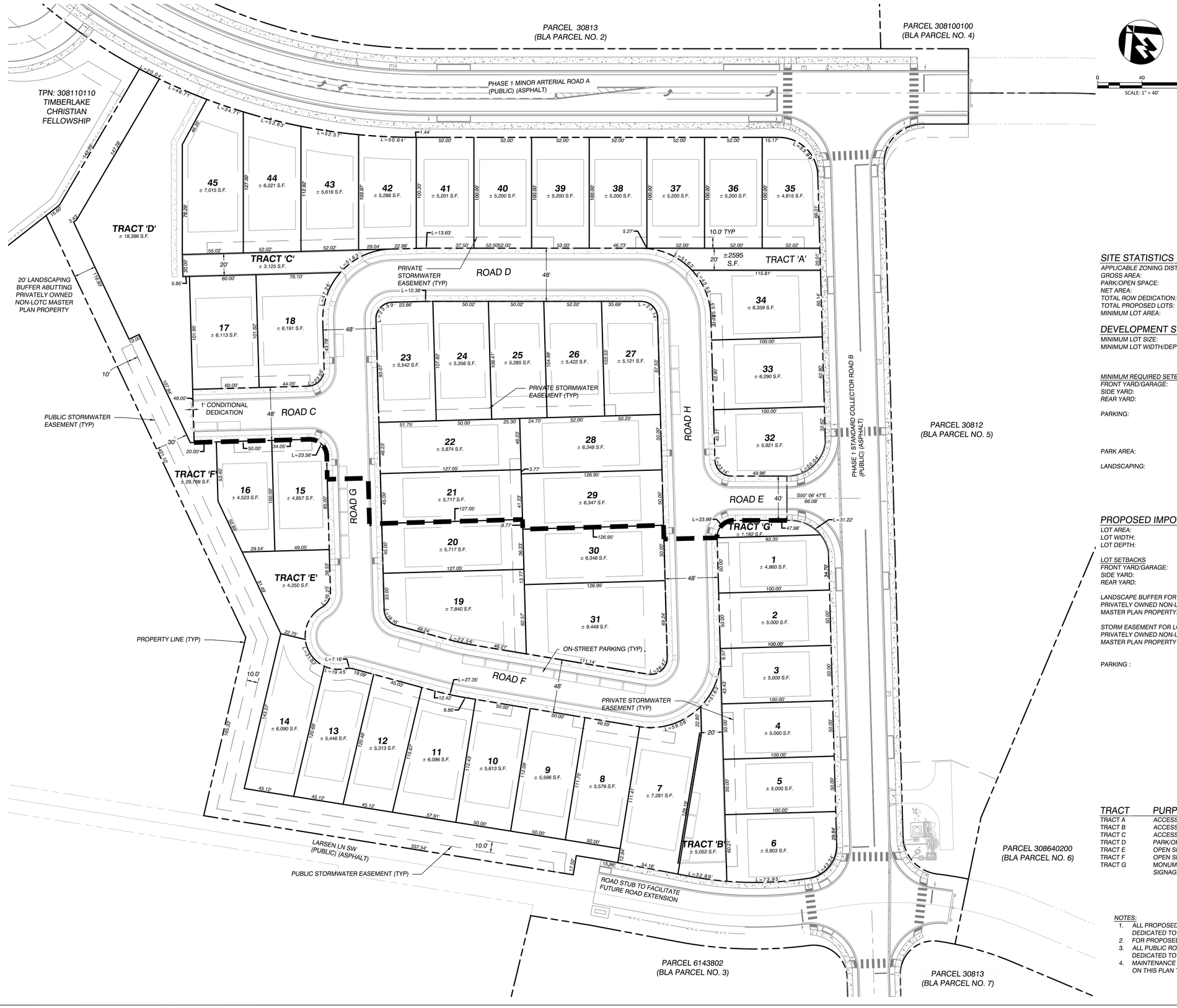
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1"= 60'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

C0.2

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591.01 - Phase 1 Subdivision\C0.4 EXISTING CONDITIONS.dwg PLOTSTYLE: Cover.stb



SITE STATISTICS

APPLICABLE ZONING DISTRICT STANDARDS:	R-2
GROSS AREA:	±388,630 SF (±8.93 AC)
PARK/OPEN SPACE:	±48,162 SF (±1.11 AC)
NET AREA:	±340,468 SF (±7.82 AC)
TOTAL ROW DEDICATION:	±70,855 SF (±1.63 AC)
TOTAL PROPOSED LOTS:	45 LOTS
MINIMUM LOT AREA:	4,500 SF

DEVELOPMENT STANDARDS

MINIMUM LOT SIZE:	3,500 SF
MINIMUM LOT WIDTH/DEPTH:	NONE PURSUANT TO LOTC CONDITION OF APPROVAL 5.A.
MINIMUM REQUIRED SETBACKS	
FRONT YARD/GARAGE:	20 FEET
SIDE YARD:	5 FEET
REAR YARD:	20 FEET
PARKING:	90 OFF-STREET PARKING SPACES (2 OFF-SITE PARKING SPACES PER DWELLING UNIT)
PARK AREA:	7,830 SF(174 SF PER LOT)
LANDSCAPING:	20-FOOT LANDSCAPE BUFFER ABUTTING PRIVATELY-OWNED PROPERTIES NOT INCLUDED IN THE LOTC MASTER PLAN

PROPOSED IMPOVEMENTS

LOT AREA:	4,500 SF MINIMUM
LOT WIDTH:	45 FEET MINIMUM
LOT DEPTH:	100 FEET MINIMUM
LOT SETBACKS	
FRONT YARD/GARAGE:	20 FEET
SIDE YARD:	5 FEET
REAR YARD:	20 FEET
LANDSCAPE BUFFER FOR LOTS ABUTTING PRIVATELY OWNED NON-LOTC MASTER PLAN PROPERTY:	20 FEET
STORM EASEMENT FOR LOTS ABUTTING PRIVATELY OWNED NON-LOTC MASTER PLAN PROPERTY :	10 FEET
PARKING :	EACH LOT HAS BEEN SIZED TO ACCOMMODATE 4 CARS (2 IN GARAGE AND 2 IN DRIVEWAY, EACH SIZED UP TO 9 FEET WIDE BY 19 FEET LONG) 21 ON-STREET PARKING SPACES (SIZED UP TO 8 FEET WIDE BY 20 FEET LONG WITH A FOOT GAP BETWEEN EACH)

TRACT	PURPOSE	AREA
TRACT A	ACCESS ROAD	±2,595 SF
TRACT B	ACCESS ROAD	±5,052 SF
TRACT C	ACCESS ROAD	±3,125 SF
TRACT D	PARK/OPEN SPACE	±18,396 SF
TRACT E	OPEN SPACE	±4,250 SF
TRACT F	OPEN SPACE	±29,766 SF
TRACT G	MONUMENT SIGNAGE AREA	±1,182 SF

NOTES:
1. ALL PROPOSED STORMWATER EASEMENTS ARE TO BE DEDICATED TO THE CITY OF CASTLE ROCK
2. FOR PROPOSED ROAD SECTIONS, SEE SHEET C3.2.
3. ALL PUBLIC ROADS SHOWN ON THIS PLAN TO BE DEDICATED TO THE CITY OF CASTLE ROCK.
4. MAINTENANCE FOR ALL PRIVATE DRIVEWAY TRACTS ON THIS PLAN TO BE MAINTAINED BY AN HOA.

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

TAW ANDREW WILLIAMS
STATE OF WASHINGTON
22012357
REGISTERED
PROFESSIONAL ENGINEER

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

PRELIMINARY PLAT

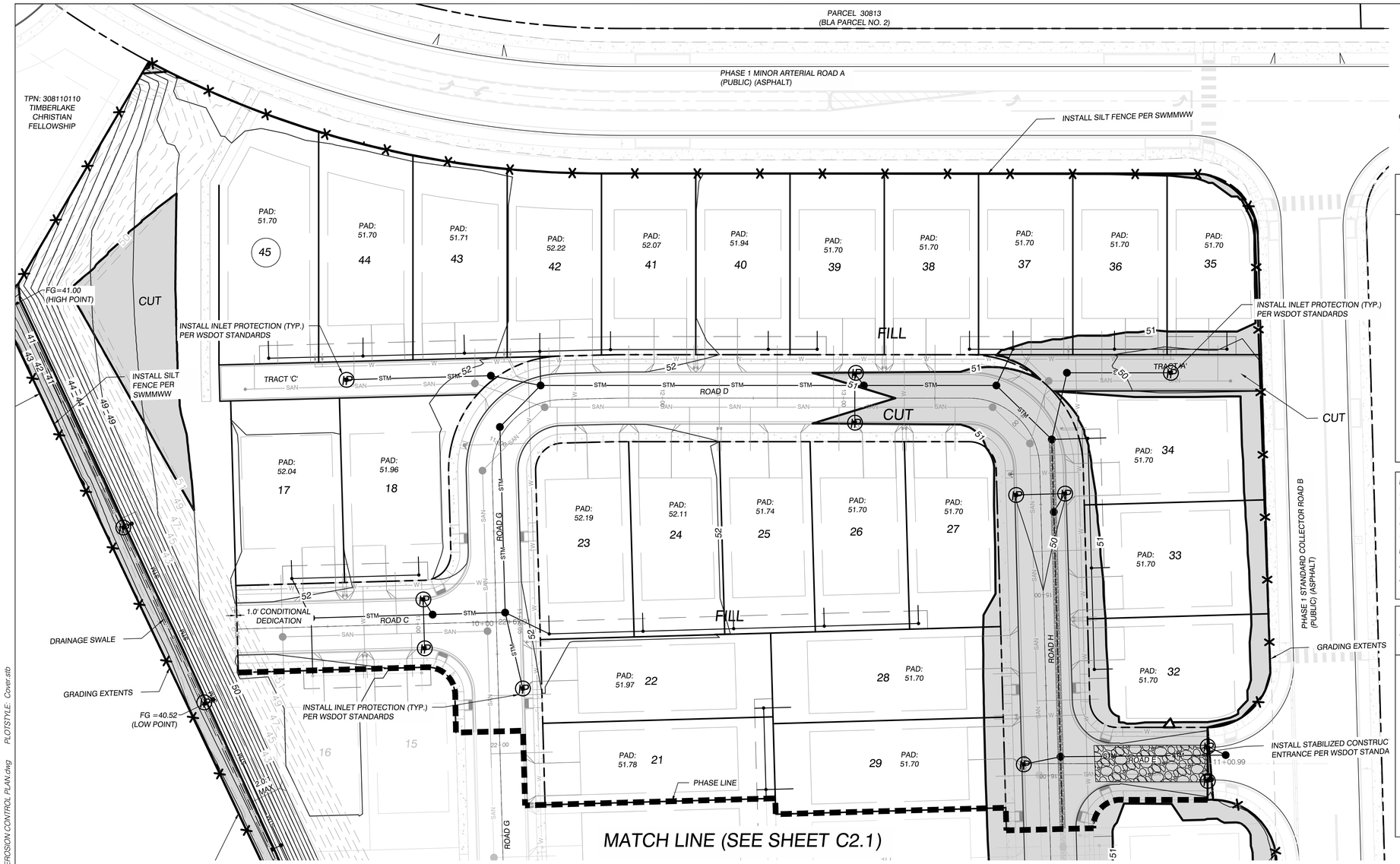
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 40'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

C1.0

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 01 - Phase 1 Subdivision\C1.0 PRELIMINARY PLAT.dwg PLOTSTYLE: Cover.stb



LEGEND

- 298 — FINISHED GRADE CONTOUR
- —298— EXISTING CONTOUR
- DRAINAGE SWALE
- AREA OF CUT
- AREA OF FILL
- IP — INLET PROTECTION
- STABALIZED CONSTRUCTION ENTRANCE
- SILT FENCE
- HIGH VISIBILITY FENCE

NOTE: DUE TO THE LIMITED EROSION CONTROL STANDARDS AVAILABLE BY THE CITY OF CASTLE ROCK, ALL EROSION AND SEDIMENT CONTROL DEVICES SHALL CONFORM WITH WSDOT STANDARDS. HOWEVER, CONTRACTOR MAY USE ALTERNATE DESIGNS IF THEY ARE APPROVED BY THE SITE INSPECTOR PRIOR TO INSTALLATION.

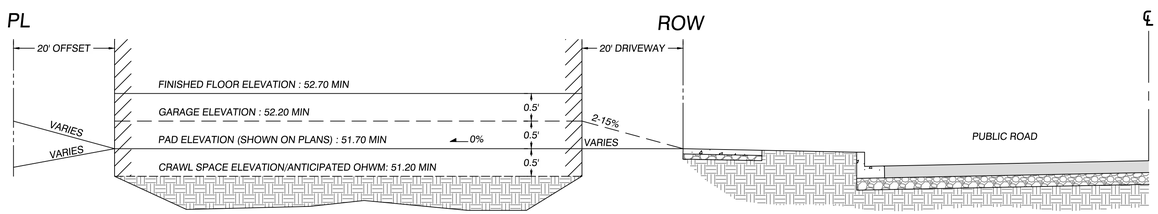
APPROXIMATE GRADING VOLUMES

CUT	2,000 CY
FILL	15,000 CY

NOTE: CUT AND FILL AREAS AND VOLUMES ARE CALCULATED FROM EXISTING GROUND TO FINISHED GRADE AND ARE NOT ADJUSTED FOR STRIPPINGS, TRENCH EXCAVATION, STRUCTURAL EXCAVATION OR SHRINK/SWELL. CONTRACTORS ARE SOLELY RESPONSIBLE FOR QUANTITY ESTIMATES FOR BIDDING PURPOSES.

CONSTRUCTION NOTES

1) ALL EROSION CONTROL DEVICES PROPOSED SHALL CONFORM WITH WSDOT STANDARDS.
2) CONTRACTOR TO CONSTRUCT EQUIPMENT AND PARKING AREA AT A SUITABLE LOCATION PRIOR TO BEGINNING GRADING ACTIVITIES. LOCATION TO BE DETERMINED PRIOR TO THE PRE-CONSTRUCTION CONFERENCE.
3) IF TRACKING OF SEDIMENT FROM THE SITE BECOMES A PROBLEM, A WHEEL WASH SHALL BE INSTALLED AT THE SITE ENTRANCE.
4) STOCKPILE AREAS PLACED ONSITE SHALL BE COORDINATED BY THE CONTRACTOR AND SURROUNDED WITH SILT FENCE AND COVERED WITH PLASTIC AS NECESSARY DURING CONSTRUCTION. MATERIAL NOT STOCKPILED ONSITE SHALL BE REMOVED TO AN APPROPRIATE IMPORT SITE.
5) ANY SLOPE LESS THAN 3:1 TO BE STABILIZED WITH SEEDING AND MULCH/STRAW.
6) CONTRACTOR IS RESPONSIBLE FOR IMPLEMENTING BMP T5.13.
7) EROSION CONTROL INSPECTION REQUIRED BEFORE YOU BEGIN ANY SITEWORK
8) THE BASE FLOOD ELEVATION IS 48.0 AND MINIMUM PAD ELEVATION (AS SHOWN ON PLAN) IS 51.70.



TYPICAL LOT SECTION

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

PRELIMINARY

3/27/2025

GRADING AND EROSION CONTROL PLAN (PHASE 1)

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

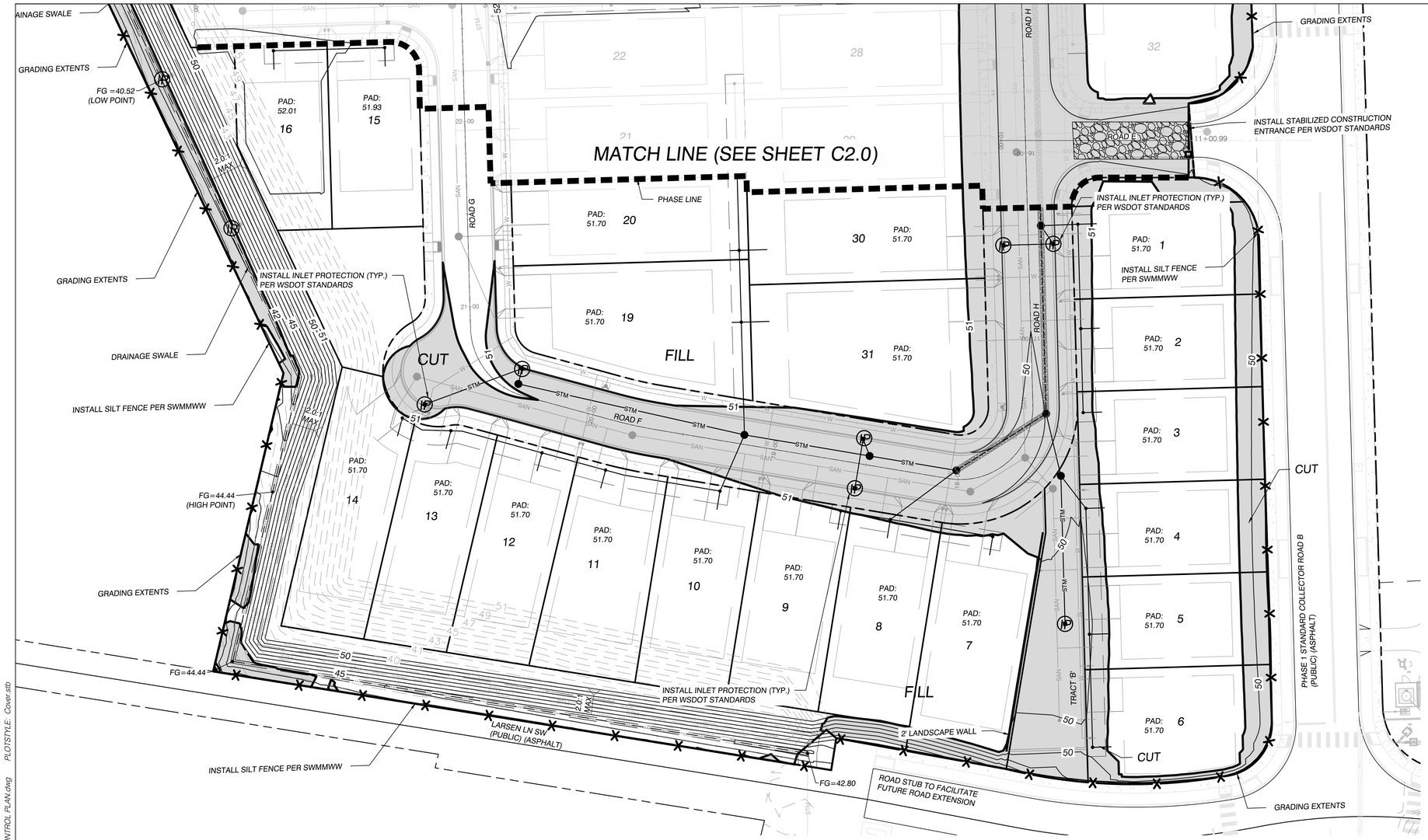
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 30'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

C2.0

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 01 - Phase 1 Subdivision\C2.0 GRADING AND EROSION CONTROL PLAN.dwg PLOTSTYLE: Cover.stb



LEGEND

- 298 — FINISHED GRADE CONTOUR
- 298 — EXISTING CONTOUR
- DRAINAGE SWALE
- AREA OF CUT
- AREA OF FILL
- INLET PROTECTION
- STABALIZED CONSTRUCTION ENTRANCE
- SILT FENCE
- HIGH VISIBILITY FENCE

NOTE: DUE TO THE LIMITED EROSION CONTROL STANDARDS AVAILABLE BY THE CITY OF CASTLE ROCK, ALL EROSION AND SEDIMENT CONTROL DEVICES SHALL CONFORM WITH WSDOT STANDARDS. HOWEVER, CONTRACTOR MAY USE ALTERNATE DESIGNS IF THEY ARE APPROVED BY THE SITE INSPECTOR PRIOR TO INSTALLATION.

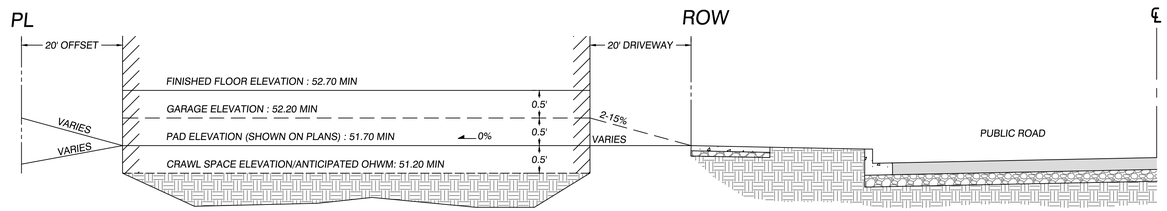
APPROXIMATE GRADING VOLUMES

CUT	2,000 CY
FILL	15,000 CY

NOTE: CUT AND FILL AREAS AND VOLUMES ARE CALCULATED FROM EXISTING GROUND TO FINISHED GRADE AND ARE NOT ADJUSTED FOR STRIPPINGS, TRENCH EXCAVATION, STRUCTURAL EXCAVATION OR SHRINK/SWELL. CONTRACTORS ARE SOLELY RESPONSIBLE FOR QUANTITY ESTIMATES FOR BIDDING PURPOSES.

CONSTRUCTION NOTES

1) ALL EROSION CONTROL DEVICES PROPOSED SHALL CONFORM WITH WSDOT STANDARDS.
2) CONTRACTOR TO CONSTRUCT EQUIPMENT AND PARKING AREA AT A SUITABLE LOCATION PRIOR TO BEGINNING GRADING ACTIVITIES. LOCATION TO BE DETERMINED PRIOR TO THE PRE-CONSTRUCTION CONFERENCE.
3) IF TRACKING OF SEDIMENT FROM THE SITE BECOMES A PROBLEM, A WHEEL WASH SHALL BE INSTALLED AT THE SITE ENTRANCE.
4) STOCKPILE AREAS PLACED ONSITE SHALL BE COORDINATED BY THE CONTRACTOR AND SURROUNDED WITH SILT FENCE AND COVERED WITH PLASTIC AS NECESSARY DURING CONSTRUCTION. MATERIAL NOT STOCKPILED ONSITE SHALL BE REMOVED TO AN APPROPRIATE IMPORT SITE.
5) ANY SLOPE LESS THAN 3:1 TO BE STABILIZED WITH SEEDING AND MULCH/STRAW.
6) CONTRACTOR IS RESPONSIBLE FOR IMPLEMENTING BMP T5.13.
7) EROSION CONTROL INSPECTION REQUIRED BEFORE YOU BEGIN ANY SITEWORK
8) THE BASE FLOOD ELEVATION IS 48.0 AND MINIMUM PAD ELEVATION (AS SHOWN ON PLAN) IS 51.70.



TYPICAL LOT SECTION

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

GRADING AND EROSION CONTROL PLAN (PHASE 2)

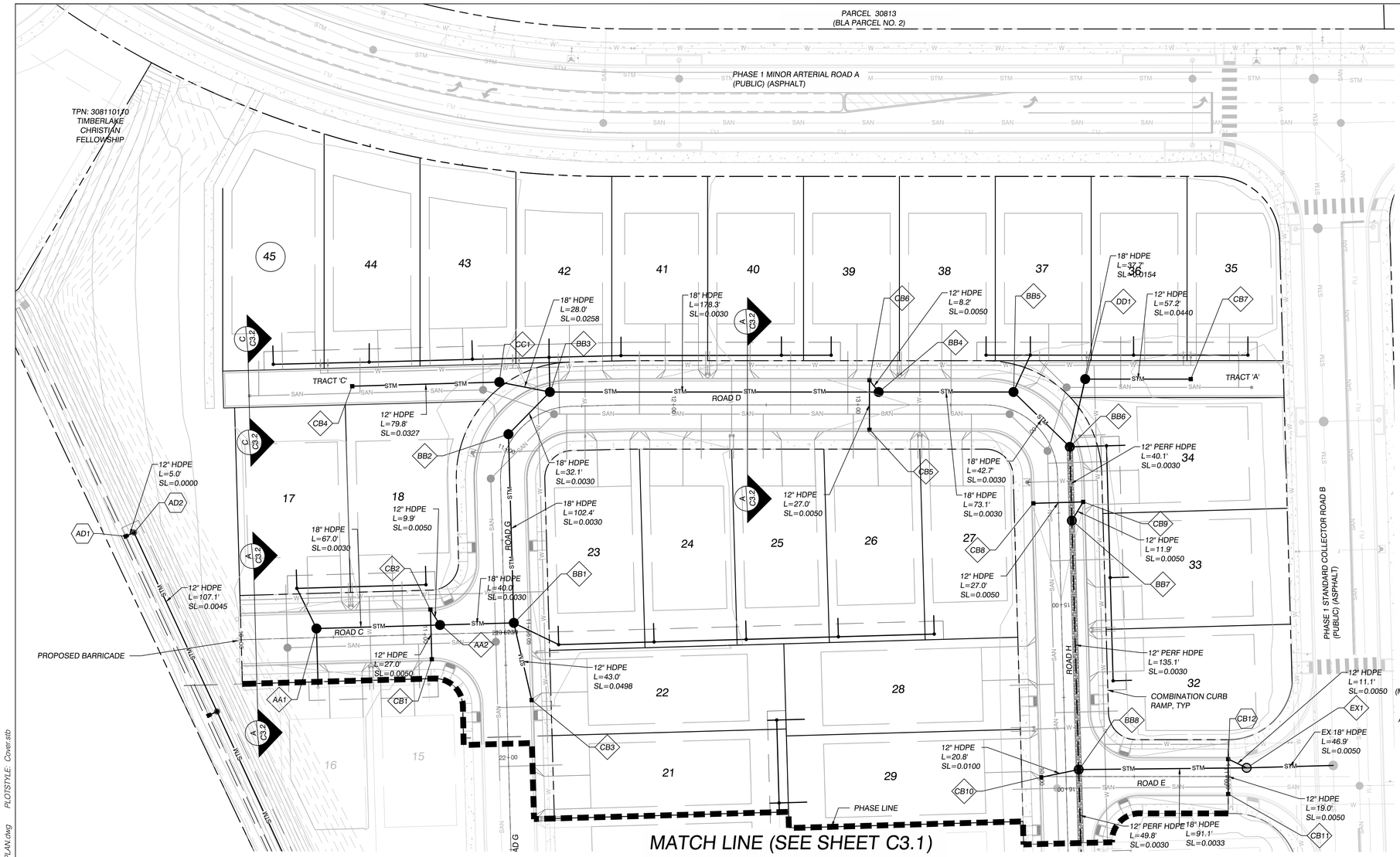
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 30'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

C2.1

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591.01 - Phase 1 Subdivision\C2.0 GRADING AND EROSION CONTROL PLAN.dwg PLOTSTYLE: Cover.stb



0 30 60

SCALE: 1" = 30'

LEGEND

- PROPOSED ASPHALT
- PROPOSED CONCRETE
- PROPOSED INFILTRATION TRENCH
- BARRICADE
- STOP SIGN

NOTE:

1. *HMA SECTIONS ARE TO BE CONSTRUCTED PER STREET SECTIONS, SHEET C3.2 .*

STORMWATER:

1. *ALL STORMWATER SYSTEMS WILL BE DESIGNED IN CONFORMANCE WITH CITY OF CASTLE ROCK STANDARDS AND THE STORMWATER MANAGEMENT MANUAL FOR WESTERN WASHINGTON.*
2. *ALL STORMWATER FACILITIES WILL BE PRIVATELY OWNED AND MAINTAINED WITH A BLANKET ACCESS AND INSPECTION EASEMENT OVER THE PROPERTY DEDICATED TO CITY OF CASTLE ROCK.*
3. *NATIVE SOILS ON THE SITE ARE CONSIDERED TO BE WWHM GROUP 1 (EXCESSIVELY DRAINED SOILS A & B).*
4. *STORMWATER RUNOFF FROM PAVED SURFACES WILL BE ROUTED TO CONTECH STORMFILTER CATCHBASINS AND THEN CONVEYED TO AN OUTFALL AFTER PROPER TREATMENT. STORMWATER RUNOFF WILL BE INFILTRATED ON SITE AND/OR DISCHARGED INTO THE COWLITZ RIVER.*
5. *INSTALL INFILTRATION TRENCH PER DETAIL BELOW*

INFILTRATION TRENCH SECTION

NO SCALE

INLET DATA

STRUCTURE ID	STRUCTURE DATA
AD1	*N: 346651.76 E: 1035084.69* *INSTALL DITCH INLET* *RIM = 41.00* *12" IE OUT = 41.00*
AD2	*N: 346650.47 E: 1035089.52* *INSTALL 24" RISER W/* *ATRIUM GRATE* *RIM = 43.03* *12" IE IN = 41.00* *12" IE OUT = 41.00*
CB1	*STA 11+03.05 (13.5' RT-SUBDIVISION ROAD C)* *INSTALL STM CB* *RIM = 51.26* *12" IE OUT = 47.26*
CB2	*STA 11+03.05 (13.5' LT-SUBDIVISION ROAD C)* *INSTALL 1-CARTRIDGE(18")* *CONTECH STORMFILTER CB* *RIM = 51.26* *12" IE IN = 47.12* *12" IE OUT = 46.52*
CB3	*STA 22+30.73 (13.5' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 1-CARTRIDGE (18")* *CONTECH STORMFILTER CB* *RIM = 51.33* *12" IE OUT = 49.03*

INLET DATA

STRUCTURE ID	STRUCTURE DATA
CB4	*N: 346635.47 E: 1035231.28* *INSTALL 1-CARTRIDGE(18")* *CONTECH STORMFILTER CB* *RIM = 51.17* *12" IE OUT = 48.87*
CB5	*STA 13+06.00 (13.5' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL STM CB* *RIM = 50.87* *12" IE OUT = 46.87*
CB6	*STA 13+06.00 (13.5' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 1-CARTRIDGE(27")* *CONTECH STORMFILTER CB* *RIM = 50.87* *12" IE IN = 46.73* *12" IE OUT = 46.23*
CB7	*N: 346346.81 E: 1035582.67* *INSTALL 1-CARTRIDGE(18")* *CONTECH STORMFILTER CB* *RIM = 49.45* *12" IE OUT = 47.15*
CB8	*STA 14+44.27 (13.5' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL STM CB* *RIM = 50.02* *12" IE OUT = 46.02*

INLET DATA

STRUCTURE ID	STRUCTURE DATA
CB9	*STA 14+44.27 (13.5' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 1-CARTRIDGE(18")* *CONTECH STORMFILTER CB* *RIM = 50.02* *12" IE IN = 45.89* *12" IE OUT = 45.39*
CB10	*STA 15+93.00 (13.5' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 1-CARTRIDGE(18")* *CONTECH STORMFILTER CB* *RIM = 49.52* *12" IE OUT = 46.47*
CB11	*STA 11+00.99 (9.5' RT-SUBDIVISION ROAD E)* *INSTALL STM CB* *RIM = 49.35* *12" IE OUT = 45.35*
CB12	*STA 11+00.99 (9.5' LT-SUBDIVISION ROAD E)* *INSTALL 1-CARTRIDGE(18")* *CONTECH STORMFILTER CB* *RIM = 49.35* *12" IE IN = 45.25* *12" IE OUT = 45.25*

STORM MANHOLE DATA

STRUCTURE ID	STRUCTURE DATA
AA1	*STA 10+41.00 (4.9' LT-SUBDIVISION ROAD C)* *INSTALL 48" STM MH* *RIM = 51.62* *18" IE OUT = 46.67*
AA2	*STA 11+08.05 (5.0' LT-SUBDIVISION ROAD C)* *INSTALL 48" STM MH* *RIM = 51.43* *18" IE IN = 46.47* *12" IE IN = 46.47* *18" IE OUT = 46.27*
BB1	*STA 10+04.98 (5.0' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 51.63* *18" IE IN = 46.15* *12" IE IN = 46.89* *18" IE OUT = 45.95*
BB2	*STA 11+07.14 (3.1' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 51.88* *18" IE IN = 45.64* *18" IE OUT = 45.44*
BB3	*STA 11+34.94 (9.3' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 51.74* *18" IE IN = 45.34* *18" IE IN = 45.34* *18" IE OUT = 45.14*

STORM MANHOLE DATA

STRUCTURE ID	STRUCTURE DATA
BB4	*STA 13+11.00 (7.0' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 50.97* *18" IE IN = 44.60* *12" IE IN = 46.19* *18" IE OUT = 44.40*
BB5	*STA 13+81.38 (9.4' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 50.49* *18" IE IN = 44.18* *18" IE OUT = 43.98*
BB6	*STA 14+16.94 (9.5' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 50.27* *18" IE IN = 43.85* *18" IE IN = 43.85* *12" IE OUT = 43.65*
BB7	*STA 14+54.27 (7.1' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 50.09* *12" IE IN = 43.53* *12" IE IN = 45.33* *12" IE OUT = 43.33*
BB8	*STA 15+89.39 (7.0' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 49.71* *12" IE IN = 42.92* *12" IE IN = 42.92* *12" IE IN = 46.26* *18" IE OUT = 42.72*

STORM MANHOLE DATA

STRUCTURE ID	STRUCTURE DATA
CC1	*N: 346586.06 E: 1035393.91* *INSTALL 48" STM MH* *RIM = 52.28* *12" IE IN = 46.26* *18" IE OUT = 46.06*
DD1	*N: 346393.60 E: 1035526.69* *INSTALL 48" STM MH* *RIM = 50.62* *12" IE IN = 44.63* *18" IE OUT = 44.43*
EX1	*N: 346165.49 E: 1035470.66* *INSTALL EX 48" STM MH* *RIM = 49.53* *18" IE IN = 42.42* *12" IE IN = 45.19* *18" IE OUT = 42.22*

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

ALEXANDER W. TAW
STATE OF WASHINGTON
22012357
REGISTERED
PROFESSIONAL ENGINEER

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

STREET AND STORM PLAN (PHASE 1)

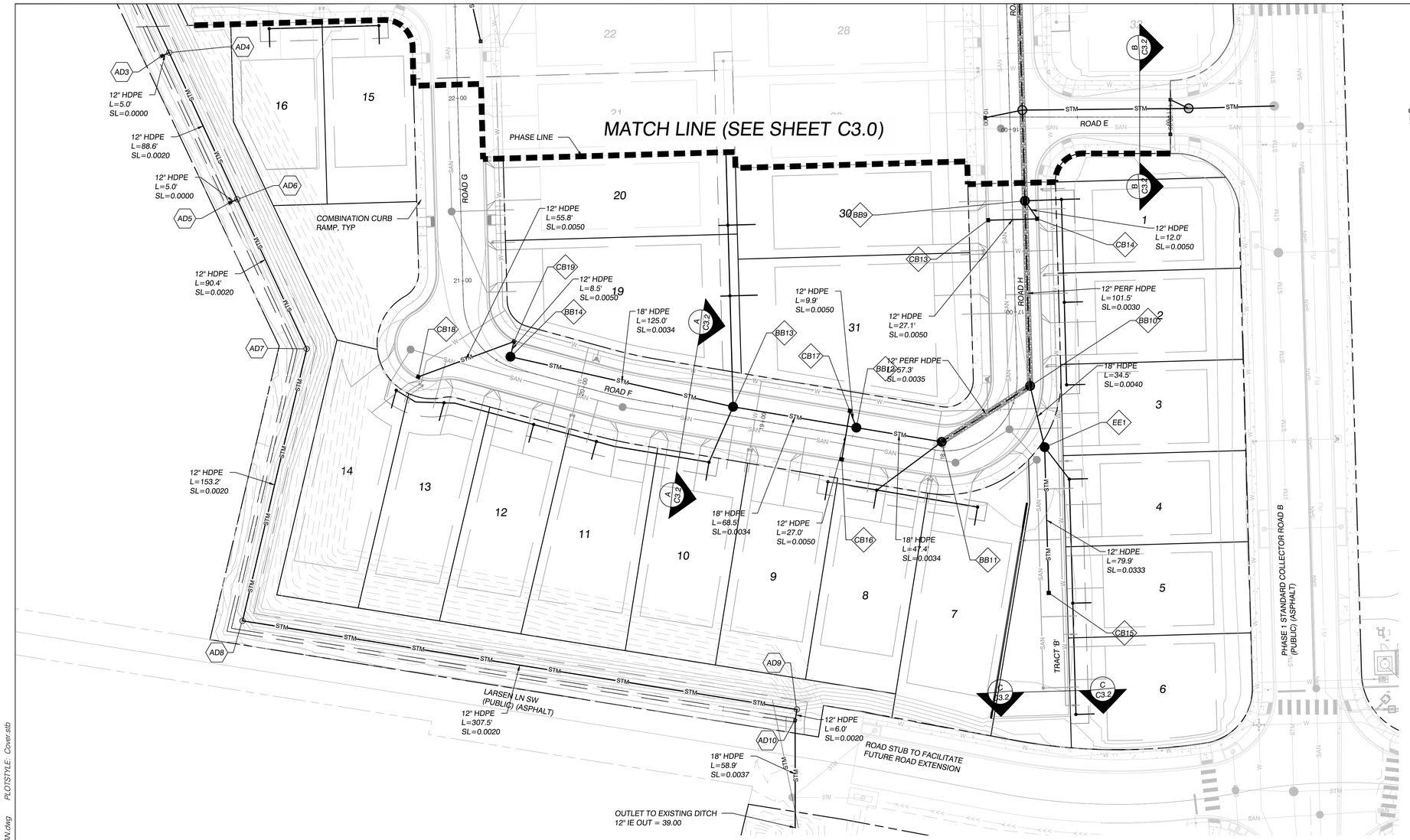
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 30'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

C3.0

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591.01 - Phase 1 Subdivision\C3.0 STREET AND STORM PLAN.dwg PLOTSTYLE: Cover.stb



0 30 60

SCALE: 1" = 30'

LEGEND

- PROPOSED ASPHALT
- PROPOSED CONCRETE
- PROPOSED INFILTRATION TRENCH
- BARRICADE
- STOP SIGN

NOTE:

1. *HMA SECTIONS ARE TO BE CONSTRUCTED PER STREET SECTIONS, SHEET C3.2 .*

STORMWATER:

1. *ALL STORMWATER SYSTEMS WILL BE DESIGNED IN CONFORMANCE WITH CITY OF CASTLE ROCK STANDARDS AND THE STORMWATER MANAGEMENT MANUAL FOR WESTERN WASHINGTON.*
2. *ALL STORMWATER FACILITIES WILL BE PRIVATELY OWNED AND MAINTAINED WITH A BLANKET ACCESS AND INSPECTION EASEMENT OVER THE PROPERTY DEDICATED TO CITY OF CASTLE ROCK.*
3. *NATIVE SOILS ON THE SITE ARE CONSIDERED TO BE WWHM GROUP 1 (EXCESSIVELY DRAINED SOILS A & B).*
4. *STORMWATER RUNOFF FROM PAVED SURFACES WILL BE ROUTED TO CONTECH STORMFILTER CATCHBASINS AND THEN CONVEYED TO AN OUTFALL AFTER PROPER TREATMENT. STORMWATER RUNOFF WILL BE INFILTRATED ON SITE AND/OR DISCHARGED INTO THE COWLITZ RIVER.*
5. *INSTALL INFILTRATION TRENCH PER DETAIL BELOW*

INLET DATA

STRUCTURE ID	STRUCTURE DATA
AD3	*N: 346548.33 E: 1035056.97* *INSTALL DITCH INLET* *RIM = 40.52* *12" IE OUT = 40.52*
AD4	*N: 346547.04 E: 1035061.80* *INSTALL 24" RISER W/ ATRIUM GRATE* *RIM = 42.92* *12" IE IN = 40.52* *12" IE OUT = 40.52*
AD5	*N: 346462.71 E: 1035034.03* *INSTALL DTCH INLET* *RIM = 40.88* *12" IE OUT = 40.34*
AD6	*N: 346461.42 E: 1035038.86* *INSTALL 24" RISER W/ ATRIUM GRATE* *RIM = 42.76* *12" IE IN = 40.34* *12" IE IN = 40.34* *12" IE OUT = 40.34*
AD7	*N: 346374.13 E: 1035015.47* *INSTALL 24" RISER W/ ATRIUM GRATE* *RIM = 42.54* *12" IE IN = 40.16* *12" IE OUT = 40.16*

INLET DATA

STRUCTURE ID	STRUCTURE DATA
AD8	*N: 346282.27 E: 103489.92* *INSTALL 24" RISER W/ ATRIUM GRATE* *RIM = 42.20* *12" IE IN = 39.85* *12" IE OUT = 39.85*
AD9	*N: 346050.26 E: 1035094.76* *INSTALL 24" AREA DRAIN W/ SOLID COVER* *RIM = 41.53* *12" IE IN = 39.23* *12" IE OUT = 39.23*
AD10	*N: 346046.36 E: 1035090.20* *INSTALL DITCH INLET* *RIM = 42.80* *12" IE IN = 39.22* *18" IE OUT = 39.22*
CB13	*STA 16+49.18 (13.5' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL STM CB* *RIM = 49.59* *12" IE OUT = 45.59*
CB14	*STA 16+49.25 (13.6' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 1-CARTRIDGE(27")* *CONTECH STORMFILTER CB* *RIM = 49.59* *12" IE IN = 45.45* *12" IE OUT = 44.95*

INLET DATA

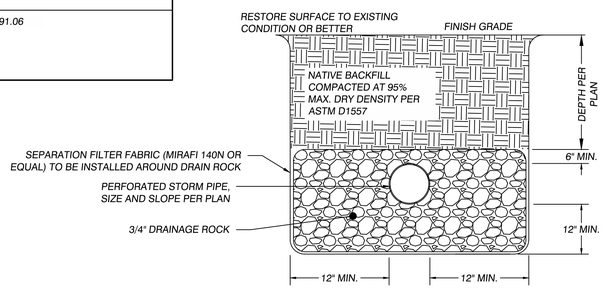
STRUCTURE ID	STRUCTURE DATA
CB15	*N: 346010.85 E: 1035241.56* *INSTALL 1-CARTRIDGE(18")* *CONTECH STORMFILTER CB* *RIM = 49.36* *12" IE OUT = 47.09*
CB16	*STA 18+53.78 (13.5' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL STM CB* *RIM = 50.20* *12" IE OUT = 46.20*
CB17	*STA 18+53.78 (13.5' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 1-CARTRIDGE(27")* *CONTECH STORMFILTER CB* *RIM = 50.20* *12" IE IN = 46.06* *12" IE OUT = 45.56*
CB18	*STA 20+66.47 (37.4' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL STM CB* *RIM = 50.36* *12" IE OUT = 46.36*
CB19	*STA 20+45.96 (13.5' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 1-CARTRIDGE(27")* *CONTECH STORMFILTER CB* *RIM = 50.78* *12" IE IN = 46.08* *12" IE OUT = 45.58*

STORM MANHOLE DATA

STRUCTURE ID	STRUCTURE DATA
BB9	*STA 16+39.18 (7.0' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 49.70* *12" IE IN = 43.27* *12" IE IN = 44.89* *12" IE OUT = 43.07*
BB10	*STA 17+39.92 (7.2' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 49.99* *12" IE IN = 43.77* *18" IE IN = 44.09* *12" IE OUT = 43.57*
BB11	*STA 18+00.88 (4.8' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 50.22* *18" IE IN = 44.17* *12" IE OUT = 43.97*
BB12	*STA 18+48.78 (5.0' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 50.36* *18" IE IN = 44.53* *12" IE IN = 45.51* *18" IE OUT = 44.33*
BB13	*STA 19+17.27 (5.1' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 50.56* *18" IE IN = 44.96* *18" IE OUT = 44.76*

STORM MANHOLE DATA

STRUCTURE ID	STRUCTURE DATA
BB14	*STA 20+43.64 (5.2' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 50.93* *12" IE IN = 45.54* *18" IE OUT = 45.38*
DD1	*STA 13+78.53 (55.9' RT-ROAD B)* *INSTALL 48" STM MH* *RIM = 49.53* *18" IE OUT = 42.22*
EE1	*N: 346073.60 E: 1035291.06* *INSTALL 48" STM MH* *RIM = 50.53* *12" IE IN = 44.43* *18" IE OUT = 44.23*



INFILTRATION TRENCH SECTION

NO SCALE

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

STREET AND STORM PLAN (PHASE 2)

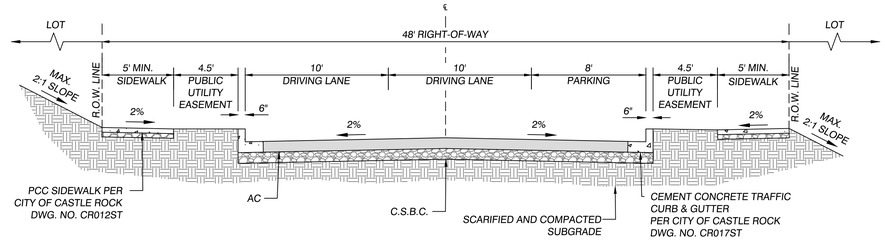
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 30'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

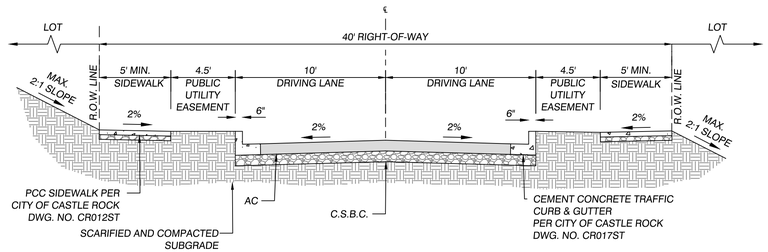
PRELIMINARY

C3.1

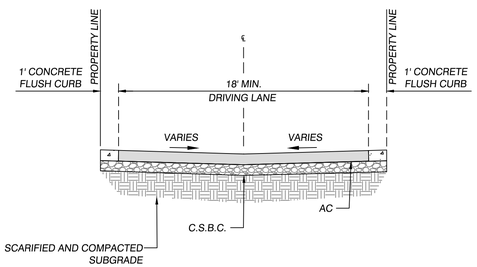
FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591.01 - Phase 1 Subdivision\C3.0 STREET AND STORM PLAN.dwg PLOTSTYLE: Cover.stb



SECTION A-A - RESIDENTIAL LOCAL ACCESS ROADWAY SECTION



SECTION B-B - SUBDIVISION ENTRANCE ROADWAY SECTION



SECTION C-C - PRIVATE TRACT SECTION

AC PAVEMENT SECTIONS

	RESIDENTIAL LOCAL ACCESS	PRIVATE TRACTS
AC THICKNESS	3"	3"
# OF AC LIFTS	1	1
CRUSHED SURFACING BASE COURSE DEPTH	9"	6"
SUBGRADE DEPTH	12"	12"

NOTE:

PAVEMENT SECTIONS SHOWN ARE PRELIMINARY RECOMMENDATIONS AS PROVIDED BY COLUMBIA WEST ENGINEERING DURING MASTER PLANNING PROCESS AND ARE BASED ON THE PROJECT GEOTECHNICAL REPORT, DATED MARCH 30, 2023. FINAL PAVEMENT SECTIONS FOR PUBLIC AND PRIVATE ROADWAYS WITHIN LOTC SHALL BE DESIGNED AND APPROVED BY A LICENSED PROFESSIONAL GEOTECHNICAL ENGINEER PRIOR TO FINAL PERMIT APPROVAL.

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

STREET SECTIONS

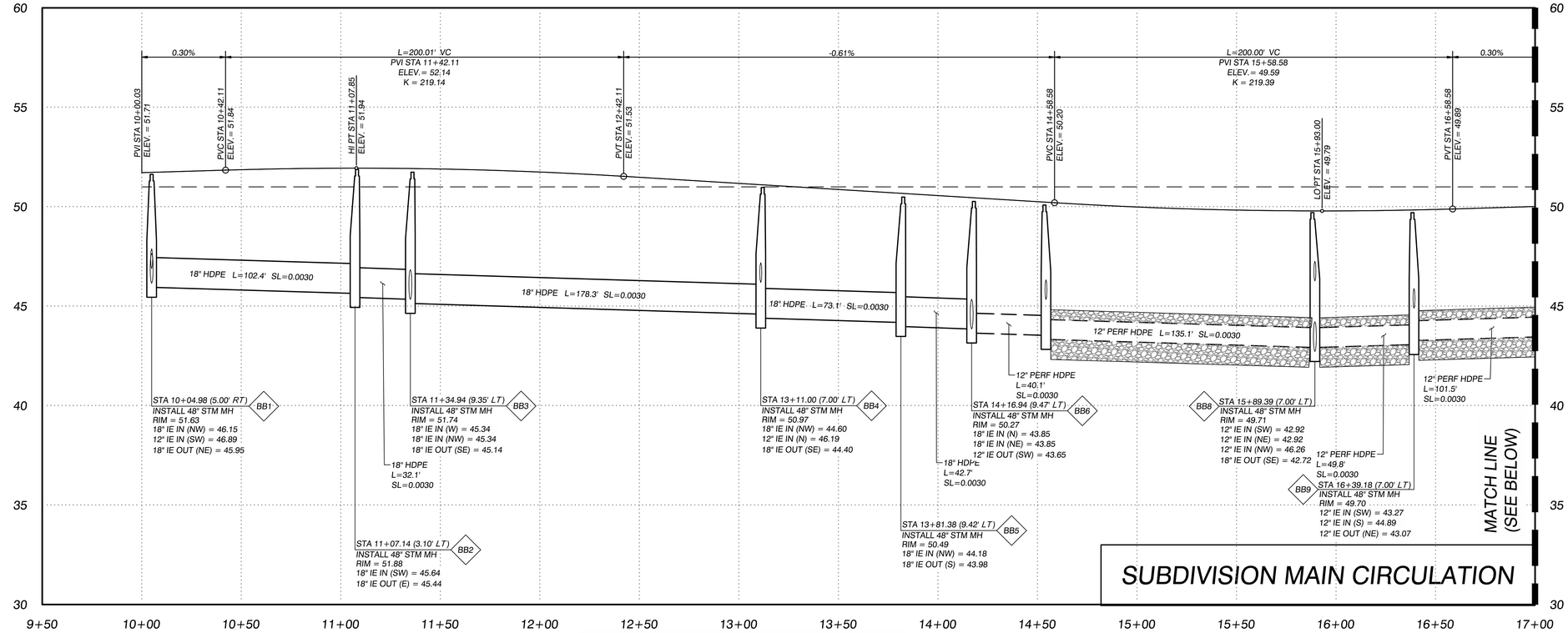
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 5'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

C3.2

FILE: W:\18591 LOTC Phase 1\500 Design\500 Drawings\Sheets\18591 01 - Phase 1 Subdivision\C3.2 STREET SECTIONS.dwg PLOTSTYLE: Cover.stb

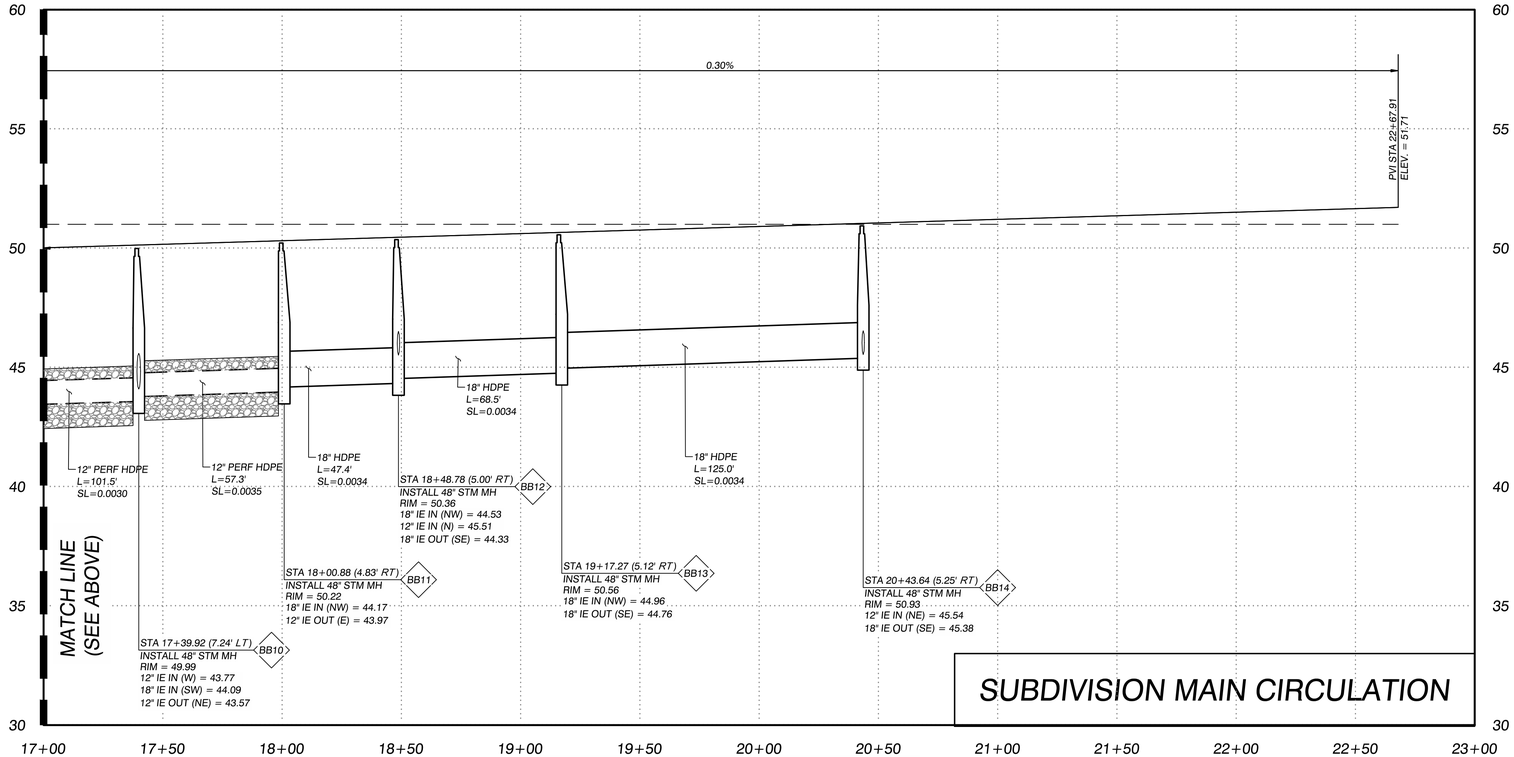


MAIN CIRCULATION PROFILE

STA 10+00 - STA 17+00

0 30 60

SCALE: 1" = 30'



MAIN CIRCULATION PROFILE

STA 17+00 - STA 22+67.91

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

TAW
STATE OF WASHINGTON
22012357
REGISTERED
PROFESSIONAL ENGINEER

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

MAIN CIRCULATION STREET AND STORM PROFILE

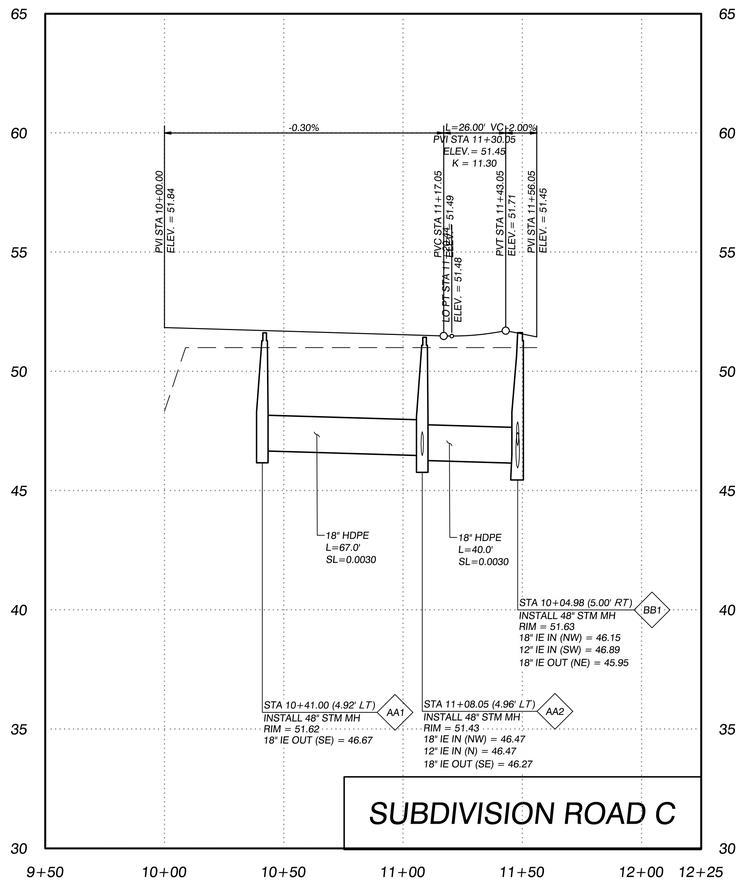
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 30'	V: 5:1
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

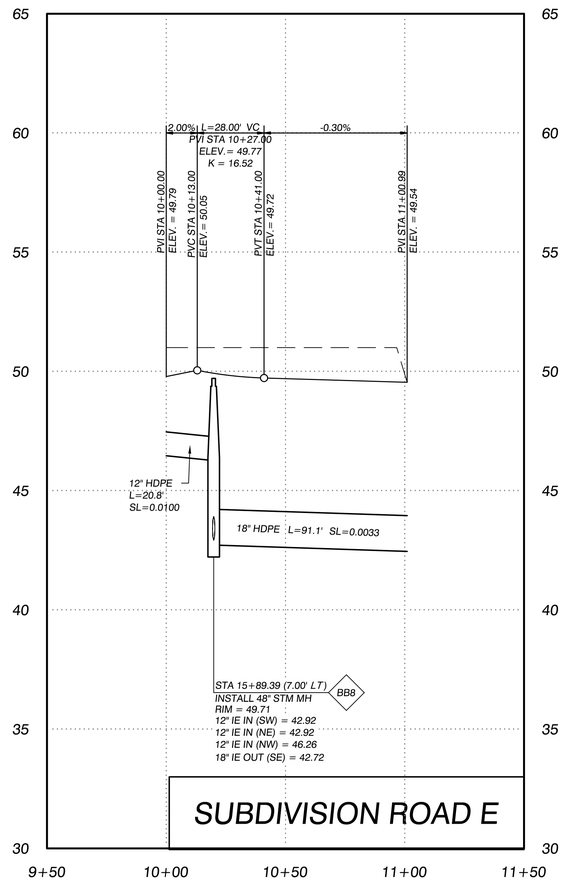
PRELIMINARY

C3.3

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 01 - Phase 1 Subdivision\C3.3 ROAD PROFILES.dwg PLOTSTYLE: Cover.stb



ROAD C PROFILE



ROAD E PROFILE

0 30 60

SCALE: 1" = 30'

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

ROAD C AND ROAD E STREET AND STORM PROFILES

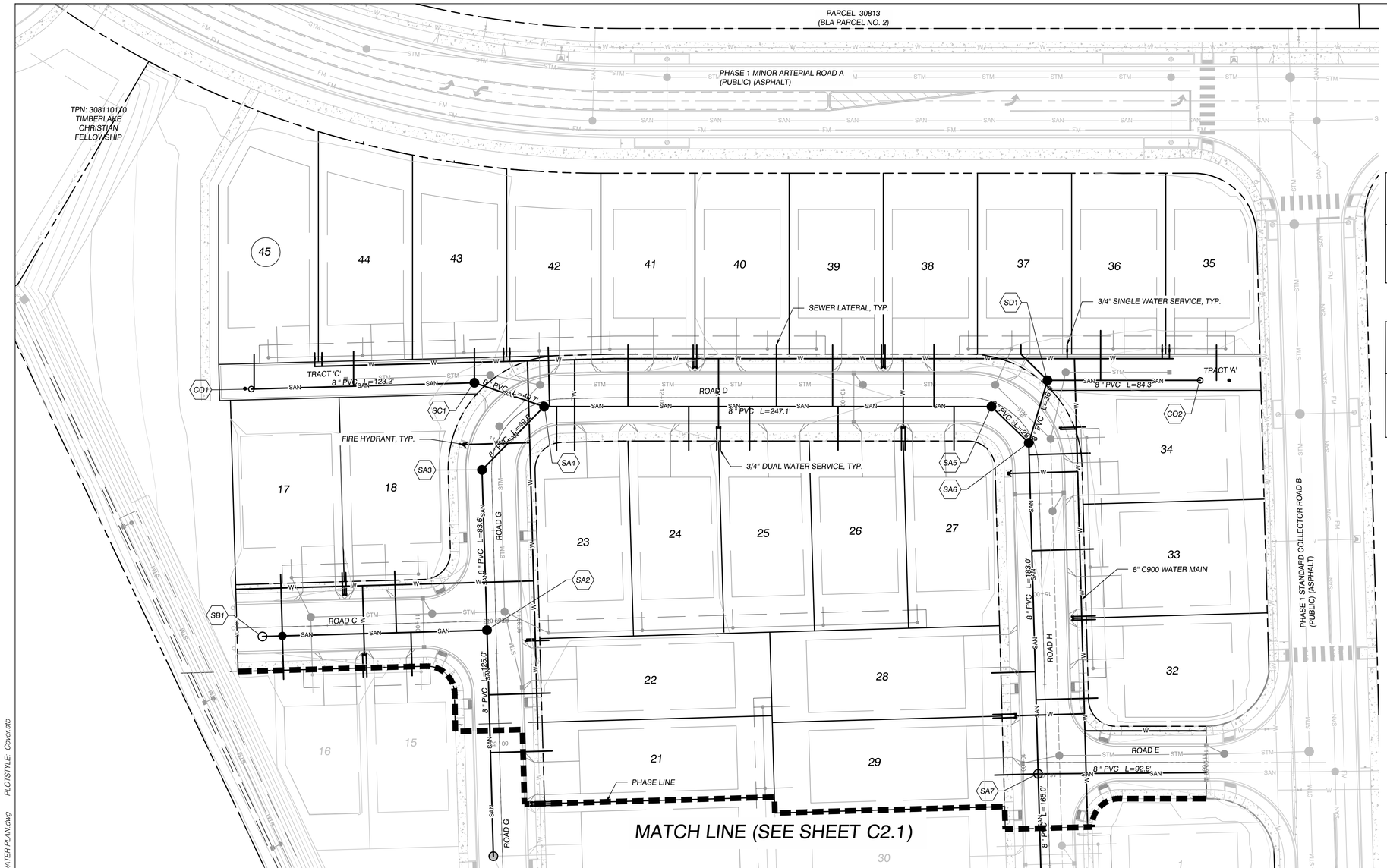
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 30'	V: 5:1
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

C3.4

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 01 - Phase 1 Subdivision\C3.3 ROAD PROFILES.dwg PLOTSTYLE: Cover.stb



CITY OF CASTLE ROCK STD. WATER DETAIL SHEETS

CR004W	FIRE HYDRANT
CR012W	CONNECTION TO EXISTING MAIN
CR019W	TRENCH - PAVEMENT RESTORATION

CITY OF CASTLE ROCK STD. SANITARY SEWER DETAIL SHEETS

CR001SS	TYPE 1 MANHOLE
CR003SS	MANHOLE COLLAR
CR006SS	CLEANOUT
CR008SS	SEWER AIR RELEASE ASSEMBLY

UTILITY NOTES:

1. *PROPOSED SANITARY FORCE MAIN SHALL BE GREEN COLORED AS REQUIRED BY CITY OF CASTLE ROCK.*
2. *ALL UTILITIES WILL CONFORM WITH CITY OF CASTLE ROCK AND WSDOT STANDARDS.*
3. *SEE SHEET C6.4 FOR SANITARY SEWER EXHIBIT OF THE FULL LOTC DEVELOPMENT. PROPOSED SANITARY SEWER DEPTH IS CONTROLLED BY THE ULTIMATE LAYOUT.*

SEWER STRUCTURE DATA

STRUCTURE ID	STRUCTURE DATA
CO1	N: 346664.78 E: 1035187.67 SAN CLEANOUT RIM = 51.75 8" IE IN = 46.11
CO2	N: 346332.45.78 E: 1035592.83 SAN CLEANOUT RIM = 49.62 8" IE OUT = 44.01
SA2	STA 22+62.88 (5.0' LT-SUBDIVISION MAIN CIRCULATION) 48" SAN MH RIM = 51.61 8" IE IN = 44.69 8" IE IN = 44.69 8" IE OUT = 44.49
SA3	STA 10+83.45 (5.3' LT-SUBDIVISION MAIN CIRCULATION) 48" SAN MH RIM = 51.82 8" IE IN = 44.09 8" IE OUT = 43.89
SA4	STA 11+34.01 (2.8' RT-SUBDIVISION MAIN CIRCULATION) 48" SAN MH RIM = 51.87 8" IE IN = 43.67 8" IE IN = 43.67 8" IE OUT = 43.47

SEWER STRUCTURE DATA

STRUCTURE ID	STRUCTURE DATA
SA5	STA 13+83.28 (2.6' RT-SUBDIVISION MAIN CIRCULATION) 48" SAN MH RIM = 50.61 8" IE IN = 42.36 8" IE OUT = 42.16
SA6	STA 14+14.86 (2.6' RT-SUBDIVISION MAIN CIRCULATION) 48" SAN MH RIM = 50.42 8" IE IN = 42.07 8" IE IN = 42.07 8" IE OUT = 41.87
SA7	STA 15+99.15 (5.0' RT-SUBDIVISION MAIN CIRCULATION) 48" SAN MH RIM = 49.69 8" IE IN = 41.05 8" IE IN = 41.05 8" IE OUT = 40.85
SB1	STA 10+14.00 (5.0' RT-SUBDIVISION ROAD C) 48" SAN MH RIM = 51.70 8" IE OUT = 46.03
SC1	N: 346588.44 E: 1035284.43 48" SAN MH RIM = 52.24 8" IE OUT = 45.56 8" IE OUT = 45.36

SEWER STRUCTURE DATA

STRUCTURE ID	STRUCTURE DATA
SD1	N: 346386.53 E: 1035528.13 48" SAN MH RIM = 50.92 8" IE IN = 43.63 8" IE OUT = 43.43

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

ALEXANDER W. TAYLOR
STATE OF WASHINGTON
22012357
REGISTERED
PROFESSIONAL ENGINEER

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

SEWER AND WATER PLAN (PHASE 1)

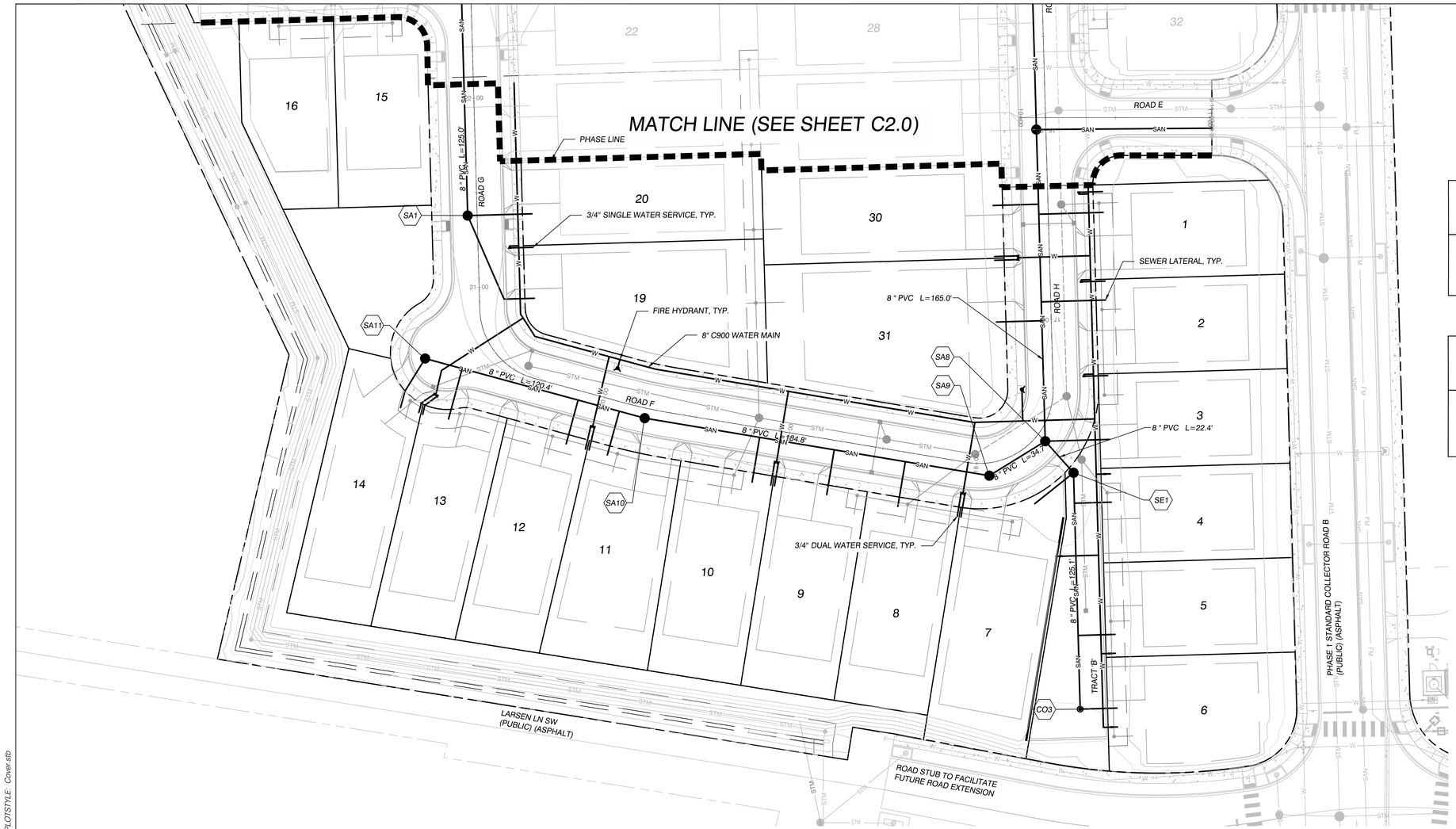
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 30'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

C4.0

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591.01 - Phase 1 Subdivision\C4.0 SEWER AND WATER PLAN.dwg PLOTSTYLE: Cover.stb



0 30 60
SCALE: 1" = 30'

CITY OF CASTLE ROCK STD. WATER DETAIL SHEETS

CR004W	FIRE HYDRANT
CR012W	CONNECTION TO EXISTING MAIN
CR019W	TRENCH - PAVEMENT RESTORATION

CITY OF CASTLE ROCK STD. SANITARY SEWER DETAIL SHEETS

CR001SS	TYPE 1 MANHOLE
CR003SS	MANHOLE COLLAR
CR006SS	CLEANOUT
CR008SS	SEWER AIR RELEASE ASSEMBLY

UTILITY NOTES:

1. PROPOSED SANITARY FORCE MAIN SHALL BE GREEN COLORED AS REQUIRED BY CITY OF CASTLE ROCK.
2. ALL UTILITIES WILL CONFORM WITH CITY OF CASTLE ROCK AND WSDOT STANDARDS.
3. SEE SHEET C6.4 FOR SANITARY SEWER EXHIBIT OF THE FULL LOTC DEVELOPMENT. PROPOSED SANITARY SEWER DEPTH IS CONTROLLED BY THE ULTIMATE LAYOUT.

SEWER STRUCTURE DATA

STRUCTURE ID	STRUCTURE DATA
CO3	N: 3459.72.81 E: 1035205.82 SAN CLEANOUT RIM = 50.02 8" IE OUT = 44.33
SA1	STA 21+37.89 (5.0' LT-SUBDIVISION MAIN CIRCULATION) 48" SAN MH RIM = 51.22 8" IE OUT = 45.25
SA8	STA 17+62.93 (5.2' LT-SUBDIVISION MAIN CIRCULATION) 48" SAN MH RIM = 50.10 8" IE IN = 42.82 8" IE IN = 42.82 8" IE OUT = 42.62
SA9	STA 17+93.81 (6.8' LT-SUBDIVISION MAIN CIRCULATION) 48" SAN MH RIM = 50.16 8" IE IN = 43.18 8" IE OUT = 42.98

SEWER STRUCTURE DATA

STRUCTURE ID	STRUCTURE DATA
SA10	STA 19+76.62 (5.3' LT-SUBDIVISION MAIN CIRCULATION) 48" SAN MH RIM = 50.73 8" IE IN = 44.21 8" IE OUT = 44.01
SA11	STA 20+74.42 (34.1' LT-SUBDIVISION MAIN CIRCULATION) 48" SAN MH RIM = 50.42 8" IE OUT = 44.75
SE1	N: 346071.04 E: 1035283.31 48" SAN MH RIM = 50.53 8" IE IN = 43.77 8" IE OUT = 43.57

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

TAW ANDREW WILLIAMS
STATE OF WASHINGTON
22012357
REGISTERED
PROFESSIONAL ENGINEER

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

SEWER AND WATER PLAN (PHASE 2)

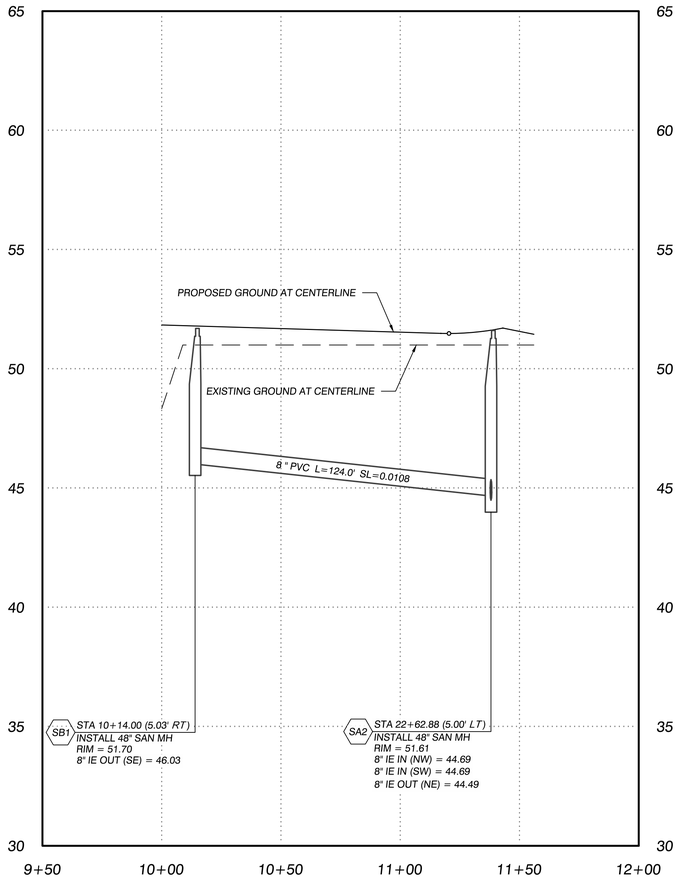
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 30'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

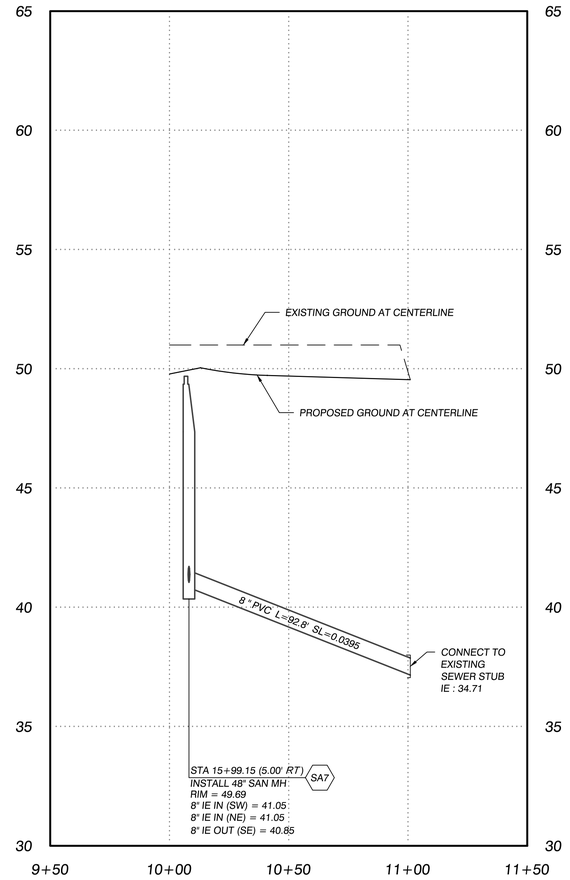
PRELIMINARY

C4.1

FILE: W:\18591 LOTC Phase 1500 Design\502 Drawings\Sheets\18591.01 - Phase 1 Subdivision\C4.0 SEWER AND WATER PLAN.dwg PLOTSTYLE: Cover.stb



ROAD C PROFILE



ROAD E PROFILE

0 30 60
SCALE: 1" = 30'

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

ROAD C AND ROAD E SEWER PROFILES

REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 30'	V: 5:1
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

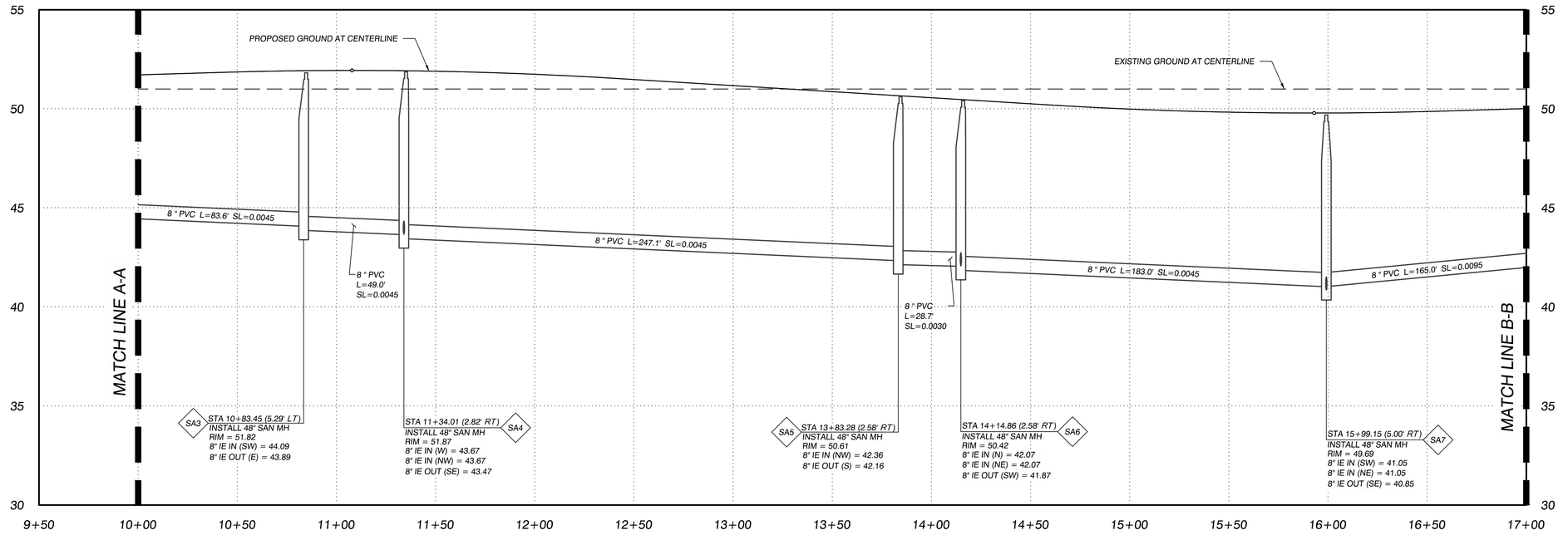
PRELIMINARY

C4.3

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

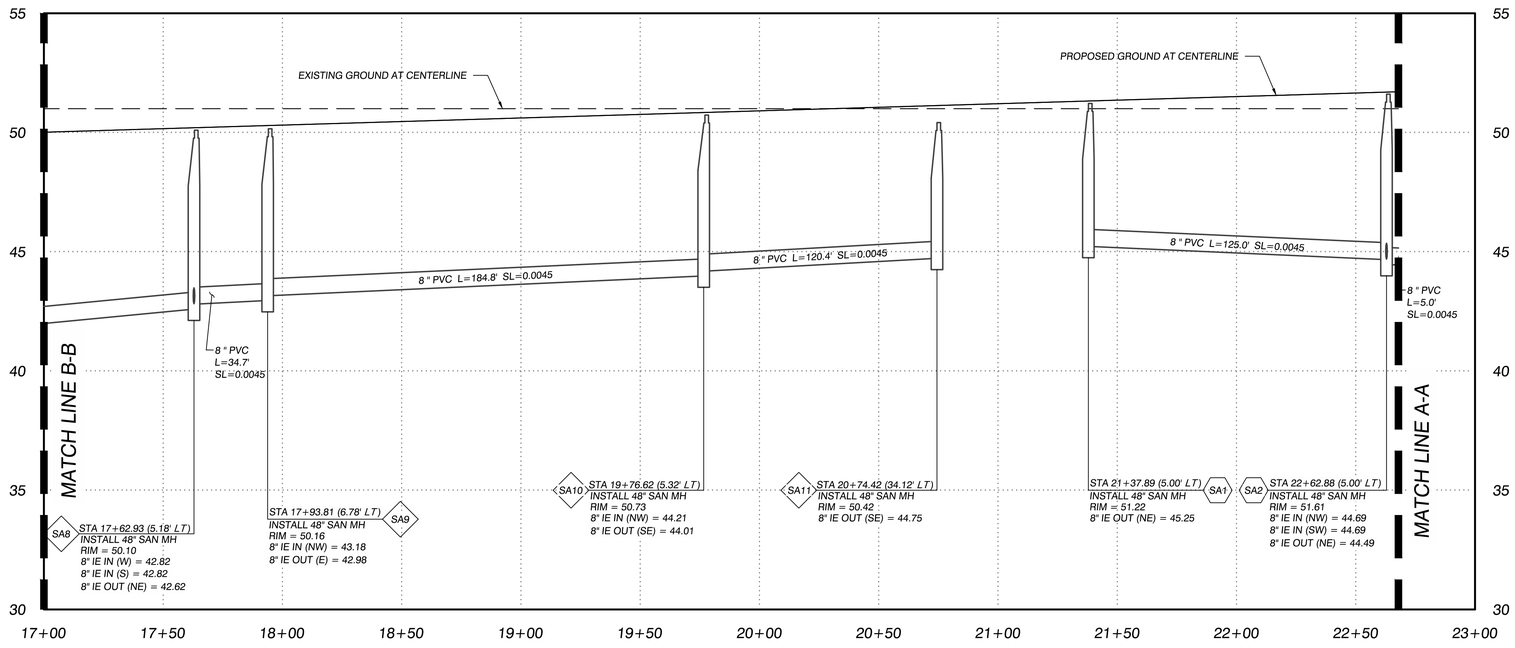
TAYLOR ANDREW WILLIAMS
STATE OF WASHINGTON
22012357
REGISTERED
PROFESSIONAL ENGINEER

FILE: W:\18591 LOTC Phase 1\500 Design\500 Drawings\Sheets\18591 01 - Phase 1 Subdivision\C4.2 SEWER AND WATER PROFILES.dwg PLOTSTYLE: Cover.stb



MAIN CIRCULATION PROFILE

STA 10+00 - STA 17+00



MAIN CIRCULATION PROFILE

STA 17+00 - STA 22+67.91

NOTE: THIS ROAD IS A LOOP AND THE PROFILES CONNECT ON EITHER SIDE. STATION 10+00 STARTS NEAR THE INTERSECTION OF ROAD C ALIGNMENT.

0 30 60
SCALE: 1" = 30'

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

ALEXANDER W. TAYLOR
STATE OF WASHINGTON
22012357
REGISTERED
PROFESSIONAL ENGINEER

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

MAIN CIRCULATION SEWER PROFILE

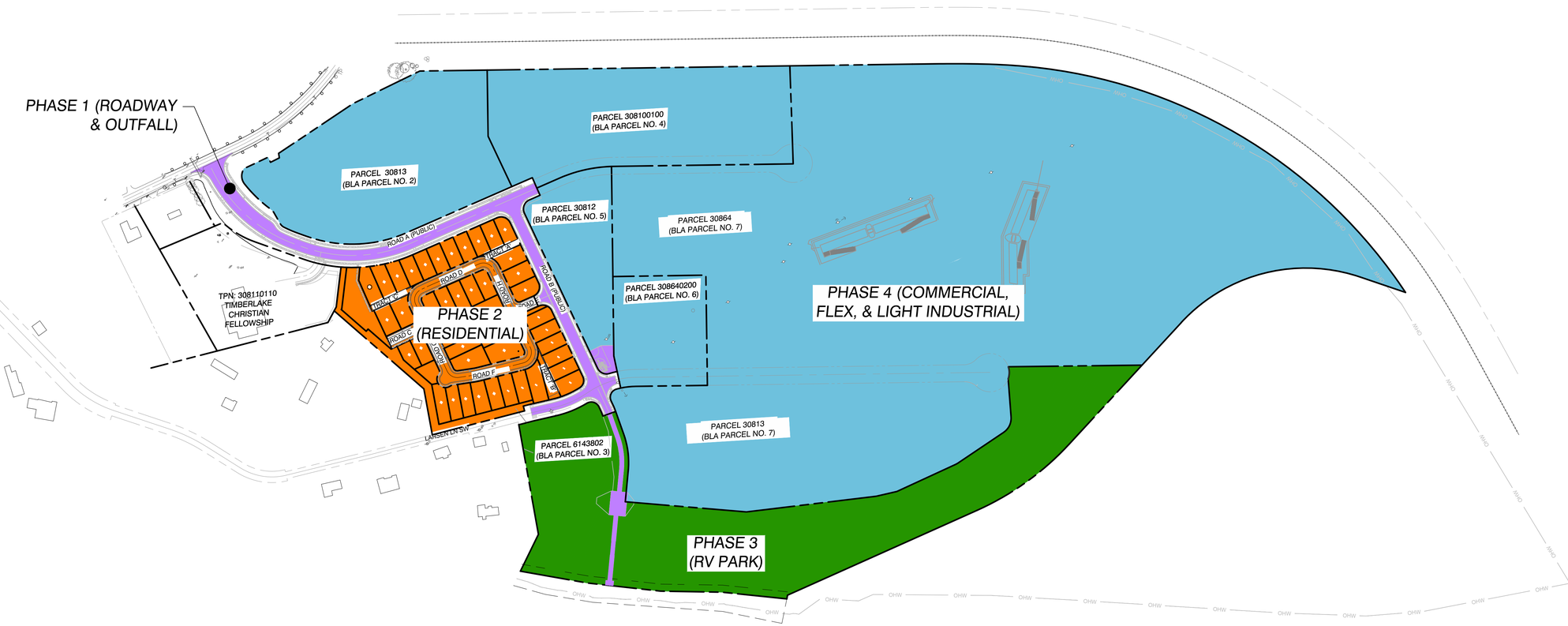
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 30'	V: 5:1
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

C4.2

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 01 - Phase 1 Subdivision\C4.2 SEWER AND WATER PROFILES.dwg PLOTSTYLE: Cover.stb



MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

PRELIMINARY MASTER PHASING PLAN

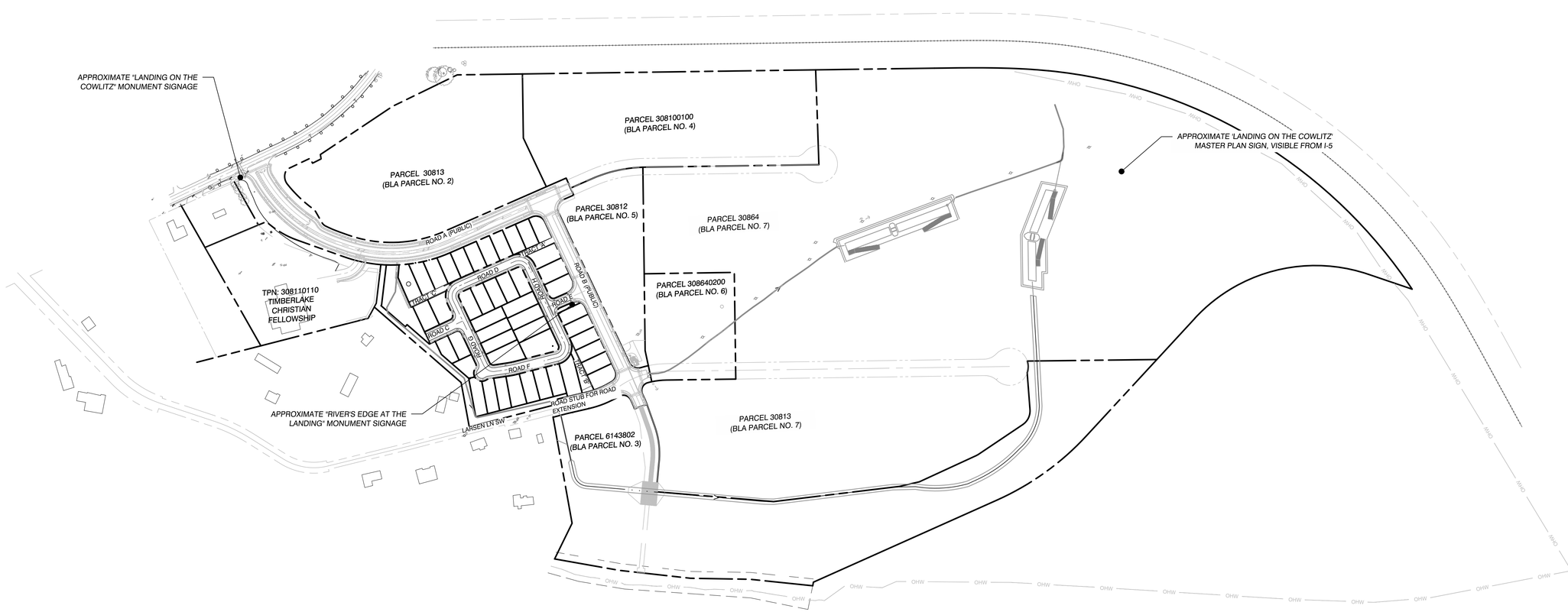
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 200'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

MP1.0

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591.01 - Phase 1 Subdivision\MP1.0 MASTER PHASING PLAN.dwg PLOTSTYLE: Cover.stb



FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591.01 - Phase 1 Subdivision\SS\1.0 MONUMENT SIGNAGE PLAN.dwg PLOTSTYLE: Cover.stb

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

TAW ANDREW WILLIAMS
STATE OF WASHINGTON
22012357
REGISTERED
PROFESSIONAL ENGINEER

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

PRELIMINARY MASTER SIGNAGE PLAN

REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 200'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

MP1.1

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591.01 - Phase 1 Subdivision\MP1.1 MASTER PARK PLAN.dwg PLOTSTYLE: Cover.stb

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

PRELIMINARY MASTER PARKS, RECREATION, AND OPEN SPACE PLAN

REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 200'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

MP1.2

0 40 80
SCALE: 1" = 40'

PARK ELEMENTS as listed below, or approved alternate:

- Steel Pavilion, 12'x12', American Parks Co.
- Timberform Parkway Table with Three Chairs, Model 2052, Columbia Cascade Co.

Preschool Play
- Curved Crawl Tunnel, Model 67711, American Parks Co.
- Pony Spring Rider, 3889-01-P, Columbia Cascade Co.
- Apex Climber, 1672-01-W1, Columbia Cascade Co.

Primary Play
- Double Belt Swing, Model 1561-2, Columbia Cascade Co.
- Play Stack 4500-408-W1-Model, Columbia Cascade Co.
- Vertical Loop Climber, 6', Model 67636, American Parks Co.

PLANT_SCHEDULE

SYMBOL	BOTANICAL / COMMON NAME	SPACING	QTY	SIZE
TREES				
	ZELKOVA SERRATA 'CITY SPRITE' / CITY SPRITE ZELKOVA	30' O.C.	46	2" CAL.
	ACER RUBRUM 'FRANKSRED' / RED SUNSET MAPLE	30' O.C.	5	2" CAL.
	AMELANCHIER X GRANDIFLORA 'AUTUMN BRILLIANCE' / AUTUMN BRILLIANCE SERVICEBERRY	20' O.C.	7	1.5" CAL.

SYMBOL	BOTANICAL / COMMON NAME	SPACING	QTY	SIZE
SHRUBS				
	CORNUS SERICEA 'ARCTIC FIRE RED'/ ARCTIC FIRE RED REDTWIG DOGWOOD	3' O.C.	20	2 GAL.
	VACCINIUM OVATUM/ EVERGREEN HUCKLEBERRY	3' O.C.	42	2 GAL.
	SPIREA JAPONICA / JAPANESE SPIREA	5' O.C.	2	3 GAL.
	AMELANCHIER UTAHENSIS / WESTERN SERVICEBERRY	15' O.C.	18	3 GAL.
	ARCTOSTAPHYLOS GLAUCA / BIG BERRY MANZANITA	15' O.C.	13	3 GAL.
	PYRACANTHA AUGUSTIFOLIA 'YUKON BELLE' / NARROWLEAF FIRETHORN	8' O.C.	20	3 GAL.
	JUNIPERUS CHINENSIS 'FAIRVIEW' / CHINESE JUNIPER	5' O.C.	34	5 GAL.
	CEANOTHUS INTEGERRIMUS / DEERBRUSH	6' O.C.	16	3 GAL.

SYMBOL	BOTANICAL / COMMON NAME	SPACING	QTY	SIZE
GROUND COVERS				
	RUBUS CALYCINOIDES 'EMERALD CARPET' / EMERAL CARPET RUBUS	24" O.C.	5,200 SF	1 GAL.
	ARCTOSTAPHYLOS UVA-URSI 'MASSACHUSETTS' / BEARBERRY	24" O.C.	3,100 SF	1 GAL.
	WALDSTEINIA FRAGARIOIDES / BARREN STRAWBERRY	18" O.C.	600 SF	1 GAL.
	LAWN - SEEDED/SOD/HYDROSEED OREGON RYEGRASS BLEND		30,400 SF	

LANDSCAPE GENERAL NOTES

1. Installation shall fully comply with all landscape code requirements and any City of Castle Rock conditions of approval.
2. Irrigation shall be provided by a fully automatic underground system design/build by the landscape contractor.
3. All landscaping shall be installed in a sound workman–like manner, and according to accepted good planting procedures with quality plant materials.
4. The proposed stormwater facilities are bioretention features integrated with the right–of–way, and will be planted by others according to Dept. of Ecology standards.
5. All existing vegetation shall be removed from areas to receive construction activities.
6. Planting beds are to be sufficiently cleaned of all construction materials, including imported rock, to the satisfaction of the Owner's Representative before beginning any landscape work.
7. All vegetation to be well rooted and well branched.
8. All plant material shall be nursery grown and meet ANSI standards.
9. Quantities indicated are for the convenience of the contractor only. Install number of plants as drawn. Contractor responsible for installing plants in quantities and locations shown.
10. Contractor shall verify species and quantities of all plant material prior to bid.
11. Plants shall be spaced as indicated in the Landscape Legend unless otherwise shown on the plan. If a discrepancy exists, the plan shall prevail.
12. Use triangular spacing for all groundcover unless noted otherwise. See Detail Sheet L1.1.
13. The owner, or his agent, shall be responsible for the maintenance of all landscaping which shall be maintained in good condition so as to present a healthy, neat, and orderly appearance, and shall be kept free from refuse and debris.
14. See Sheet L1.1 for Planting Details.
15. See Sheet L1.1 for Planting Specifications.
16. See Sheet L1.2 for Irrigation Specifications.

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

STATE OF WASHINGTON · MEANIE POE · 3607 · EXP 4/30/2026 · LICENSED LANDSCAPE ARCHITECT

PRELIMINARY

3/20/2025

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

PRELIMINARY LANDSCAPE PLAN
RIVER'S EDGE AT THE LANDING SUBDIVISION

REVISIONS:

JOB NO.:	18591.01
DATE:	3/20/2025
SCALE: H: 1" = 40'	V: N/A
DESIGNED BY:	MCP
DRAWN BY:	MCP
CHECKED BY:	TAW

PRELIMINARY

L1.0

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591.01 - Phase 1 Subdivision\L1.0 LANDSCAPE PLANTING PLAN.dwg PLOTSTYLE: Planning.stb

PLANTING SPECIFICATIONS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
1. Plants
2. Planting soils
3. Tree stabilization
4. Root Barrier
5. Tree Wrap

1.2 ESTABLISHMENT AND WARRANTY PERIOD REQUIREMENTS

A. All plant materials shall be maintained in a healthy condition until the end of the Establishment, Maintenance and Warranty Period. Establishment and Maintenance period is for one year and is initiated by substantial completion compliance. Replace dead and unhealthy plants immediately.

B. All plant materials and equipment replaced under warranty shall be replaced in accordance with all provisions of the Contract Documents. Plant material shall be of the same variety, size, and quantity as originally installed.
1. Owner reserves the right to inspect plant materials replaced under warranty and reject those which do not conform to specified standards.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, including soils.
1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project
3. Tree Stabilization Materials
4. Tree Wrap
5. Imported Planting Soil
6. Bark Mulch

B. Samples for Verification: For each of the following:
1. Bark Mulch: 1–quart volume of each mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
2. Root Barrier

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

1.5 WARRANTY

A. Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
b. Structural failures including plantings falling or blowing over.
c. Faulty performance of tree stabilization
2. Warranty Periods from Date of Substantial Completion:
a. Trees, Shrubs, and Ornamental Grasses: 12 months.
b. Ground Covers and Other Plants: 12 months.
3. Include the following remedial actions as a minimum:
a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

1.6 MAINTENANCE SERVICE

A. Initial Maintenance: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
1. Maintenance Period: 12 months from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery–grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well–shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

2.2 ORGANIC SOIL AMENDMENTS

A. Compost: Well–composted, stable, and weed–free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4–inch (19–mm sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
1. Organic Matter Content: 50 to 60 percent of dry weight.

2.3 FERTILIZERS

A. Planting Tablets: Tightly compressed chip type, long–lasting, slow–release, commercial–grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
1. 20–10–5 slow release plant tablets, 10 gram size. Agriform or equal.

2.4 PLANTING SOIL

A. Imported Planting Soil ASTM D 5268 topsoil, with pH range of 5.5 to 7, a minimum of 30 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth. Mix ASTM D 5268 topsoil with the following soil amendments in the following quantities to produce planting soil:
1. Mix Compost to Topsoil by Volume: 1:4 . Shall be pre mixed prior to delivery.

2.5 MULCHES

A. Bark Mulch: Provide standard, commercially produced, medium–course, dark brown, bark mulch. Bark shall be ground Fir or Hemlock bark of uniform color, free from weeds, seed, sawdust, splinters and shall not contain resin, tannin or other compounds detrimental to plant life. All materials shall pass a 1–inch mesh screen.

2.6 PESTICIDES

A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre–Emergent Herbicide (Selective and Non–Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post–Emergent Herbicide (Selective and Non–Selective): Effective for controlling weed growth that has already germinated.

2.7 TREE STABILIZATION MATERIALS

A. Stakes and Guys: See drawings for materials and instruction.

2.8 TREE WRAP

A. Corrugated or crepe paper, designed specifically to resist insect infestation and sun scald.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
1. Verify that no foreign or deleterious material or liquid such as gravel, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Do not mix or place soils in frozen, wet, or muddy conditions.
3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PROTECTION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

3.3 PLANTING AREA ESTABLISHMENT

A. Locate all planting beds in field. Flag planting beds with white field–marking chalk or approved equal. All planting beds to be adjusted and approved by Owner's Representative prior to plant location.

B. Over excavate all shrub and tree planting beds to a depth of 12". Protect in place existing gravel base integrity for walks and curbs. Remove excavations from site and dispose at contractor's expense. Install root control barriers prior to backfilling.

C. Loosen subgrade of planting areas to a minimum depth of 6 inches depth. Remove stones larger than 1 inch (25 mm in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
1. Spread planting soil in 4 –6 inches lifts but not less than required to meet finish grades after natural settlement.
2. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.

D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

E. Before planting, obtain owners representative's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45–degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

B. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

3.5 TREE AND SHRUB PLANTING

A. The Owner's Representative will approve individual plant material and location of plant material prior to installation.

B. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top–most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

C. Provide slow release–fertilizer tablets during backfill at the following rates. Locate plant tablets 1 inch from roots and at mid–depth. Space evenly
1 Gallon Shrub = 1 Tablet
2 Gallon Shrub = 2 tablet
3 Gallon Shrub = 2 Tablet
5 Gallon Shrub = 3 Tablet

3.7 PLANTING AREA MULCHING

A. Mulch finish grade surfaces of planting areas and other areas indicated.
1. Bark mulch in Planting Areas: Apply 3–inch average thickness of bark mulch, and finish level with adjacent finish grades.
2. Bark mulch shall be a minimum of 6–inches from tree trunks and 3–inches from shrub crowns.

3.8 WRAPPING

A. Deciduous trees over 1–1/2 inch caliper when within five feet of pavement shall be wrapped promptly after planting to prevent sunscald, wrapping as approved by American Association of Nurserymen. Wrap spirally from ground line to the height of the first branch. Wrap in neat and snug manner and secure with tape similarly colored to tree wrap at bottom, top and in the middle. Wrap before staking or guying.

3.9 PLANT MAINTENANCE

A. Maintain plants after written notice of Substantial Completion of the Project. If plants are not installed before the dormant period, November 15th to March 1st, maintain for a period of 90 days after the dormant period or until Final Acceptance, whichever is later.
1. Inspect plants at least once a week and perform maintenance promptly.
2. Maintain trees, shrubs and ground covers by watering, pruning, spraying, cultivating, and weeding as required for healthy growth.
3. Water when soil moisture is below optimum level for best plant growth.
4. Remove and replace impaired or dead plants promptly during specified planting season.
5. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required.
6. Eradicate all weeds, grass, and other undesired vegetation growth from planting areas. Remove dead weeds and dispose legally off–site. Remove all perennial weeds completely, including all underground parts.
7. Restore all soil settlement to original grade

B. Replace mulch materials damaged or lost in areas of subsidence

C. Fertilizing: Perform as necessary to maintain cover crop in a healthy growing condition.
1. Fertilize trees, shrubs and ground cover once at the end of the Maintenance Period.
2. In March, within the first growing season, fertilize all planting areas with 1 application of each of the maintenance fertilizers, at the rate of 7 pounds per 1,000 square feet of soil surface.

3.10 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre–Emergent Herbicides (Selective and Non–Selective): Apply to tree, shrub, and ground–cover areas in accordance with manufacturer's written recommendations. .

C. Post–Emergent Herbicides (Selective and Non–Selective): Apply only as necessary to treat already–germinated weeds and in accordance with manufacturer's written recommendations.

3.11 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

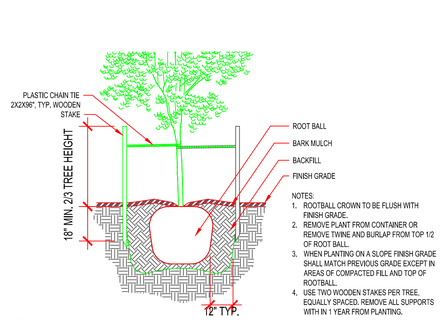
B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

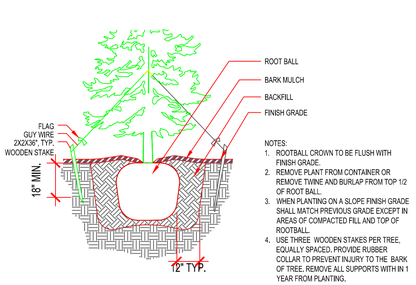
3.12 ACCEPTANCE

A. Substantial Completion:
1. Notify the Owner's Representative in writing of the completion of planting.
2. Within 10 days after notification of completion of Work, the Owner's Representative will inspect the Work in the presence of the Contractor and the Owner, and prepare a Notice of Substantial Completion, along with a list of items that require completion and correction (i.e., Punch List).
3. Notice of Substantial Completion constitutes the commencement of the Maintenance Period.

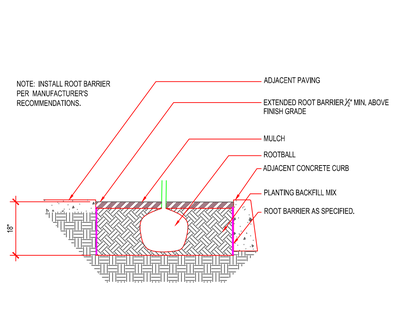
B. Final Acceptance:
1. The final inspection of all planting will be made by the Owner, Owner's Representative in the presence of the Contractor, following completion and correction of all items on the Punch List, and prior to the expiration of the Maintenance Period.
2. Before Final Acceptance will be granted, the site must be in the condition stipulated all correction items on the Punch List completed to the satisfaction of the Owner and Owner's Representative.
3. If Final Acceptance is not granted at the end of the Maintenance Period, continue maintaining plantings until Final Acceptance is granted, at no additional cost to the Owner.



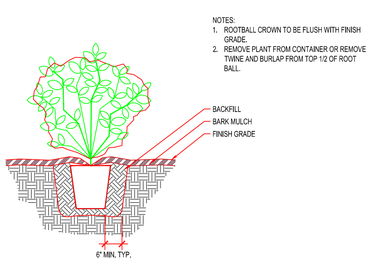
1 DECIDUOUS TREE PLANTING
Not to scale



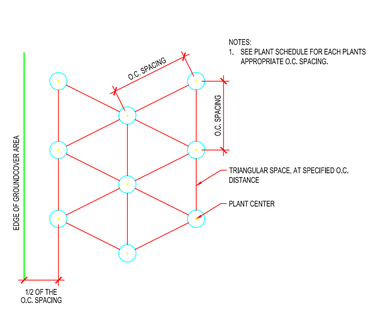
2 EVERGREEN TREE PLANTING
Not to scale



3 ROOT BARRIER
Not to scale



4 SHRUB/GROUNDCOVER PLANTING
Not to scale



5 GROUNDCOVER SPACING
Not to scale

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

STATE OF WASHINGTON
MELANIE A. WOLF
21807
EXP 4/28/2025
LICENSED LANDSCAPE ARCHITECT

PRELIMINARY

01/24/2025

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

PLANTING SPECIFICATIONS AND DETAILS
PHASE 1 SUBDIVISION PRELIMINARY ENGINEERING

REVISIONS:

JOB NO.:	18591.01
DATE:	3/20/2025
SCALE: H: 1"= 50'	V: N/A
DESIGNED BY:	MCP
DRAWN BY:	MCP
CHECKED BY:	TAW

PRELIMINARY

L1.1

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591.01 - Phase 1 Subdivision\L1.1 PLANTING SPECIFICATIONS AND DETAILS.dwg PLOTSTYLE: Sanitary and Water.stb

IRRIGATION NOTES:

1. PART 1 – GENERAL
1.1. SCOPE: Furnish design services and plans, labor, material, equipment and services for installation of a new irrigation system all in accordance with requirements of this and other specifications, local and state codes and equipment manufacturer's recommendations and specifications.
1.2. RELATED WORK BY OTHERS:
1.2.1. Provisions for electrical services to controller location.
1.2.2. Conduit from controller location to exterior of building, preferably to an adjacent landscape area.
1.2.3. Conduit from controller location to rain sensor if wired model utilized.
1.2.4. Water meter at point of connection.
1.2.5. Ball valve at point of connection.
1.3. QUALITY ASSURANCE:
1.3.1. Acceptable manufacturer: Hunter, Rainbird
1.3.2. Contractor shall be licensed and bonded in State of Washington.
1.3.3. Contractor shall have at least 5 years prior experience in projects of equal or larger size.
1.3.4. Contractor shall employ on-site at all times at least one person who is thoroughly experienced and competent in all phases of the work of this section and who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed and the manufacturer's recommended methods of installation, and who shall direct all work performed under this section.
1.3.5. Conform to the "Uniform Plumbing Code" as adopted and modified by the State of Washington and all legally constituted authorities having jurisdiction.
1.3.6. Materials and Equipment: New materials and equipment of type and brands as specified herein or accepted substitute.
1.4. DESIGN AND PLAN:
1.4.1. Design requirements:
1.4.1.1. Contractor shall provide design and layout of a new irrigation system meeting requirements of this and other specifications.
1.4.1.2. Meet requirements of local and state codes.
1.4.1.3. Meet recommendations and specifications of equipment manufacturer.
1.4.1.4. Contractor shall obtain services of an irrigation system designer with a minimum 5 years experience.
1.4.1.5. Provide minimum water coverage of 100% in all lawn, shrub and groundcover areas.
1.4.1.6. Lay out system to obtain optimum coverage utilizing manufacturer's standard heads. Spray across walks, onto walls, buildings, windows or paved areas is not acceptable.
1.4.1.7. Obtain static water pressure from local jurisdiction and install pressure regulating equipment as necessary including, but not limited to, pressure relief valves, pressure regulating valves, etc.
1.4.1.8. Install approved backflow protection to the public water source. If acceptable, use a double check backflow prevention device.
1.4.1.9. Install manual drain valves and gravel backfilled sumps of one cubic foot minimum size on each zone. Slope lines to drain valves.
1.4.1.10. Provide ball valves on supply lines for isolation of various sections of the irrigation system.
1.4.1.11. Provide quick coupling valves at various locations on site. Locations to be acceptable to Project Representative.
1.4.2. Plan Requirements:
1.4.2.1. Provide at same scale as landscape plan.
1.4.2.2. Prepare on good quality tracing paper.
1.4.2.3. Irrigation plan shall indicate system irrigation head and nozzle layout, location and size of all zones, piping size and layout, fittings, equipment necessary for full installation of entire system, locations and sizes of sleeving.
1.5. VERIFICATION OF EXISTING CONDITIONS:
1.5.1. Before proceeding with the installation of any section of the irrigation system, verify all existing irrigation conditions.
1.6. VERIFICATION OF DIMENSIONS:
1.6.1. Before proceeding with the installation of any section of the irrigation system, check and verify correlation between ground measurements and Drawings.
1.6.2. Advise Project Representative of discrepancies before proceeding.
1.7. VERIFICATION OF WATER PRESSURE:
1.7.1. Verify water pressure at point of connection.
1.7.2. Submit pressure test results to Project Representative prior to any work.
1.8. PROTECTION OF UNFINISHED WORK:
1.8.1. Protect work at all times.
1.8.2. Keep rock, dirt, gravel, debris and foreign materials from entering pipe, valves and other irrigation equipment.
1.8.3. Flag/barricade open trenches, valve locations/boxes, etc. when not actively working in area.
1.9. VERIFICATION OF CONTROLLER LOCATION:
1.9.1. Verify exact location of controller with Project Representative.
1.9.2. Coordinate electrical service, conduit to building exterior and conduit to rain sensor (if wired model is utilized) with other trades.
1.10. ENVIRONMENTAL CONDITIONS:
1.10.1. No solvent welding of PVC pipe in freezing weather.
1.10.2. Protect active utilities. If encountered, notify persons owning same.
1.11. UTILITIES:
1.11.1. Be responsible for location of underground utilities.
1.11.2. Protect active utilities. If encountered, notify persons owning same.
1.12. STORAGE:
1.12.1. Store on job site only as approved.
1.12.2. Be responsible for security and protection.
1.12.3. Store no PVC pipe or fittings in direct sunlight.
1.13. EQUIPMENT FOR OPERATION:
1.13.1. Provide Owner with the following operation equipment.
1.13.2. Turn over to Owner at time of Final Inspection:
1.13.2.1. (2) lock cap key, Weathermatic RLK-1 or accepted substitute.
1.13.2.2. (2) snap-lock unlocking tools for valve box covers.
1.13.2.3. (2) quick coupling valve keys.
1.13.2.4. (2) hose swivel.
1.13.2.5. (2) lock cap key, Rain Bird 2049 or accepted substitute.
1.13.2.6. (2) valve operating key, 30-inch handle length.
1.13.2.7. (2) irrigation controller keys.
1.14. RECORD DRAWINGS:
1.14.1. Maintain current with work progress, one red pencil marked print showing all deviations from drawings occurring during installation.
1.14.2. Show locations of stubouts, manual drains, valves, pipe lines, splices and other subsurface features as installed.
1.14.3. Show dimension references from subsurface features to permanent structural or surface elements sufficient to identify in the field.
1.14.4. Submit clean red-lined mylar at end of project.
1.14.5. Place one (1) reduced size laminated print inside controller door.
1.15. SUBMITTALS:
1.15.1. Within 14 days after award of contract, submit:
1.15.1.1. Irrigation design plan for new irrigation system.
1.15.1.2. Manufacturer's printed product information and catalog cut sheets for all system components.
1.15.1.3. Sleeving plan showing sizes and locations of all sleeving.
1.15.1.4. Static water pressure test results.
1.15.2. Submit to Project Representative at time of inspection for final approval.
1.15.2.1. As-built irrigation mylar.
1.15.2.2. Copy of guarantees, warranties or affidavits applicable to equipment or materials beyond Contractor's 1-year guarantee period.
1.15.2.3. Manufacturer's catalog cuts describing all equipment and material used.
1.15.2.4. Names, addresses and phone numbers of manufacturers and local suppliers of equipment.
1.15.2.5. Written operating and maintenance instructions for all electrical or mechanical equipment used.
1.15.3. Submit to Project Representative three (3) complete copies of the above submittals in hard cover binder.
1.16. GUARANTEE:
1.16.1. Guarantee the irrigation system or any part thereof, against defective material or workmanship for one (1) year from the date of final acceptance.
1.16.2. Repair any settling of backfilled trenches occurring during a one (1) year period after final acceptance.
1.16.3. Include restoration of planting, paving or other improvements of any kink associated with corrections.
1.16.4. Make corrections without expense to Owner.

2. PART 2 – PRODUCTS
2.1. GENERAL:
2.1.1. A. New materials and equipment.
2.1.2. Manufacturer's catalog numbers indicated below.
2.1.3. Substitutions or equals only by written approval of the Landscape Architect.
2.2. IRRIGATION HEADS:
2.2.1. Construction as specified by model number reference.
2.2.2. Manufacturer's catalog numbers indicated below.
2.2.3. Lawn heads – 6" pop up.
2.2.3.1. Spray heads: Rainbird RD1800 series, plastic body and nozzle or accepted substitute.
2.2.3.2. Rotor heads: Rainbird 5000 MPR series, plastic body and nozzle or accepted substitute.
2.2.4. Shrub heads – 6" pop up.
2.2.3.1. Spray heads: Rainbird RD1800 series, plastic body and nozzle or accepted substitute.
2.2.3.2. Rotor heads: Rainbird 5000 MPR series, plastic body and nozzle or accepted substitute.
2.2.4. Groundcover heads – 12" pop up.
2.2.3.1. Spray heads: Rainbird RD1800 series, plastic body and nozzle or accepted substitute.
2.3. PIPE AND FITTINGS:
2.3.1. PVC Pipe for Supply Lines: PVC pipe, Polyvinyl Chloride Plastic; PVC 1120, Schedule 40, Type I, normal impact, I.P.S, NSF approved plain and/or bell end; color white; meeting requirements ASTM D2241 and D1784.
2.3.2. PVC Pipe for Lateral Lines: PVC pipe, Polyvinyl Chloride Plastic; PVC 1120, Class 200, Type I, normal impact, I.P.S, NSF approved plain and/or bell end; color white; meeting requirements ASTM D2241 and D1784.
2.3.3. PVC Pipe Fittings: PVC 1120, Schedule 40, Type I, normal impact, I.P.S, NSF approved; meeting requirements ASTM D2466-74.
2.3.4. Galvanized Pipe and Fittings: Standard weight pipe, hot dipped galvanized and threaded. Threaded cast iron or galvanized malleable fittings.
2.3.5. PVC Riser: PVC 1120, Type I, normal impact I.P.S, NSF approved Schedule 80 PVC, conform to PS 21-70. Cut to required lengths; threaded both ends, color dark grey.
2.4. SLEEVES:
2.4.1. Under parking, driveway paving and through walls – Schedule 40 PVC pipe.
2.4.2. All other – Class 200 PVC pipe.
2.4.3. Sleeve diameter shall be two sizes larger than diameter of pipe installed in sleeve.
2.4.4. Install separate sleeve dedicated for irrigation control wire.
2.5. PVC SOLVENT CEMENT:
2.5.1. NSF approved solvent for PVC to 4" pipe size.
2.5.2. Meeting requirements of ASTM D 2584-73a, #705.
2.5.3. Weld-On 705 or accepted substitute.
2.6. PVC PRIMER AND CLEANER:
2.6.1. Weld-On P-70 or accepted substitute.
2.7. BALL VALVE:
2.7.1. Full port, brass or bronze with stainless steel ball and Teflon seat.
2.8. MANUAL DRAIN VALVE:
2.8.1. Brass globe valve, 1/2" size with cross-type wheel.
2.9. QUICK-COUPLING VALVE:
2.9.1. One piece, double slot, 3/4" inlet with vinyl cover and lock top.
2.9.2. Rain Bird Model or accepted substitute.
2.10. QUICK-COUPLING VALVE KEY:
2.10.1. Rain Bird or accepted substitute.
2.11. LOCK CAP KEY:
2.11.1. Rain Bird or accepted substitute.
2.12. HOSE SWIVEL:
2.12.1. Rain Bird or accepted substitute.
2.13. LOCKING KEY AND LID:
2.13.1. Rain Bird or accepted substitute.
2.14. LOCKING LID FOR MANUAL DRAIN VALVE:
2.14.1. Weathermatic 906L or accepted substitute.
2.15. VALVE BOX:
2.15.1. Ametek Economy, Standard and Jumbo sized boxes, extensions and locking covers where applicable or accepted substitute.
2.16. DRAINAGE ROCK:
2.16.1. 1-1/2"-inch clean, washed round drain rock.
2.17. BACKFLOW PREVENTION DEVICE:
2.17.1. As approved by local jurisdiction. If acceptable, use a double check backflow prevention device.
2.17.2. Size as required.
2.18. RAIN SENSOR:
2.18.1. Rain Bird Model RSD-BEx, WR2 or accepted substitute.
2.19. REMOTE CONTROL VALVE:
2.19.1. Rain Bird PEB Series, 24 volt electric valve or accepted substitute.
2.19.2. Sizes as required.
2.20. CONTROL WIRE:
2.20.1. Type UF bearing U/L label for direct underground burial, NEC Class II circuites. AWG sizes, #14 minimum.
2.21. ELECTRIC CONNECTIONS:
2.21.1. 3M DBY connectors or accepted substitute.
2.22. IRRIGATION CONTROLLER:
2.22.1. Rain Bird Model ESP-LX Modular Series wall mounted controller with lock and two (2) keys or accepted substitute.
2.22.2. Number of circuits as determined by planting types and planter layout.

3. PART 3 – EXECUTION
3.1. GENERAL:
3.1.1. Install materials and equipment in strict accordance with manufacturer's written specifications and commendations.
3.1.2. Comply with local and state codes.
3.1.3. Maintain job premises clean and free from accumulations of debris or disorder at all times. Remove equipment and surplus materials from each area of work as completed.
3.1.4. Leave no work in condition that would jeopardize other persons or property.
3.1.5. Test all lines for one hour minimum at pressure of water source. Receive approval of test prior to back filling work. Test acceptable if no more than 5psi loss after 1 hour. Coordinate with Project Representative.
3.2. TRENCH EXCAVATION:
3.2.1. Straight or "snaked" slightly.
3.2.2. Slope bottoms uniformly, 1/2% minimum grade to drain.
3.2.3. Trench depth 18" minimum (lateral lines), 24" minimum (supply lines) and 30" maximum, bottoms free from sharp rocks or objects that may damage pipe.
3.2.4. Trench width sufficient to allow proper tamping of backfill around pipe.
3.2.5. Keep topsoil separate from subsoils. Replace in order of removal.
3.2.6. Do not machine trench through root zones of existing trees to remain. Hand dig only.
3.3. TRENCH BACKFILL:
3.3.1. Do no backfilling until approval of pressure test.
3.3.2. Use excavated soil or sand bedding materials.
3.3.3. Material shall be free from rock and/or debris that may damage pipe or prevent proper compaction.
3.3.4. Place 6-inch maximum lifts and compact thoroughly.
3.3.5. Place mainline backfill only when pipe is filled with water; 25 psi pressure minimum.
3.4. INSTALLATION OF PIPE:
3.4.1. Sizes, type as specified.
3.4.1.1. Lay with support beneath entire lengths.
3.4.1.2. Slope all pipe to gravity drain.
3.4.1.3. Snake PVC piping to allow for expansion and contraction.
3.4.1.4. Combine runs in common trench where feasible with 3-inch minimum vertical and horizontal separation.
3.4.1.5. Flush lines prior to installation of valves, irrigating heads and nozzles.
3.4.1.6. Install stubouts for future connection(s) as approved. Enclose stubouts in valve box.
3.4.2. Cutting and joining:
3.4.2.1. Cut pipe square, debur and remove all surface contaminants or moisture.
3.4.2.2. Chamber all out ends.
3.4.2.3. Apply primer and solvent cement in accordance with manufacturer's recommendations.
3.4.2.4. Make threaded joints leak resistant, with freedom of movement.
3.4.2.5. Use Teflon thread sealant for threaded joints.
3.4.2.6. Clean out threads and use tape or compound joint sealants for all galvanized pipe connections. Leave no more than two (2) threads showing all joints.
3.5. INSTALLATION OF SLEEVING:
3.5.1. Install sleeving under all asphalt, concrete or other hard surface pavement areas and through walls as required.
3.5.2. Size as required for pipe and control valve wiring.
3.5.3. Coordinate for placement prior to asphalt/concrete/wall work.
3.5.4. Position sleeves so pipe can be easily moved.
3.5.5. Jack/boare under existing pavement as required.
3.5.6. Install separate sleeve dedicated for irrigation control wiring.
3.5.7. Extend sleeves 12 inches minimum beyond walk or pavement edge.
3.6. INSTALLATION OF VALVES:
3.6.1. Types as specified.
3.6.1.1. Install in accordance with manufacturer's specifications and recommendations.
3.6.1.2. Install manual drain valves at locations to completely drain all pipe lines. Minimum one manual drain valve per zone.
3.7. SYSTEM PURGING:
3.7.1. Prior to backfilling installed system, installing irrigation heads and testing the system, purge all system zones with clean water at sufficient pressure and duration to verify that lines are free and clear of any rocks, dirt, gravel, debriz, foreign materials and/or contaminants.
3.7.2. If blockages are discovered, remove sections of system piping and remove blockages as required, reconnect sections and repurge system.
3.7.3. Install irrigation heads and test all system zones with clean water of sufficient pressure and duration to ensure the system is capable of handling the loads required and verify that controller and valves are functioning as intended.
3.8. INSTALLATION OF IRRIGATION HEADS:
3.8.1. Types as specified. Install in accordance with manufacturer's recommendations and specifications.
3.8.2. Adjust and balance:
3.8.2.1. Adjust and balance each system zone.
3.8.2.2. Achieve uniform area coverage by all head types.
3.8.2.3. Spray across walks, onto walks, buildings, windows or paved areas is not acceptable.
3.9. INSTALLATION OF IRRIGATION CONTROLLER:
3.9.1. Type as specified.
3.9.1.1. Install wall or pedestal mounted unit or battery-powered unit per manufacturer's recommendations and specifications.
3.9.1.2. Enclose all control wiring in conduit.
3.9.1.3. Verify exact placement of controller with Project Representative.
3.9.1.4. Adjust irrigation controller timing for each zone based on plant type, sun exposure, microclimatic conditions, current industry standards, etc.
3.9.2. Work by other trades including the following (Landscape Contractor to coordinate):
3.9.2.1. Provision for electrical service to controller location.
3.9.2.2. Control wire conduit to exterior of building.
3.10. INSTALLATION OF RAIN SENSOR:
3.10.1. Install per manufacturer's recommendations and specifications.
3.10.2. Location as acceptable to Project Representative.
3.10.3. Coordinate conduit from irrigation controller to rain sensor location with appropriate trades.
3.11. INSTALLATION OF CONTROL WIRE:
3.11.1. For wire sizes, refer to wire sizing chart published by manufacturer of control valves.
3.11.2. Use specified electrical connectors at all splices. Place all splices in valve boxes, and note locations on as-built record drawings.
3.11.3. Bundle wire together with electrical tape at 10-foot intervals. Provide 12-inch expansion coils every 100 feet where runs exceed this length and at each valve.
3.11.4. Place wire at bottom of pipe runs to provide protection.
3.11.5. Provide one extra wire to each control valve similar to common wire for use if wire fails. Color to be different. Label as "Extra Wire" at controller. If multiple controllers are utilized, provide on extra wire per controller.
3.11.6. Install additional sets of irrigation control wires at stubouts as approved.
3.12. FINAL TESTING:
3.12.1. Test entire system for one (1) hour at normal operating pressure.
3.12.2. Test is acceptable if, after one (1) hour of pressure testing, at normal operating pressure, operating pressure has decreased one (1) percent of loss.
3.12.3. If test fails, immediately trace leaks and correct.
3.12.4. Replace soils liquefied by system failures with stable materials.
3.12.5. Repeat system test as indicated above until testing meets requirements.

END OF IRRIGATION NOTES

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

STATE OF WASHINGTON
MELANIE P. WOLF
LICENSED LANDSCAPE ARCHITECT
EXP 4/28/2025

PRELIMINARY

01/24/2025

LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

IRRIGATION SPECIFICATIONS
PHASE 1 SUBDIVISION PRELIMINARY ENGINEERING

REVISIONS:

JOB NO.:	18591.01
DATE:	3/20/2025
SCALE: H: 1"= 50'	V: N/A
DESIGNED BY:	MCP
DRAWN BY:	MCP
CHECKED BY:	TAW

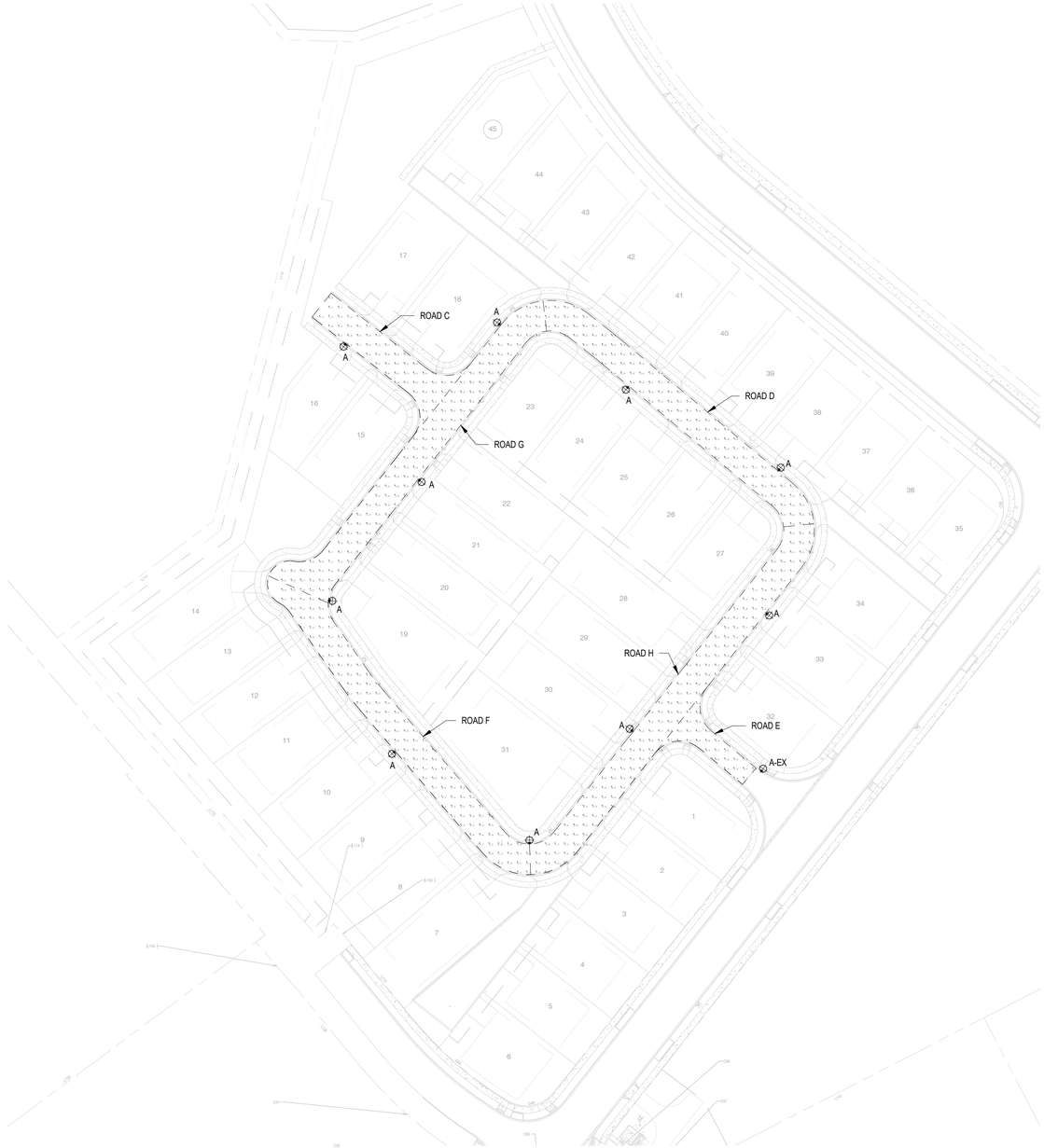
FINAL

L1.2

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591.01 - Phase 1 Subdivision\L1.2 IRRIGATION SPECIFICATIONS.dwg PLOTSTYLE: Sanitary and Water.stb

LUMINAIRE SCHEDULE

FIXTURE CALLOUT	FIXTURE DESCRIPTION	FIXTURE MODEL #	POLE PART #	MTG. HEIGHT	WATTS	VOLTAGE	QTY
A	LED POLE MTD. ACORN	PT-A850SRLED-5P-6ARC35T3-MDL03-A/CM	3916T5(MOD)/GFI/IUC/1-DBA/1-DHPA-Strap/CM	16' - 0"	92 VA	120 V	10
A-EX	EXISTING ACORN	PT-A850SRLED-5P-6ARC35T3-MDL03-A/CM	3916T5(MOD)/GFI/IUC/1-DBA/1-DHPA-Strap/CM	16' - 0"	92 VA	120 V	1



1 SITE
1" = 60'-0"

60 0 60 120
1" = 60'-0"
SCALE FEET

CITY OF CASTLE ROCK STREET LIGHTING CRITERIA

TARGET ILLUMINATION LEVELS

ROADWAY CLASSIFICATION TYPE	AVERAGE* (FC)	UNIFORMITY RATIO** (AVG/MIN)
COLLECTOR	0.4	6:1

ROADWAY SECTION:	AVERAGE:	MINIMUM:	AVG/MIN:
ROAD C	0.92FC	0.2FC	4.6
ROAD E	0.85FC	0.2FC	4.25
ROAD F	0.97FC	0.2FC	4.85
ROAD G	0.96FC	0.2FC	4.8
ROAD H	0.95FC	0.2FC	4.75
OVERALL LIGHTING	0.95FC	0.2FC	4.75

CASCADE ELECTRICAL
1100 SE 23RD AVE
BATTLE GROUND,WA 98604
PHONE (360)687-1668

RIVER'S EDGE AT THE LANDING SUBDIVISION

CASTLE ROCK, WA

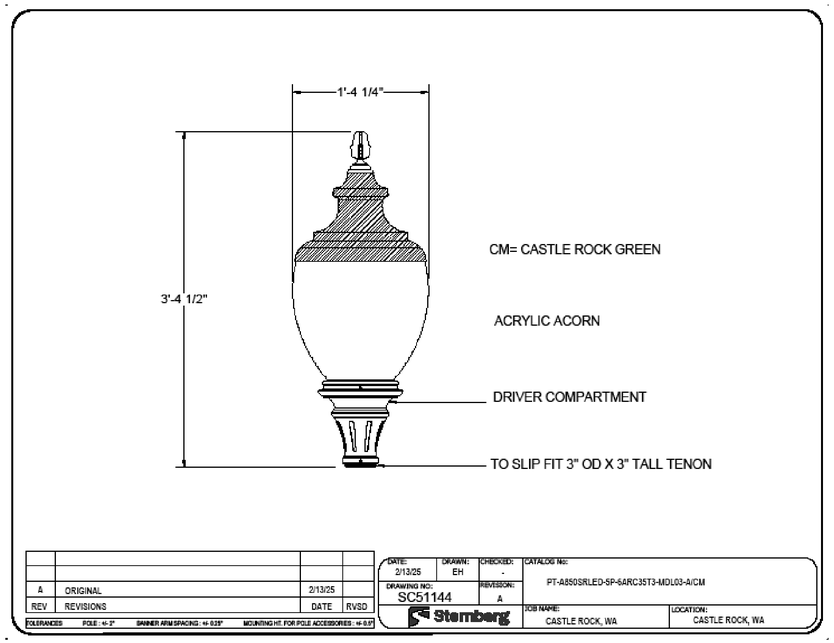
MARK	DATE	DESCRIPTION
REVISIONS		

PROJECT NUMBER:	25-P04
ISSUE DATE:	3/26/2025
DESIGNED BY:	DEREK S.
REVIEWED BY:	RAND J.

PERMIT SET

SHEET
CL1.0
STREET PHOTOMETRICS
SCALE
As indicated

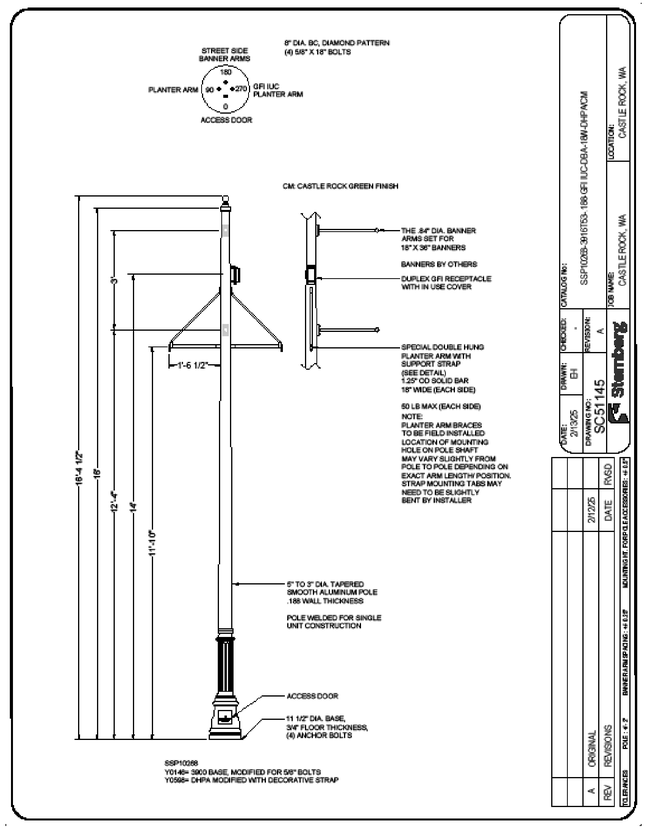
N



A	ORIGINAL	2/13/25	
REV	REVISIONS	DATE	RVSD

TOLERANCES: POLE: +/- 2" BANNER ARM SPACING: +/- 0.25" MOUNTING HT. FOR POLE ACCESSORIES: +/- 0.5"

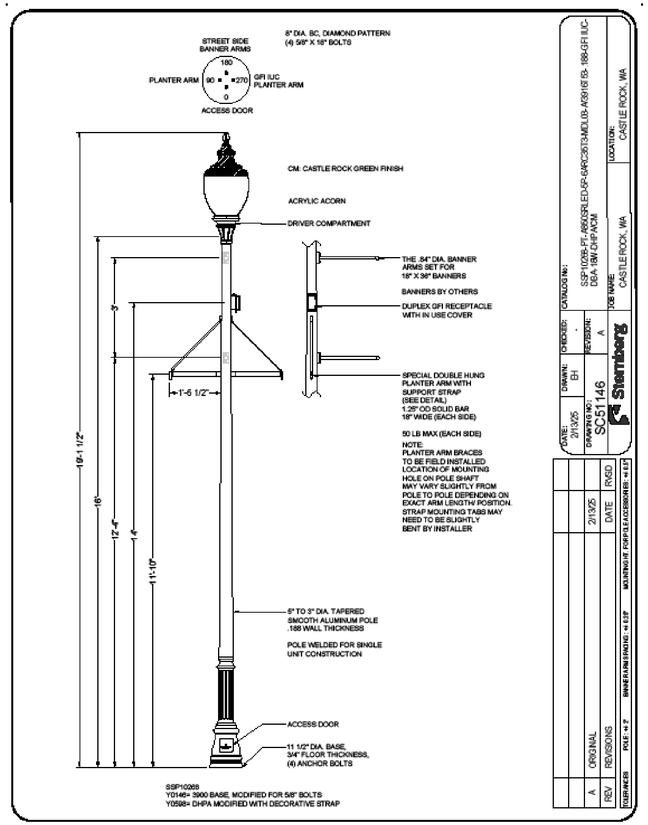
DATE: 2/13/25 | DRAWN: EH | CHECKED: - | CATALOG No: PT-A850SRLED-SP-6ARC35T3-MDL03-A/CM
DRAWING NO: SC51144 | REVISION: A
Stemberg
JOB NAME: CASTLE ROCK, WA | LOCATION: CASTLE ROCK, WA



DATE: 2/13/25 | DRAWN: EH | CHECKED: - | CATALOG No: SSP10269-SP16TSS-18W-GFI IUC-DBA-18W-DHP-ACM
DRAWING NO: SC51145 | REVISION: A
Stemberg
JOB NAME: CASTLE ROCK, WA | LOCATION: CASTLE ROCK, WA

A	ORIGINAL	2/13/25	
REV	REVISIONS	DATE	RVSD

TOLERANCES: POLE: +/- 2" BANNER ARM SPACING: +/- 0.25" MOUNTING HT. FOR POLE ACCESSORIES: +/- 0.5"



DATE: 2/13/25 | DRAWN: EH | CHECKED: - | CATALOG No: SSP10295-PT-A850SRLED-SP-6ARC35T3-MDL03-A/SW1GFI IUC-DBA-18W-DHP-ACM
DRAWING NO: SC51146 | REVISION: A
Stemberg
JOB NAME: CASTLE ROCK, WA | LOCATION: CASTLE ROCK, WA

A	ORIGINAL	2/13/25	
REV	REVISIONS	DATE	RVSD

TOLERANCES: POLE: +/- 2" BANNER ARM SPACING: +/- 0.25" MOUNTING HT. FOR POLE ACCESSORIES: +/- 0.5"

CASCADE ELECTRICAL
1100 SE 23RD AVE
BATTLE GROUND,WA 98604
PHONE (360)687-1668

RIVER'S EDGE AT THE LANDING SUBDIVISION

CASTLE ROCK, WA

MARK	DATE	DESCRIPTION
REVISIONS		

PROJECT NUMBER: 25-P04	
ISSUE DATE:	3/26/2025
DESIGNED BY:	DEREK S.
REVIEWED BY:	RAND J.

PERMIT SET

SHEET

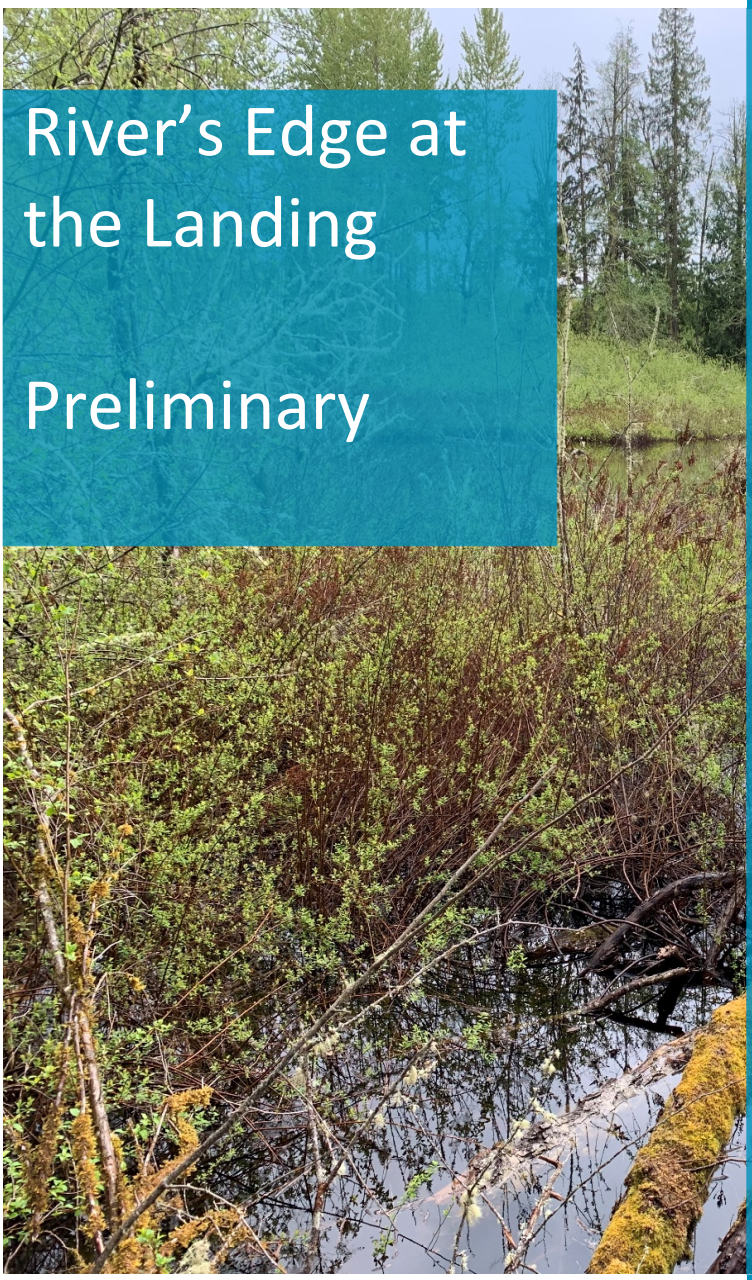
CL1.1

FIXTURE SPECIFICATIONS

SCALE

River's Edge at the Landing

Preliminary



Technical Information Report

River's Edge at the Landing

March 26, 2025

PREPARED FOR :
City of Castle Rock
141 A St SW, Castle Rock, WA 98611

CLIENT :
CT6, LLC
Shane Tapani
360-687-1148
PO Box 1419
Battle Ground, WA 98604

Jurisdiction Project Number : XXXXX

MacKay Sposito
Prepared By : Paton Malley
Project Number : 18591.01

03/26/2025

TAYLOR ANDREW WILLIAMS
STATE OF WASHINGTON
22012357
REGISTERED
PROFESSIONAL ENGINEER

MacKay Sposito

Vancouver Office
18405 SE Mill Plain Blvd, Suite 100 • Vancouver, WA 98683
360.695.3411 • info@mackaysposito.com

March 26, 2025

Preliminary Technical Information Report (TIR)
River's Edge at Landing on the Cowlitz

Engineer's Certification
March 26, 2025
City of Castle Rock
Project Engineer

"I hereby state this Technical Information Report (TIR) has been prepared under my supervision and meets the standards of care and expertise which is usual and customary in this community for professional engineers. The TIR includes the required information per City of Castle Rock's Storm Drainage Standards and complies with the 1992 Stormwater Management Manual for the Puget Sound Basin. The proposed stormwater design is feasible."

03/26/2025

Taylor Wilson, PE
Project Manager

Table of Contents

1. Project Overview 1

1.1 Site Information 1

1.2 Determination of Applicable Minimum Requirements 2

2. Minimum Requirements 3

2.1 Meeting the Minimum Requirements 3

2.2 Soil Evaluation 6

3. Conveyance System 7

3.1 Conveyance System Analysis and Design 7

4. References 8

Tables

Table 1 - Existing Basins 2

Table 2 – Proposed Basins 3

Appendices

Appendix A Maps

Appendix B Hydrologic Exhibits and Calculations

Appendix C Geotechnical Report

Appendix D Final Plans

Appendix E Operation and Maintenance

1. Project Overview

1.1 Site Information

The proposed project involves the construction of the River's Edge at the Landing Subdivision, including access and circulation roads, public sewer and water systems, stormwater treatment and conveyance systems, private utility connections for each residence, sidewalks and ADA ramps, and landscaping. Access to the subdivision will be provided by a connection to Road B, which will be constructed as part of Phase 1 construction of the Landing on the Cowlitz (LOTC) Master Plan. Water, sewer, and stormwater will all connect to the public utility systems to be constructed during Phase 1 construction. These improvements can be seen in more detail in the plans attached in Appendix D.

Topography

The project site is located in the City of Castle Rock, Cowlitz County, WA. The site is located at Parcel 308640100, as adjusted by BLA #CR-BLA-24-01 (AFN #3762029 and AFN #3763318). Road A, Road B, and Road C/Larsen Ln of the Phase 1 Access & Utilities project bound the residential parcel to the north, east, and south, respectively. Residential properties and the Timberlake Church bound it to the west. Historically, much of this area falls within the FEMA 100-year flood plain elevation of 48.

While the LOTC Phase 1 development has not been constructed at the time of this report, the improvements proposed on those plans are shown as the existing conditions for this phase of the development. By the time this project is constructed, the proposed site will be graded to a pad elevation of 51 feet (above the base flood elevation) and the Phase 1 Roadways and utility systems will be constructed per the grades shown in those plans. With the site raised to an elevation of 51 feet, a maximum slope of 3:1 connects the site to an existing stormwater ditch along the northern property line.

Existing Storm Systems

There are no existing stormwater structures within the site, except for an existing stormwater ditch that captures offsite runoff from the adjacent properties running onto the LOTC development. This ditch drains westerly along the northern property line, turns south for a short stretch, passes under Larsen Lane through a culvert, and into a detention pond tied to the offsite LOTC Outfall system. The Phase 1 roadways surrounding the subdivision parcel drains to the onsite detention pond/ditch and LOTC Outfall system.

Assumptions and Design Parameters

This report is being prepared as a supplement to the Stormwater Master Plan that has been prepared for the full LOTC Development. From this point forward, the proposed onsite storm system for the subdivision will be referred to as the "River's Edge storm system" and the Phase 1 Access and Utilities storm system will be referred to as the "Phase 1 storm system". All proposed residential lots and impervious areas of the River's Edge site will drain to a storm system within the site roadways, while some of the pervious landscaped areas along the northern and western edges of the site will drain to a drainage swale along the property line. The existing swale along that northern property line will need some minor re-grading to ensure that the proposed grading onsite works with all perimeter conditions. However, the redesigned ditch will still follow the same drainage pattern as the existing ditch with the addition of a few area drains and a conveyance pipe. This offsite run-on was analyzed as part of the

LOTC Stormwater Master Plan, and a conveyance analysis of the proposed ditch and pipe will be provided at the time of final design. The River's Edge storm system within the roadway will connect to the Phase 1 storm system at the entrance to the subdivision via a manhole that will be constructed during Phase 1. Therefore, all runoff onsite will eventually be conveyed to the outfall system to the Cowlitz River (whether that be through the onsite of offsite system).

Per the City of castle Rock Design Standards, the stormwater design for this project must conform with the regulations outlined in the 1992 Stormwater Management Manual for the Puget Sound Basin (SWMMPSB). However, this project proposes using mechanical treatment catch basins. Because these facilities are not included in the 1992 SWMMPSB, the design will also need to meet some requirements from the 2024 Stormwater Management Manual for Western Washington (SWMMWW).

As part of the LOTC Stormwater Master Plan, it was assumed that each lot will have a roof area of 1,500 square feet. This assumption was used in all modeling done for the preliminary storm design as well. Adjustments to these assumptions will be made at final engineering, after a builder selects floor plans for the lots.

1.2 Determination of Applicable Minimum Requirements

The stormwater management design of this project is required to comply with Section 5 of the City of Castle Rock Development Policies and Public Works Standards, and the 1992 SWMMPSB. Per Section I-2.4.1 of the 1992 SWMMPSB and Figure I-2.1 'Flowchart for Determining Minimum Requirements,' attached in Appendix B, Minimum Requirements 1-11 will apply to the site development.

The Existing Basin Map attached in Appendix A represents only the proposed development. Analysis of all offsite run-on to the proposed ditch will be included with the LOTC Stormwater Master Plan. A Proposed Basin Map is also attached in Appendix A. Given that this report is being prepared for preliminary engineering and not final design, a conveyance analysis was not completed at this time. However, an emphasis was put on preliminary treatment design to approximate the locations of mechanical filter catch basins and roughly size the filters needed. Therefore, the proposed basin map only provides more detailed information on the areas that have been modeled for treatment (proposed roadways, driveways, private driveway tracts, etc). As previously mentioned, the assumed roof area used in the Stormwater Master Plan is 1,500 square feet per lot. For now, the areas associated with these lots have been omitted from in depth analysis because the roof areas will bypass treatment. This will be achieved by a private storm system within easements on the front of the lots, connecting directly to storm manholes after treatment. This piping and all associated easements are shown in the preliminary plans. A more detailed proposed basin map will be completed at the time of final engineering, along with full conveyance modeling for the River's Edge storm system.

Table 1 - Existing Basins

Basin	Drainage System	Pervious Area (AC)	Impervious Area (AC)	Total Area (AC)
1	Onsite	7.65	0.00	**7.65**
2	Onsite	1.21	0.00	**1.21**
3	Offsite	0.18	0.00	**0.18**
Total		**9.04**	**0.00**	**9.04**

Table 2 – Proposed Basins

Basin	Drainage System	Pervious Area (AC)	Impervious Area (AC)	Total Area (AC)
1	Onsite	0.11	0.22	**0.33**
2	Onsite	0.03	0.07	**0.10**
3	Onsite	0.10	0.25	**0.35**
4	Onsite	0.11	0.21	**0.32**
5	Onsite	0.05	0.13	**0.18**
6	Onsite	0.13	0.25	**0.38**
7	Onsite	0.07	0.12	**0.19**
8	Onsite	0.09	0.17	**0.26**
9	Onsite	0.06	0.08	**0.14**
10	Onsite	0.07	0.17	**0.14**
11	Onsite	0.12	0.27	**0.39**
12	Onsite	0.12	0.10	**0.22**
Lots	Onsite (Bypassing Treatment)	3.29	1.55 (1,500 SF per lot)	**4.84**
13	Offsite	1.10	0	**1.10**
Total		**5.43**	**3.61**	**9.04**

2. Minimum Requirements

2.1 Meeting the Minimum Requirements

The stormwater management design for this project complies with the City of Castle Rock Storm Drainage Standards and the 1992 Stormwater Management Manual for the Puget Sound Basin. All required information is included in this stormwater report and the proposed stormwater facilities are feasible.

I-2.5 Minimum Requirement #1: Erosion and Sediment Control

A Preliminary Erosion Control Plan has been included with the project plans and are attached in Appendixes D. There is an existing SWPPP in place for the Mass Grading and Phase 1 construction onsite. An updated SWPPP will be included for this phase at the time of Final Engineering.

I-2.6 Minimum Requirement #2: Preservation of Natural Drainage Systems

Natural drainage patterns have been mimicked where possible or improved to direct all runoff onsite to the LOTC outfall to the Cowlitz River.

I-2.7 Minimum Requirement #3: Source Control of Pollution

The proposed use of this site is residential, therefore there are no source control BMPs required. However, the following BMPs are proposed:

BMP S2.00 Maintenance of Storm Drainage Facilities

I-2.8 Minimum Requirement #4: Runoff Treatment BMPs

Per Table I-4.2, because Oil/Water Separation, Nutrient Control, and Streambank Erosion Control are not required, Conventional Treatment is all that is required onsite (WADOE, 1992). Runoff onsite will be treated by Contech StormFilter mechanical treatment catch basins. Per Section V-11 Manufactured Treatment Devices as BMPs, the proposed devices are adequate for providing basic treatment (WADOE, 2024). The proposed basins shown in the Proposed Basin Map have been modeled in WWHM to determine their respective water quality flow rates. The combined water quality flow rate for the areas receiving treatment is 137.57 GPM, which equates to eight 27'' PSORB cartridges or eleven 12'' SPORB cartridges. The preliminary WWHM2012 calculations for the sizing of the treatment filters can be found in Appendix B. A more detailed layout of the proposed cartridge locations is included in the preliminary stormwater plan, attached in Appendix D. For more detailed information on the contributing areas to each facility, see the Proposed Basin Map attached in Appendix A.

Because a treatment method from the 2024 SWMMWW has been selected, the Minimum Requirements from the 2024 manual have been reviewed. Per Figure I-3.1 'Flow Chart for Determining Requirements for New Development,' nearly all proposed basins onsite result in over 5,000 square feet of new impervious surface area. All Minimum Requirements apply to those sub basins. For simplicity, every basin will be designed to meet all Minimum Requirements. Per Figure I-3.3 'Flowchart for Determining MR #5 Requirements,' attached in Appendix B, the developer will meet the LID Performance Standards onsite by implementing LID devices where practical. The site is flow control exempt, but perforated pipes within infiltration trenches will reduce the runoff leaving the site. The proposed infiltration trenches will be designed to ensure runoff flows from the site comply with all models done for the LOTC Stormwater Master Plan. More detailed infiltration models will be provided at the time of Final Engineering. BMP T5.13 Post Construction Soil Quality and Depth will also be implemented to all landscaped areas.

I-2.9 Minimum Requirement #5: Streambank Erosion Control

All runoff onsite will outlet to the Cowlitz River, a flow control exempt water body, or will be infiltrated. As discussed above, some infiltration will be conducted onsite to ensure that flows to the LOTC Master Outfall comply with the values used in the Master Stormwater Plan. There is no streambank erosion present in the current condition. The proposed condition will result in no excess runoff to the streams onsite, so streambank erosion is not expected as part of this project. The discussion between the city regarding this issue is detailed in the Stormwater Master Plan.

I-2.10 Minimum Requirement #6: Wetlands

No runoff onsite will be directed to the onsite wetlands in the proposed conditions. Therefore, this minimum requirement is not required.

I-2.11 Minimum Requirement #7: Water Quality Sensitive Areas

There are no water quality sensitive areas that will be affected by this project. Therefore, this minimum requirement is not required.

I-2.12 Minimum Requirement #8: Off-site Analysis and Mitigation

An offsite analysis was conducted a quarter mile downstream from the outlet to the Cowlitz River using the available data. The following items were analyzed for both existing and proposed conditions.

i. Excessive sedimentation: There is no excessive sedimentation present in the current condition. The proposed condition will greatly increase the impervious surface area, resulting in increases to both runoff volume and flow. Sedimentation prevention measures will be implemented both during construction and in the final condition. Measures taken during construction are detailed further in the SWPPP for this project. Stormwater treatment onsite will be provided by bioretention facilities before runoff is conveyed to the site outfall to the Cowlitz River. Further Erosion Control measures are detailed in the associated plan set and storm report for the outfall itself.
ii. Streambank Erosion: There is no streambank erosion present in the current condition. The proposed condition will result in no excess runoff to the streams onsite, so streambank erosion is not expected as part of this project.
iii. Discharges to Groundwater or Recharge Zones: Runoff onsite will outlet directly to the Cowlitz River
iv. Violations of Water Quality Standards: Not present in the current or proposed condition
v. Spills and Discharges of Priority Pollutants: Not present in the current or proposed condition

I-2.13 Minimum Requirement #9: Basin Planning

Basin Planning will not be required to modify any other Minimum Requirements.

I-2.14 Minimum Requirement #10: Operation and Maintenance

The City will take ownership of the public storm drain system upon completion of the construction. A private HOA will be responsible for the operation and maintenance of the proposed private stormwater facilities onsite. Pages from the 1992 SWMMPSB are attached in Appendix E detailing maintenance requirements for applicable components onsite. The site will be inspected for defects and maintained as needed at least once every season, as well as after all major storm events (including an in excess of the 100-year storm event).

I-2.15 Minimum Requirement #11: Financial Liability

A performance bond or other appropriate financial instruments (as approved by the City) shall be provided to ensure compliance with these standards.

2.2 Soil Evaluation

A geotechnical report was conducted by Columbia West for the whole LOTC development, dated March 30, 2023, as well as a follow up exploration in March of 2024. These reports are attached in Appendix C. The soils onsite are categorized as Hydrologic Group A.

Groundwater Data

Groundwater was not encountered in depths up to 13 feet below ground surface (BGS) in test pits 20, 21, and 22 as part of the follow up exploration. Site groundwater was observed between 15 to 35 feet below ground surface (BGS) during boring and was reported from 9 to 35 feet BGS in exploration logs. According to the geotechnical report, perched groundwater may be present in localized areas.

3. Conveyance System

3.1 Conveyance System Analysis and Design

All runoff onsite that does not infiltrate within the proposed infiltration trench will be conveyed to the Phase 1 storm system, and ultimately the onsite and offsite outfall systems. Conveyance models will be included at the time of Final Engineering to ensure that all storm systems onsite are adequately sized for onsite runoff as well as offsite run-on from surrounding areas.

A conveyance model has already been conducted as part of the Stormwater Master Plan to ensure that runoff generated by this development was appropriately factored into the ultimate design. Models will be included to ensure that flows leaving the site comply with all assumptions made in the Stormwater Master Plan.

4. References

Castle Rock Public Works Department. 2020. *Development Policies and Public Works Standards.* Castle Rock, WA: City of Castle Rock.

Cowlitz County Public Works Department. 2017. *Cowlitz County Stormwater Drainage Manual.* Cowlitz County.

Hinman, Curtis. 2012. *Low Impact Development Technical Guidance Manual for Puget Sound.* PSP 2012-3. Puyallup, WA: Washington State University Extension.

Ridgefield Public Works Department. 2017. *Engineering Standards for Public Works Construction.* Ridgefield, WA: City of Ridgefield.

USDA Natural Resources Conservation Service. 2023. *National Soil Survey Handbook, Title 430.* United States Department of Agriculture.

USDA Soil Conservation Service. 1972. *Soil Survey of Clark County.* United States Department of Agriculture.

USDA Soil Science Division Staff. 2018. *Soil Survey Manual.* United States Department of Agriculture.

WADOE. 2006. *Guidance for UIC Wells that Manage Stormwater.* 05-10-067. Olympia, WA: Washington State Department of Ecology.

—. 1992. *Stormwater Management Manual for the Puget Sound Basin.*

—. 2024. *Stormwater Manual for Western Washington.* 24-10-013. Olympia, WA: Washington State Department of Ecology.

Appendix A Maps

Vicinity Map

Aerial Map with Contours

WWHM Soil Group Classification

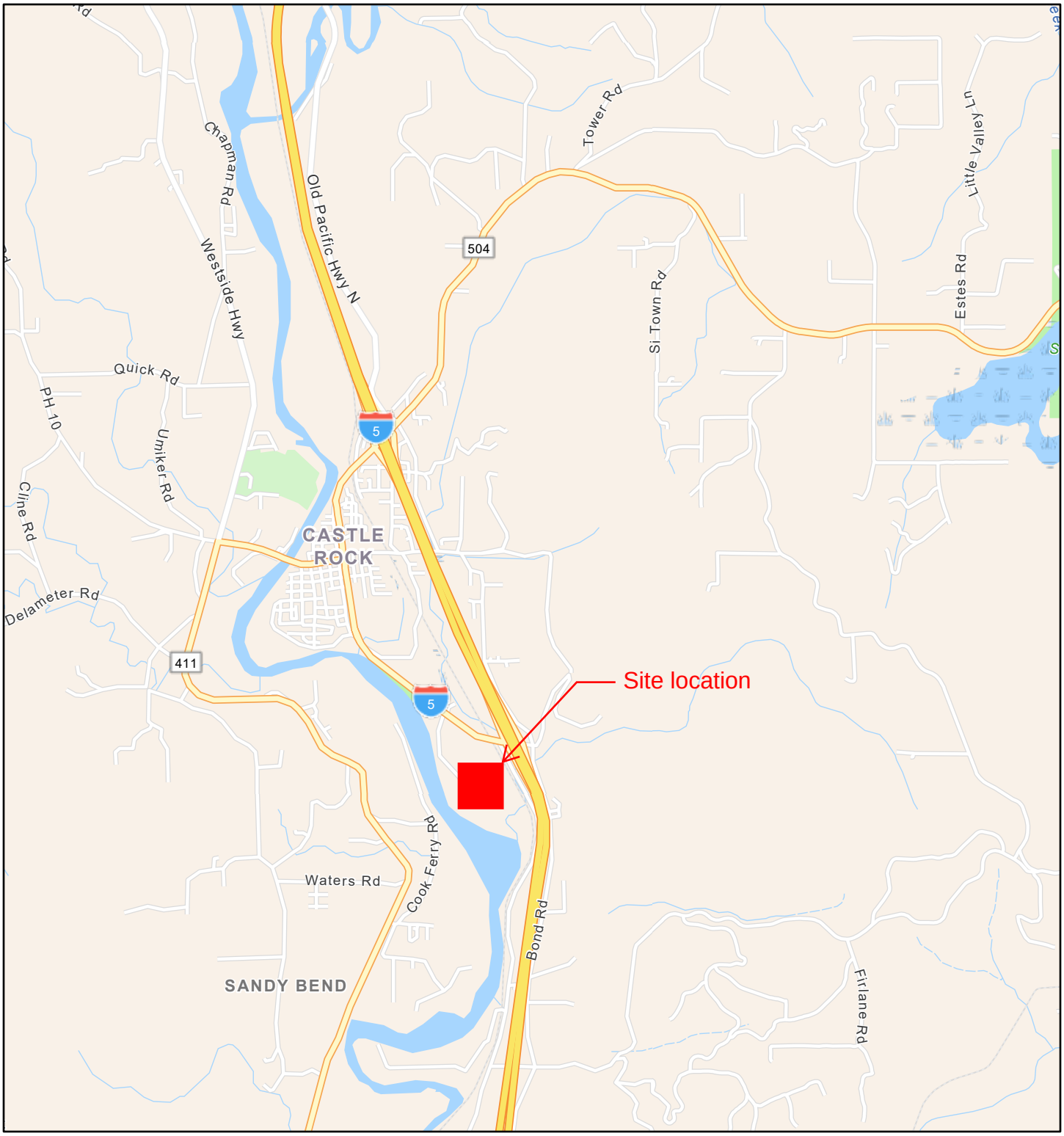
NRCS Soil Map

Isopluvial Maps

Existing Basin Map

Proposed Basin Map

Vicinity Map



11/1/2024, 10:40:00 AM

County Boundary

1:72,224

0 0.42 0.85 1.7 mi

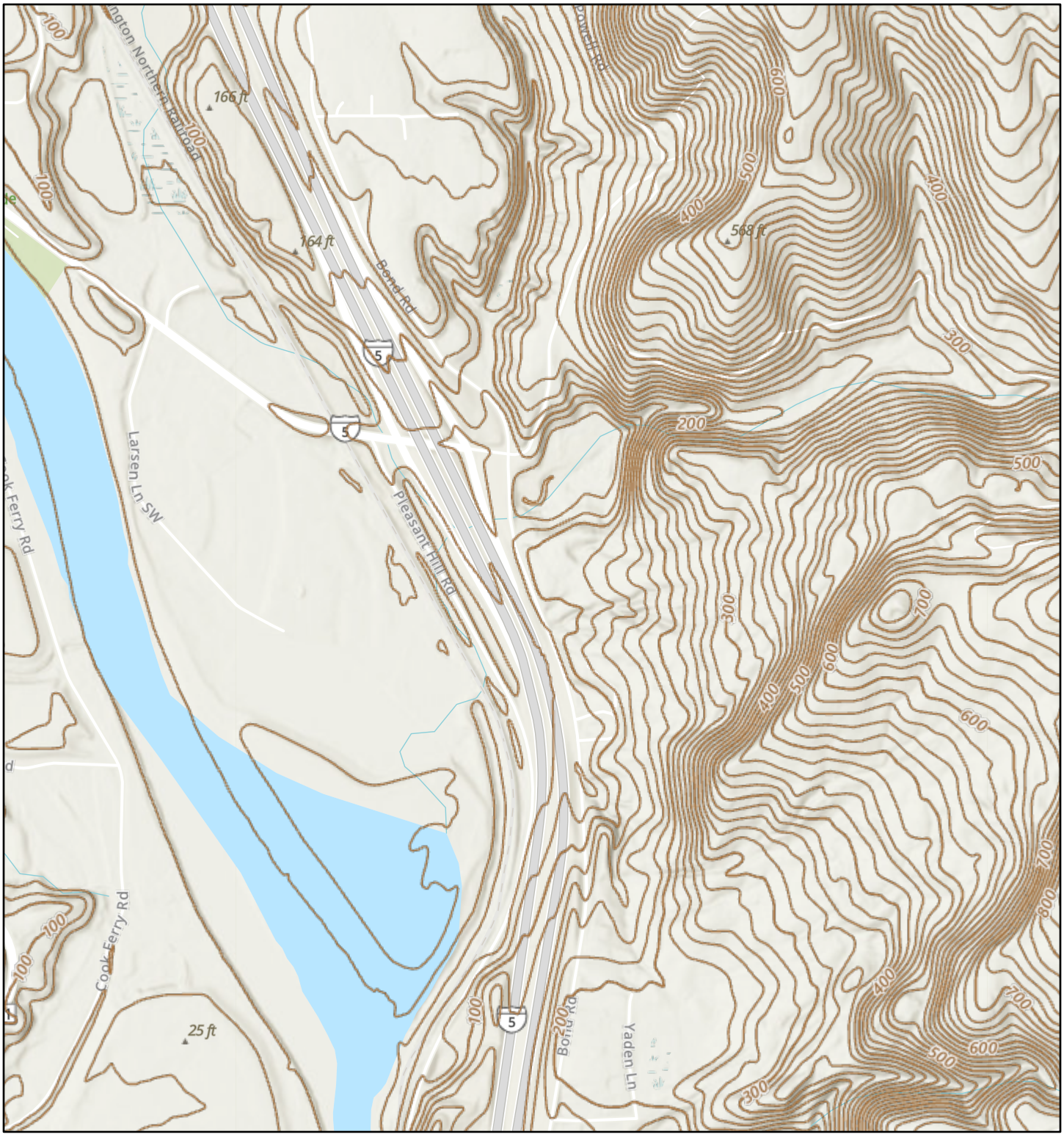
0 0.5 1 2 km

Oregon State Parks, State of Oregon GEO, WA State Parks GIS, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA, USFWS

Web AppBuilder for ArcGIS

Authenticated | Source: Esri, USDA FSA | Washington Geological Survey | USGS The National Map: 3D Elevation Program. Data Refreshed September, 2024. | Washington Department of Natural

Aerial with Contours



11/1/2024, 10:44:46 AM

1:18,056

0 0.1 0.2 0.4 mi

0 0.15 0.3 0.6 km

County Boundary

Normal Intermediate Contours

Normal Index Contours

USGS The National Map: 3D Elevation Program. Data Refreshed September, 2024., Esri Community Maps Contributors, Oregon State Parks, State of Oregon GEO, WA State Parks GIS, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA, USFWS, Esri, NASA, NGA, USGS,

Web AppBuilder for ArcGIS

Authenticated | Source: Esri, USDA FSA | Washington Geological Survey | USGS The National Map: 3D Elevation Program. Data Refreshed September, 2024. | Washington Department of Natural

APPENDIX AIII-1.1

ISOPLUVIAL MAPS FOR DESIGN STORMS

Included in this appendix are the 2, 10 and 100-year, 24-hour design storm and mean annual precipitation isopluvial maps for the Puget Sound basin. These have been taken from NOAA Atlas 2 "Precipitation - Frequency Atlas of the Western United States, Volume IX, Washington.

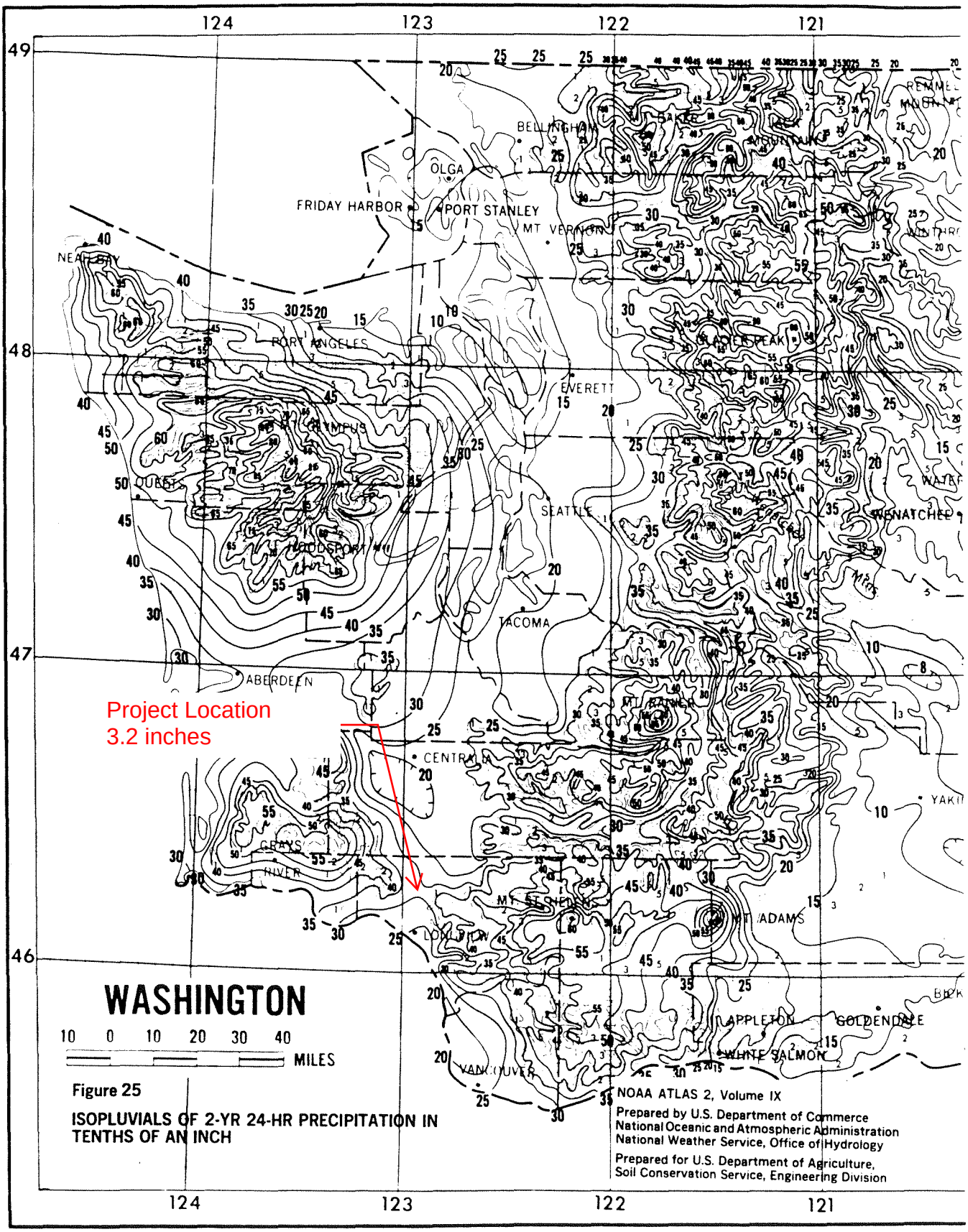


Figure 25

ISOPLUVIALS OF 2-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume IX

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

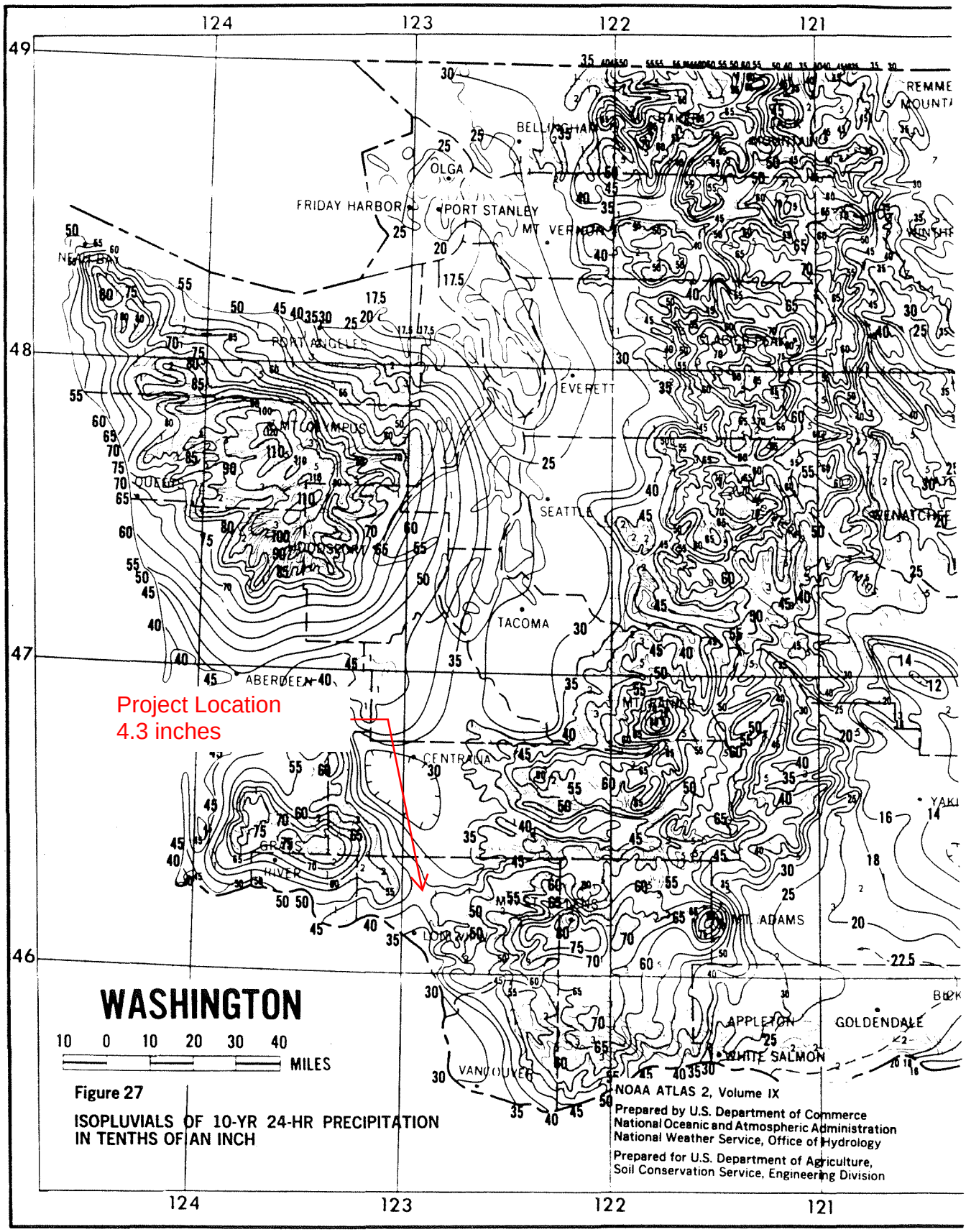


Figure 27

ISOPLUVIALS OF 10-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume IX

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

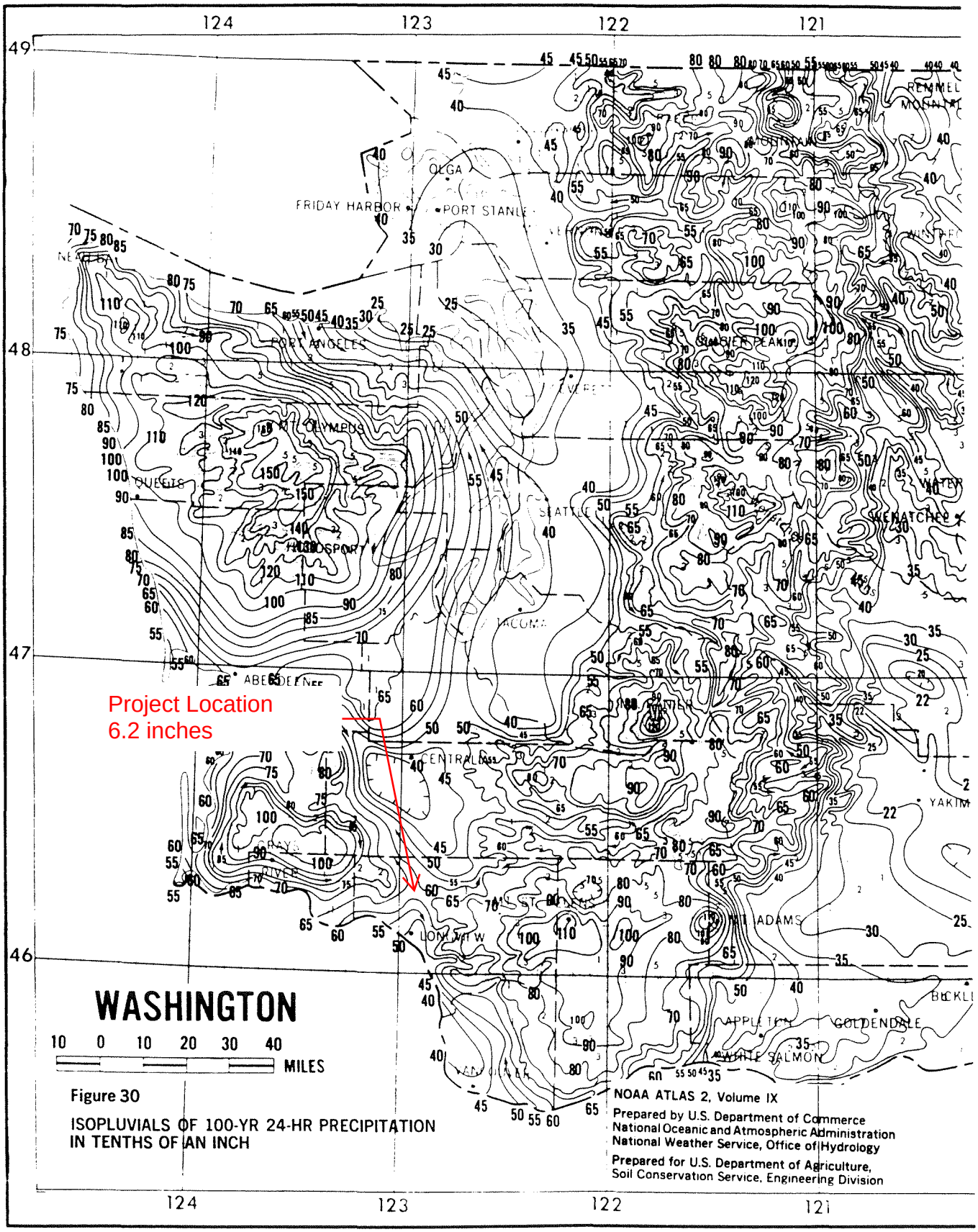
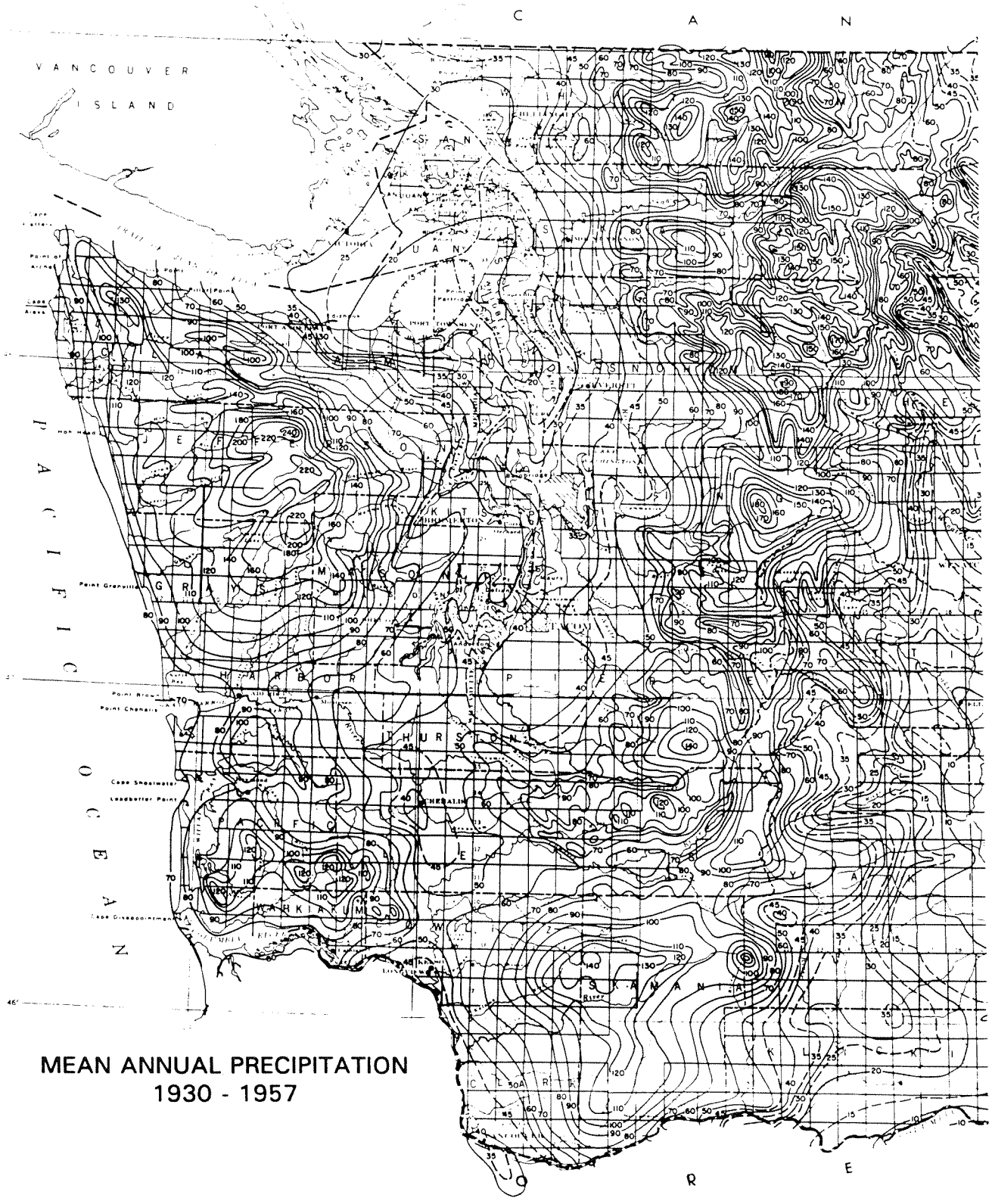


Figure 30

ISOPLUVIALS OF 100-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH



MEAN ANNUAL PRECIPITATION
1930 - 1957

Soil Map—Cowlitz County, Washington
(Soil Map)

Map Scale: 1:1,690 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Cowlitz County, Washington
Survey Area Data: Version 25, Aug 26, 2024

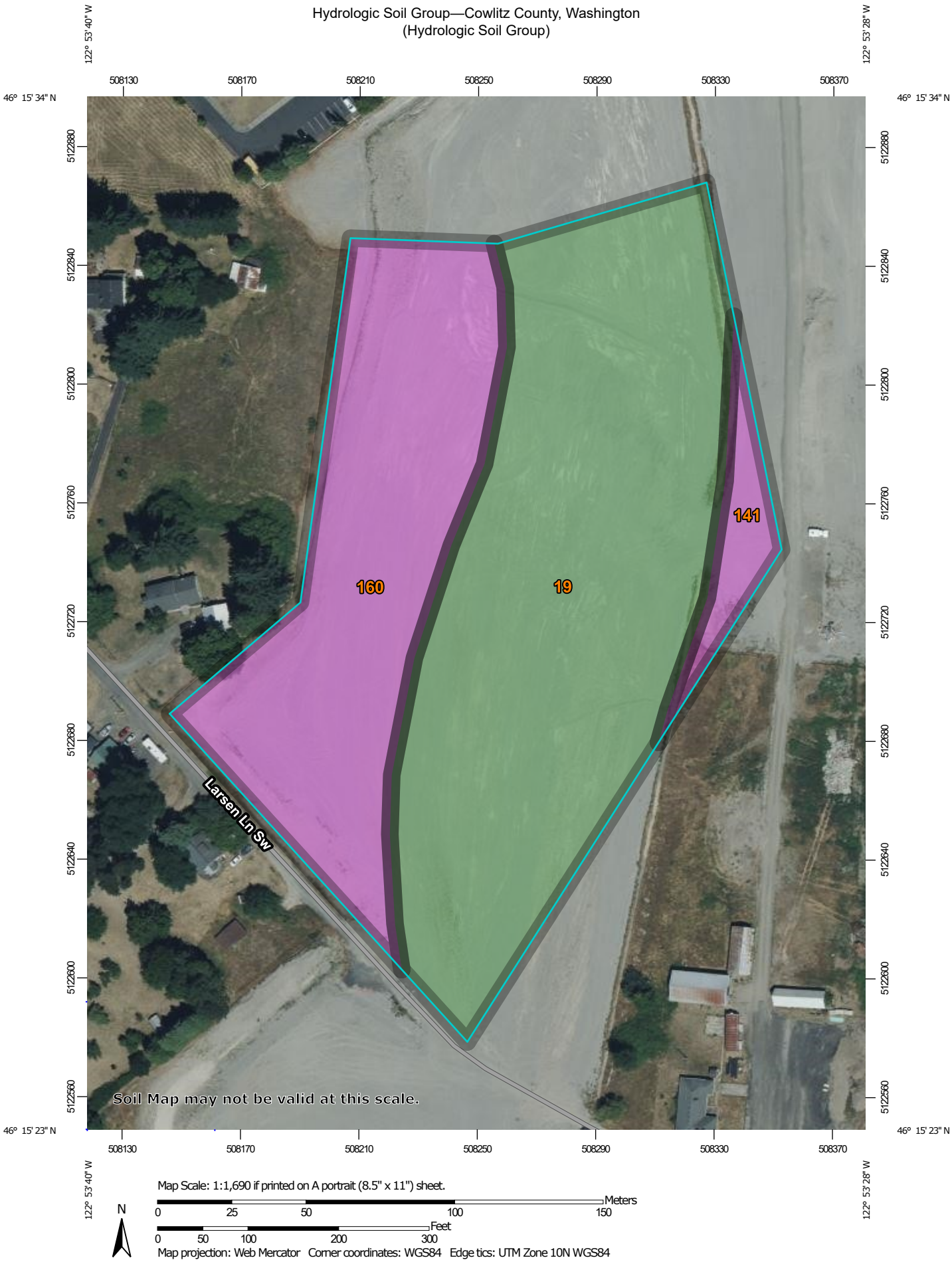
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 26, 2023—Aug 14, 2023

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
19	Carrolls loamy sand, 0 to 2 percent slopes	5.0	60.2%
141	Newberg fine sandy loam, 0 to 3 percent slopes	0.4	4.5%
160	Pilchuck loamy fine sand, 0 to 8 percent slopes	3.0	35.4%
Totals for Area of Interest		**8.4**	**100.0%**



Map Scale: 1:1,690 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Cowlitz County, Washington
Survey Area Data: Version 25, Aug 26, 2024

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 26, 2023—Aug 14, 2023

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
19	Carrolls loamy sand, 0 to 2 percent slopes	A/D	5.0	60.2%
141	Newberg fine sandy loam, 0 to 3 percent slopes	A	0.4	4.5%
160	Pilchuck loamy fine sand, 0 to 8 percent slopes	A	3.0	35.4%
Totals for Area of Interest			**8.4**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

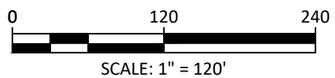
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



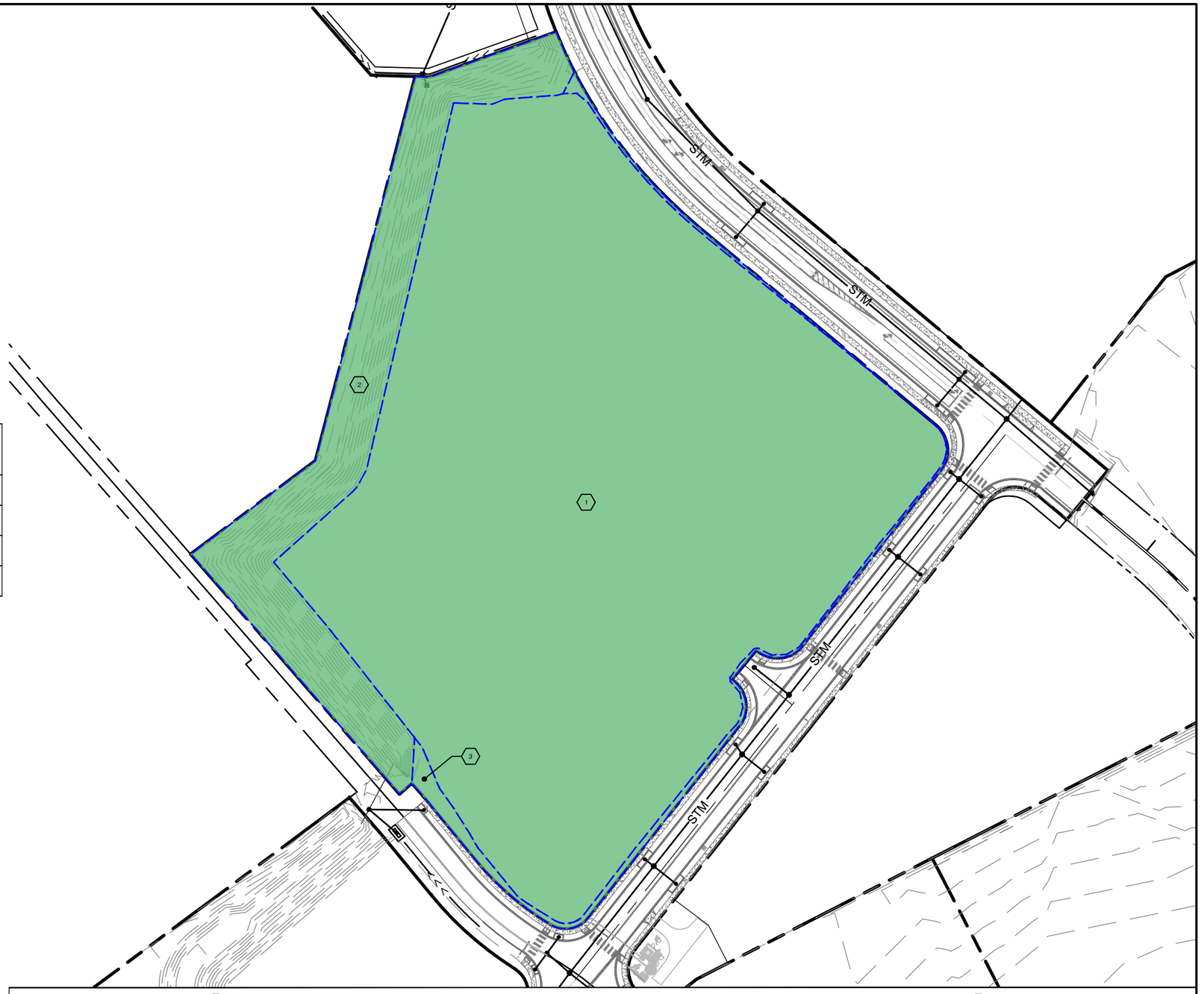
Basin	Impervious Area (SF)	Impervious Area (AC)	Pervious Area (SF)	Pervious Area (AC)	Total (AC)
1	0	0.00	333319	7.65	7.65
2	0	0.00	52512	1.21	1.21
3	0	0.00	7943	0.18	0.18
Total	0	0.00	393774	9.04	9.04

LEGEND

BASIN LINE

IMPERVIOUS AREA

PERVIOUS AREA



MacKay Sposito

ENERGY PUBLIC WORKS LAND DEVELOPMENT

www.mackaysposito.com

RIVER'S EDGE AT LANDING ON THE COWLITZ

EXISTING BASIN MAP

PROJECT NO.:	18591.01
DRAWN BY:	PJM
CHECKED BY:	TAW
DATE:	3/27/2025
SHEET NO.	A6

FILE: W:\18591 LOTC Phase 1\500 Design\501 Documents\Technical Files\Working Docs\Stormwater\Subdivision\TIR\Preliminary\01 Appendices\Appendix A - Maps\Existing Basin Map.dwg

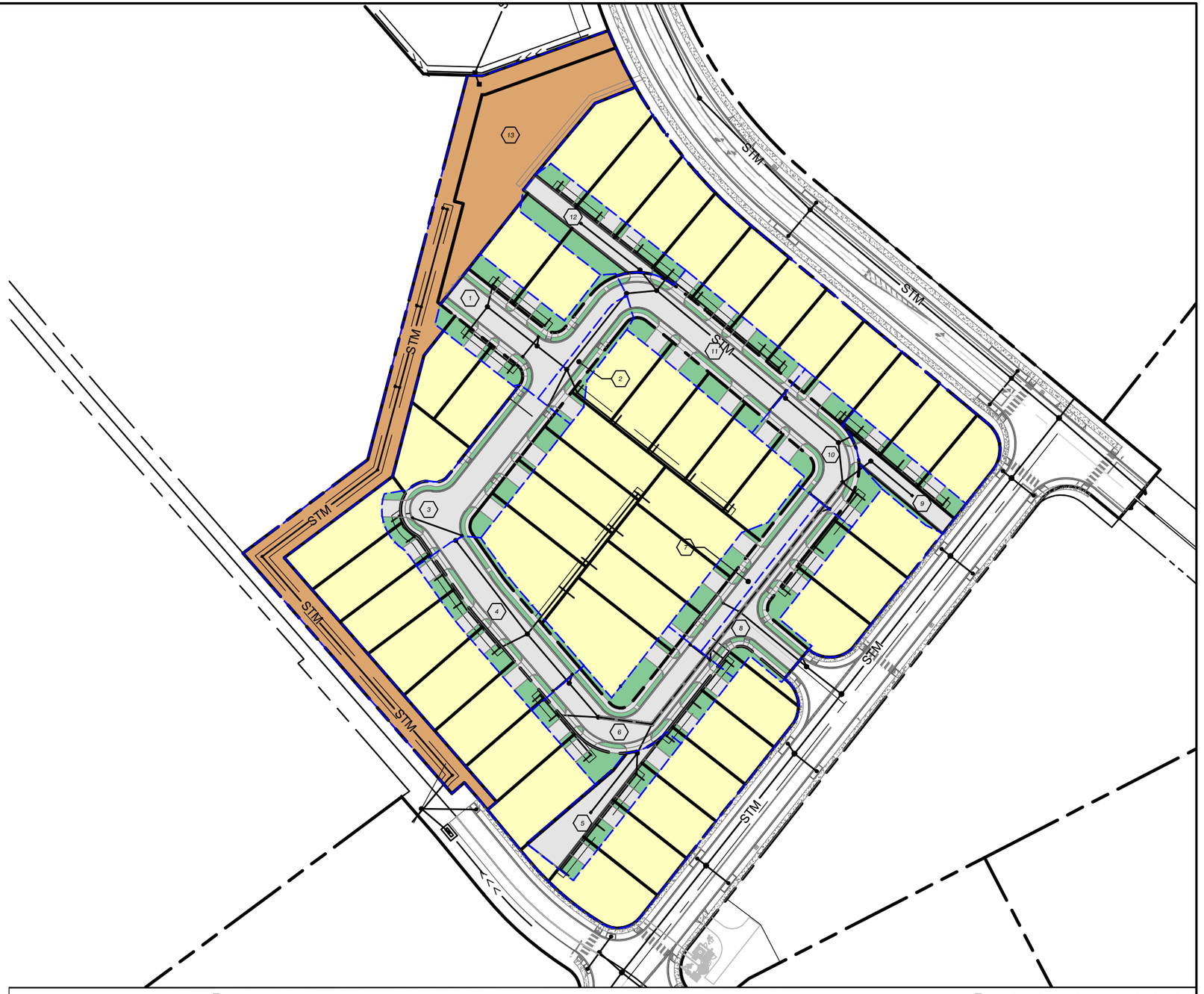
0 120 240

SCALE: 1" = 120'

Basin	Impervious Area (SF)	Impervious Area (AC)	Pervious Area (SF)	Pervious Area (AC)	Total (AC)
1	9791	0.22	4601	0.11	0.33
2	3191	0.07	1270	0.03	0.10
3	11090	0.25	4232	0.10	0.35
4	9284	0.21	4620	0.11	0.32
5	5870	0.13	2278	0.05	0.19
6	10840	0.25	5530	0.13	0.38
7	5041	0.12	2854	0.07	0.18
8	7233	0.17	3892	0.09	0.26
9	3593	0.08	2538	0.06	0.14
10	7598	0.17	3206	0.07	0.25
11	11937	0.27	5438	0.12	0.40
12	4154	0.10	5203	0.12	0.21
13	0	0.00	47814	1.10	1.10
Lots	67500	1.55	143176	3.29	4.84
Total	157122	3.61	236652	5.43	9.04

LEGEND

- BASIN LINE
- IMPERVIOUS AREA
- PERVIOUS AREA
- RESIDENTIAL LOTS (BYPASSING TREATMENT)
- PARK/OPEN SPACE (OFFSITE SYSTEM)



MacKay Sposito

ENERGY PUBLIC WORKS LAND DEVELOPMENT

www.mackaysposito.com

RIVER'S EDGE AT THE LANDING

PROPOSED BASIN MAP

PROJECT NO.:	18591.01
DRAWN BY:	PJM
CHECKED BY:	TAW
DATE:	3/27/2025
SHEET NO.	A7

FILE: W:\18591 LOTC Phase 1\500 Design\501 Documents\Technical Files\Working Docs\Stormwater\Subdivision\TIR\Preliminary\01 Appendices\Appendix A - Maps\Proposed Basin Map.dwg

Appendix B Hydrologic Exhibits and Calculations

Figure I-2.1 Flowchart for Determining Minimum Requirements (1992 SWMMSWB)

Figure I-3.1 Flowchart for Determining Minimum Requirements for New Development (2024 SWMMWW)

Figure I-3.3 Flowchart for Determining MR #5 Requirements (2024 SWMMWW)

WWHM Water Quality Flow Rate Calculations

Figure I-2.1 Flowchart Demonstrating Minimum Requirements

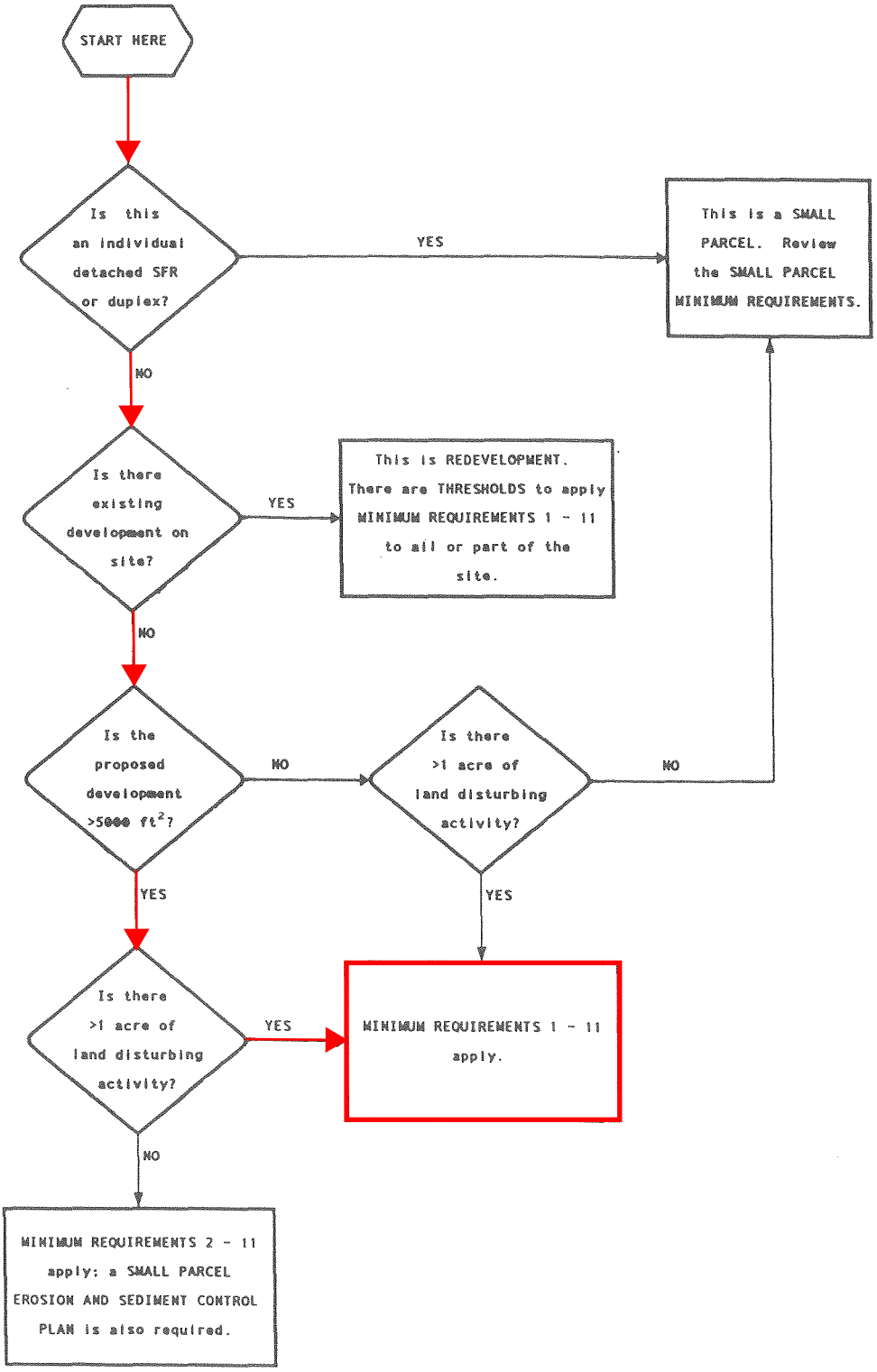


Figure I-3.1: Flow Chart for Determining Requirements for New Development

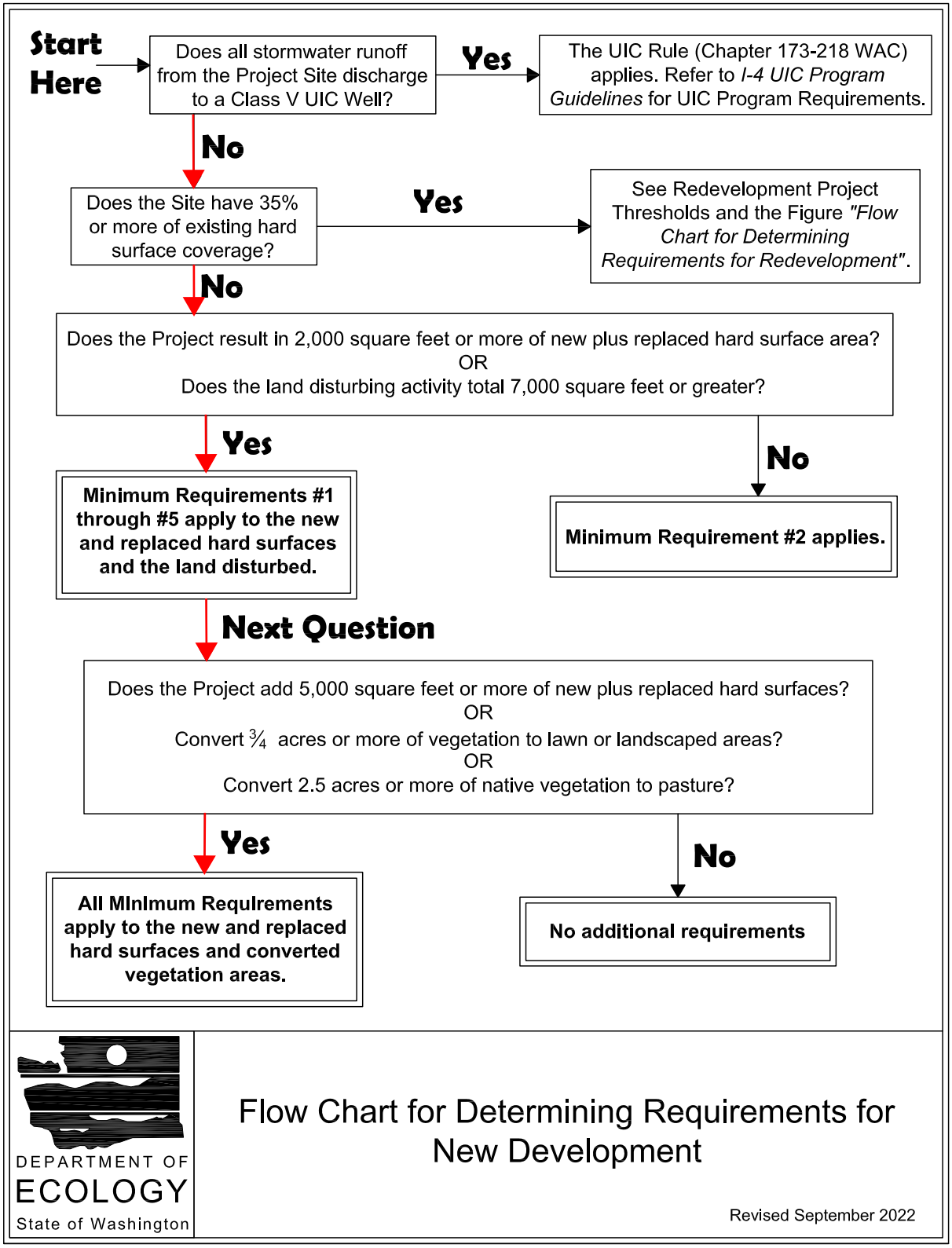
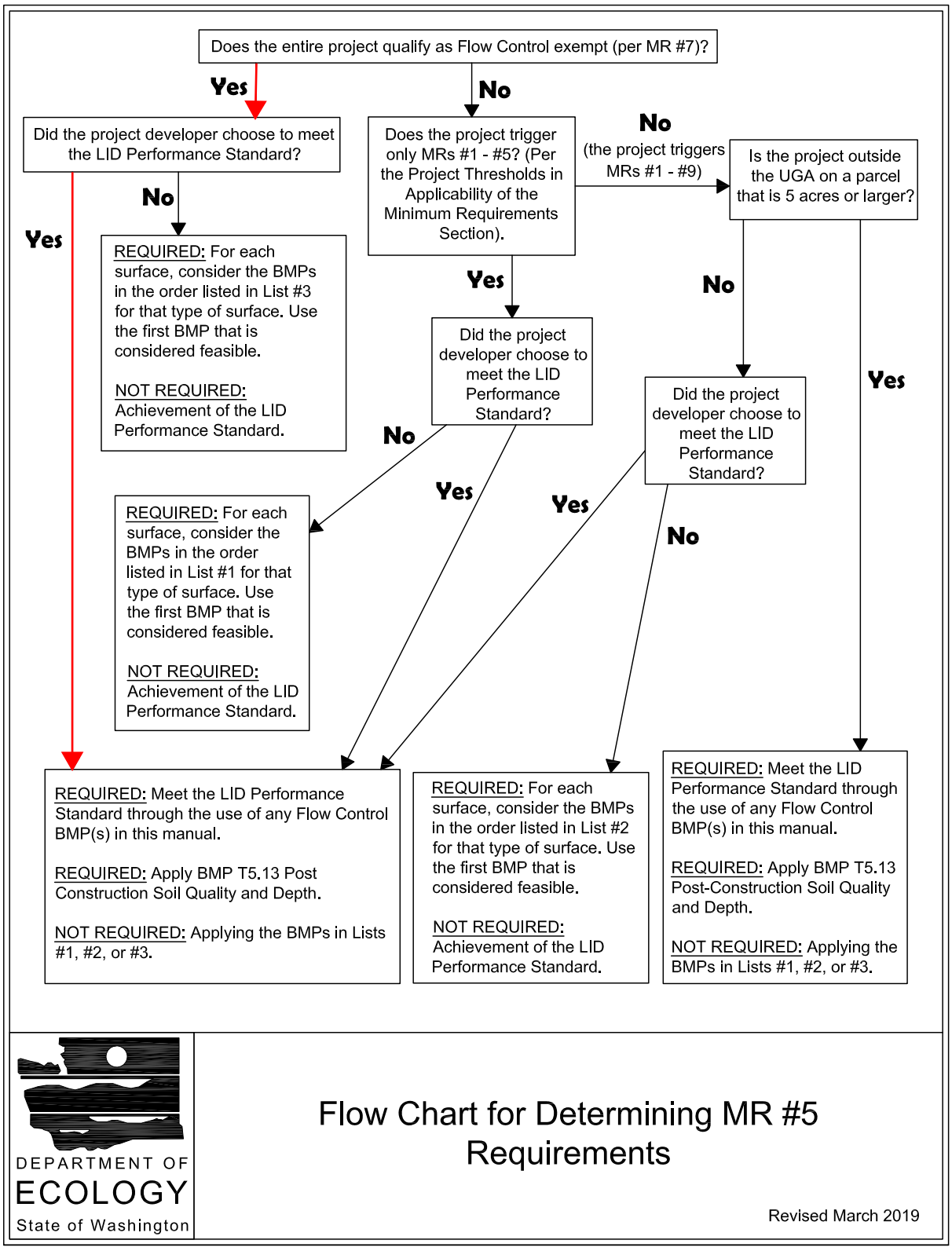


Figure I-3.3: Flow Chart for Determining MR #5 Requirements



WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: 18591.01 - Mechicanial Treatment

Site Name:	LOTC Subdivision
Site Address:	
City:	Castle Rock
Report Date:	3/26/2025
Gage:	Longview
Data Start:	1955/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.429
Version Date:	2024/06/28
Version:	4.3.1

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

A1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Mod	1.44
Pervious Total	1.44
Impervious Land Use	acre
Impervious Total	0
Basin Total	1.44

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Mitigated Land Use

1

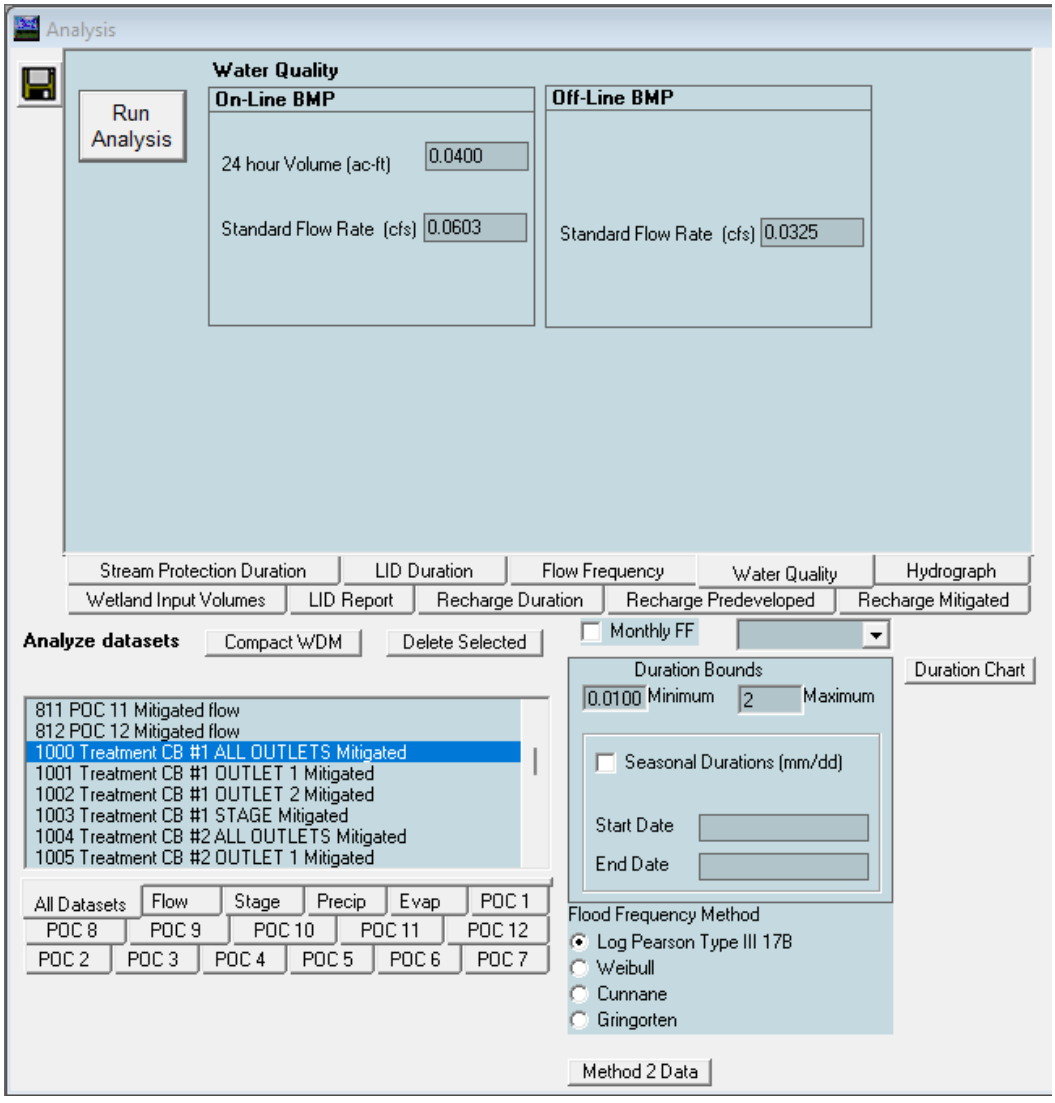
Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Flat	0.11
Pervious Total	0.11
Impervious Land Use	acre
ROADS FLAT	0.22
Impervious Total	0.22
Basin Total	0.33

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Treatment CB #1	Treatment CB #1

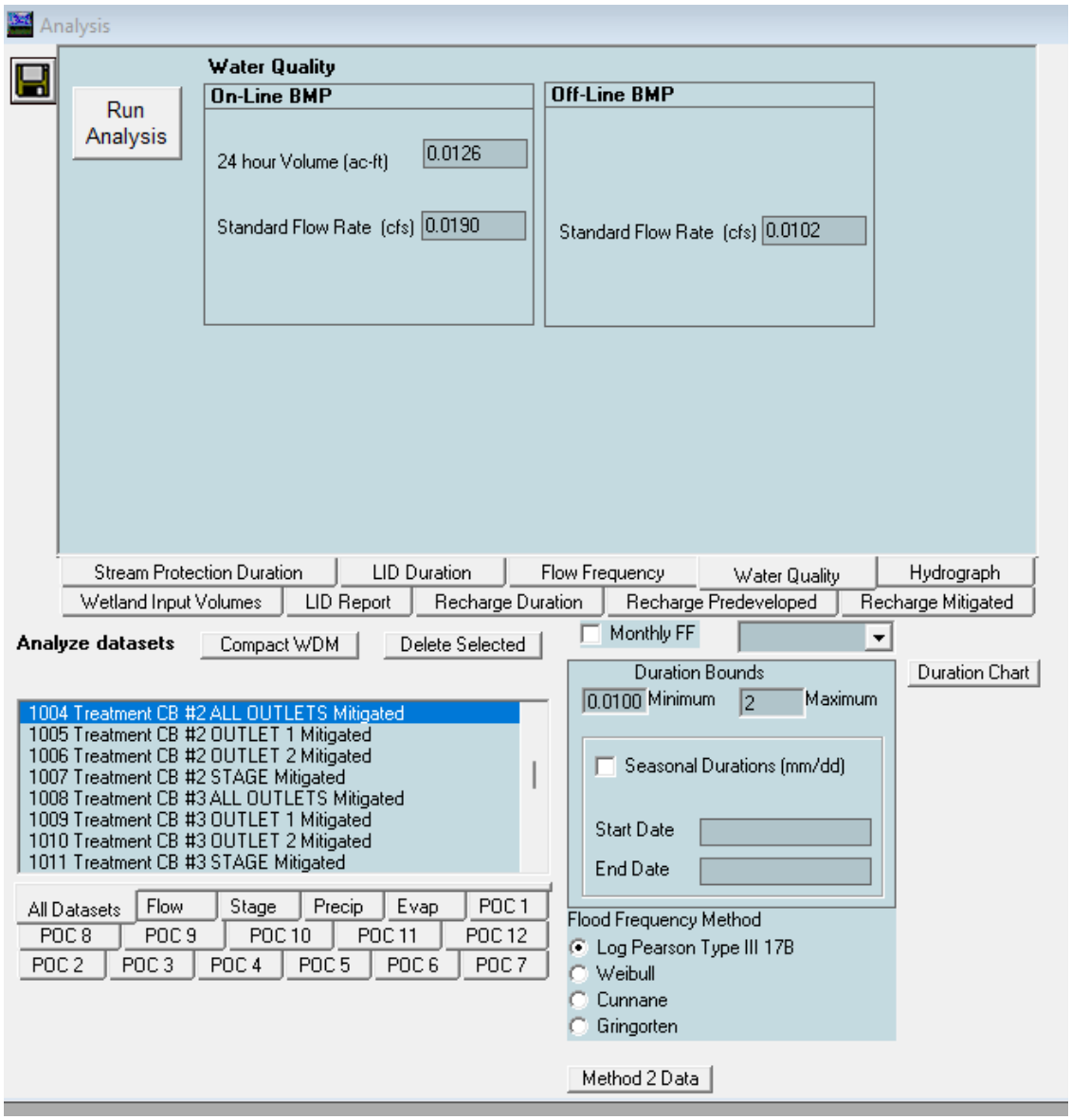


2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Flat	0.03
Pervious Total	0.03
Impervious Land Use	acre
ROADS FLAT	0.07
Impervious Total	0.07
Basin Total	0.1

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Treatment CB #2	Treatment CB #2	

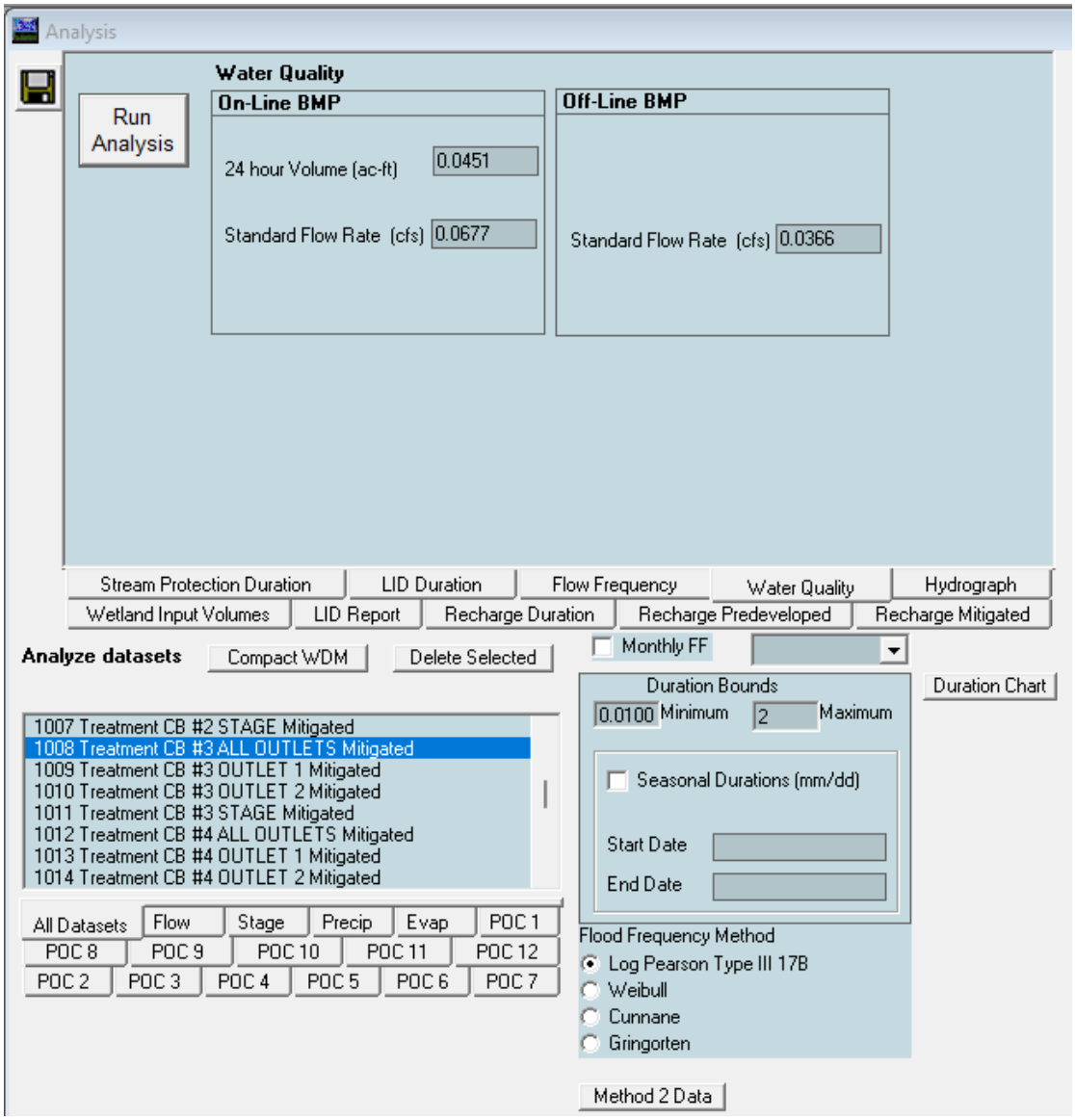


3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Flat	0.1
Pervious Total	0.1
Impervious Land Use	acre
ROADS FLAT	0.25
Impervious Total	0.25
Basin Total	0.35

Element Flow Componants:

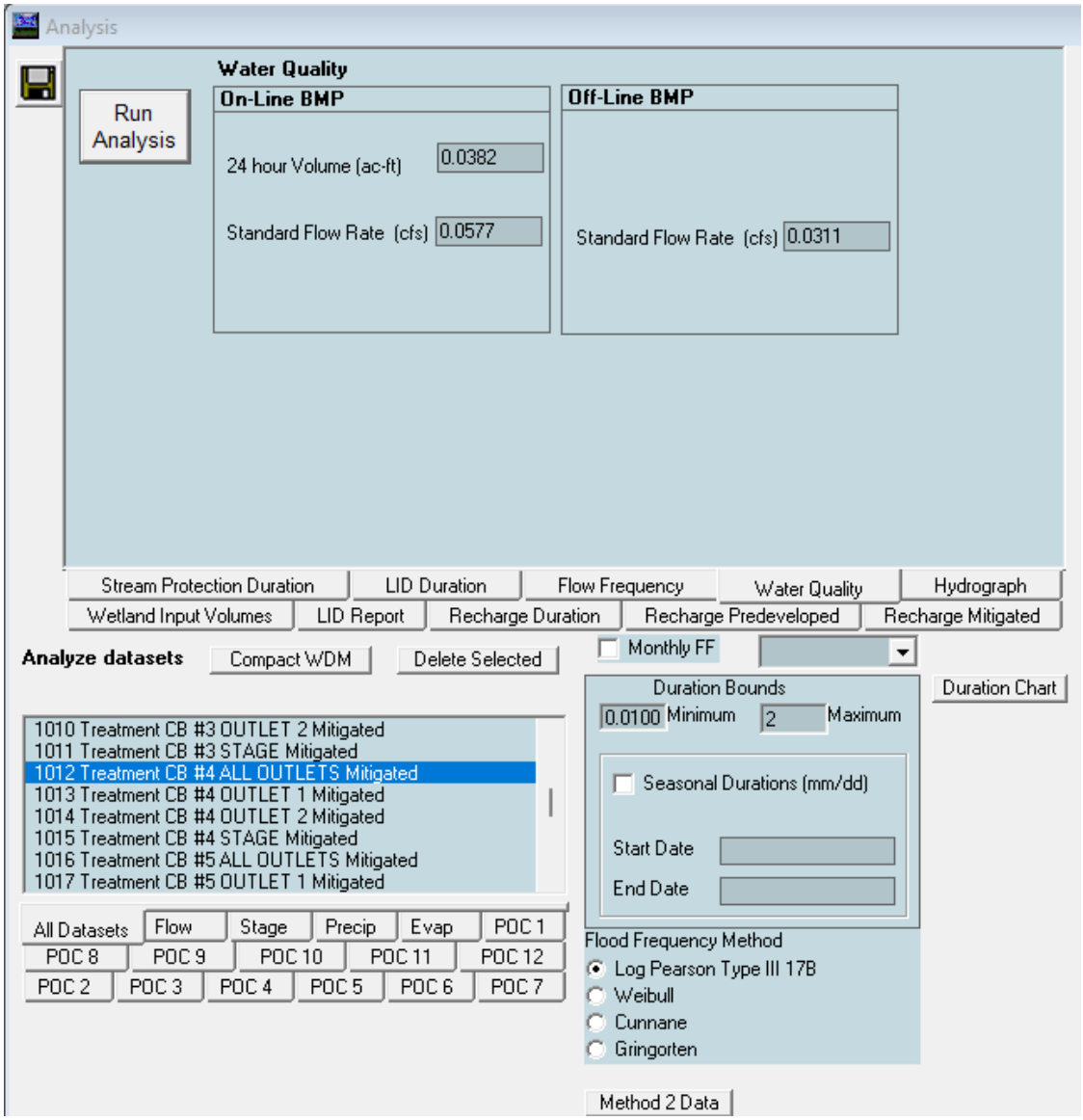
Surface	Interflow	Groundwater
Componant Flows To:		
Treatment CB #3	Treatment CB #3	



4

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Flat	0.11
Pervious Total	0.11
Impervious Land Use	acre
ROADS FLAT	0.21
Impervious Total	0.21
Basin Total	0.32

Element Flow Componants:
Surface Interflow Groundwater
Componant Flows To:
Treatment CB #4 Treatment CB #4



5

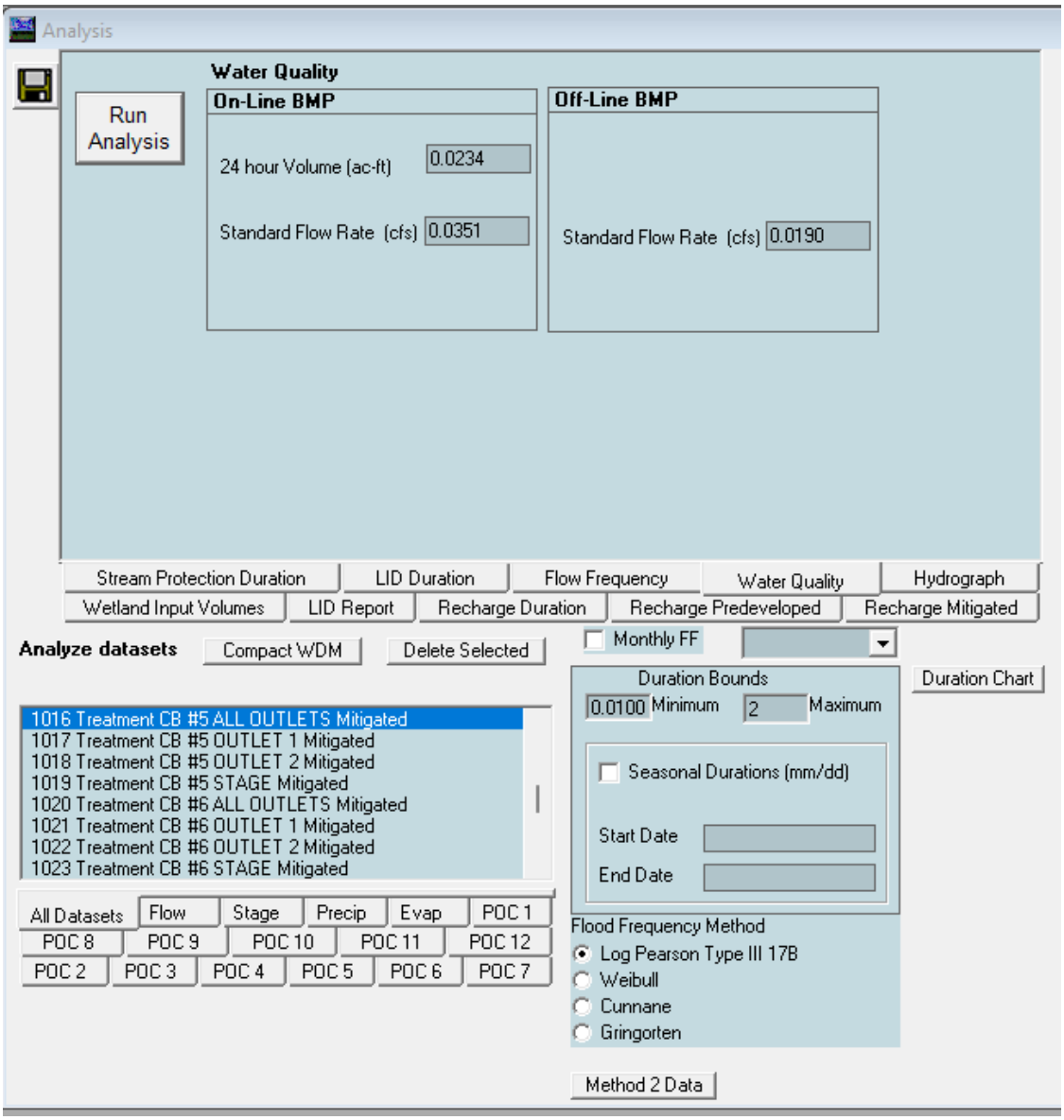
Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Flat	0.05
Pervious Total	0.05
Impervious Land Use	acre
ROADS FLAT	0.13
Impervious Total	0.13
Basin Total	0.18

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Treatment CB #5	Treatment CB #5

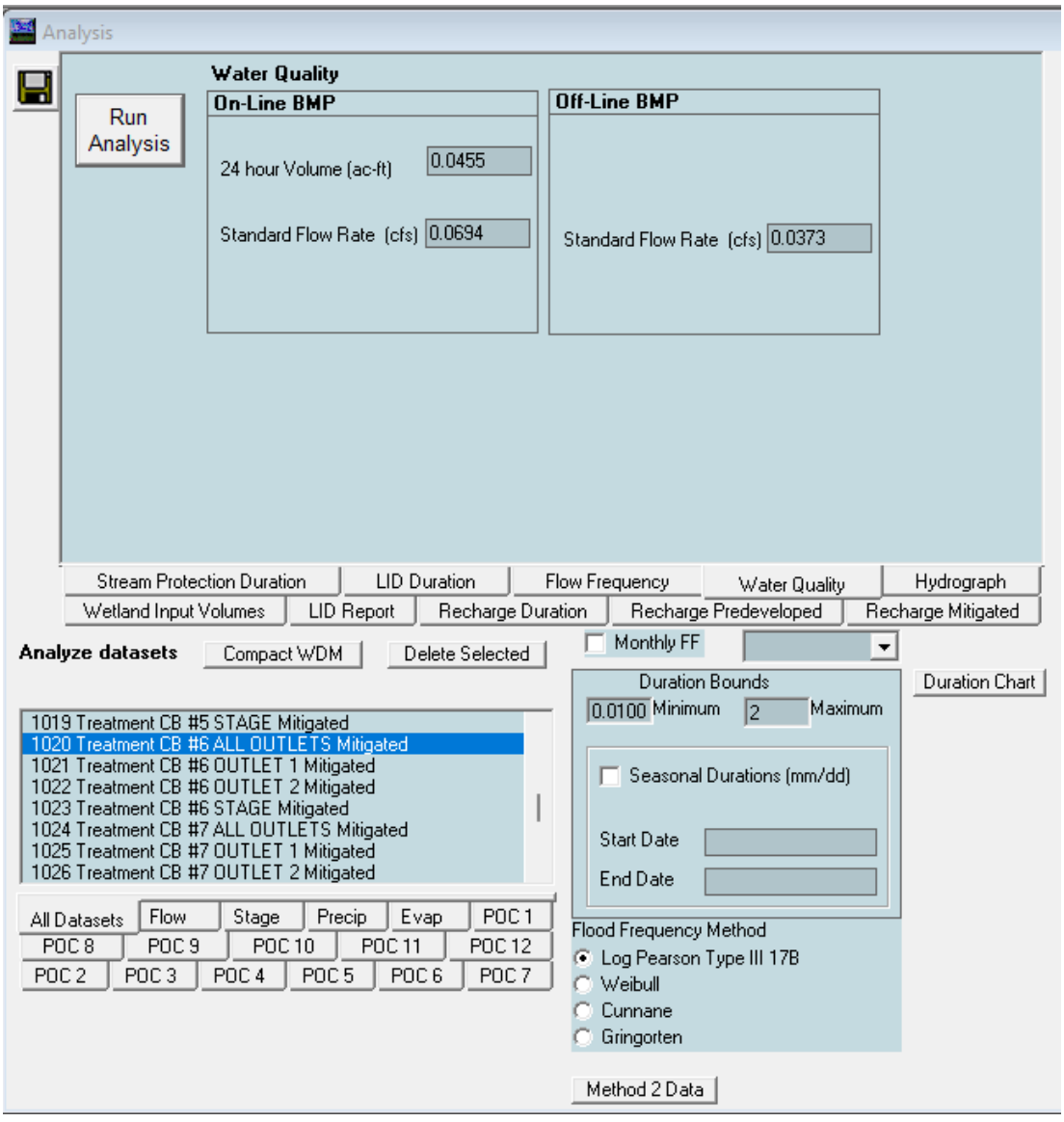


6

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Mod	0.13
Pervious Total	0.13
Impervious Land Use	acre
ROADS FLAT	0.25
Impervious Total	0.25
Basin Total	0.38

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Treatment CB #6	Treatment CB #6	

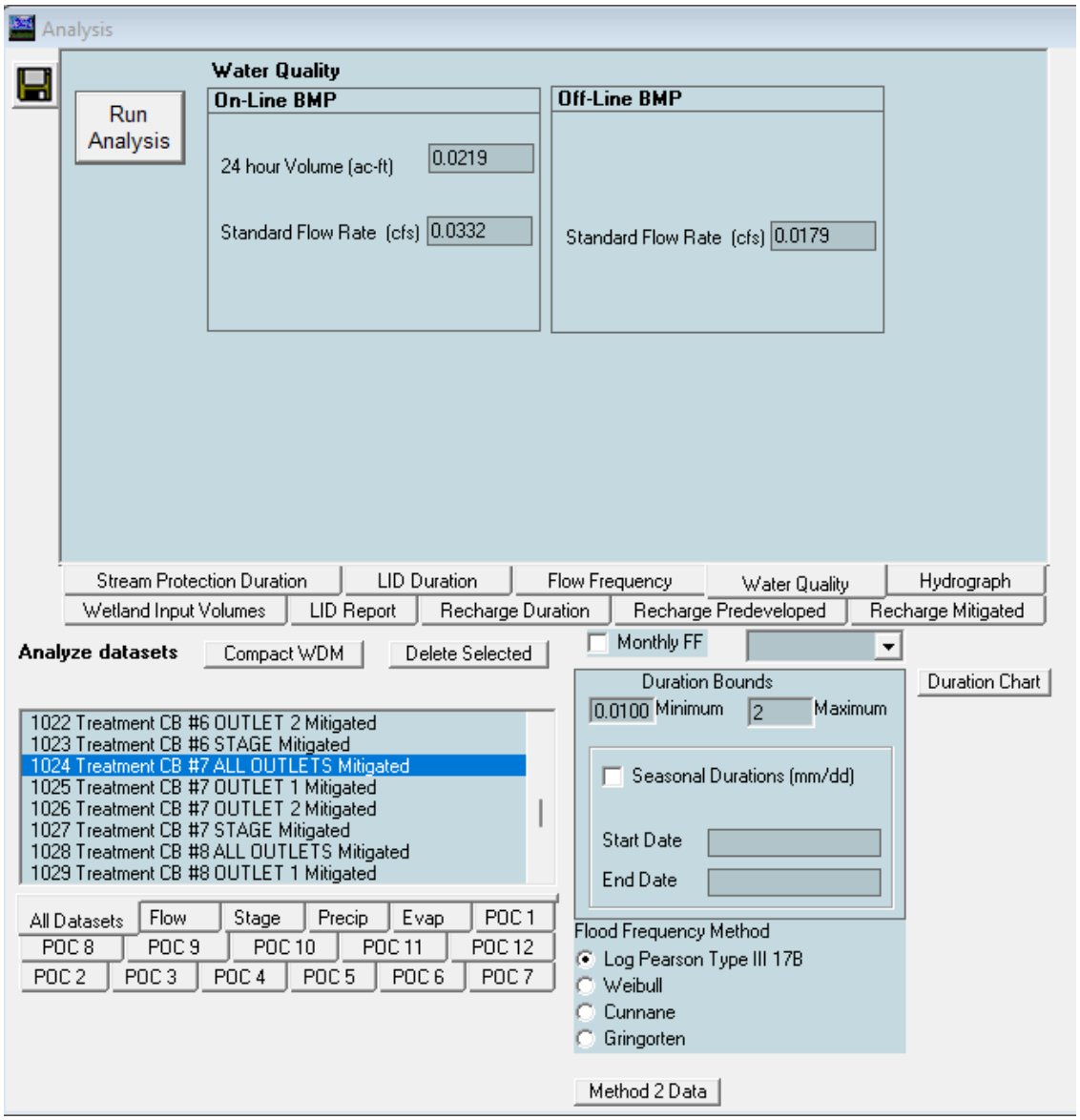


7

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Flat	0.07
Pervious Total	0.07
Impervious Land Use	acre
ROADS FLAT	0.12
Impervious Total	0.12
Basin Total	0.19

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Treatment CB #7	Treatment CB #7	

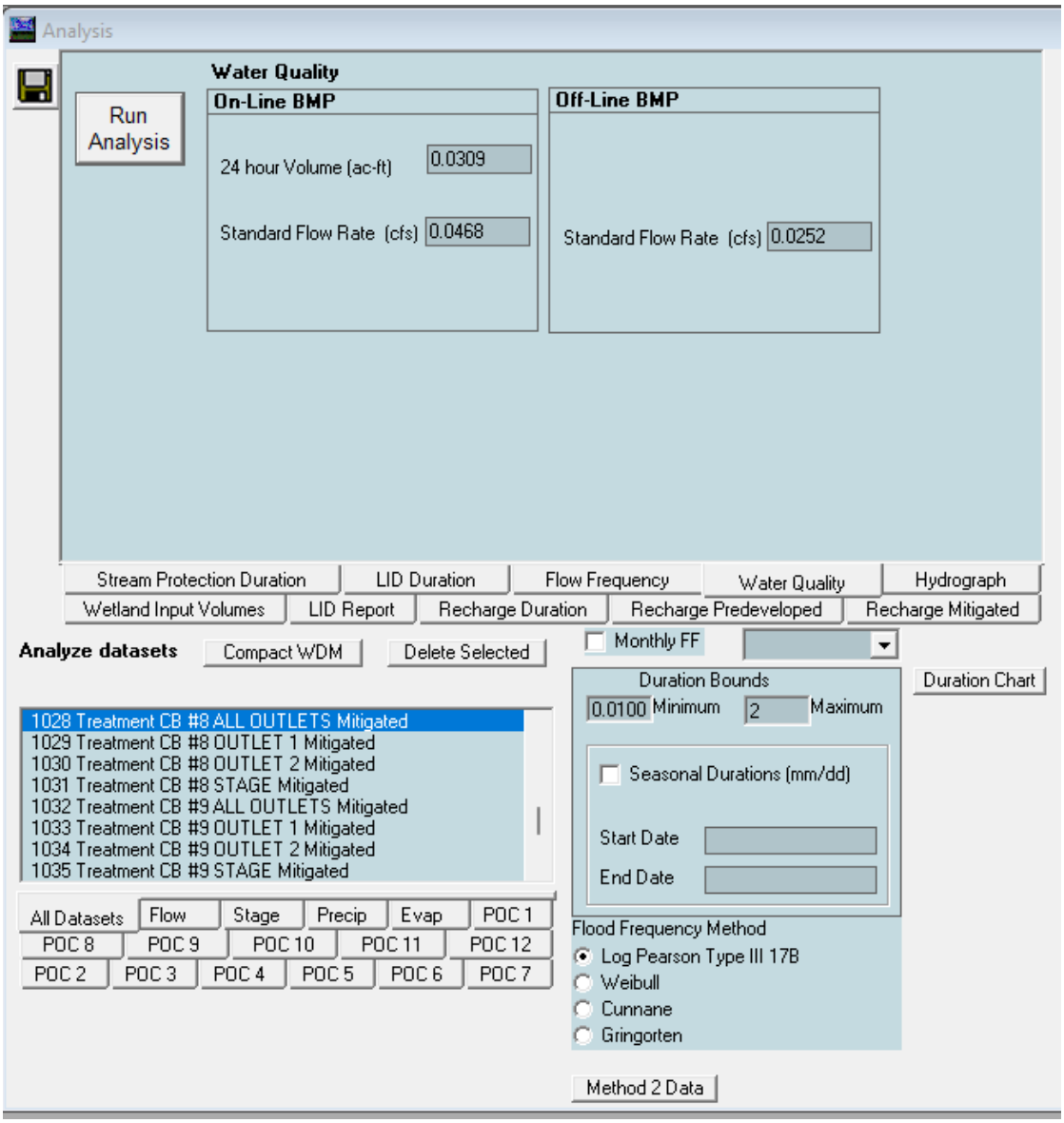


8

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Flat	0.09
Pervious Total	0.09
Impervious Land Use	acre
ROADS FLAT	0.17
Impervious Total	0.17
Basin Total	0.26

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Treatment CB #8	Treatment CB #8	

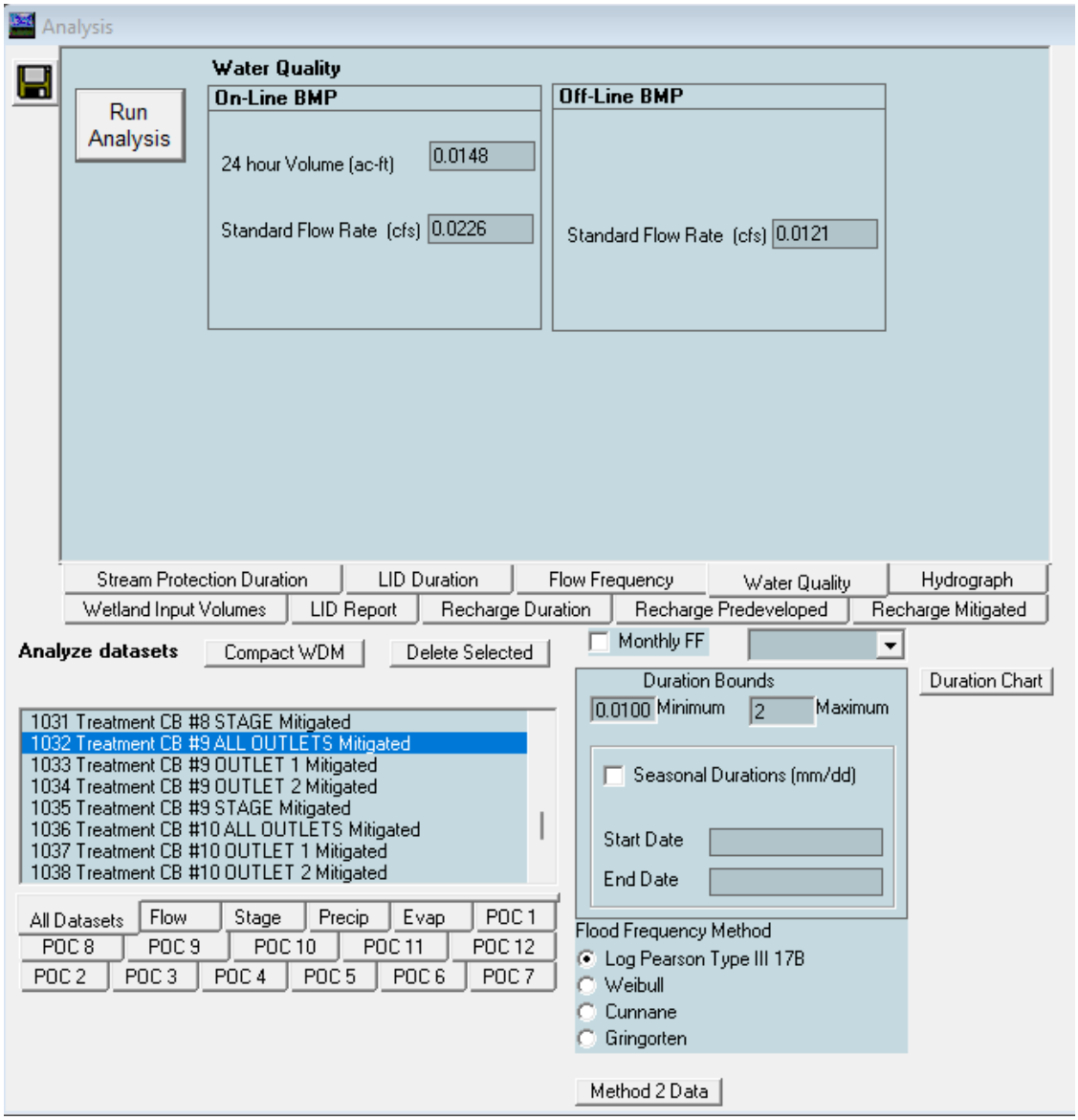


9

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Flat	0.06
Pervious Total	0.06
Impervious Land Use	acre
ROADS FLAT	0.08
Impervious Total	0.08
Basin Total	0.14

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Treatment CB #9	Treatment CB #9	

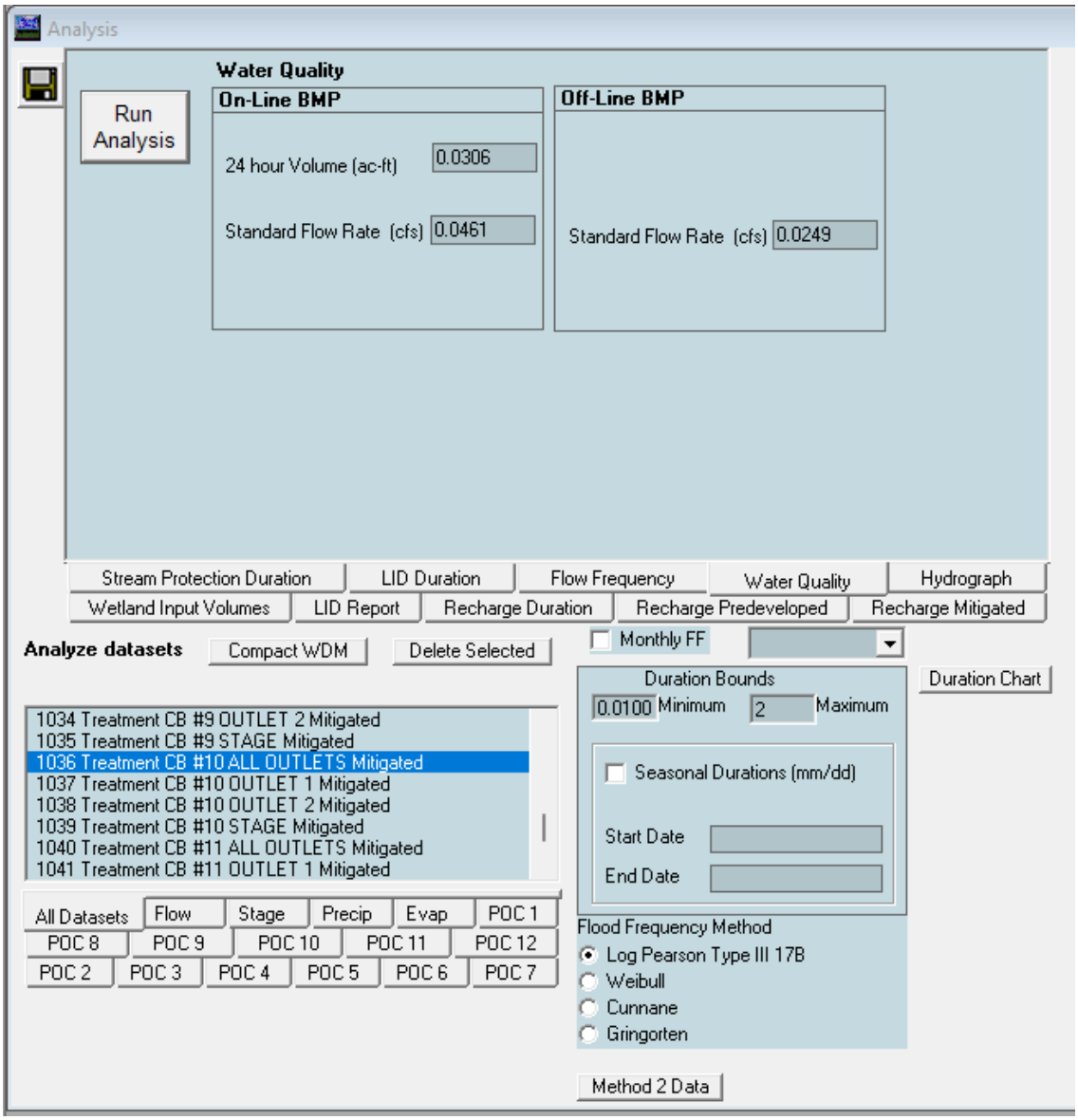


10

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Flat	0.07
Pervious Total	0.07
Impervious Land Use	acre
ROADS FLAT	0.17
Impervious Total	0.17
Basin Total	0.24

Element Flow Componants:

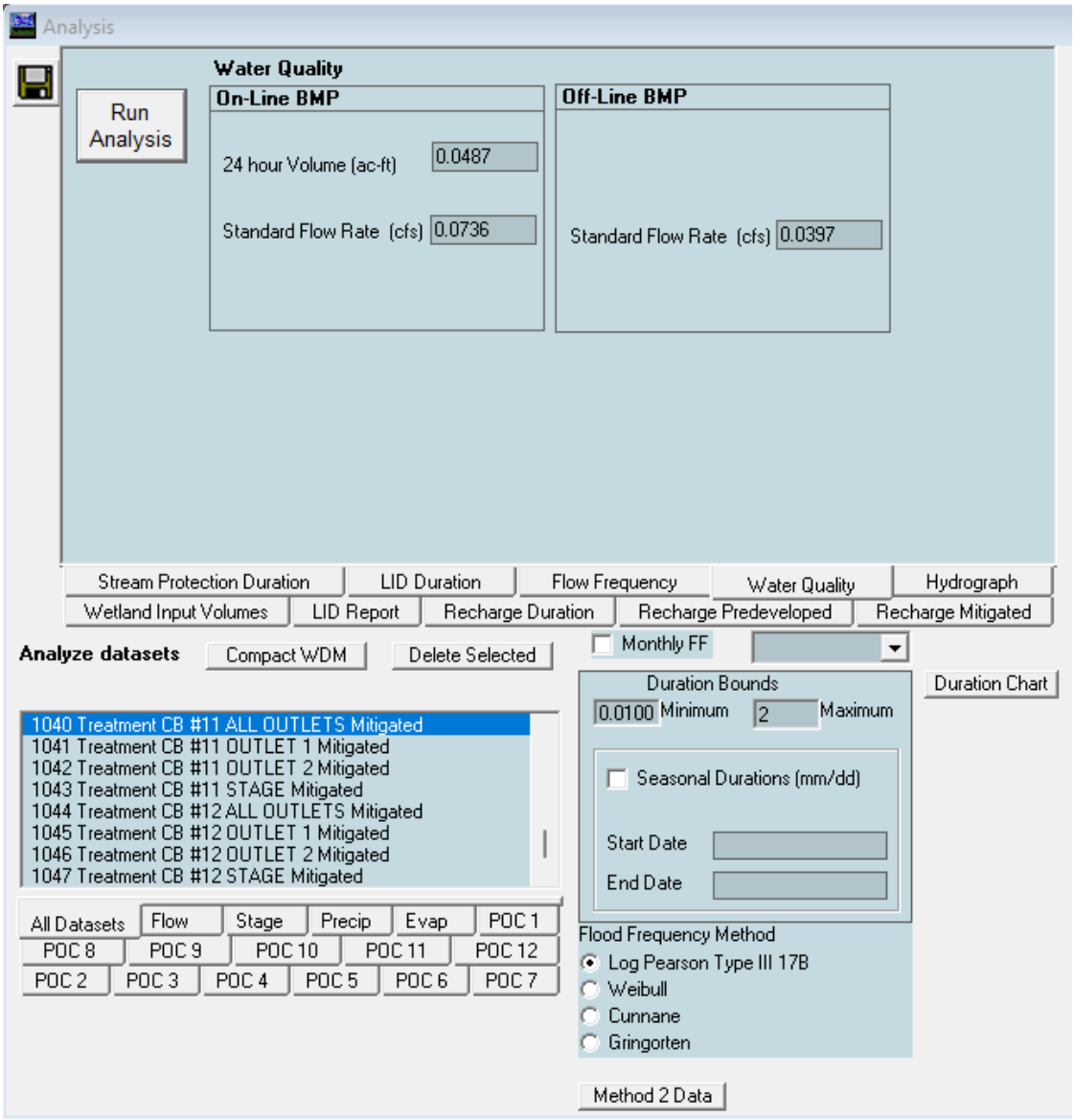
Surface	Interflow	Groundwater
Componant Flows To:		
Treatment CB #10	Treatment CB #10	



11

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Flat	0.12
Pervious Total	0.12
Impervious Land Use	acre
ROADS FLAT	0.27
Impervious Total	0.27
Basin Total	0.39

Element Flow Componants:
Surface Interflow Groundwater
Componant Flows To:
Treatment CB #11 Treatment CB #11

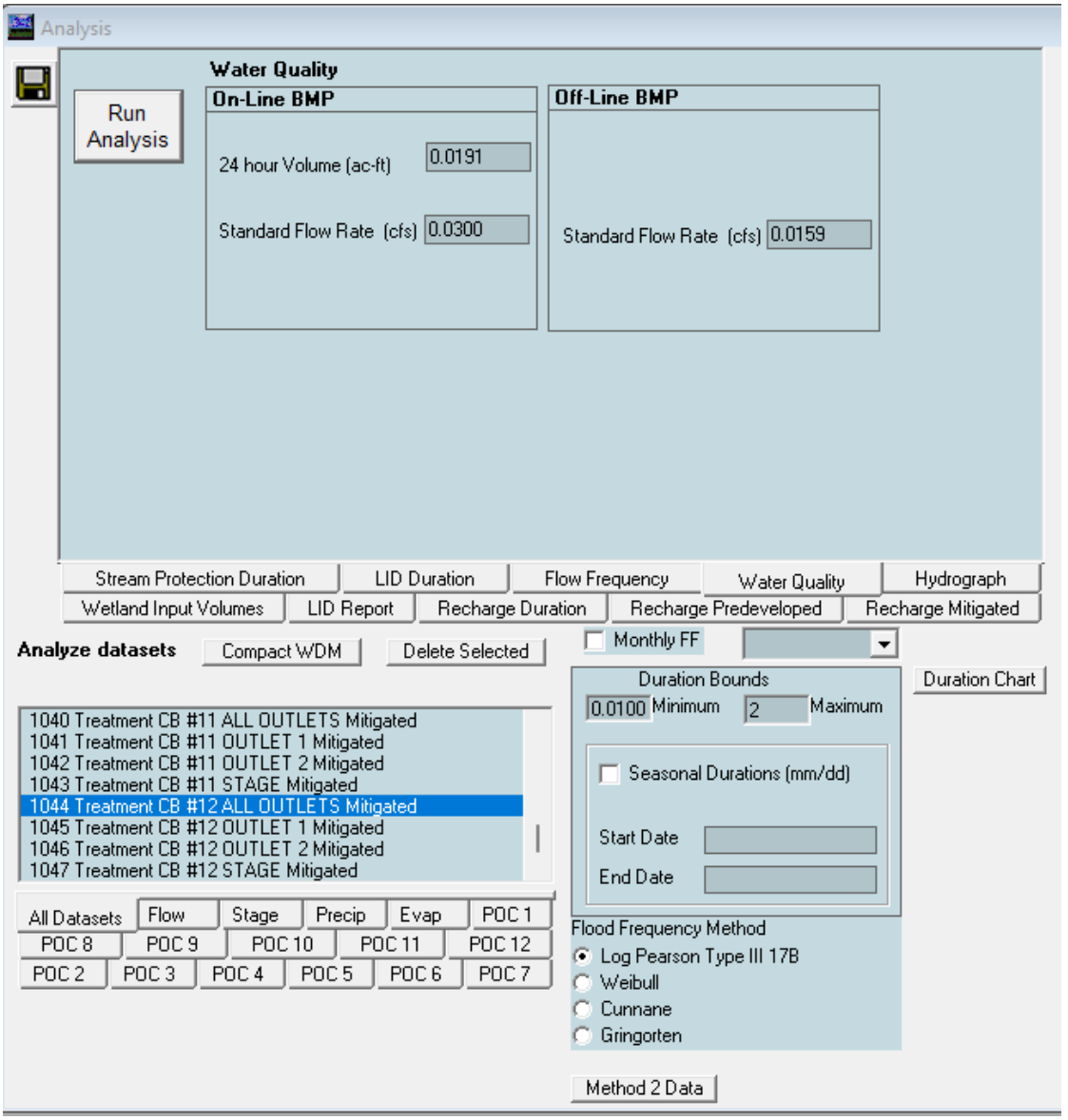


12

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Flat	0.12
Pervious Total	0.12
Impervious Land Use	acre
ROADS FLAT	0.1
Impervious Total	0.1
Basin Total	0.22

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Treatment CB #12	Treatment CB #12	



Mitigated Routing

Treatment CB #1

Bottom Length: 10.00 ft.
Bottom Length: 10.00 ft.
Depth: 10 ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1

Threshold Splitter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Primary(cfs)	Secondary(cfs)
0.000	0.002	0.000	2.000	0.000
0.111	0.002	0.000	2.000	0.000
0.222	0.002	0.000	2.000	0.000
0.333	0.002	0.000	2.000	0.000
0.444	0.002	0.001	2.000	0.000
0.555	0.002	0.001	2.000	0.000
0.666	0.002	0.001	2.000	0.000
0.777	0.002	0.001	2.000	0.000
0.888	0.002	0.002	2.000	0.000
1.000	0.002	0.002	2.000	0.000
1.111	0.002	0.002	2.000	0.000
1.222	0.002	0.002	2.000	0.000
1.333	0.002	0.003	2.000	0.000
1.444	0.002	0.003	2.000	0.000
1.555	0.002	0.003	2.000	0.000
1.666	0.002	0.003	2.000	0.000
1.777	0.002	0.004	2.000	0.000
1.888	0.002	0.004	2.000	0.000
2.000	0.002	0.004	2.000	0.000
2.111	0.002	0.004	2.000	0.000
2.222	0.002	0.005	2.000	0.000
2.333	0.002	0.005	2.000	0.000
2.444	0.002	0.005	2.000	0.000
2.555	0.002	0.005	2.000	0.000
2.666	0.002	0.006	2.000	0.000
2.777	0.002	0.006	2.000	0.000
2.888	0.002	0.006	2.000	1000
3.000	0.002	0.006	2.000	1000
3.111	0.002	0.007	2.000	1000
3.222	0.002	0.007	2.000	1000
3.333	0.002	0.007	2.000	1000
3.444	0.002	0.007	2.000	1000
3.555	0.002	0.008	2.000	1000
3.666	0.002	0.008	2.000	1000
3.777	0.002	0.008	2.000	1000
3.888	0.002	0.008	2.000	1000
4.000	0.002	0.009	2.000	1000
4.111	0.002	0.009	2.000	1000
4.222	0.002	0.009	2.000	1000
4.333	0.002	0.009	2.000	1000
4.444	0.002	0.010	2.000	1000
4.555	0.002	0.010	2.000	1000
4.666	0.002	0.010	2.000	1000
4.777	0.002	0.011	2.000	1000
4.888	0.002	0.011	2.000	1000

5.000	0.002	0.011	2.000	1000
5.111	0.002	0.011	2.000	1000
5.222	0.002	0.012	2.000	1000
5.333	0.002	0.012	2.000	1000
5.444	0.002	0.012	2.000	1000
5.555	0.002	0.012	2.000	1000
5.666	0.002	0.013	2.000	1000
5.777	0.002	0.013	2.000	1000
5.888	0.002	0.013	2.000	1000
6.000	0.002	0.013	2.000	1000
6.111	0.002	0.014	2.000	1000
6.222	0.002	0.014	2.000	1000
6.333	0.002	0.014	2.000	1000
6.444	0.002	0.014	2.000	1000
6.555	0.002	0.015	2.000	1000
6.666	0.002	0.015	2.000	1000
6.777	0.002	0.015	2.000	1000
6.888	0.002	0.015	2.000	1000
7.000	0.002	0.016	2.000	1000
7.111	0.002	0.016	2.000	1000
7.222	0.002	0.016	2.000	1000
7.333	0.002	0.016	2.000	1000
7.444	0.002	0.017	2.000	1000
7.555	0.002	0.017	2.000	1000
7.666	0.002	0.017	2.000	1000
7.777	0.002	0.017	2.000	1000
7.888	0.002	0.018	2.000	1000
8.000	0.002	0.018	2.000	1000
8.111	0.002	0.018	2.000	1000
8.222	0.002	0.018	2.000	1000
8.333	0.002	0.019	2.000	1000
8.444	0.002	0.019	2.000	1000
8.555	0.002	0.019	2.000	1000
8.666	0.002	0.019	2.000	1000
8.777	0.002	0.020	2.000	1000
8.888	0.002	0.020	2.000	1000
9.000	0.002	0.020	2.000	1000
9.111	0.002	0.020	2.000	1000
9.222	0.002	0.021	2.000	1000
9.333	0.002	0.021	2.000	1000
9.444	0.002	0.021	2.000	1000
9.555	0.002	0.021	2.000	1000
9.666	0.002	0.022	2.000	1000
9.777	0.002	0.022	2.000	1000
9.888	0.002	0.022	2.000	1000
10.00	0.002	0.023	2.000	1000
10.11	0.002	0.023	2.000	1000

Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.
Element Outlets:
Outlet 1 Outlet 2
Outlet Flows To:

Treatment CB #2

Bottom Length: 10.00 ft.
Bottom Length: 10.00 ft.
Depth: 10 ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1

Threshold Splitter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Primary(cfs)	Secondary(cfs)
0.000	0.002	0.000	2.000	0.000
0.111	0.002	0.000	2.000	0.000
0.222	0.002	0.000	2.000	0.000
0.333	0.002	0.000	2.000	0.000
0.444	0.002	0.001	2.000	0.000
0.555	0.002	0.001	2.000	0.000
0.666	0.002	0.001	2.000	0.000
0.777	0.002	0.001	2.000	0.000
0.888	0.002	0.002	2.000	0.000
1.000	0.002	0.002	2.000	0.000
1.111	0.002	0.002	2.000	0.000
1.222	0.002	0.002	2.000	0.000
1.333	0.002	0.003	2.000	0.000
1.444	0.002	0.003	2.000	0.000
1.555	0.002	0.003	2.000	0.000
1.666	0.002	0.003	2.000	0.000
1.777	0.002	0.004	2.000	0.000
1.888	0.002	0.004	2.000	0.000
2.000	0.002	0.004	2.000	0.000
2.111	0.002	0.004	2.000	0.000
2.222	0.002	0.005	2.000	0.000
2.333	0.002	0.005	2.000	0.000
2.444	0.002	0.005	2.000	0.000
2.555	0.002	0.005	2.000	0.000
2.666	0.002	0.006	2.000	0.000
2.777	0.002	0.006	2.000	0.000
2.888	0.002	0.006	2.000	1000
3.000	0.002	0.006	2.000	1000
3.111	0.002	0.007	2.000	1000
3.222	0.002	0.007	2.000	1000
3.333	0.002	0.007	2.000	1000
3.444	0.002	0.007	2.000	1000
3.555	0.002	0.008	2.000	1000
3.666	0.002	0.008	2.000	1000
3.777	0.002	0.008	2.000	1000
3.888	0.002	0.008	2.000	1000
4.000	0.002	0.009	2.000	1000
4.111	0.002	0.009	2.000	1000
4.222	0.002	0.009	2.000	1000
4.333	0.002	0.009	2.000	1000
4.444	0.002	0.010	2.000	1000
4.555	0.002	0.010	2.000	1000
4.666	0.002	0.010	2.000	1000
4.777	0.002	0.011	2.000	1000
4.888	0.002	0.011	2.000	1000
5.000	0.002	0.011	2.000	1000
5.111	0.002	0.011	2.000	1000

5.222	0.002	0.012	2.000	1000
5.333	0.002	0.012	2.000	1000
5.444	0.002	0.012	2.000	1000
5.555	0.002	0.012	2.000	1000
5.666	0.002	0.013	2.000	1000
5.777	0.002	0.013	2.000	1000
5.888	0.002	0.013	2.000	1000
6.000	0.002	0.013	2.000	1000
6.111	0.002	0.014	2.000	1000
6.222	0.002	0.014	2.000	1000
6.333	0.002	0.014	2.000	1000
6.444	0.002	0.014	2.000	1000
6.555	0.002	0.015	2.000	1000
6.666	0.002	0.015	2.000	1000
6.777	0.002	0.015	2.000	1000
6.888	0.002	0.015	2.000	1000
7.000	0.002	0.016	2.000	1000
7.111	0.002	0.016	2.000	1000
7.222	0.002	0.016	2.000	1000
7.333	0.002	0.016	2.000	1000
7.444	0.002	0.017	2.000	1000
7.555	0.002	0.017	2.000	1000
7.666	0.002	0.017	2.000	1000
7.777	0.002	0.017	2.000	1000
7.888	0.002	0.018	2.000	1000
8.000	0.002	0.018	2.000	1000
8.111	0.002	0.018	2.000	1000
8.222	0.002	0.018	2.000	1000
8.333	0.002	0.019	2.000	1000
8.444	0.002	0.019	2.000	1000
8.555	0.002	0.019	2.000	1000
8.666	0.002	0.019	2.000	1000
8.777	0.002	0.020	2.000	1000
8.888	0.002	0.020	2.000	1000
9.000	0.002	0.020	2.000	1000
9.111	0.002	0.020	2.000	1000
9.222	0.002	0.021	2.000	1000
9.333	0.002	0.021	2.000	1000
9.444	0.002	0.021	2.000	1000
9.555	0.002	0.021	2.000	1000
9.666	0.002	0.022	2.000	1000
9.777	0.002	0.022	2.000	1000
9.888	0.002	0.022	2.000	1000
10.00	0.002	0.023	2.000	1000
10.11	0.002	0.023	2.000	1000

Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.
Element Outlets:
Outlet 1 Outlet 2
Outlet Flows To:

Treatment CB #3

Bottom Length: 10.00 ft.
Bottom Length: 10.00 ft.
Depth: 10 ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1

Threshold Splitter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Primary(cfs)	Secondary(cfs)
0.000	0.002	0.000	2.000	0.000
0.111	0.002	0.000	2.000	0.000
0.222	0.002	0.000	2.000	0.000
0.333	0.002	0.000	2.000	0.000
0.444	0.002	0.001	2.000	0.000
0.555	0.002	0.001	2.000	0.000
0.666	0.002	0.001	2.000	0.000
0.777	0.002	0.001	2.000	0.000
0.888	0.002	0.002	2.000	0.000
1.000	0.002	0.002	2.000	0.000
1.111	0.002	0.002	2.000	0.000
1.222	0.002	0.002	2.000	0.000
1.333	0.002	0.003	2.000	0.000
1.444	0.002	0.003	2.000	0.000
1.555	0.002	0.003	2.000	0.000
1.666	0.002	0.003	2.000	0.000
1.777	0.002	0.004	2.000	0.000
1.888	0.002	0.004	2.000	0.000
2.000	0.002	0.004	2.000	0.000
2.111	0.002	0.004	2.000	0.000
2.222	0.002	0.005	2.000	0.000
2.333	0.002	0.005	2.000	0.000
2.444	0.002	0.005	2.000	0.000
2.555	0.002	0.005	2.000	0.000
2.666	0.002	0.006	2.000	0.000
2.777	0.002	0.006	2.000	0.000
2.888	0.002	0.006	2.000	1000
3.000	0.002	0.006	2.000	1000
3.111	0.002	0.007	2.000	1000
3.222	0.002	0.007	2.000	1000
3.333	0.002	0.007	2.000	1000
3.444	0.002	0.007	2.000	1000
3.555	0.002	0.008	2.000	1000
3.666	0.002	0.008	2.000	1000
3.777	0.002	0.008	2.000	1000
3.888	0.002	0.008	2.000	1000
4.000	0.002	0.009	2.000	1000
4.111	0.002	0.009	2.000	1000
4.222	0.002	0.009	2.000	1000
4.333	0.002	0.009	2.000	1000
4.444	0.002	0.010	2.000	1000
4.555	0.002	0.010	2.000	1000
4.666	0.002	0.010	2.000	1000
4.777	0.002	0.011	2.000	1000
4.888	0.002	0.011	2.000	1000
5.000	0.002	0.011	2.000	1000
5.111	0.002	0.011	2.000	1000

5.222	0.002	0.012	2.000	1000
5.333	0.002	0.012	2.000	1000
5.444	0.002	0.012	2.000	1000
5.555	0.002	0.012	2.000	1000
5.666	0.002	0.013	2.000	1000
5.777	0.002	0.013	2.000	1000
5.888	0.002	0.013	2.000	1000
6.000	0.002	0.013	2.000	1000
6.111	0.002	0.014	2.000	1000
6.222	0.002	0.014	2.000	1000
6.333	0.002	0.014	2.000	1000
6.444	0.002	0.014	2.000	1000
6.555	0.002	0.015	2.000	1000
6.666	0.002	0.015	2.000	1000
6.777	0.002	0.015	2.000	1000
6.888	0.002	0.015	2.000	1000
7.000	0.002	0.016	2.000	1000
7.111	0.002	0.016	2.000	1000
7.222	0.002	0.016	2.000	1000
7.333	0.002	0.016	2.000	1000
7.444	0.002	0.017	2.000	1000
7.555	0.002	0.017	2.000	1000
7.666	0.002	0.017	2.000	1000
7.777	0.002	0.017	2.000	1000
7.888	0.002	0.018	2.000	1000
8.000	0.002	0.018	2.000	1000
8.111	0.002	0.018	2.000	1000
8.222	0.002	0.018	2.000	1000
8.333	0.002	0.019	2.000	1000
8.444	0.002	0.019	2.000	1000
8.555	0.002	0.019	2.000	1000
8.666	0.002	0.019	2.000	1000
8.777	0.002	0.020	2.000	1000
8.888	0.002	0.020	2.000	1000
9.000	0.002	0.020	2.000	1000
9.111	0.002	0.020	2.000	1000
9.222	0.002	0.021	2.000	1000
9.333	0.002	0.021	2.000	1000
9.444	0.002	0.021	2.000	1000
9.555	0.002	0.021	2.000	1000
9.666	0.002	0.022	2.000	1000
9.777	0.002	0.022	2.000	1000
9.888	0.002	0.022	2.000	1000
10.00	0.002	0.023	2.000	1000
10.11	0.002	0.023	2.000	1000

Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.
Element Outlets:
Outlet 1 Outlet 2
Outlet Flows To:

Treatment CB #4

Bottom Length: 10.00 ft.
Bottom Length: 10.00 ft.
Depth: 10 ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1

Threshold Splitter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Primary(cfs)	Secondary(cfs)
0.000	0.002	0.000	2.000	0.000
0.111	0.002	0.000	2.000	0.000
0.222	0.002	0.000	2.000	0.000
0.333	0.002	0.000	2.000	0.000
0.444	0.002	0.001	2.000	0.000
0.555	0.002	0.001	2.000	0.000
0.666	0.002	0.001	2.000	0.000
0.777	0.002	0.001	2.000	0.000
0.888	0.002	0.002	2.000	0.000
1.000	0.002	0.002	2.000	0.000
1.111	0.002	0.002	2.000	0.000
1.222	0.002	0.002	2.000	0.000
1.333	0.002	0.003	2.000	0.000
1.444	0.002	0.003	2.000	0.000
1.555	0.002	0.003	2.000	0.000
1.666	0.002	0.003	2.000	0.000
1.777	0.002	0.004	2.000	0.000
1.888	0.002	0.004	2.000	0.000
2.000	0.002	0.004	2.000	0.000
2.111	0.002	0.004	2.000	0.000
2.222	0.002	0.005	2.000	0.000
2.333	0.002	0.005	2.000	0.000
2.444	0.002	0.005	2.000	0.000
2.555	0.002	0.005	2.000	0.000
2.666	0.002	0.006	2.000	0.000
2.777	0.002	0.006	2.000	0.000
2.888	0.002	0.006	2.000	1000
3.000	0.002	0.006	2.000	1000
3.111	0.002	0.007	2.000	1000
3.222	0.002	0.007	2.000	1000
3.333	0.002	0.007	2.000	1000
3.444	0.002	0.007	2.000	1000
3.555	0.002	0.008	2.000	1000
3.666	0.002	0.008	2.000	1000
3.777	0.002	0.008	2.000	1000
3.888	0.002	0.008	2.000	1000
4.000	0.002	0.009	2.000	1000
4.111	0.002	0.009	2.000	1000
4.222	0.002	0.009	2.000	1000
4.333	0.002	0.009	2.000	1000
4.444	0.002	0.010	2.000	1000
4.555	0.002	0.010	2.000	1000
4.666	0.002	0.010	2.000	1000
4.777	0.002	0.011	2.000	1000
4.888	0.002	0.011	2.000	1000
5.000	0.002	0.011	2.000	1000
5.111	0.002	0.011	2.000	1000

5.222	0.002	0.012	2.000	1000
5.333	0.002	0.012	2.000	1000
5.444	0.002	0.012	2.000	1000
5.555	0.002	0.012	2.000	1000
5.666	0.002	0.013	2.000	1000
5.777	0.002	0.013	2.000	1000
5.888	0.002	0.013	2.000	1000
6.000	0.002	0.013	2.000	1000
6.111	0.002	0.014	2.000	1000
6.222	0.002	0.014	2.000	1000
6.333	0.002	0.014	2.000	1000
6.444	0.002	0.014	2.000	1000
6.555	0.002	0.015	2.000	1000
6.666	0.002	0.015	2.000	1000
6.777	0.002	0.015	2.000	1000
6.888	0.002	0.015	2.000	1000
7.000	0.002	0.016	2.000	1000
7.111	0.002	0.016	2.000	1000
7.222	0.002	0.016	2.000	1000
7.333	0.002	0.016	2.000	1000
7.444	0.002	0.017	2.000	1000
7.555	0.002	0.017	2.000	1000
7.666	0.002	0.017	2.000	1000
7.777	0.002	0.017	2.000	1000
7.888	0.002	0.018	2.000	1000
8.000	0.002	0.018	2.000	1000
8.111	0.002	0.018	2.000	1000
8.222	0.002	0.018	2.000	1000
8.333	0.002	0.019	2.000	1000
8.444	0.002	0.019	2.000	1000
8.555	0.002	0.019	2.000	1000
8.666	0.002	0.019	2.000	1000
8.777	0.002	0.020	2.000	1000
8.888	0.002	0.020	2.000	1000
9.000	0.002	0.020	2.000	1000
9.111	0.002	0.020	2.000	1000
9.222	0.002	0.021	2.000	1000
9.333	0.002	0.021	2.000	1000
9.444	0.002	0.021	2.000	1000
9.555	0.002	0.021	2.000	1000
9.666	0.002	0.022	2.000	1000
9.777	0.002	0.022	2.000	1000
9.888	0.002	0.022	2.000	1000
10.00	0.002	0.023	2.000	1000
10.11	0.002	0.023	2.000	1000

Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.
Element Outlets:
Outlet 1 Outlet 2
Outlet Flows To:

Treatment CB #5

Bottom Length: 10.00 ft.
Bottom Length: 10.00 ft.
Depth: 10 ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1

Threshold Splitter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Primary(cfs)	Secondary(cfs)
0.000	0.002	0.000	2.000	0.000
0.111	0.002	0.000	2.000	0.000
0.222	0.002	0.000	2.000	0.000
0.333	0.002	0.000	2.000	0.000
0.444	0.002	0.001	2.000	0.000
0.555	0.002	0.001	2.000	0.000
0.666	0.002	0.001	2.000	0.000
0.777	0.002	0.001	2.000	0.000
0.888	0.002	0.002	2.000	0.000
1.000	0.002	0.002	2.000	0.000
1.111	0.002	0.002	2.000	0.000
1.222	0.002	0.002	2.000	0.000
1.333	0.002	0.003	2.000	0.000
1.444	0.002	0.003	2.000	0.000
1.555	0.002	0.003	2.000	0.000
1.666	0.002	0.003	2.000	0.000
1.777	0.002	0.004	2.000	0.000
1.888	0.002	0.004	2.000	0.000
2.000	0.002	0.004	2.000	0.000
2.111	0.002	0.004	2.000	0.000
2.222	0.002	0.005	2.000	0.000
2.333	0.002	0.005	2.000	0.000
2.444	0.002	0.005	2.000	0.000
2.555	0.002	0.005	2.000	0.000
2.666	0.002	0.006	2.000	0.000
2.777	0.002	0.006	2.000	0.000
2.888	0.002	0.006	2.000	1000
3.000	0.002	0.006	2.000	1000
3.111	0.002	0.007	2.000	1000
3.222	0.002	0.007	2.000	1000
3.333	0.002	0.007	2.000	1000
3.444	0.002	0.007	2.000	1000
3.555	0.002	0.008	2.000	1000
3.666	0.002	0.008	2.000	1000
3.777	0.002	0.008	2.000	1000
3.888	0.002	0.008	2.000	1000
4.000	0.002	0.009	2.000	1000
4.111	0.002	0.009	2.000	1000
4.222	0.002	0.009	2.000	1000
4.333	0.002	0.009	2.000	1000
4.444	0.002	0.010	2.000	1000
4.555	0.002	0.010	2.000	1000
4.666	0.002	0.010	2.000	1000
4.777	0.002	0.011	2.000	1000
4.888	0.002	0.011	2.000	1000
5.000	0.002	0.011	2.000	1000
5.111	0.002	0.011	2.000	1000

5.222	0.002	0.012	2.000	1000
5.333	0.002	0.012	2.000	1000
5.444	0.002	0.012	2.000	1000
5.555	0.002	0.012	2.000	1000
5.666	0.002	0.013	2.000	1000
5.777	0.002	0.013	2.000	1000
5.888	0.002	0.013	2.000	1000
6.000	0.002	0.013	2.000	1000
6.111	0.002	0.014	2.000	1000
6.222	0.002	0.014	2.000	1000
6.333	0.002	0.014	2.000	1000
6.444	0.002	0.014	2.000	1000
6.555	0.002	0.015	2.000	1000
6.666	0.002	0.015	2.000	1000
6.777	0.002	0.015	2.000	1000
6.888	0.002	0.015	2.000	1000
7.000	0.002	0.016	2.000	1000
7.111	0.002	0.016	2.000	1000
7.222	0.002	0.016	2.000	1000
7.333	0.002	0.016	2.000	1000
7.444	0.002	0.017	2.000	1000
7.555	0.002	0.017	2.000	1000
7.666	0.002	0.017	2.000	1000
7.777	0.002	0.017	2.000	1000
7.888	0.002	0.018	2.000	1000
8.000	0.002	0.018	2.000	1000
8.111	0.002	0.018	2.000	1000
8.222	0.002	0.018	2.000	1000
8.333	0.002	0.019	2.000	1000
8.444	0.002	0.019	2.000	1000
8.555	0.002	0.019	2.000	1000
8.666	0.002	0.019	2.000	1000
8.777	0.002	0.020	2.000	1000
8.888	0.002	0.020	2.000	1000
9.000	0.002	0.020	2.000	1000
9.111	0.002	0.020	2.000	1000
9.222	0.002	0.021	2.000	1000
9.333	0.002	0.021	2.000	1000
9.444	0.002	0.021	2.000	1000
9.555	0.002	0.021	2.000	1000
9.666	0.002	0.022	2.000	1000
9.777	0.002	0.022	2.000	1000
9.888	0.002	0.022	2.000	1000
10.00	0.002	0.023	2.000	1000
10.11	0.002	0.023	2.000	1000

Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.
Element Outlets:
Outlet 1 Outlet 2
Outlet Flows To:

Treatment CB #6

Bottom Length: 10.00 ft.
Bottom Length: 10.00 ft.
Depth: 10 ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1

Threshold Splitter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Primary(cfs)	Secondary(cfs)
0.000	0.002	0.000	2.000	0.000
0.111	0.002	0.000	2.000	0.000
0.222	0.002	0.000	2.000	0.000
0.333	0.002	0.000	2.000	0.000
0.444	0.002	0.001	2.000	0.000
0.555	0.002	0.001	2.000	0.000
0.666	0.002	0.001	2.000	0.000
0.777	0.002	0.001	2.000	0.000
0.888	0.002	0.002	2.000	0.000
1.000	0.002	0.002	2.000	0.000
1.111	0.002	0.002	2.000	0.000
1.222	0.002	0.002	2.000	0.000
1.333	0.002	0.003	2.000	0.000
1.444	0.002	0.003	2.000	0.000
1.555	0.002	0.003	2.000	0.000
1.666	0.002	0.003	2.000	0.000
1.777	0.002	0.004	2.000	0.000
1.888	0.002	0.004	2.000	0.000
2.000	0.002	0.004	2.000	0.000
2.111	0.002	0.004	2.000	0.000
2.222	0.002	0.005	2.000	0.000
2.333	0.002	0.005	2.000	0.000
2.444	0.002	0.005	2.000	0.000
2.555	0.002	0.005	2.000	0.000
2.666	0.002	0.006	2.000	0.000
2.777	0.002	0.006	2.000	0.000
2.888	0.002	0.006	2.000	1000
3.000	0.002	0.006	2.000	1000
3.111	0.002	0.007	2.000	1000
3.222	0.002	0.007	2.000	1000
3.333	0.002	0.007	2.000	1000
3.444	0.002	0.007	2.000	1000
3.555	0.002	0.008	2.000	1000
3.666	0.002	0.008	2.000	1000
3.777	0.002	0.008	2.000	1000
3.888	0.002	0.008	2.000	1000
4.000	0.002	0.009	2.000	1000
4.111	0.002	0.009	2.000	1000
4.222	0.002	0.009	2.000	1000
4.333	0.002	0.009	2.000	1000
4.444	0.002	0.010	2.000	1000
4.555	0.002	0.010	2.000	1000
4.666	0.002	0.010	2.000	1000
4.777	0.002	0.011	2.000	1000
4.888	0.002	0.011	2.000	1000
5.000	0.002	0.011	2.000	1000
5.111	0.002	0.011	2.000	1000

5.222	0.002	0.012	2.000	1000
5.333	0.002	0.012	2.000	1000
5.444	0.002	0.012	2.000	1000
5.555	0.002	0.012	2.000	1000
5.666	0.002	0.013	2.000	1000
5.777	0.002	0.013	2.000	1000
5.888	0.002	0.013	2.000	1000
6.000	0.002	0.013	2.000	1000
6.111	0.002	0.014	2.000	1000
6.222	0.002	0.014	2.000	1000
6.333	0.002	0.014	2.000	1000
6.444	0.002	0.014	2.000	1000
6.555	0.002	0.015	2.000	1000
6.666	0.002	0.015	2.000	1000
6.777	0.002	0.015	2.000	1000
6.888	0.002	0.015	2.000	1000
7.000	0.002	0.016	2.000	1000
7.111	0.002	0.016	2.000	1000
7.222	0.002	0.016	2.000	1000
7.333	0.002	0.016	2.000	1000
7.444	0.002	0.017	2.000	1000
7.555	0.002	0.017	2.000	1000
7.666	0.002	0.017	2.000	1000
7.777	0.002	0.017	2.000	1000
7.888	0.002	0.018	2.000	1000
8.000	0.002	0.018	2.000	1000
8.111	0.002	0.018	2.000	1000
8.222	0.002	0.018	2.000	1000
8.333	0.002	0.019	2.000	1000
8.444	0.002	0.019	2.000	1000
8.555	0.002	0.019	2.000	1000
8.666	0.002	0.019	2.000	1000
8.777	0.002	0.020	2.000	1000
8.888	0.002	0.020	2.000	1000
9.000	0.002	0.020	2.000	1000
9.111	0.002	0.020	2.000	1000
9.222	0.002	0.021	2.000	1000
9.333	0.002	0.021	2.000	1000
9.444	0.002	0.021	2.000	1000
9.555	0.002	0.021	2.000	1000
9.666	0.002	0.022	2.000	1000
9.777	0.002	0.022	2.000	1000
9.888	0.002	0.022	2.000	1000
10.00	0.002	0.023	2.000	1000
10.11	0.002	0.023	2.000	1000

Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.
Element Outlets:
Outlet 1 Outlet 2
Outlet Flows To:

Treatment CB #7

Bottom Length: 10.00 ft.
Bottom Length: 10.00 ft.
Depth: 10 ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1

Threshold Splitter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Primary(cfs)	Secondary(cfs)
0.000	0.002	0.000	2.000	0.000
0.111	0.002	0.000	2.000	0.000
0.222	0.002	0.000	2.000	0.000
0.333	0.002	0.000	2.000	0.000
0.444	0.002	0.001	2.000	0.000
0.555	0.002	0.001	2.000	0.000
0.666	0.002	0.001	2.000	0.000
0.777	0.002	0.001	2.000	0.000
0.888	0.002	0.002	2.000	0.000
1.000	0.002	0.002	2.000	0.000
1.111	0.002	0.002	2.000	0.000
1.222	0.002	0.002	2.000	0.000
1.333	0.002	0.003	2.000	0.000
1.444	0.002	0.003	2.000	0.000
1.555	0.002	0.003	2.000	0.000
1.666	0.002	0.003	2.000	0.000
1.777	0.002	0.004	2.000	0.000
1.888	0.002	0.004	2.000	0.000
2.000	0.002	0.004	2.000	0.000
2.111	0.002	0.004	2.000	0.000
2.222	0.002	0.005	2.000	0.000
2.333	0.002	0.005	2.000	0.000
2.444	0.002	0.005	2.000	0.000
2.555	0.002	0.005	2.000	0.000
2.666	0.002	0.006	2.000	0.000
2.777	0.002	0.006	2.000	0.000
2.888	0.002	0.006	2.000	1000
3.000	0.002	0.006	2.000	1000
3.111	0.002	0.007	2.000	1000
3.222	0.002	0.007	2.000	1000
3.333	0.002	0.007	2.000	1000
3.444	0.002	0.007	2.000	1000
3.555	0.002	0.008	2.000	1000
3.666	0.002	0.008	2.000	1000
3.777	0.002	0.008	2.000	1000
3.888	0.002	0.008	2.000	1000
4.000	0.002	0.009	2.000	1000
4.111	0.002	0.009	2.000	1000
4.222	0.002	0.009	2.000	1000
4.333	0.002	0.009	2.000	1000
4.444	0.002	0.010	2.000	1000
4.555	0.002	0.010	2.000	1000
4.666	0.002	0.010	2.000	1000
4.777	0.002	0.011	2.000	1000
4.888	0.002	0.011	2.000	1000
5.000	0.002	0.011	2.000	1000
5.111	0.002	0.011	2.000	1000

5.222	0.002	0.012	2.000	1000
5.333	0.002	0.012	2.000	1000
5.444	0.002	0.012	2.000	1000
5.555	0.002	0.012	2.000	1000
5.666	0.002	0.013	2.000	1000
5.777	0.002	0.013	2.000	1000
5.888	0.002	0.013	2.000	1000
6.000	0.002	0.013	2.000	1000
6.111	0.002	0.014	2.000	1000
6.222	0.002	0.014	2.000	1000
6.333	0.002	0.014	2.000	1000
6.444	0.002	0.014	2.000	1000
6.555	0.002	0.015	2.000	1000
6.666	0.002	0.015	2.000	1000
6.777	0.002	0.015	2.000	1000
6.888	0.002	0.015	2.000	1000
7.000	0.002	0.016	2.000	1000
7.111	0.002	0.016	2.000	1000
7.222	0.002	0.016	2.000	1000
7.333	0.002	0.016	2.000	1000
7.444	0.002	0.017	2.000	1000
7.555	0.002	0.017	2.000	1000
7.666	0.002	0.017	2.000	1000
7.777	0.002	0.017	2.000	1000
7.888	0.002	0.018	2.000	1000
8.000	0.002	0.018	2.000	1000
8.111	0.002	0.018	2.000	1000
8.222	0.002	0.018	2.000	1000
8.333	0.002	0.019	2.000	1000
8.444	0.002	0.019	2.000	1000
8.555	0.002	0.019	2.000	1000
8.666	0.002	0.019	2.000	1000
8.777	0.002	0.020	2.000	1000
8.888	0.002	0.020	2.000	1000
9.000	0.002	0.020	2.000	1000
9.111	0.002	0.020	2.000	1000
9.222	0.002	0.021	2.000	1000
9.333	0.002	0.021	2.000	1000
9.444	0.002	0.021	2.000	1000
9.555	0.002	0.021	2.000	1000
9.666	0.002	0.022	2.000	1000
9.777	0.002	0.022	2.000	1000
9.888	0.002	0.022	2.000	1000
10.00	0.002	0.023	2.000	1000
10.11	0.002	0.023	2.000	1000

Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.
Element Outlets:
Outlet 1 Outlet 2
Outlet Flows To:

Treatment CB #8

Bottom Length: 10.00 ft.
Bottom Length: 10.00 ft.
Depth: 10 ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1

Threshold Splitter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Primary(cfs)	Secondary(cfs)
0.000	0.002	0.000	2.000	0.000
0.111	0.002	0.000	2.000	0.000
0.222	0.002	0.000	2.000	0.000
0.333	0.002	0.000	2.000	0.000
0.444	0.002	0.001	2.000	0.000
0.555	0.002	0.001	2.000	0.000
0.666	0.002	0.001	2.000	0.000
0.777	0.002	0.001	2.000	0.000
0.888	0.002	0.002	2.000	0.000
1.000	0.002	0.002	2.000	0.000
1.111	0.002	0.002	2.000	0.000
1.222	0.002	0.002	2.000	0.000
1.333	0.002	0.003	2.000	0.000
1.444	0.002	0.003	2.000	0.000
1.555	0.002	0.003	2.000	0.000
1.666	0.002	0.003	2.000	0.000
1.777	0.002	0.004	2.000	0.000
1.888	0.002	0.004	2.000	0.000
2.000	0.002	0.004	2.000	0.000
2.111	0.002	0.004	2.000	0.000
2.222	0.002	0.005	2.000	0.000
2.333	0.002	0.005	2.000	0.000
2.444	0.002	0.005	2.000	0.000
2.555	0.002	0.005	2.000	0.000
2.666	0.002	0.006	2.000	0.000
2.777	0.002	0.006	2.000	0.000
2.888	0.002	0.006	2.000	1000
3.000	0.002	0.006	2.000	1000
3.111	0.002	0.007	2.000	1000
3.222	0.002	0.007	2.000	1000
3.333	0.002	0.007	2.000	1000
3.444	0.002	0.007	2.000	1000
3.555	0.002	0.008	2.000	1000
3.666	0.002	0.008	2.000	1000
3.777	0.002	0.008	2.000	1000
3.888	0.002	0.008	2.000	1000
4.000	0.002	0.009	2.000	1000
4.111	0.002	0.009	2.000	1000
4.222	0.002	0.009	2.000	1000
4.333	0.002	0.009	2.000	1000
4.444	0.002	0.010	2.000	1000
4.555	0.002	0.010	2.000	1000
4.666	0.002	0.010	2.000	1000
4.777	0.002	0.011	2.000	1000
4.888	0.002	0.011	2.000	1000
5.000	0.002	0.011	2.000	1000
5.111	0.002	0.011	2.000	1000

5.222	0.002	0.012	2.000	1000
5.333	0.002	0.012	2.000	1000
5.444	0.002	0.012	2.000	1000
5.555	0.002	0.012	2.000	1000
5.666	0.002	0.013	2.000	1000
5.777	0.002	0.013	2.000	1000
5.888	0.002	0.013	2.000	1000
6.000	0.002	0.013	2.000	1000
6.111	0.002	0.014	2.000	1000
6.222	0.002	0.014	2.000	1000
6.333	0.002	0.014	2.000	1000
6.444	0.002	0.014	2.000	1000
6.555	0.002	0.015	2.000	1000
6.666	0.002	0.015	2.000	1000
6.777	0.002	0.015	2.000	1000
6.888	0.002	0.015	2.000	1000
7.000	0.002	0.016	2.000	1000
7.111	0.002	0.016	2.000	1000
7.222	0.002	0.016	2.000	1000
7.333	0.002	0.016	2.000	1000
7.444	0.002	0.017	2.000	1000
7.555	0.002	0.017	2.000	1000
7.666	0.002	0.017	2.000	1000
7.777	0.002	0.017	2.000	1000
7.888	0.002	0.018	2.000	1000
8.000	0.002	0.018	2.000	1000
8.111	0.002	0.018	2.000	1000
8.222	0.002	0.018	2.000	1000
8.333	0.002	0.019	2.000	1000
8.444	0.002	0.019	2.000	1000
8.555	0.002	0.019	2.000	1000
8.666	0.002	0.019	2.000	1000
8.777	0.002	0.020	2.000	1000
8.888	0.002	0.020	2.000	1000
9.000	0.002	0.020	2.000	1000
9.111	0.002	0.020	2.000	1000
9.222	0.002	0.021	2.000	1000
9.333	0.002	0.021	2.000	1000
9.444	0.002	0.021	2.000	1000
9.555	0.002	0.021	2.000	1000
9.666	0.002	0.022	2.000	1000
9.777	0.002	0.022	2.000	1000
9.888	0.002	0.022	2.000	1000
10.00	0.002	0.023	2.000	1000
10.11	0.002	0.023	2.000	1000

Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.
Element Outlets:
Outlet 1 Outlet 2
Outlet Flows To:

Treatment CB #9

Bottom Length: 10.00 ft.
Bottom Length: 10.00 ft.
Depth: 10 ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1

Threshold Splitter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Primary(cfs)	Secondary(cfs)
0.000	0.002	0.000	2.000	0.000
0.111	0.002	0.000	2.000	0.000
0.222	0.002	0.000	2.000	0.000
0.333	0.002	0.000	2.000	0.000
0.444	0.002	0.001	2.000	0.000
0.555	0.002	0.001	2.000	0.000
0.666	0.002	0.001	2.000	0.000
0.777	0.002	0.001	2.000	0.000
0.888	0.002	0.002	2.000	0.000
1.000	0.002	0.002	2.000	0.000
1.111	0.002	0.002	2.000	0.000
1.222	0.002	0.002	2.000	0.000
1.333	0.002	0.003	2.000	0.000
1.444	0.002	0.003	2.000	0.000
1.555	0.002	0.003	2.000	0.000
1.666	0.002	0.003	2.000	0.000
1.777	0.002	0.004	2.000	0.000
1.888	0.002	0.004	2.000	0.000
2.000	0.002	0.004	2.000	0.000
2.111	0.002	0.004	2.000	0.000
2.222	0.002	0.005	2.000	0.000
2.333	0.002	0.005	2.000	0.000
2.444	0.002	0.005	2.000	0.000
2.555	0.002	0.005	2.000	0.000
2.666	0.002	0.006	2.000	0.000
2.777	0.002	0.006	2.000	0.000
2.888	0.002	0.006	2.000	1000
3.000	0.002	0.006	2.000	1000
3.111	0.002	0.007	2.000	1000
3.222	0.002	0.007	2.000	1000
3.333	0.002	0.007	2.000	1000
3.444	0.002	0.007	2.000	1000
3.555	0.002	0.008	2.000	1000
3.666	0.002	0.008	2.000	1000
3.777	0.002	0.008	2.000	1000
3.888	0.002	0.008	2.000	1000
4.000	0.002	0.009	2.000	1000
4.111	0.002	0.009	2.000	1000
4.222	0.002	0.009	2.000	1000
4.333	0.002	0.009	2.000	1000
4.444	0.002	0.010	2.000	1000
4.555	0.002	0.010	2.000	1000
4.666	0.002	0.010	2.000	1000
4.777	0.002	0.011	2.000	1000
4.888	0.002	0.011	2.000	1000
5.000	0.002	0.011	2.000	1000
5.111	0.002	0.011	2.000	1000

5.222	0.002	0.012	2.000	1000
5.333	0.002	0.012	2.000	1000
5.444	0.002	0.012	2.000	1000
5.555	0.002	0.012	2.000	1000
5.666	0.002	0.013	2.000	1000
5.777	0.002	0.013	2.000	1000
5.888	0.002	0.013	2.000	1000
6.000	0.002	0.013	2.000	1000
6.111	0.002	0.014	2.000	1000
6.222	0.002	0.014	2.000	1000
6.333	0.002	0.014	2.000	1000
6.444	0.002	0.014	2.000	1000
6.555	0.002	0.015	2.000	1000
6.666	0.002	0.015	2.000	1000
6.777	0.002	0.015	2.000	1000
6.888	0.002	0.015	2.000	1000
7.000	0.002	0.016	2.000	1000
7.111	0.002	0.016	2.000	1000
7.222	0.002	0.016	2.000	1000
7.333	0.002	0.016	2.000	1000
7.444	0.002	0.017	2.000	1000
7.555	0.002	0.017	2.000	1000
7.666	0.002	0.017	2.000	1000
7.777	0.002	0.017	2.000	1000
7.888	0.002	0.018	2.000	1000
8.000	0.002	0.018	2.000	1000
8.111	0.002	0.018	2.000	1000
8.222	0.002	0.018	2.000	1000
8.333	0.002	0.019	2.000	1000
8.444	0.002	0.019	2.000	1000
8.555	0.002	0.019	2.000	1000
8.666	0.002	0.019	2.000	1000
8.777	0.002	0.020	2.000	1000
8.888	0.002	0.020	2.000	1000
9.000	0.002	0.020	2.000	1000
9.111	0.002	0.020	2.000	1000
9.222	0.002	0.021	2.000	1000
9.333	0.002	0.021	2.000	1000
9.444	0.002	0.021	2.000	1000
9.555	0.002	0.021	2.000	1000
9.666	0.002	0.022	2.000	1000
9.777	0.002	0.022	2.000	1000
9.888	0.002	0.022	2.000	1000
10.00	0.002	0.023	2.000	1000
10.11	0.002	0.023	2.000	1000

Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.
Element Outlets:
Outlet 1 Outlet 2
Outlet Flows To:

Treatment CB #10

Bottom Length: 10.00 ft.
Bottom Length: 10.00 ft.
Depth: 10 ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1

Threshold Splitter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Primary(cfs)	Secondary(cfs)
0.000	0.002	0.000	2.000	0.000
0.111	0.002	0.000	2.000	0.000
0.222	0.002	0.000	2.000	0.000
0.333	0.002	0.000	2.000	0.000
0.444	0.002	0.001	2.000	0.000
0.555	0.002	0.001	2.000	0.000
0.666	0.002	0.001	2.000	0.000
0.777	0.002	0.001	2.000	0.000
0.888	0.002	0.002	2.000	0.000
1.000	0.002	0.002	2.000	0.000
1.111	0.002	0.002	2.000	0.000
1.222	0.002	0.002	2.000	0.000
1.333	0.002	0.003	2.000	0.000
1.444	0.002	0.003	2.000	0.000
1.555	0.002	0.003	2.000	0.000
1.666	0.002	0.003	2.000	0.000
1.777	0.002	0.004	2.000	0.000
1.888	0.002	0.004	2.000	0.000
2.000	0.002	0.004	2.000	0.000
2.111	0.002	0.004	2.000	0.000
2.222	0.002	0.005	2.000	0.000
2.333	0.002	0.005	2.000	0.000
2.444	0.002	0.005	2.000	0.000
2.555	0.002	0.005	2.000	0.000
2.666	0.002	0.006	2.000	0.000
2.777	0.002	0.006	2.000	0.000
2.888	0.002	0.006	2.000	1000
3.000	0.002	0.006	2.000	1000
3.111	0.002	0.007	2.000	1000
3.222	0.002	0.007	2.000	1000
3.333	0.002	0.007	2.000	1000
3.444	0.002	0.007	2.000	1000
3.555	0.002	0.008	2.000	1000
3.666	0.002	0.008	2.000	1000
3.777	0.002	0.008	2.000	1000
3.888	0.002	0.008	2.000	1000
4.000	0.002	0.009	2.000	1000
4.111	0.002	0.009	2.000	1000
4.222	0.002	0.009	2.000	1000
4.333	0.002	0.009	2.000	1000
4.444	0.002	0.010	2.000	1000
4.555	0.002	0.010	2.000	1000
4.666	0.002	0.010	2.000	1000
4.777	0.002	0.011	2.000	1000
4.888	0.002	0.011	2.000	1000
5.000	0.002	0.011	2.000	1000
5.111	0.002	0.011	2.000	1000

5.222	0.002	0.012	2.000	1000
5.333	0.002	0.012	2.000	1000
5.444	0.002	0.012	2.000	1000
5.555	0.002	0.012	2.000	1000
5.666	0.002	0.013	2.000	1000
5.777	0.002	0.013	2.000	1000
5.888	0.002	0.013	2.000	1000
6.000	0.002	0.013	2.000	1000
6.111	0.002	0.014	2.000	1000
6.222	0.002	0.014	2.000	1000
6.333	0.002	0.014	2.000	1000
6.444	0.002	0.014	2.000	1000
6.555	0.002	0.015	2.000	1000
6.666	0.002	0.015	2.000	1000
6.777	0.002	0.015	2.000	1000
6.888	0.002	0.015	2.000	1000
7.000	0.002	0.016	2.000	1000
7.111	0.002	0.016	2.000	1000
7.222	0.002	0.016	2.000	1000
7.333	0.002	0.016	2.000	1000
7.444	0.002	0.017	2.000	1000
7.555	0.002	0.017	2.000	1000
7.666	0.002	0.017	2.000	1000
7.777	0.002	0.017	2.000	1000
7.888	0.002	0.018	2.000	1000
8.000	0.002	0.018	2.000	1000
8.111	0.002	0.018	2.000	1000
8.222	0.002	0.018	2.000	1000
8.333	0.002	0.019	2.000	1000
8.444	0.002	0.019	2.000	1000
8.555	0.002	0.019	2.000	1000
8.666	0.002	0.019	2.000	1000
8.777	0.002	0.020	2.000	1000
8.888	0.002	0.020	2.000	1000
9.000	0.002	0.020	2.000	1000
9.111	0.002	0.020	2.000	1000
9.222	0.002	0.021	2.000	1000
9.333	0.002	0.021	2.000	1000
9.444	0.002	0.021	2.000	1000
9.555	0.002	0.021	2.000	1000
9.666	0.002	0.022	2.000	1000
9.777	0.002	0.022	2.000	1000
9.888	0.002	0.022	2.000	1000
10.00	0.002	0.023	2.000	1000
10.11	0.002	0.023	2.000	1000

Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.
Element Outlets:
Outlet 1 Outlet 2
Outlet Flows To:

Treatment CB #11

Bottom Length: 10.00 ft.
Bottom Length: 10.00 ft.
Depth: 10 ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1

Threshold Splitter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Primary(cfs)	Secondary(cfs)
0.000	0.002	0.000	2.000	0.000
0.111	0.002	0.000	2.000	0.000
0.222	0.002	0.000	2.000	0.000
0.333	0.002	0.000	2.000	0.000
0.444	0.002	0.001	2.000	0.000
0.555	0.002	0.001	2.000	0.000
0.666	0.002	0.001	2.000	0.000
0.777	0.002	0.001	2.000	0.000
0.888	0.002	0.002	2.000	0.000
1.000	0.002	0.002	2.000	0.000
1.111	0.002	0.002	2.000	0.000
1.222	0.002	0.002	2.000	0.000
1.333	0.002	0.003	2.000	0.000
1.444	0.002	0.003	2.000	0.000
1.555	0.002	0.003	2.000	0.000
1.666	0.002	0.003	2.000	0.000
1.777	0.002	0.004	2.000	0.000
1.888	0.002	0.004	2.000	0.000
2.000	0.002	0.004	2.000	0.000
2.111	0.002	0.004	2.000	0.000
2.222	0.002	0.005	2.000	0.000
2.333	0.002	0.005	2.000	0.000
2.444	0.002	0.005	2.000	0.000
2.555	0.002	0.005	2.000	0.000
2.666	0.002	0.006	2.000	0.000
2.777	0.002	0.006	2.000	0.000
2.888	0.002	0.006	2.000	1000
3.000	0.002	0.006	2.000	1000
3.111	0.002	0.007	2.000	1000
3.222	0.002	0.007	2.000	1000
3.333	0.002	0.007	2.000	1000
3.444	0.002	0.007	2.000	1000
3.555	0.002	0.008	2.000	1000
3.666	0.002	0.008	2.000	1000
3.777	0.002	0.008	2.000	1000
3.888	0.002	0.008	2.000	1000
4.000	0.002	0.009	2.000	1000
4.111	0.002	0.009	2.000	1000
4.222	0.002	0.009	2.000	1000
4.333	0.002	0.009	2.000	1000
4.444	0.002	0.010	2.000	1000
4.555	0.002	0.010	2.000	1000
4.666	0.002	0.010	2.000	1000
4.777	0.002	0.011	2.000	1000
4.888	0.002	0.011	2.000	1000
5.000	0.002	0.011	2.000	1000
5.111	0.002	0.011	2.000	1000

5.222	0.002	0.012	2.000	1000
5.333	0.002	0.012	2.000	1000
5.444	0.002	0.012	2.000	1000
5.555	0.002	0.012	2.000	1000
5.666	0.002	0.013	2.000	1000
5.777	0.002	0.013	2.000	1000
5.888	0.002	0.013	2.000	1000
6.000	0.002	0.013	2.000	1000
6.111	0.002	0.014	2.000	1000
6.222	0.002	0.014	2.000	1000
6.333	0.002	0.014	2.000	1000
6.444	0.002	0.014	2.000	1000
6.555	0.002	0.015	2.000	1000
6.666	0.002	0.015	2.000	1000
6.777	0.002	0.015	2.000	1000
6.888	0.002	0.015	2.000	1000
7.000	0.002	0.016	2.000	1000
7.111	0.002	0.016	2.000	1000
7.222	0.002	0.016	2.000	1000
7.333	0.002	0.016	2.000	1000
7.444	0.002	0.017	2.000	1000
7.555	0.002	0.017	2.000	1000
7.666	0.002	0.017	2.000	1000
7.777	0.002	0.017	2.000	1000
7.888	0.002	0.018	2.000	1000
8.000	0.002	0.018	2.000	1000
8.111	0.002	0.018	2.000	1000
8.222	0.002	0.018	2.000	1000
8.333	0.002	0.019	2.000	1000
8.444	0.002	0.019	2.000	1000
8.555	0.002	0.019	2.000	1000
8.666	0.002	0.019	2.000	1000
8.777	0.002	0.020	2.000	1000
8.888	0.002	0.020	2.000	1000
9.000	0.002	0.020	2.000	1000
9.111	0.002	0.020	2.000	1000
9.222	0.002	0.021	2.000	1000
9.333	0.002	0.021	2.000	1000
9.444	0.002	0.021	2.000	1000
9.555	0.002	0.021	2.000	1000
9.666	0.002	0.022	2.000	1000
9.777	0.002	0.022	2.000	1000
9.888	0.002	0.022	2.000	1000
10.00	0.002	0.023	2.000	1000
10.11	0.002	0.023	2.000	1000

Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.
Element Outlets:
Outlet 1 Outlet 2
Outlet Flows To:

Treatment CB #12

Bottom Length: 10.00 ft.
Bottom Length: 10.00 ft.
Depth: 10 ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1

Threshold Splitter Hydraulic Table

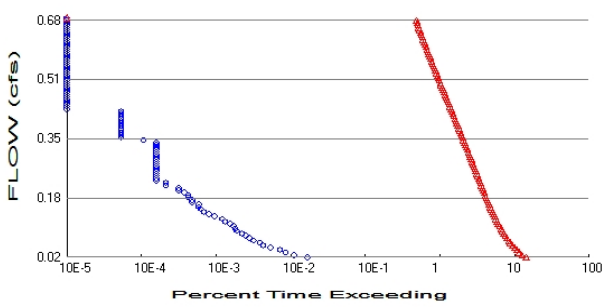
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Primary(cfs)	Secondary(cfs)
0.000	0.002	0.000	2.000	0.000
0.111	0.002	0.000	2.000	0.000
0.222	0.002	0.000	2.000	0.000
0.333	0.002	0.000	2.000	0.000
0.444	0.002	0.001	2.000	0.000
0.555	0.002	0.001	2.000	0.000
0.666	0.002	0.001	2.000	0.000
0.777	0.002	0.001	2.000	0.000
0.888	0.002	0.002	2.000	0.000
1.000	0.002	0.002	2.000	0.000
1.111	0.002	0.002	2.000	0.000
1.222	0.002	0.002	2.000	0.000
1.333	0.002	0.003	2.000	0.000
1.444	0.002	0.003	2.000	0.000
1.555	0.002	0.003	2.000	0.000
1.666	0.002	0.003	2.000	0.000
1.777	0.002	0.004	2.000	0.000
1.888	0.002	0.004	2.000	0.000
2.000	0.002	0.004	2.000	0.000
2.111	0.002	0.004	2.000	0.000
2.222	0.002	0.005	2.000	0.000
2.333	0.002	0.005	2.000	0.000
2.444	0.002	0.005	2.000	0.000
2.555	0.002	0.005	2.000	0.000
2.666	0.002	0.006	2.000	0.000
2.777	0.002	0.006	2.000	0.000
2.888	0.002	0.006	2.000	1000
3.000	0.002	0.006	2.000	1000
3.111	0.002	0.007	2.000	1000
3.222	0.002	0.007	2.000	1000
3.333	0.002	0.007	2.000	1000
3.444	0.002	0.007	2.000	1000
3.555	0.002	0.008	2.000	1000
3.666	0.002	0.008	2.000	1000
3.777	0.002	0.008	2.000	1000
3.888	0.002	0.008	2.000	1000
4.000	0.002	0.009	2.000	1000
4.111	0.002	0.009	2.000	1000
4.222	0.002	0.009	2.000	1000
4.333	0.002	0.009	2.000	1000
4.444	0.002	0.010	2.000	1000
4.555	0.002	0.010	2.000	1000
4.666	0.002	0.010	2.000	1000
4.777	0.002	0.011	2.000	1000
4.888	0.002	0.011	2.000	1000
5.000	0.002	0.011	2.000	1000
5.111	0.002	0.011	2.000	1000

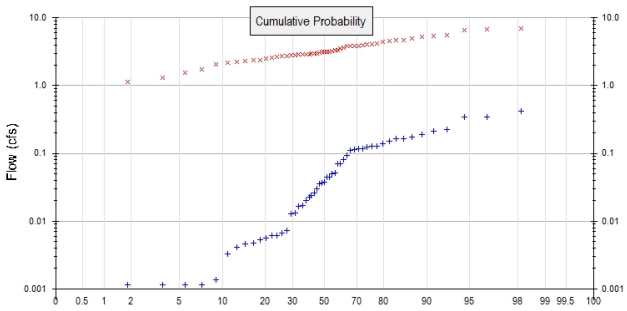
5.222	0.002	0.012	2.000	1000
5.333	0.002	0.012	2.000	1000
5.444	0.002	0.012	2.000	1000
5.555	0.002	0.012	2.000	1000
5.666	0.002	0.013	2.000	1000
5.777	0.002	0.013	2.000	1000
5.888	0.002	0.013	2.000	1000
6.000	0.002	0.013	2.000	1000
6.111	0.002	0.014	2.000	1000
6.222	0.002	0.014	2.000	1000
6.333	0.002	0.014	2.000	1000
6.444	0.002	0.014	2.000	1000
6.555	0.002	0.015	2.000	1000
6.666	0.002	0.015	2.000	1000
6.777	0.002	0.015	2.000	1000
6.888	0.002	0.015	2.000	1000
7.000	0.002	0.016	2.000	1000
7.111	0.002	0.016	2.000	1000
7.222	0.002	0.016	2.000	1000
7.333	0.002	0.016	2.000	1000
7.444	0.002	0.017	2.000	1000
7.555	0.002	0.017	2.000	1000
7.666	0.002	0.017	2.000	1000
7.777	0.002	0.017	2.000	1000
7.888	0.002	0.018	2.000	1000
8.000	0.002	0.018	2.000	1000
8.111	0.002	0.018	2.000	1000
8.222	0.002	0.018	2.000	1000
8.333	0.002	0.019	2.000	1000
8.444	0.002	0.019	2.000	1000
8.555	0.002	0.019	2.000	1000
8.666	0.002	0.019	2.000	1000
8.777	0.002	0.020	2.000	1000
8.888	0.002	0.020	2.000	1000
9.000	0.002	0.020	2.000	1000
9.111	0.002	0.020	2.000	1000
9.222	0.002	0.021	2.000	1000
9.333	0.002	0.021	2.000	1000
9.444	0.002	0.021	2.000	1000
9.555	0.002	0.021	2.000	1000
9.666	0.002	0.022	2.000	1000
9.777	0.002	0.022	2.000	1000
9.888	0.002	0.022	2.000	1000
10.00	0.002	0.023	2.000	1000
10.11	0.002	0.023	2.000	1000

Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.
Element Outlets:
Outlet 1 Outlet 2
Outlet Flows To:

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 1.44
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 1.06
Total Impervious Area: 2.04

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.031703
5 year	0.124202
10 year	0.238198
25 year	0.455668
50 year	0.676105
100 year	0.948859

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	3.266628
5 year	4.477324
10 year	5.164345
25 year	5.919529
50 year	6.411893
100 year	6.853152

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	0.224	4.225
1957	0.023	4.618
1958	0.343	4.690
1959	0.082	3.109
1960	0.341	4.901
1961	0.166	3.842
1962	0.423	4.487
1963	0.125	5.411
1964	0.070	3.366
1965	0.037	3.119

1966	0.005	2.898
1967	0.017	2.346
1968	0.003	2.025
1969	0.017	2.967
1970	0.024	2.240
1971	0.152	3.539
1972	0.113	2.869
1973	0.005	2.200
1974	0.163	4.035
1975	0.175	6.716
1976	0.095	3.900
1977	0.001	2.641
1978	0.190	4.059
1979	0.006	2.303
1980	0.013	2.882
1981	0.020	3.236
1982	0.111	2.829
1983	0.045	3.806
1984	0.138	2.870
1985	0.004	2.930
1986	0.129	3.882
1987	0.007	3.653
1988	0.001	2.733
1989	0.005	1.309
1990	0.050	2.718
1991	0.119	3.351
1992	0.006	2.561
1993	0.030	2.391
1994	0.026	1.738
1995	0.007	4.388
1996	0.215	5.226
1997	0.052	3.128
1998	0.044	6.645
1999	0.006	1.545
2000	0.013	2.940
2001	0.001	0.847
2002	0.036	6.972
2003	0.001	5.579
2004	0.001	1.133
2005	0.001	3.064
2006	0.071	2.776
2007	0.117	3.816
2008	0.036	2.504
2009	0.129	3.110

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.4231	6.9720
2	0.3434	6.7156
3	0.3407	6.6448
4	0.2237	5.5794
5	0.2149	5.4110
6	0.1900	5.2256
7	0.1752	4.9009
8	0.1659	4.6895
9	0.1626	4.6185
10	0.1516	4.4867

11	0.1378	4.3884
12	0.1287	4.2251
13	0.1285	4.0595
14	0.1246	4.0346
15	0.1188	3.9001
16	0.1166	3.8816
17	0.1126	3.8422
18	0.1105	3.8160
19	0.0946	3.8061
20	0.0817	3.6529
21	0.0706	3.5386
22	0.0700	3.3656
23	0.0520	3.3509
24	0.0503	3.2365
25	0.0452	3.1283
26	0.0440	3.1190
27	0.0371	3.1103
28	0.0362	3.1095
29	0.0360	3.0639
30	0.0299	2.9665
31	0.0259	2.9402
32	0.0237	2.9296
33	0.0227	2.8984
34	0.0202	2.8815
35	0.0170	2.8703
36	0.0167	2.8686
37	0.0130	2.8285
38	0.0127	2.7761
39	0.0072	2.7327
40	0.0066	2.7181
41	0.0062	2.6413
42	0.0061	2.5609
43	0.0056	2.5045
44	0.0054	2.3907
45	0.0047	2.3461
46	0.0046	2.3033
47	0.0041	2.2401
48	0.0032	2.2002
49	0.0013	2.0253
50	0.0012	1.7385
51	0.0012	1.5452
52	0.0011	1.3092
53	0.0011	1.1327
54	0.0010	0.8471

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0159	315	270392	85838	Fail
0.0225	209	239718	114697	Fail
0.0292	161	217942	135367	Fail
0.0359	136	202984	149252	Fail
0.0425	101	188688	186819	Fail
0.0492	81	175963	217238	Fail
0.0559	73	166325	227842	Fail
0.0625	60	156934	261556	Fail
0.0692	52	148413	285409	Fail
0.0759	47	142164	302476	Fail
0.0825	42	135215	321940	Fail
0.0892	36	129061	358502	Fail
0.0959	34	124403	365891	Fail
0.1026	32	119310	372843	Fail
0.1092	29	114633	395286	Fail
0.1159	25	110827	443308	Fail
0.1226	23	106737	464073	Fail
0.1292	18	102798	571100	Fail
0.1359	15	99617	664113	Fail
0.1426	13	96095	739192	Fail
0.1492	12	92744	772866	Fail
0.1559	11	90074	818854	Fail
0.1626	11	87025	791136	Fail
0.1692	9	84204	935600	Fail
0.1759	9	81762	908466	Fail
0.1826	8	79148	989350	Fail
0.1893	8	76630	957875	Fail
0.1959	7	74509	1064414	Fail
0.2026	6	72237	1203950	Fail
0.2093	6	70003	1166716	Fail
0.2159	4	68185	1704625	Fail
0.2226	4	66216	1655400	Fail
0.2293	3	64209	2140300	Fail
0.2359	3	62505	2083500	Fail
0.2426	3	60649	2021633	Fail
0.2493	3	58869	1962300	Fail
0.2559	3	57468	1915600	Fail
0.2626	3	55726	1857533	Fail
0.2693	3	54116	1803866	Fail
0.2760	3	52734	1757800	Fail
0.2826	3	51144	1704800	Fail
0.2893	3	49572	1652400	Fail
0.2960	3	48284	1609466	Fail
0.3026	3	46883	1562766	Fail
0.3093	3	45444	1514800	Fail
0.3160	3	44213	1473766	Fail
0.3226	3	42831	1427700	Fail
0.3293	3	41581	1386033	Fail
0.3360	3	40483	1349433	Fail
0.3426	2	39271	1963550	Fail
0.3493	1	38078	3807800	Fail
0.3560	1	37075	3707500	Fail
0.3627	1	35920	3592000	Fail
0.3693	1	34803	3480300	Fail

0.3760	1	33875	3387500	Fail
0.3827	1	32758	3275800	Fail
0.3893	1	31811	3181100	Fail
0.3960	1	30997	3099700	Fail
0.4027	1	30050	3005000	Fail
0.4093	1	29122	2912200	Fail
0.4160	1	28213	2821300	Fail
0.4227	1	27475	2747500	Fail
0.4293	0	26661	n/a	Fail
0.4360	0	25846	n/a	Fail
0.4427	0	25203	n/a	Fail
0.4494	0	24445	n/a	Fail
0.4560	0	23688	n/a	Fail
0.4627	0	23006	n/a	Fail
0.4694	0	22135	n/a	Fail
0.4760	0	21472	n/a	Fail
0.4827	0	20885	n/a	Fail
0.4894	0	20242	n/a	Fail
0.4960	0	19636	n/a	Fail
0.5027	0	19143	n/a	Fail
0.5094	0	18520	n/a	Fail
0.5160	0	17996	n/a	Fail
0.5227	0	17564	n/a	Fail
0.5294	0	17081	n/a	Fail
0.5361	0	16574	n/a	Fail
0.5427	0	16116	n/a	Fail
0.5494	0	15601	n/a	Fail
0.5561	0	15091	n/a	Fail
0.5627	0	14701	n/a	Fail
0.5694	0	14258	n/a	Fail
0.5761	0	13842	n/a	Fail
0.5827	0	13476	n/a	Fail
0.5894	0	13101	n/a	Fail
0.5961	0	12709	n/a	Fail
0.6027	0	12366	n/a	Fail
0.6094	0	11997	n/a	Fail
0.6161	0	11622	n/a	Fail
0.6228	0	11331	n/a	Fail
0.6294	0	11030	n/a	Fail
0.6361	0	10702	n/a	Fail
0.6428	0	10439	n/a	Fail
0.6494	0	10144	n/a	Fail
0.6561	0	9873	n/a	Fail
0.6628	0	9640	n/a	Fail
0.6694	0	9367	n/a	Fail
0.6761	0	9144	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.04 acre-feet
On-line facility target flow:	0.0603 cfs.
Adjusted for 15 min:	0.0603 cfs.
Off-line facility target flow:	0.0325 cfs.
Adjusted for 15 min:	0.0325 cfs.

POC 2

POC #2 was not reported because POC must exist in both scenarios and both scenarios must have been run.

POC 3

POC #3 was not reported because POC must exist in both scenarios and both scenarios must have been run.

POC 4

POC #4 was not reported because POC must exist in both scenarios and both scenarios must have been run.

POC 5

POC #5 was not reported because POC must exist in both scenarios and both scenarios must have been run.

POC 6

POC #6 was not reported because POC must exist in both scenarios and both scenarios must have been run.

POC 7

POC #7 was not reported because POC must exist in both scenarios and both scenarios must have been run.

POC 8

POC #8 was not reported because POC must exist in both scenarios and both scenarios must have been run.

POC 9

POC #9 was not reported because POC must exist in both scenarios and both scenarios must have been run.

POC 10

POC #10 was not reported because POC must exist in both scenarios and both scenarios must have been run.

POC 11

POC #11 was not reported because POC must exist in both scenarios and both scenarios must have been run.

POC 12

POC #12 was not reported because POC must exist in both scenarios and both scenarios must have been run.

Model Default Modifications

Total of 344 changes have been made.

PERLND Changes

Name	Property	Original	Changed
A/B; Forest; Flat	LZSN	12	5
A/B; Forest; Flat	KVARY	0	0.3
A/B; Forest; Flat	AGWRC	0.96	0.996
A/B; Forest; Flat	UZSN	1.5	0.5
A/B; Forest; Flat	IRC	0.4	0.7
A/B; Forest; Mod	LZSN	12	5
A/B; Forest; Mod	KVARY	0	0.3
A/B; Forest; Mod	AGWRC	0.96	0.996
A/B; Forest; Mod	UZSN	1.5	0.5
A/B; Forest; Mod	IRC	0.4	0.7
A/B; Forest; Steep	LZSN	12	5
A/B; Forest; Steep	KVARY	0	0.3
A/B; Forest; Steep	AGWRC	0.96	0.996
A/B; Forest; Steep	UZSN	1.5	0.5
A/B; Forest; Steep	IRC	0.4	0.7
A/B; Pasture; Flat	LZSN	12	5
A/B; Pasture; Flat	KVARY	0	0.3
A/B; Pasture; Flat	AGWRC	0.96	0.996
A/B; Pasture; Flat	UZSN	1.5	0.5
A/B; Pasture; Flat	IRC	0.4	0.7
A/B; Pasture; Mod	LZSN	12	5
A/B; Pasture; Mod	KVARY	0	0.3
A/B; Pasture; Mod	AGWRC	0.96	0.996
A/B; Pasture; Mod	UZSN	1.5	0.5
A/B; Pasture; Mod	IRC	0.4	0.7
A/B; Pasture; Steep	LZSN	12	5
A/B; Pasture; Steep	KVARY	0	0.3
A/B; Pasture; Steep	AGWRC	0.96	0.996
A/B; Pasture; Steep	UZSN	1.5	0.5
A/B; Pasture; Steep	IRC	0.4	0.7
A/B; Lawn; Flat	LZSN	12	5
A/B; Lawn; Flat	INFILT	1	0.8
A/B; Lawn; Flat	KVARY	0	0.3
A/B; Lawn; Flat	AGWRC	0.96	0.996
A/B; Lawn; Flat	UZSN	1.3	0.5
A/B; Lawn; Flat	IRC	0.4	0.7
A/B; Lawn; Mod	LZSN	12	5
A/B; Lawn; Mod	INFILT	1	0.8
A/B; Lawn; Mod	KVARY	0	0.3
A/B; Lawn; Mod	AGWRC	0.96	0.996
A/B; Lawn; Mod	UZSN	1.3	0.5
A/B; Lawn; Mod	IRC	0.4	0.7
A/B; Lawn; Steep	LZSN	12	5
A/B; Lawn; Steep	INFILT	1	0.8

A/B; Lawn; Steep	KVARY	0	0.3
A/B; Lawn; Steep	AGWRC	0.96	0.996
A/B; Lawn; Steep	UZSN	1.3	0.5
A/B; Lawn; Steep	IRC	0.4	0.7
C; Forest; Flat	LZSN	11	4.5
C; Forest; Flat	INFILT	0.2	0.08
C; Forest; Flat	KVARY	0	0.5
C; Forest; Flat	AGWRC	0.96	0.996
C; Forest; Flat	UZSN	1.4	0.5
C; Forest; Flat	INTFW	1	6
C; Forest; Flat	IRC	0.4	0.5
C; Forest; Mod	LZSN	11	4.5
C; Forest; Mod	INFILT	0.2	0.08
C; Forest; Mod	KVARY	0	0.5
C; Forest; Mod	AGWRC	0.96	0.996
C; Forest; Mod	UZSN	1.4	0.5
C; Forest; Mod	INTFW	1	6
C; Forest; Mod	IRC	0.4	0.5
C; Forest; Steep	LZSN	11	4.5
C; Forest; Steep	INFILT	0.2	0.08
C; Forest; Steep	KVARY	0	0.5
C; Forest; Steep	AGWRC	0.96	0.996
C; Forest; Steep	UZSN	1.4	0.3
C; Forest; Steep	INTFW	1	6
C; Forest; Steep	IRC	0.4	0.3
C; Pasture; Flat	LZSN	11	4.5
C; Pasture; Flat	INFILT	0.15	0.06
C; Pasture; Flat	KVARY	0	0.5
C; Pasture; Flat	AGWRC	0.96	0.996
C; Pasture; Flat	UZSN	1.4	0.4
C; Pasture; Flat	INTFW	1	6
C; Pasture; Flat	IRC	0.4	0.5
C; Pasture; Mod	LZSN	11	4.5
C; Pasture; Mod	INFILT	0.15	0.06
C; Pasture; Mod	KVARY	0	0.5
C; Pasture; Mod	AGWRC	0.96	0.996
C; Pasture; Mod	UZSN	1.4	0.4
C; Pasture; Mod	INTFW	1	6
C; Pasture; Mod	IRC	0.4	0.5
C; Pasture; Steep	LZSN	11	4.5
C; Pasture; Steep	INFILT	0.15	0.06
C; Pasture; Steep	KVARY	0	0.5
C; Pasture; Steep	AGWRC	0.96	0.996
C; Pasture; Steep	UZSN	1.4	0.25
C; Pasture; Steep	INTFW	1	6
C; Pasture; Steep	IRC	0.4	0.3
C; Lawn; Flat	LZSN	11	4.5
C; Lawn; Flat	INFILT	0.1	0.03
C; Lawn; Flat	KVARY	0	0.5
C; Lawn; Flat	AGWRC	0.96	0.996
C; Lawn; Flat	UZSN	1.2	0.25
C; Lawn; Flat	INTFW	1	6

C; Lawn; Flat	IRC	0.4	0.5
C; Lawn; Mod	LZSN	11	4.5
C; Lawn; Mod	INFILT	0.1	0.03
C; Lawn; Mod	KVARY	0	0.5
C; Lawn; Mod	AGWRC	0.96	0.996
C; Lawn; Mod	UZSN	1.2	0.25
C; Lawn; Mod	INTFW	1	6
C; Lawn; Mod	IRC	0.4	0.5
C; Lawn; Steep	LZSN	11	4.5
C; Lawn; Steep	INFILT	0.1	0.03
C; Lawn; Steep	KVARY	0	0.5
C; Lawn; Steep	AGWRC	0.96	0.996
C; Lawn; Steep	UZSN	1.2	0.15
C; Lawn; Steep	INTFW	1	6
C; Lawn; Steep	IRC	0.4	0.3
SAT; Forest; Flat	LZSN	9	4
SAT; Forest; Flat	INFILT	0.08	2
SAT; Forest; Flat	LSUR	400	100
SAT; Forest; Flat	SLSUR	0.05	0.001
SAT; Forest; Flat	KVARY	0	0.5
SAT; Forest; Flat	AGWRC	0.96	0.996
SAT; Forest; Flat	INFEXP	2.5	10
SAT; Forest; Flat	AGWETP	0	0.7
SAT; Forest; Flat	UZSN	1	3
SAT; Forest; Flat	NSUR	0.35	0.5
SAT; Forest; Flat	INTFW	4	1
SAT; Forest; Flat	IRC	0.4	0.7
SAT; Forest; Flat	LZETP	0.7	0.8
SAT; Forest; Mod	LZSN	9	4
SAT; Forest; Mod	INFILT	0.08	2
SAT; Forest; Mod	LSUR	400	100
SAT; Forest; Mod	SLSUR	0.1	0.01
SAT; Forest; Mod	KVARY	0	0.5
SAT; Forest; Mod	AGWRC	0.96	0.996
SAT; Forest; Mod	INFEXP	2.5	10
SAT; Forest; Mod	AGWETP	0	0.7
SAT; Forest; Mod	UZSN	1	3
SAT; Forest; Mod	NSUR	0.35	0.5
SAT; Forest; Mod	INTFW	4	1
SAT; Forest; Mod	IRC	0.4	0.7
SAT; Forest; Mod	LZETP	0.7	0.8
SAT; Forest; Steep	LZSN	9	4
SAT; Forest; Steep	INFILT	0.08	2
SAT; Forest; Steep	LSUR	400	100
SAT; Forest; Steep	SLSUR	0.15	0.1
SAT; Forest; Steep	KVARY	0	0.5
SAT; Forest; Steep	AGWRC	0.96	0.996
SAT; Forest; Steep	INFEXP	2.5	10
SAT; Forest; Steep	AGWETP	0	0.7
SAT; Forest; Steep	UZSN	1	3
SAT; Forest; Steep	NSUR	0.35	0.5

SAT; Forest; Steep	INTFW	4	1
SAT; Forest; Steep	IRC	0.4	0.7
SAT; Forest; Steep	LZETP	0.7	0.8
SAT; Pasture; Flat	LZSN	9	4
SAT; Pasture; Flat	INFILT	0.06	1.8
SAT; Pasture; Flat	LSUR	400	100
SAT; Pasture; Flat	SLSUR	0.05	0.001
SAT; Pasture; Flat	KVARY	0	0.5
SAT; Pasture; Flat	AGWRC	0.96	0.996
SAT; Pasture; Flat	INFEXP	2.5	10
SAT; Pasture; Flat	AGWETP	0	0.5
SAT; Pasture; Flat	UZSN	1	3
SAT; Pasture; Flat	NSUR	0.3	0.5
SAT; Pasture; Flat	INTFW	4	1
SAT; Pasture; Flat	IRC	0.4	0.7
SAT; Pasture; Flat	LZETP	0.4	0.6
SAT; Pasture; Mod	LZSN	9	4
SAT; Pasture; Mod	INFILT	0.06	1.8
SAT; Pasture; Mod	LSUR	400	100
SAT; Pasture; Mod	SLSUR	0.1	0.01
SAT; Pasture; Mod	KVARY	0	0.5
SAT; Pasture; Mod	AGWRC	0.96	0.996
SAT; Pasture; Mod	INFEXP	2.5	10
SAT; Pasture; Mod	AGWETP	0	0.5
SAT; Pasture; Mod	UZSN	1	3
SAT; Pasture; Mod	NSUR	0.3	0.5
SAT; Pasture; Mod	INTFW	4	1
SAT; Pasture; Mod	IRC	0.4	0.7
SAT; Pasture; Mod	LZETP	0.4	0.6
SAT; Pasture; Steep	LZSN	9	4
SAT; Pasture; Steep	INFILT	0.06	1.8
SAT; Pasture; Steep	LSUR	400	100
SAT; Pasture; Steep	SLSUR	0.15	0.1
SAT; Pasture; Steep	KVARY	0	0.5
SAT; Pasture; Steep	AGWRC	0.96	0.996
SAT; Pasture; Steep	INFEXP	2.5	10
SAT; Pasture; Steep	AGWETP	0	0.5
SAT; Pasture; Steep	UZSN	1	3
SAT; Pasture; Steep	NSUR	0.3	0.5
SAT; Pasture; Steep	INTFW	4	1
SAT; Pasture; Steep	IRC	0.4	0.7
SAT; Pasture; Steep	LZETP	0.4	0.6
SAT; Lawn; Flat	LZSN	9	4
SAT; Lawn; Flat	INFILT	0.05	1
SAT; Lawn; Flat	LSUR	400	100
SAT; Lawn; Flat	SLSUR	0.05	0.001
SAT; Lawn; Flat	KVARY	0	0.5
SAT; Lawn; Flat	AGWRC	0.96	0.996
SAT; Lawn; Flat	INFEXP	2.5	10
SAT; Lawn; Flat	AGWETP	0	0.35
SAT; Lawn; Flat	UZSN	0.8	3
SAT; Lawn; Flat	NSUR	0.25	0.5

SAT; Lawn; Flat	INTFW	4	1
SAT; Lawn; Flat	IRC	0.4	0.7
SAT; Lawn; Flat	LZETP	0.25	0.4
SAT; Lawn; Mod	LZSN	9	4
SAT; Lawn; Mod	INFILT	0.05	1
SAT; Lawn; Mod	LSUR	400	100
SAT; Lawn; Mod	SLSUR	0.1	0.01
SAT; Lawn; Mod	KVARY	0	0.5
SAT; Lawn; Mod	AGWRC	0.96	0.996
SAT; Lawn; Mod	INFEXP	2.5	10
SAT; Lawn; Mod	AGWETP	0	0.35
SAT; Lawn; Mod	UZSN	0.8	3
SAT; Lawn; Mod	NSUR	0.25	0.5
SAT; Lawn; Mod	INTFW	4	1
SAT; Lawn; Mod	IRC	0.4	0.7
SAT; Lawn; Mod	LZETP	0.25	0.4
SAT; Lawn; Steep	LZSN	9	4
SAT; Lawn; Steep	INFILT	0.05	1
SAT; Lawn; Steep	LSUR	400	100
SAT; Lawn; Steep	SLSUR	0.15	0.1
SAT; Lawn; Steep	KVARY	0	0.5
SAT; Lawn; Steep	AGWRC	0.96	0.996
SAT; Lawn; Steep	INFEXP	2.5	10
SAT; Lawn; Steep	AGWETP	0	0.35
SAT; Lawn; Steep	UZSN	0.8	3
SAT; Lawn; Steep	NSUR	0.25	0.5
SAT; Lawn; Steep	INTFW	4	1
SAT; Lawn; Steep	IRC	0.4	0.7
SAT; Lawn; Steep	LZETP	0.25	0.4
C/IMP DISP /FLAT	LZSN	6	4.5
C/IMP DISP /FLAT	INFILT	0.04	0.03
C/IMP DISP /FLAT	KVARY	0	0.5
C/IMP DISP /FLAT	AGWRC	0.96	0.996
C/IMP DISP /FLAT	INFEXP	3	2
C/IMP DISP /FLAT	CEPSC	0.2	0.1
C/IMP DISP /FLAT	UZSN	0.4	0.25
C/IMP DISP /FLAT	NSUR	0.35	0.25
C/IMP DISP /FLAT	INTFW	2	6
C/IMP DISP /FLAT	IRC	0.4	0.5
C/IMP DISP /FLAT	LZETP	0.7	0.25
C/IMP DISP /MOD	LZSN	6	4.5
C/IMP DISP /MOD	INFILT	0.04	0.03
C/IMP DISP /MOD	KVARY	0	0.5
C/IMP DISP /MOD	AGWRC	0.96	0.996
C/IMP DISP /MOD	INFEXP	3	2
C/IMP DISP /MOD	CEPSC	0.2	0.1
C/IMP DISP /MOD	UZSN	0.4	0.25
C/IMP DISP /MOD	NSUR	0.35	0.25
C/IMP DISP /MOD	INTFW	2	6
C/IMP DISP /MOD	IRC	0.4	0.5
C/IMP DISP /MOD	LZETP	0.7	0.25
C/IMP DISP /STEE	LZSN	6	4.5

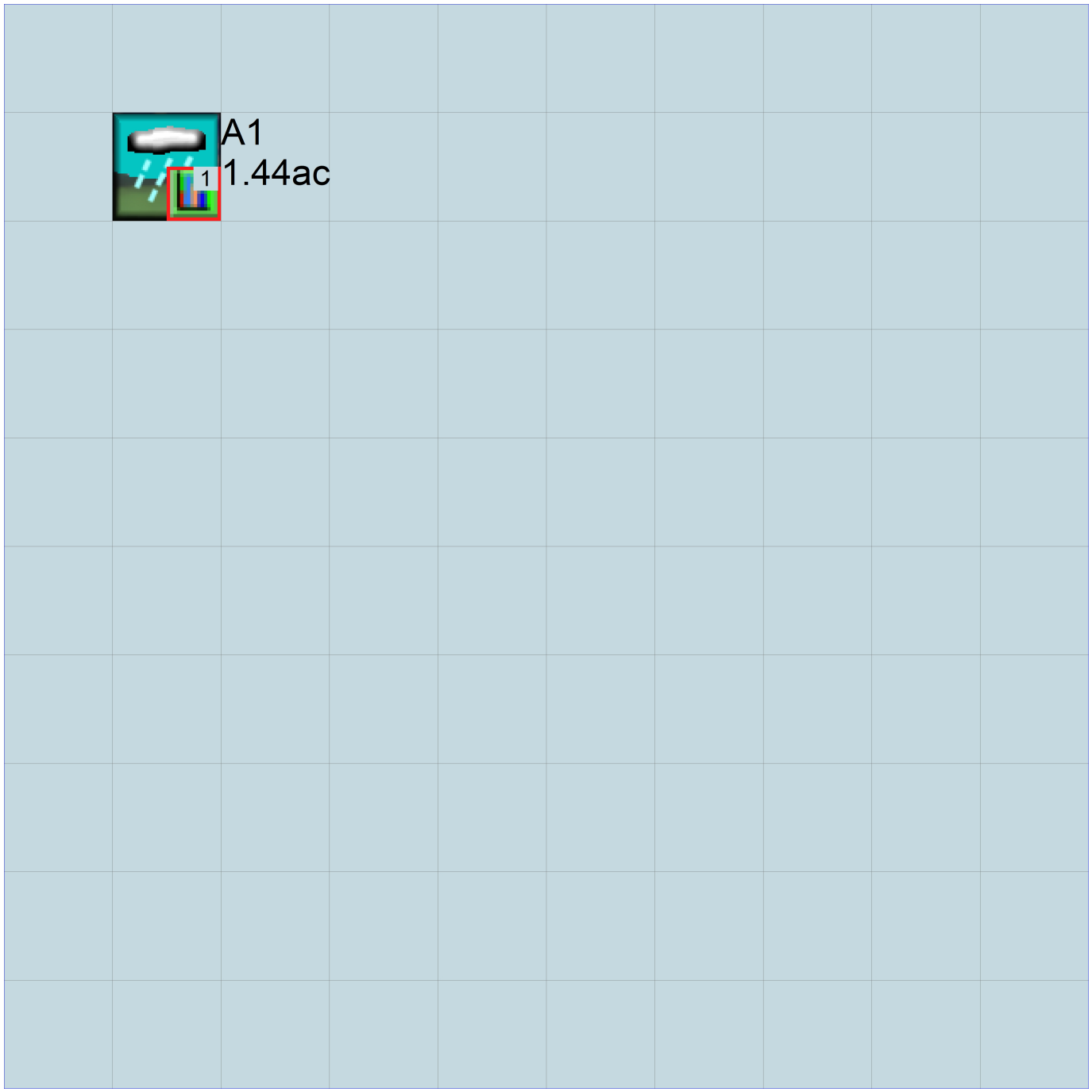
C/IMP DISP /STEE	INFILT	0.04	0.03
C/IMP DISP /STEE	KVARY	0	0.5
C/IMP DISP /STEE	AGWRC	0.96	0.996
C/IMP DISP /STEE	INFEXP	3	2
C/IMP DISP /STEE	CEPSC	0.2	0.1
C/IMP DISP /STEE	UZSN	0.4	0.15
C/IMP DISP /STEE	NSUR	0.35	0.25
C/IMP DISP /STEE	INTFW	2	6
C/IMP DISP /STEE	IRC	0.4	0.3
C/IMP DISP /STEE	LZETP	0.7	0.25
A/B/IMP INF/FLAT	LZSN	6	5
A/B/IMP INF/FLAT	INFILT	0.03	0.8
A/B/IMP INF/FLAT	KVARY	0	0.3
A/B/IMP INF/FLAT	AGWRC	0.96	0.996
A/B/IMP INF/FLAT	INFEXP	3	2
A/B/IMP INF/FLAT	CEPSC	0.15	0.1
A/B/IMP INF/FLAT	UZSN	0.4	0.5
A/B/IMP INF/FLAT	NSUR	0.3	0.25
A/B/IMP INF/FLAT	INTFW	2	0
A/B/IMP INF/FLAT	IRC	0.4	0.7
A/B/IMP INF/FLAT	LZETP	0.4	0.25
A/B/IMP INF/MOD	LZSN	6	5
A/B/IMP INF/MOD	INFILT	0.03	0.8
A/B/IMP INF/MOD	KVARY	0	0.3
A/B/IMP INF/MOD	AGWRC	0.96	0.996
A/B/IMP INF/MOD	INFEXP	3	2
A/B/IMP INF/MOD	CEPSC	0.15	0.1
A/B/IMP INF/MOD	UZSN	0.4	0.5
A/B/IMP INF/MOD	NSUR	0.3	0.25
A/B/IMP INF/MOD	INTFW	2	0
A/B/IMP INF/MOD	IRC	0.4	0.7
A/B/IMP INF/MOD	LZETP	0.4	0.25
A/B/IMP INF/STEE	LZSN	6	5
A/B/IMP INF/STEE	INFILT	0.03	0.8
A/B/IMP INF/STEE	KVARY	0	0.3
A/B/IMP INF/STEE	AGWRC	0.96	0.996
A/B/IMP INF/STEE	INFEXP	3	2
A/B/IMP INF/STEE	CEPSC	0.15	0.1
A/B/IMP INF/STEE	UZSN	0.4	0.5
A/B/IMP INF/STEE	NSUR	0.3	0.25
A/B/IMP INF/STEE	INTFW	2	0
A/B/IMP INF/STEE	IRC	0.4	0.7
A/B/IMP INF/STEE	LZETP	0.4	0.25
SAT/IMP DIS/FLAT	LZSN	6	4
SAT/IMP DIS/FLAT	INFILT	0.02	1
SAT/IMP DIS/FLAT	LSUR	400	100
SAT/IMP DIS/FLAT	SLSUR	0.05	0.001
SAT/IMP DIS/FLAT	KVARY	0	0.5
SAT/IMP DIS/FLAT	AGWRC	0.96	0.996
SAT/IMP DIS/FLAT	INFEXP	3	10
SAT/IMP DIS/FLAT	AGWETP	0	0.35
SAT/IMP DIS/FLAT	UZSN	0.2	3

SAT/IMP DIS/FLAT	NSUR	0.25	0.5
SAT/IMP DIS/FLAT	INTFW	2	1
SAT/IMP DIS/FLAT	IRC	0.4	0.7
SAT/IMP DIS/FLAT	LZETP	0.25	0.4
SAT/IMP DIS/MOD	LZSN	6	4
SAT/IMP DIS/MOD	INFILT	0.02	1
SAT/IMP DIS/MOD	LSUR	400	100
SAT/IMP DIS/MOD	SLSUR	0.1	0.01
SAT/IMP DIS/MOD	KVARY	0	0.5
SAT/IMP DIS/MOD	AGWRC	0.96	0.996
SAT/IMP DIS/MOD	INFEXP	3	10
SAT/IMP DIS/MOD	AGWETP	0	0.35
SAT/IMP DIS/MOD	UZSN	0.2	3
SAT/IMP DIS/MOD	NSUR	0.25	0.5
SAT/IMP DIS/MOD	INTFW	2	1
SAT/IMP DIS/MOD	IRC	0.4	0.7
SAT/IMP DIS/MOD	LZETP	0.25	0.4
SAT/IMP DIS/STEE	LZSN	6	4
SAT/IMP DIS/STEE	INFILT	0.02	1
SAT/IMP DIS/STEE	LSUR	400	100
SAT/IMP DIS/STEE	SLSUR	0.15	0.1
SAT/IMP DIS/STEE	KVARY	0	0.5
SAT/IMP DIS/STEE	AGWRC	0.96	0.996
SAT/IMP DIS/STEE	INFEXP	3	10
SAT/IMP DIS/STEE	AGWETP	0	0.35
SAT/IMP DIS/STEE	UZSN	0.2	3
SAT/IMP DIS/STEE	NSUR	0.25	0.5
SAT/IMP DIS/STEE	INTFW	2	1
SAT/IMP DIS/STEE	IRC	0.4	0.7
SAT/IMP DIS/STEE	LZETP	0.25	0.4
Green/ECO/ROOF	LZSN	6	1
Green/ECO/ROOF	INFILT	0.5	0.05
Green/ECO/ROOF	LSUR	100	50
Green/ECO/ROOF	KVARY	0	0.5
Green/ECO/ROOF	AGWRC	0.96	0.1
Green/ECO/ROOF	INFEXP	10	2
Green/ECO/ROOF	AGWETP	0.7	0.8
Green/ECO/ROOF	CEPSC	0.2	0.1
Green/ECO/ROOF	UZSN	3	0.1
Green/ECO/ROOF	NSUR	0.5	0.55
Green/ECO/ROOF	IRC	0.7	0.1

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591.01 - Mechicanial Treatment.wdm
MESSU       25   Pre18591.01 - Mechicanial Treatment.MES
            27   Pre18591.01 - Mechicanial Treatment.L61
            28   Pre18591.01 - Mechicanial Treatment.L62
            30   POC18591.01 - Mechicanial Treatment1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       2
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        A1                          MAX                   1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                      in  out           ***
    2     A/B, Forest, Mod        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    2         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    2         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    2         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    2               0         5         2       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    2              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    2          0.2       0.5      0.35         0       0.7       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    2              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1
```

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
A1***
PERLND   2                       1.44     COPY   501     12
PERLND   2                       1.44     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *      *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------><--------> ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                     ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><---><---><---><---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591.01 - Mechicanial Treatment.wdm
MESSU       25   Mit18591.01 - Mechicanial Treatment.MES
            27   Mit18591.01 - Mechicanial Treatment.L61
            28   Mit18591.01 - Mechicanial Treatment.L62
            30   POC18591.01 - Mechicanial Treatment1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       7
      IMPLND       1
      PERLND       8
      RCHRES       1
      RCHRES       2
      RCHRES       3
      RCHRES       4
      RCHRES       5
      RCHRES       6
      RCHRES       7
      RCHRES       8
      RCHRES       9
      RCHRES      10
      RCHRES      11
      RCHRES      12
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Treatment CB #1             MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    7     A/B, Lawn, Flat         1    1    1    1   27    0
```

```
    8     A/B, Lawn, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    7         0    0    1    0    0    0    0    0    0    0    0    0
    8         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    7         0    0    4    0    0    0    0    0    0    0    0    0    1    9
    8         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    7         0    0    0    0    0    0    0    0    0    0    0
    8         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    7              0         5       0.8       400      0.05       0.3     0.996
    8              0         5       0.8       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    7              0         0         2         2         0         0         0
    8              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    7          0.1       0.5      0.25         0       0.7      0.25
    8          0.1       0.5      0.25         0       0.7      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS       AGWS      GWVS
    7              0         0         0         0         3          1         0
    8              0         0         0         0         3          1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                  in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY
```

```
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    4    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
1***
PERLND   7                        0.11     RCHRES   1      2
PERLND   7                        0.11     RCHRES   1      3
IMPLND   1                        0.22     RCHRES   1      5
2***
PERLND   7                        0.03     RCHRES   2      2
PERLND   7                        0.03     RCHRES   2      3
IMPLND   1                        0.07     RCHRES   2      5
3***
PERLND   7                         0.1     RCHRES   3      2
PERLND   7                         0.1     RCHRES   3      3
IMPLND   1                        0.25     RCHRES   3      5
4***
PERLND   7                        0.11     RCHRES   4      2
PERLND   7                        0.11     RCHRES   4      3
IMPLND   1                        0.21     RCHRES   4      5
5***
PERLND   7                        0.05     RCHRES   5      2
PERLND   7                        0.05     RCHRES   5      3
IMPLND   1                        0.13     RCHRES   5      5
6***
PERLND   8                        0.13     RCHRES   6      2
PERLND   8                        0.13     RCHRES   6      3
IMPLND   1                        0.25     RCHRES   6      5
7***
PERLND   7                        0.07     RCHRES   7      2
PERLND   7                        0.07     RCHRES   7      3
IMPLND   1                        0.12     RCHRES   7      5
8***
PERLND   7                        0.09     RCHRES   8      2
PERLND   7                        0.09     RCHRES   8      3
IMPLND   1                        0.17     RCHRES   8      5
9***
PERLND   7                        0.06     RCHRES   9      2
PERLND   7                        0.06     RCHRES   9      3
```

```
IMPLND   1                      0.08     RCHRES   9      5
10***
PERLND   7                      0.07     RCHRES  10      2
PERLND   7                      0.07     RCHRES  10      3
IMPLND   1                      0.17     RCHRES  10      5
11***
PERLND   7                      0.12     RCHRES  11      2
PERLND   7                      0.12     RCHRES  11      3
IMPLND   1                      0.27     RCHRES  11      5
12***
PERLND   7                      0.12     RCHRES  12      2
PERLND   7                      0.12     RCHRES  12      3
IMPLND   1                       0.1     RCHRES  12      5

******Routing******
PERLND   7                      0.11     COPY     1     12
IMPLND   1                      0.22     COPY     1     15
PERLND   7                      0.11     COPY     1     13
PERLND   7                      0.03     COPY     1     12
IMPLND   1                      0.07     COPY     1     15
PERLND   7                      0.03     COPY     1     13
PERLND   7                       0.1     COPY     1     12
IMPLND   1                      0.25     COPY     1     15
PERLND   7                       0.1     COPY     1     13
PERLND   7                      0.11     COPY     1     12
IMPLND   1                      0.21     COPY     1     15
PERLND   7                      0.11     COPY     1     13
PERLND   7                      0.05     COPY     1     12
IMPLND   1                      0.13     COPY     1     15
PERLND   7                      0.05     COPY     1     13
PERLND   8                      0.13     COPY     1     12
IMPLND   1                      0.25     COPY     1     15
PERLND   8                      0.13     COPY     1     13
PERLND   7                      0.07     COPY     1     12
IMPLND   1                      0.12     COPY     1     15
PERLND   7                      0.07     COPY     1     13
PERLND   7                      0.09     COPY     1     12
IMPLND   1                      0.17     COPY     1     15
PERLND   7                      0.09     COPY     1     13
PERLND   7                      0.06     COPY     1     12
IMPLND   1                      0.08     COPY     1     15
PERLND   7                      0.06     COPY     1     13
PERLND   7                      0.07     COPY     1     12
IMPLND   1                      0.17     COPY     1     15
PERLND   7                      0.07     COPY     1     13
PERLND   7                      0.12     COPY     1     12
IMPLND   1                      0.27     COPY     1     15
PERLND   7                      0.12     COPY     1     13
PERLND   7                      0.12     COPY     1     12
IMPLND   1                       0.1     COPY     1     15
PERLND   7                      0.12     COPY     1     13
RCHRES   1                         1     COPY   501     17
RCHRES   1                         1     COPY   601     17
RCHRES   1                         1     COPY   501     17
RCHRES   1                         1     COPY   601     17
RCHRES   2                         1     COPY   501     17
RCHRES   2                         1     COPY   601     17
RCHRES   2                         1     COPY   501     17
RCHRES   2                         1     COPY   601     17
RCHRES   3                         1     COPY   501     17
RCHRES   3                         1     COPY   601     17
RCHRES   3                         1     COPY   501     17
RCHRES   3                         1     COPY   601     17
RCHRES   4                         1     COPY   501     17
RCHRES   4                         1     COPY   601     17
RCHRES   4                         1     COPY   501     17
RCHRES   4                         1     COPY   601     17
RCHRES   5                         1     COPY   501     17
RCHRES   5                         1     COPY   601     17
RCHRES   5                         1     COPY   501     17
```

```
RCHRES   5                              1     COPY   601     17
RCHRES   6                              1     COPY   501     17
RCHRES   6                              1     COPY   601     17
RCHRES   6                              1     COPY   501     17
RCHRES   6                              1     COPY   601     17
RCHRES   7                              1     COPY   501     17
RCHRES   7                              1     COPY   601     17
RCHRES   7                              1     COPY   501     17
RCHRES   7                              1     COPY   601     17
RCHRES   8                              1     COPY   501     17
RCHRES   8                              1     COPY   601     17
RCHRES   8                              1     COPY   501     17
RCHRES   8                              1     COPY   601     17
RCHRES   9                              1     COPY   501     17
RCHRES   9                              1     COPY   601     17
RCHRES   9                              1     COPY   501     17
RCHRES   9                              1     COPY   601     17
RCHRES  10                              1     COPY   501     17
RCHRES  10                              1     COPY   601     17
RCHRES  10                              1     COPY   501     17
RCHRES  10                              1     COPY   601     17
RCHRES  11                              1     COPY   501     17
RCHRES  11                              1     COPY   601     17
RCHRES  11                              1     COPY   501     17
RCHRES  11                              1     COPY   601     17
RCHRES  12                              1     COPY   501     17
RCHRES  12                              1     COPY   601     17
RCHRES  12                              1     COPY   501     17
RCHRES  12                              1     COPY   601     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<-----------------><---> User T-series  Engl Metr LKFG             ***
                                      in  out                                ***
    1     Treatment CB #1         2    1    1    1   28    0    1
    2     Treatment CB #2         2    1    1    1   28    0    1
    3     Treatment CB #3         2    1    1    1   28    0    1
    4     Treatment CB #4         2    1    1    1   28    0    1
    5     Treatment CB #5         2    1    1    1   28    0    1
    6     Treatment CB #6         2    1    1    1   28    0    1
    7     Treatment CB #7         2    1    1    1   28    0    1
    8     Treatment CB #8         2    1    1    1   28    0    1
    9     Treatment CB #9         2    1    1    1   28    0    1
   10     Treatment CB #10-079    2    1    1    1   28    0    1
   11     Treatment CB #11-080    2    1    1    1   28    0    1
   12     Treatment CB #12-081    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
    4         1    0    0    0    0    0    0    0    0    0
    5         1    0    0    0    0    0    0    0    0    0
```

```
  6         1    0    0    0    0    0    0    0    0    0
  7         1    0    0    0    0    0    0    0    0    0
  8         1    0    0    0    0    0    0    0    0    0
  9         1    0    0    0    0    0    0    0    0    0
 10         1    0    0    0    0    0    0    0    0    0
 11         1    0    0    0    0    0    0    0    0    0
 12         1    0    0    0    0    0    0    0    0    0
END ACTIVITY

PRINT-INFO
  <PLS > ***************** Print-flags ****************** PIVL  PYR
  # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  1         4    0    0    0    0    0    0    0    0    0    1    9
  2         4    0    0    0    0    0    0    0    0    0    1    9
  3         4    0    0    0    0    0    0    0    0    0    1    9
  4         4    0    0    0    0    0    0    0    0    0    1    9
  5         4    0    0    0    0    0    0    0    0    0    1    9
  6         4    0    0    0    0    0    0    0    0    0    1    9
  7         4    0    0    0    0    0    0    0    0    0    1    9
  8         4    0    0    0    0    0    0    0    0    0    1    9
  9         4    0    0    0    0    0    0    0    0    0    1    9
 10         4    0    0    0    0    0    0    0    0    0    1    9
 11         4    0    0    0    0    0    0    0    0    0    1    9
 12         4    0    0    0    0    0    0    0    0    0    1    9
END PRINT-INFO

HYDR-PARM1
  RCHRES  Flags for each HYDR Section                                    ***
  # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
         FG FG FG FG  possible  exit  *** possible  exit      possible  exit
          *  *  *  *    *  *  *  *  *      *  *  *  *  *        ***
  1       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  2       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  3       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  4       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  5       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  6       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  7       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  8       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  9       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
 10       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
 11       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
 12       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
END HYDR-PARM1

HYDR-PARM2
  # -  #    FTABNO       LEN      DELTH     STCOR        KS      DB50       ***
<------><--------><--------><--------><--------><--------><-------->       ***
  1              1      0.01       0.0       0.0       0.0       0.0
  2              2      0.01       0.0       0.0       0.0       0.0
  3              3      0.01       0.0       0.0       0.0       0.0
  4              4      0.01       0.0       0.0       0.0       0.0
  5              5      0.01       0.0       0.0       0.0       0.0
  6              6      0.01       0.0       0.0       0.0       0.0
  7              7      0.01       0.0       0.0       0.0       0.0
  8              8      0.01       0.0       0.0       0.0       0.0
  9              9      0.01       0.0       0.0       0.0       0.0
 10             10      0.01       0.0       0.0       0.0       0.0
 11             11      0.01       0.0       0.0       0.0       0.0
 12             12      0.01       0.0       0.0       0.0       0.0
END HYDR-PARM2
HYDR-INIT
  RCHRES  Initial conditions for each HYDR section                       ***
  # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
        *** ac-ft     for each possible exit        for each possible exit
<------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  1            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  2            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  3            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  4            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
```

```
    5            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    6            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    7            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    8            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    9            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
   10         0            4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
   11         0            4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
   12         0            4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   90    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.002296  0.000000  2.000000  0.000000
  0.111111  0.002296  0.000255  2.000000  0.000000
  0.222222  0.002296  0.000510  2.000000  0.000000
  0.333333  0.002296  0.000765  2.000000  0.000000
  0.444444  0.002296  0.001020  2.000000  0.000000
  0.555556  0.002296  0.001275  2.000000  0.000000
  0.666667  0.002296  0.001530  2.000000  11.00000
  0.777778  0.002296  0.001786  2.000000  21.00000
  0.888889  0.002296  0.002041  2.000000  31.00000
  1.000000  0.002296  0.002296  2.000000  41.00000
  1.111111  0.002296  0.002551  2.000000  51.00000
  1.222222  0.002296  0.002806  2.000000  61.00000
  1.333333  0.002296  0.003061  2.000000  71.00000
  1.444444  0.002296  0.003316  2.000000  81.00000
  1.555556  0.002296  0.003571  2.000000  91.00000
  1.666667  0.002296  0.003826  2.000000  101.0000
  1.777778  0.002296  0.004081  2.000000  111.0000
  1.888889  0.002296  0.004336  2.000000  121.0000
  2.000000  0.002296  0.004591  2.000000  131.0000
  2.111111  0.002296  0.004846  2.000000  141.0000
  2.222222  0.002296  0.005102  2.000000  151.0000
  2.333333  0.002296  0.005357  2.000000  161.0000
  2.444444  0.002296  0.005612  2.000000  171.0000
  2.555556  0.002296  0.005867  2.000000  181.0000
  2.666667  0.002296  0.006122  2.000000  191.0000
  2.777778  0.002296  0.006377  2.000000  201.0000
  2.888889  0.002296  0.006632  2.000000  211.0000
  3.000000  0.002296  0.006887  2.000000  221.0000
  3.111111  0.002296  0.007142  2.000000  231.0000
  3.222222  0.002296  0.007397  2.000000  241.0000
  3.333333  0.002296  0.007652  2.000000  251.0000
  3.444444  0.002296  0.007907  2.000000  261.0000
  3.555556  0.002296  0.008162  2.000000  271.0000
  3.666667  0.002296  0.008418  2.000000  281.0000
  3.777778  0.002296  0.008673  2.000000  291.0000
  3.888889  0.002296  0.008928  2.000000  301.0000
  4.000000  0.002296  0.009183  2.000000  311.0000
  4.111111  0.002296  0.009438  2.000000  321.0000
  4.222222  0.002296  0.009693  2.000000  331.0000
  4.333333  0.002296  0.009948  2.000000  341.0000
  4.444444  0.002296  0.010203  2.000000  351.0000
  4.555556  0.002296  0.010458  2.000000  361.0000
  4.666667  0.002296  0.010713  2.000000  371.0000
  4.777778  0.002296  0.010968  2.000000  381.0000
  4.888889  0.002296  0.011223  2.000000  391.0000
  5.000000  0.002296  0.011478  2.000000  401.0000
  5.111111  0.002296  0.011733  2.000000  411.0000
  5.222222  0.002296  0.011989  2.000000  421.0000
  5.333333  0.002296  0.012244  2.000000  431.0000
  5.444444  0.002296  0.012499  2.000000  441.0000
  5.555556  0.002296  0.012754  2.000000  451.0000
  5.666667  0.002296  0.013009  2.000000  461.0000
```

```
5.777778  0.002296  0.013264  2.000000  471.0000
5.888889  0.002296  0.013519  2.000000  481.0000
6.000000  0.002296  0.013774  2.000000  491.0000
6.111111  0.002296  0.014029  2.000000  501.0000
6.222222  0.002296  0.014284  2.000000  511.0000
6.333333  0.002296  0.014539  2.000000  521.0000
6.444444  0.002296  0.014794  2.000000  531.0000
6.555556  0.002296  0.015049  2.000000  541.0000
6.666667  0.002296  0.015305  2.000000  551.0000
6.777778  0.002296  0.015560  2.000000  561.0000
6.888889  0.002296  0.015815  2.000000  571.0000
7.000000  0.002296  0.016070  2.000000  581.0000
7.111111  0.002296  0.016325  2.000000  591.0000
7.222222  0.002296  0.016580  2.000000  601.0000
7.333333  0.002296  0.016835  2.000000  611.0000
7.444444  0.002296  0.017090  2.000000  621.0000
7.555556  0.002296  0.017345  2.000000  631.0000
7.666667  0.002296  0.017600  2.000000  641.0000
7.777778  0.002296  0.017855  2.000000  651.0000
7.888889  0.002296  0.018110  2.000000  661.0000
8.000000  0.002296  0.018365  2.000000  671.0000
8.111111  0.002296  0.018621  2.000000  681.0000
8.222222  0.002296  0.018876  2.000000  691.0000
8.333333  0.002296  0.019131  2.000000  701.0000
8.444444  0.002296  0.019386  2.000000  711.0000
8.555556  0.002296  0.019641  2.000000  721.0000
8.666667  0.002296  0.019896  2.000000  731.0000
8.777778  0.002296  0.020151  2.000000  741.0000
8.888889  0.002296  0.020406  2.000000  751.0000
9.000000  0.002296  0.020661  2.000000  761.0000
9.111111  0.002296  0.020916  2.000000  771.0000
9.222222  0.002296  0.021171  2.000000  781.0000
9.333333  0.002296  0.021426  2.000000  791.0000
9.444444  0.002296  0.021681  2.000000  801.0000
9.555556  0.002296  0.021937  2.000000  811.0000
9.666667  0.002296  0.022192  2.000000  821.0000
9.777778  0.002296  0.022447  2.000000  831.0000
9.888889  0.002296  0.022702  2.000000  841.0000
END FTABLE  1
FTABLE      2
 90    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.002296  0.000000  2.000000  0.000000
0.111111  0.002296  0.000255  2.000000  0.000000
0.222222  0.002296  0.000510  2.000000  0.000000
0.333333  0.002296  0.000765  2.000000  0.000000
0.444444  0.002296  0.001020  2.000000  0.000000
0.555556  0.002296  0.001275  2.000000  0.000000
0.666667  0.002296  0.001530  2.000000  11.00000
0.777778  0.002296  0.001786  2.000000  21.00000
0.888889  0.002296  0.002041  2.000000  31.00000
1.000000  0.002296  0.002296  2.000000  41.00000
1.111111  0.002296  0.002551  2.000000  51.00000
1.222222  0.002296  0.002806  2.000000  61.00000
1.333333  0.002296  0.003061  2.000000  71.00000
1.444444  0.002296  0.003316  2.000000  81.00000
1.555556  0.002296  0.003571  2.000000  91.00000
1.666667  0.002296  0.003826  2.000000  101.0000
1.777778  0.002296  0.004081  2.000000  111.0000
1.888889  0.002296  0.004336  2.000000  121.0000
2.000000  0.002296  0.004591  2.000000  131.0000
2.111111  0.002296  0.004846  2.000000  141.0000
2.222222  0.002296  0.005102  2.000000  151.0000
2.333333  0.002296  0.005357  2.000000  161.0000
2.444444  0.002296  0.005612  2.000000  171.0000
2.555556  0.002296  0.005867  2.000000  181.0000
2.666667  0.002296  0.006122  2.000000  191.0000
2.777778  0.002296  0.006377  2.000000  201.0000
2.888889  0.002296  0.006632  2.000000  211.0000
```

```
3.000000  0.002296  0.006887  2.000000  221.0000
3.111111  0.002296  0.007142  2.000000  231.0000
3.222222  0.002296  0.007397  2.000000  241.0000
3.333333  0.002296  0.007652  2.000000  251.0000
3.444444  0.002296  0.007907  2.000000  261.0000
3.555556  0.002296  0.008162  2.000000  271.0000
3.666667  0.002296  0.008418  2.000000  281.0000
3.777778  0.002296  0.008673  2.000000  291.0000
3.888889  0.002296  0.008928  2.000000  301.0000
4.000000  0.002296  0.009183  2.000000  311.0000
4.111111  0.002296  0.009438  2.000000  321.0000
4.222222  0.002296  0.009693  2.000000  331.0000
4.333333  0.002296  0.009948  2.000000  341.0000
4.444444  0.002296  0.010203  2.000000  351.0000
4.555556  0.002296  0.010458  2.000000  361.0000
4.666667  0.002296  0.010713  2.000000  371.0000
4.777778  0.002296  0.010968  2.000000  381.0000
4.888889  0.002296  0.011223  2.000000  391.0000
5.000000  0.002296  0.011478  2.000000  401.0000
5.111111  0.002296  0.011733  2.000000  411.0000
5.222222  0.002296  0.011989  2.000000  421.0000
5.333333  0.002296  0.012244  2.000000  431.0000
5.444444  0.002296  0.012499  2.000000  441.0000
5.555556  0.002296  0.012754  2.000000  451.0000
5.666667  0.002296  0.013009  2.000000  461.0000
5.777778  0.002296  0.013264  2.000000  471.0000
5.888889  0.002296  0.013519  2.000000  481.0000
6.000000  0.002296  0.013774  2.000000  491.0000
6.111111  0.002296  0.014029  2.000000  501.0000
6.222222  0.002296  0.014284  2.000000  511.0000
6.333333  0.002296  0.014539  2.000000  521.0000
6.444444  0.002296  0.014794  2.000000  531.0000
6.555556  0.002296  0.015049  2.000000  541.0000
6.666667  0.002296  0.015305  2.000000  551.0000
6.777778  0.002296  0.015560  2.000000  561.0000
6.888889  0.002296  0.015815  2.000000  571.0000
7.000000  0.002296  0.016070  2.000000  581.0000
7.111111  0.002296  0.016325  2.000000  591.0000
7.222222  0.002296  0.016580  2.000000  601.0000
7.333333  0.002296  0.016835  2.000000  611.0000
7.444444  0.002296  0.017090  2.000000  621.0000
7.555556  0.002296  0.017345  2.000000  631.0000
7.666667  0.002296  0.017600  2.000000  641.0000
7.777778  0.002296  0.017855  2.000000  651.0000
7.888889  0.002296  0.018110  2.000000  661.0000
8.000000  0.002296  0.018365  2.000000  671.0000
8.111111  0.002296  0.018621  2.000000  681.0000
8.222222  0.002296  0.018876  2.000000  691.0000
8.333333  0.002296  0.019131  2.000000  701.0000
8.444444  0.002296  0.019386  2.000000  711.0000
8.555556  0.002296  0.019641  2.000000  721.0000
8.666667  0.002296  0.019896  2.000000  731.0000
8.777778  0.002296  0.020151  2.000000  741.0000
8.888889  0.002296  0.020406  2.000000  751.0000
9.000000  0.002296  0.020661  2.000000  761.0000
9.111111  0.002296  0.020916  2.000000  771.0000
9.222222  0.002296  0.021171  2.000000  781.0000
9.333333  0.002296  0.021426  2.000000  791.0000
9.444444  0.002296  0.021681  2.000000  801.0000
9.555556  0.002296  0.021937  2.000000  811.0000
9.666667  0.002296  0.022192  2.000000  821.0000
9.777778  0.002296  0.022447  2.000000  831.0000
9.888889  0.002296  0.022702  2.000000  841.0000
END FTABLE  2
FTABLE      3
 90    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.002296  0.000000  2.000000  0.000000
0.111111  0.002296  0.000255  2.000000  0.000000
```

0.222222	0.002296	0.000510	2.000000	0.000000
0.333333	0.002296	0.000765	2.000000	0.000000
0.444444	0.002296	0.001020	2.000000	0.000000
0.555556	0.002296	0.001275	2.000000	0.000000
0.666667	0.002296	0.001530	2.000000	11.00000
0.777778	0.002296	0.001786	2.000000	21.00000
0.888889	0.002296	0.002041	2.000000	31.00000
1.000000	0.002296	0.002296	2.000000	41.00000
1.111111	0.002296	0.002551	2.000000	51.00000
1.222222	0.002296	0.002806	2.000000	61.00000
1.333333	0.002296	0.003061	2.000000	71.00000
1.444444	0.002296	0.003316	2.000000	81.00000
1.555556	0.002296	0.003571	2.000000	91.00000
1.666667	0.002296	0.003826	2.000000	101.0000
1.777778	0.002296	0.004081	2.000000	111.0000
1.888889	0.002296	0.004336	2.000000	121.0000
2.000000	0.002296	0.004591	2.000000	131.0000
2.111111	0.002296	0.004846	2.000000	141.0000
2.222222	0.002296	0.005102	2.000000	151.0000
2.333333	0.002296	0.005357	2.000000	161.0000
2.444444	0.002296	0.005612	2.000000	171.0000
2.555556	0.002296	0.005867	2.000000	181.0000
2.666667	0.002296	0.006122	2.000000	191.0000
2.777778	0.002296	0.006377	2.000000	201.0000
2.888889	0.002296	0.006632	2.000000	211.0000
3.000000	0.002296	0.006887	2.000000	221.0000
3.111111	0.002296	0.007142	2.000000	231.0000
3.222222	0.002296	0.007397	2.000000	241.0000
3.333333	0.002296	0.007652	2.000000	251.0000
3.444444	0.002296	0.007907	2.000000	261.0000
3.555556	0.002296	0.008162	2.000000	271.0000
3.666667	0.002296	0.008418	2.000000	281.0000
3.777778	0.002296	0.008673	2.000000	291.0000
3.888889	0.002296	0.008928	2.000000	301.0000
4.000000	0.002296	0.009183	2.000000	311.0000
4.111111	0.002296	0.009438	2.000000	321.0000
4.222222	0.002296	0.009693	2.000000	331.0000
4.333333	0.002296	0.009948	2.000000	341.0000
4.444444	0.002296	0.010203	2.000000	351.0000
4.555556	0.002296	0.010458	2.000000	361.0000
4.666667	0.002296	0.010713	2.000000	371.0000
4.777778	0.002296	0.010968	2.000000	381.0000
4.888889	0.002296	0.011223	2.000000	391.0000
5.000000	0.002296	0.011478	2.000000	401.0000
5.111111	0.002296	0.011733	2.000000	411.0000
5.222222	0.002296	0.011989	2.000000	421.0000
5.333333	0.002296	0.012244	2.000000	431.0000
5.444444	0.002296	0.012499	2.000000	441.0000
5.555556	0.002296	0.012754	2.000000	451.0000
5.666667	0.002296	0.013009	2.000000	461.0000
5.777778	0.002296	0.013264	2.000000	471.0000
5.888889	0.002296	0.013519	2.000000	481.0000
6.000000	0.002296	0.013774	2.000000	491.0000
6.111111	0.002296	0.014029	2.000000	501.0000
6.222222	0.002296	0.014284	2.000000	511.0000
6.333333	0.002296	0.014539	2.000000	521.0000
6.444444	0.002296	0.014794	2.000000	531.0000
6.555556	0.002296	0.015049	2.000000	541.0000
6.666667	0.002296	0.015305	2.000000	551.0000
6.777778	0.002296	0.015560	2.000000	561.0000
6.888889	0.002296	0.015815	2.000000	571.0000
7.000000	0.002296	0.016070	2.000000	581.0000
7.111111	0.002296	0.016325	2.000000	591.0000
7.222222	0.002296	0.016580	2.000000	601.0000
7.333333	0.002296	0.016835	2.000000	611.0000
7.444444	0.002296	0.017090	2.000000	621.0000
7.555556	0.002296	0.017345	2.000000	631.0000
7.666667	0.002296	0.017600	2.000000	641.0000
7.777778	0.002296	0.017855	2.000000	651.0000
7.888889	0.002296	0.018110	2.000000	661.0000

```
8.000000  0.002296  0.018365  2.000000  671.0000
8.111111  0.002296  0.018621  2.000000  681.0000
8.222222  0.002296  0.018876  2.000000  691.0000
8.333333  0.002296  0.019131  2.000000  701.0000
8.444444  0.002296  0.019386  2.000000  711.0000
8.555556  0.002296  0.019641  2.000000  721.0000
8.666667  0.002296  0.019896  2.000000  731.0000
8.777778  0.002296  0.020151  2.000000  741.0000
8.888889  0.002296  0.020406  2.000000  751.0000
9.000000  0.002296  0.020661  2.000000  761.0000
9.111111  0.002296  0.020916  2.000000  771.0000
9.222222  0.002296  0.021171  2.000000  781.0000
9.333333  0.002296  0.021426  2.000000  791.0000
9.444444  0.002296  0.021681  2.000000  801.0000
9.555556  0.002296  0.021937  2.000000  811.0000
9.666667  0.002296  0.022192  2.000000  821.0000
9.777778  0.002296  0.022447  2.000000  831.0000
9.888889  0.002296  0.022702  2.000000  841.0000
END FTABLE  3
FTABLE      4
 90    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.002296  0.000000  2.000000  0.000000
0.111111  0.002296  0.000255  2.000000  0.000000
0.222222  0.002296  0.000510  2.000000  0.000000
0.333333  0.002296  0.000765  2.000000  0.000000
0.444444  0.002296  0.001020  2.000000  0.000000
0.555556  0.002296  0.001275  2.000000  0.000000
0.666667  0.002296  0.001530  2.000000  11.00000
0.777778  0.002296  0.001786  2.000000  21.00000
0.888889  0.002296  0.002041  2.000000  31.00000
1.000000  0.002296  0.002296  2.000000  41.00000
1.111111  0.002296  0.002551  2.000000  51.00000
1.222222  0.002296  0.002806  2.000000  61.00000
1.333333  0.002296  0.003061  2.000000  71.00000
1.444444  0.002296  0.003316  2.000000  81.00000
1.555556  0.002296  0.003571  2.000000  91.00000
1.666667  0.002296  0.003826  2.000000  101.0000
1.777778  0.002296  0.004081  2.000000  111.0000
1.888889  0.002296  0.004336  2.000000  121.0000
2.000000  0.002296  0.004591  2.000000  131.0000
2.111111  0.002296  0.004846  2.000000  141.0000
2.222222  0.002296  0.005102  2.000000  151.0000
2.333333  0.002296  0.005357  2.000000  161.0000
2.444444  0.002296  0.005612  2.000000  171.0000
2.555556  0.002296  0.005867  2.000000  181.0000
2.666667  0.002296  0.006122  2.000000  191.0000
2.777778  0.002296  0.006377  2.000000  201.0000
2.888889  0.002296  0.006632  2.000000  211.0000
3.000000  0.002296  0.006887  2.000000  221.0000
3.111111  0.002296  0.007142  2.000000  231.0000
3.222222  0.002296  0.007397  2.000000  241.0000
3.333333  0.002296  0.007652  2.000000  251.0000
3.444444  0.002296  0.007907  2.000000  261.0000
3.555556  0.002296  0.008162  2.000000  271.0000
3.666667  0.002296  0.008418  2.000000  281.0000
3.777778  0.002296  0.008673  2.000000  291.0000
3.888889  0.002296  0.008928  2.000000  301.0000
4.000000  0.002296  0.009183  2.000000  311.0000
4.111111  0.002296  0.009438  2.000000  321.0000
4.222222  0.002296  0.009693  2.000000  331.0000
4.333333  0.002296  0.009948  2.000000  341.0000
4.444444  0.002296  0.010203  2.000000  351.0000
4.555556  0.002296  0.010458  2.000000  361.0000
4.666667  0.002296  0.010713  2.000000  371.0000
4.777778  0.002296  0.010968  2.000000  381.0000
4.888889  0.002296  0.011223  2.000000  391.0000
5.000000  0.002296  0.011478  2.000000  401.0000
5.111111  0.002296  0.011733  2.000000  411.0000
```

```
5.222222  0.002296  0.011989  2.000000  421.0000
5.333333  0.002296  0.012244  2.000000  431.0000
5.444444  0.002296  0.012499  2.000000  441.0000
5.555556  0.002296  0.012754  2.000000  451.0000
5.666667  0.002296  0.013009  2.000000  461.0000
5.777778  0.002296  0.013264  2.000000  471.0000
5.888889  0.002296  0.013519  2.000000  481.0000
6.000000  0.002296  0.013774  2.000000  491.0000
6.111111  0.002296  0.014029  2.000000  501.0000
6.222222  0.002296  0.014284  2.000000  511.0000
6.333333  0.002296  0.014539  2.000000  521.0000
6.444444  0.002296  0.014794  2.000000  531.0000
6.555556  0.002296  0.015049  2.000000  541.0000
6.666667  0.002296  0.015305  2.000000  551.0000
6.777778  0.002296  0.015560  2.000000  561.0000
6.888889  0.002296  0.015815  2.000000  571.0000
7.000000  0.002296  0.016070  2.000000  581.0000
7.111111  0.002296  0.016325  2.000000  591.0000
7.222222  0.002296  0.016580  2.000000  601.0000
7.333333  0.002296  0.016835  2.000000  611.0000
7.444444  0.002296  0.017090  2.000000  621.0000
7.555556  0.002296  0.017345  2.000000  631.0000
7.666667  0.002296  0.017600  2.000000  641.0000
7.777778  0.002296  0.017855  2.000000  651.0000
7.888889  0.002296  0.018110  2.000000  661.0000
8.000000  0.002296  0.018365  2.000000  671.0000
8.111111  0.002296  0.018621  2.000000  681.0000
8.222222  0.002296  0.018876  2.000000  691.0000
8.333333  0.002296  0.019131  2.000000  701.0000
8.444444  0.002296  0.019386  2.000000  711.0000
8.555556  0.002296  0.019641  2.000000  721.0000
8.666667  0.002296  0.019896  2.000000  731.0000
8.777778  0.002296  0.020151  2.000000  741.0000
8.888889  0.002296  0.020406  2.000000  751.0000
9.000000  0.002296  0.020661  2.000000  761.0000
9.111111  0.002296  0.020916  2.000000  771.0000
9.222222  0.002296  0.021171  2.000000  781.0000
9.333333  0.002296  0.021426  2.000000  791.0000
9.444444  0.002296  0.021681  2.000000  801.0000
9.555556  0.002296  0.021937  2.000000  811.0000
9.666667  0.002296  0.022192  2.000000  821.0000
9.777778  0.002296  0.022447  2.000000  831.0000
9.888889  0.002296  0.022702  2.000000  841.0000
END FTABLE  4
FTABLE      5
 90    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.002296  0.000000  2.000000  0.000000
0.111111  0.002296  0.000255  2.000000  0.000000
0.222222  0.002296  0.000510  2.000000  0.000000
0.333333  0.002296  0.000765  2.000000  0.000000
0.444444  0.002296  0.001020  2.000000  0.000000
0.555556  0.002296  0.001275  2.000000  0.000000
0.666667  0.002296  0.001530  2.000000  11.00000
0.777778  0.002296  0.001786  2.000000  21.00000
0.888889  0.002296  0.002041  2.000000  31.00000
1.000000  0.002296  0.002296  2.000000  41.00000
1.111111  0.002296  0.002551  2.000000  51.00000
1.222222  0.002296  0.002806  2.000000  61.00000
1.333333  0.002296  0.003061  2.000000  71.00000
1.444444  0.002296  0.003316  2.000000  81.00000
1.555556  0.002296  0.003571  2.000000  91.00000
1.666667  0.002296  0.003826  2.000000  101.0000
1.777778  0.002296  0.004081  2.000000  111.0000
1.888889  0.002296  0.004336  2.000000  121.0000
2.000000  0.002296  0.004591  2.000000  131.0000
2.111111  0.002296  0.004846  2.000000  141.0000
2.222222  0.002296  0.005102  2.000000  151.0000
2.333333  0.002296  0.005357  2.000000  161.0000
```

```
2.444444  0.002296  0.005612  2.000000  171.0000
2.555556  0.002296  0.005867  2.000000  181.0000
2.666667  0.002296  0.006122  2.000000  191.0000
2.777778  0.002296  0.006377  2.000000  201.0000
2.888889  0.002296  0.006632  2.000000  211.0000
3.000000  0.002296  0.006887  2.000000  221.0000
3.111111  0.002296  0.007142  2.000000  231.0000
3.222222  0.002296  0.007397  2.000000  241.0000
3.333333  0.002296  0.007652  2.000000  251.0000
3.444444  0.002296  0.007907  2.000000  261.0000
3.555556  0.002296  0.008162  2.000000  271.0000
3.666667  0.002296  0.008418  2.000000  281.0000
3.777778  0.002296  0.008673  2.000000  291.0000
3.888889  0.002296  0.008928  2.000000  301.0000
4.000000  0.002296  0.009183  2.000000  311.0000
4.111111  0.002296  0.009438  2.000000  321.0000
4.222222  0.002296  0.009693  2.000000  331.0000
4.333333  0.002296  0.009948  2.000000  341.0000
4.444444  0.002296  0.010203  2.000000  351.0000
4.555556  0.002296  0.010458  2.000000  361.0000
4.666667  0.002296  0.010713  2.000000  371.0000
4.777778  0.002296  0.010968  2.000000  381.0000
4.888889  0.002296  0.011223  2.000000  391.0000
5.000000  0.002296  0.011478  2.000000  401.0000
5.111111  0.002296  0.011733  2.000000  411.0000
5.222222  0.002296  0.011989  2.000000  421.0000
5.333333  0.002296  0.012244  2.000000  431.0000
5.444444  0.002296  0.012499  2.000000  441.0000
5.555556  0.002296  0.012754  2.000000  451.0000
5.666667  0.002296  0.013009  2.000000  461.0000
5.777778  0.002296  0.013264  2.000000  471.0000
5.888889  0.002296  0.013519  2.000000  481.0000
6.000000  0.002296  0.013774  2.000000  491.0000
6.111111  0.002296  0.014029  2.000000  501.0000
6.222222  0.002296  0.014284  2.000000  511.0000
6.333333  0.002296  0.014539  2.000000  521.0000
6.444444  0.002296  0.014794  2.000000  531.0000
6.555556  0.002296  0.015049  2.000000  541.0000
6.666667  0.002296  0.015305  2.000000  551.0000
6.777778  0.002296  0.015560  2.000000  561.0000
6.888889  0.002296  0.015815  2.000000  571.0000
7.000000  0.002296  0.016070  2.000000  581.0000
7.111111  0.002296  0.016325  2.000000  591.0000
7.222222  0.002296  0.016580  2.000000  601.0000
7.333333  0.002296  0.016835  2.000000  611.0000
7.444444  0.002296  0.017090  2.000000  621.0000
7.555556  0.002296  0.017345  2.000000  631.0000
7.666667  0.002296  0.017600  2.000000  641.0000
7.777778  0.002296  0.017855  2.000000  651.0000
7.888889  0.002296  0.018110  2.000000  661.0000
8.000000  0.002296  0.018365  2.000000  671.0000
8.111111  0.002296  0.018621  2.000000  681.0000
8.222222  0.002296  0.018876  2.000000  691.0000
8.333333  0.002296  0.019131  2.000000  701.0000
8.444444  0.002296  0.019386  2.000000  711.0000
8.555556  0.002296  0.019641  2.000000  721.0000
8.666667  0.002296  0.019896  2.000000  731.0000
8.777778  0.002296  0.020151  2.000000  741.0000
8.888889  0.002296  0.020406  2.000000  751.0000
9.000000  0.002296  0.020661  2.000000  761.0000
9.111111  0.002296  0.020916  2.000000  771.0000
9.222222  0.002296  0.021171  2.000000  781.0000
9.333333  0.002296  0.021426  2.000000  791.0000
9.444444  0.002296  0.021681  2.000000  801.0000
9.555556  0.002296  0.021937  2.000000  811.0000
9.666667  0.002296  0.022192  2.000000  821.0000
9.777778  0.002296  0.022447  2.000000  831.0000
9.888889  0.002296  0.022702  2.000000  841.0000
END FTABLE  5
FTABLE      6
```

90 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.002296	0.000000	2.000000	0.000000		
0.111111	0.002296	0.000255	2.000000	0.000000		
0.222222	0.002296	0.000510	2.000000	0.000000		
0.333333	0.002296	0.000765	2.000000	0.000000		
0.444444	0.002296	0.001020	2.000000	0.000000		
0.555556	0.002296	0.001275	2.000000	0.000000		
0.666667	0.002296	0.001530	2.000000	11.00000		
0.777778	0.002296	0.001786	2.000000	21.00000		
0.888889	0.002296	0.002041	2.000000	31.00000		
1.000000	0.002296	0.002296	2.000000	41.00000		
1.111111	0.002296	0.002551	2.000000	51.00000		
1.222222	0.002296	0.002806	2.000000	61.00000		
1.333333	0.002296	0.003061	2.000000	71.00000		
1.444444	0.002296	0.003316	2.000000	81.00000		
1.555556	0.002296	0.003571	2.000000	91.00000		
1.666667	0.002296	0.003826	2.000000	101.0000		
1.777778	0.002296	0.004081	2.000000	111.0000		
1.888889	0.002296	0.004336	2.000000	121.0000		
2.000000	0.002296	0.004591	2.000000	131.0000		
2.111111	0.002296	0.004846	2.000000	141.0000		
2.222222	0.002296	0.005102	2.000000	151.0000		
2.333333	0.002296	0.005357	2.000000	161.0000		
2.444444	0.002296	0.005612	2.000000	171.0000		
2.555556	0.002296	0.005867	2.000000	181.0000		
2.666667	0.002296	0.006122	2.000000	191.0000		
2.777778	0.002296	0.006377	2.000000	201.0000		
2.888889	0.002296	0.006632	2.000000	211.0000		
3.000000	0.002296	0.006887	2.000000	221.0000		
3.111111	0.002296	0.007142	2.000000	231.0000		
3.222222	0.002296	0.007397	2.000000	241.0000		
3.333333	0.002296	0.007652	2.000000	251.0000		
3.444444	0.002296	0.007907	2.000000	261.0000		
3.555556	0.002296	0.008162	2.000000	271.0000		
3.666667	0.002296	0.008418	2.000000	281.0000		
3.777778	0.002296	0.008673	2.000000	291.0000		
3.888889	0.002296	0.008928	2.000000	301.0000		
4.000000	0.002296	0.009183	2.000000	311.0000		
4.111111	0.002296	0.009438	2.000000	321.0000		
4.222222	0.002296	0.009693	2.000000	331.0000		
4.333333	0.002296	0.009948	2.000000	341.0000		
4.444444	0.002296	0.010203	2.000000	351.0000		
4.555556	0.002296	0.010458	2.000000	361.0000		
4.666667	0.002296	0.010713	2.000000	371.0000		
4.777778	0.002296	0.010968	2.000000	381.0000		
4.888889	0.002296	0.011223	2.000000	391.0000		
5.000000	0.002296	0.011478	2.000000	401.0000		
5.111111	0.002296	0.011733	2.000000	411.0000		
5.222222	0.002296	0.011989	2.000000	421.0000		
5.333333	0.002296	0.012244	2.000000	431.0000		
5.444444	0.002296	0.012499	2.000000	441.0000		
5.555556	0.002296	0.012754	2.000000	451.0000		
5.666667	0.002296	0.013009	2.000000	461.0000		
5.777778	0.002296	0.013264	2.000000	471.0000		
5.888889	0.002296	0.013519	2.000000	481.0000		
6.000000	0.002296	0.013774	2.000000	491.0000		
6.111111	0.002296	0.014029	2.000000	501.0000		
6.222222	0.002296	0.014284	2.000000	511.0000		
6.333333	0.002296	0.014539	2.000000	521.0000		
6.444444	0.002296	0.014794	2.000000	531.0000		
6.555556	0.002296	0.015049	2.000000	541.0000		
6.666667	0.002296	0.015305	2.000000	551.0000		
6.777778	0.002296	0.015560	2.000000	561.0000		
6.888889	0.002296	0.015815	2.000000	571.0000		
7.000000	0.002296	0.016070	2.000000	581.0000		
7.111111	0.002296	0.016325	2.000000	591.0000		
7.222222	0.002296	0.016580	2.000000	601.0000		
7.333333	0.002296	0.016835	2.000000	611.0000		

```
7.444444  0.002296  0.017090  2.000000  621.0000
7.555556  0.002296  0.017345  2.000000  631.0000
7.666667  0.002296  0.017600  2.000000  641.0000
7.777778  0.002296  0.017855  2.000000  651.0000
7.888889  0.002296  0.018110  2.000000  661.0000
8.000000  0.002296  0.018365  2.000000  671.0000
8.111111  0.002296  0.018621  2.000000  681.0000
8.222222  0.002296  0.018876  2.000000  691.0000
8.333333  0.002296  0.019131  2.000000  701.0000
8.444444  0.002296  0.019386  2.000000  711.0000
8.555556  0.002296  0.019641  2.000000  721.0000
8.666667  0.002296  0.019896  2.000000  731.0000
8.777778  0.002296  0.020151  2.000000  741.0000
8.888889  0.002296  0.020406  2.000000  751.0000
9.000000  0.002296  0.020661  2.000000  761.0000
9.111111  0.002296  0.020916  2.000000  771.0000
9.222222  0.002296  0.021171  2.000000  781.0000
9.333333  0.002296  0.021426  2.000000  791.0000
9.444444  0.002296  0.021681  2.000000  801.0000
9.555556  0.002296  0.021937  2.000000  811.0000
9.666667  0.002296  0.022192  2.000000  821.0000
9.777778  0.002296  0.022447  2.000000  831.0000
9.888889  0.002296  0.022702  2.000000  841.0000
END FTABLE  6
FTABLE      7
 90    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.002296  0.000000  2.000000  0.000000
0.111111  0.002296  0.000255  2.000000  0.000000
0.222222  0.002296  0.000510  2.000000  0.000000
0.333333  0.002296  0.000765  2.000000  0.000000
0.444444  0.002296  0.001020  2.000000  0.000000
0.555556  0.002296  0.001275  2.000000  0.000000
0.666667  0.002296  0.001530  2.000000  11.00000
0.777778  0.002296  0.001786  2.000000  21.00000
0.888889  0.002296  0.002041  2.000000  31.00000
1.000000  0.002296  0.002296  2.000000  41.00000
1.111111  0.002296  0.002551  2.000000  51.00000
1.222222  0.002296  0.002806  2.000000  61.00000
1.333333  0.002296  0.003061  2.000000  71.00000
1.444444  0.002296  0.003316  2.000000  81.00000
1.555556  0.002296  0.003571  2.000000  91.00000
1.666667  0.002296  0.003826  2.000000  101.0000
1.777778  0.002296  0.004081  2.000000  111.0000
1.888889  0.002296  0.004336  2.000000  121.0000
2.000000  0.002296  0.004591  2.000000  131.0000
2.111111  0.002296  0.004846  2.000000  141.0000
2.222222  0.002296  0.005102  2.000000  151.0000
2.333333  0.002296  0.005357  2.000000  161.0000
2.444444  0.002296  0.005612  2.000000  171.0000
2.555556  0.002296  0.005867  2.000000  181.0000
2.666667  0.002296  0.006122  2.000000  191.0000
2.777778  0.002296  0.006377  2.000000  201.0000
2.888889  0.002296  0.006632  2.000000  211.0000
3.000000  0.002296  0.006887  2.000000  221.0000
3.111111  0.002296  0.007142  2.000000  231.0000
3.222222  0.002296  0.007397  2.000000  241.0000
3.333333  0.002296  0.007652  2.000000  251.0000
3.444444  0.002296  0.007907  2.000000  261.0000
3.555556  0.002296  0.008162  2.000000  271.0000
3.666667  0.002296  0.008418  2.000000  281.0000
3.777778  0.002296  0.008673  2.000000  291.0000
3.888889  0.002296  0.008928  2.000000  301.0000
4.000000  0.002296  0.009183  2.000000  311.0000
4.111111  0.002296  0.009438  2.000000  321.0000
4.222222  0.002296  0.009693  2.000000  331.0000
4.333333  0.002296  0.009948  2.000000  341.0000
4.444444  0.002296  0.010203  2.000000  351.0000
4.555556  0.002296  0.010458  2.000000  361.0000
```

```
4.666667  0.002296  0.010713  2.000000  371.0000
4.777778  0.002296  0.010968  2.000000  381.0000
4.888889  0.002296  0.011223  2.000000  391.0000
5.000000  0.002296  0.011478  2.000000  401.0000
5.111111  0.002296  0.011733  2.000000  411.0000
5.222222  0.002296  0.011989  2.000000  421.0000
5.333333  0.002296  0.012244  2.000000  431.0000
5.444444  0.002296  0.012499  2.000000  441.0000
5.555556  0.002296  0.012754  2.000000  451.0000
5.666667  0.002296  0.013009  2.000000  461.0000
5.777778  0.002296  0.013264  2.000000  471.0000
5.888889  0.002296  0.013519  2.000000  481.0000
6.000000  0.002296  0.013774  2.000000  491.0000
6.111111  0.002296  0.014029  2.000000  501.0000
6.222222  0.002296  0.014284  2.000000  511.0000
6.333333  0.002296  0.014539  2.000000  521.0000
6.444444  0.002296  0.014794  2.000000  531.0000
6.555556  0.002296  0.015049  2.000000  541.0000
6.666667  0.002296  0.015305  2.000000  551.0000
6.777778  0.002296  0.015560  2.000000  561.0000
6.888889  0.002296  0.015815  2.000000  571.0000
7.000000  0.002296  0.016070  2.000000  581.0000
7.111111  0.002296  0.016325  2.000000  591.0000
7.222222  0.002296  0.016580  2.000000  601.0000
7.333333  0.002296  0.016835  2.000000  611.0000
7.444444  0.002296  0.017090  2.000000  621.0000
7.555556  0.002296  0.017345  2.000000  631.0000
7.666667  0.002296  0.017600  2.000000  641.0000
7.777778  0.002296  0.017855  2.000000  651.0000
7.888889  0.002296  0.018110  2.000000  661.0000
8.000000  0.002296  0.018365  2.000000  671.0000
8.111111  0.002296  0.018621  2.000000  681.0000
8.222222  0.002296  0.018876  2.000000  691.0000
8.333333  0.002296  0.019131  2.000000  701.0000
8.444444  0.002296  0.019386  2.000000  711.0000
8.555556  0.002296  0.019641  2.000000  721.0000
8.666667  0.002296  0.019896  2.000000  731.0000
8.777778  0.002296  0.020151  2.000000  741.0000
8.888889  0.002296  0.020406  2.000000  751.0000
9.000000  0.002296  0.020661  2.000000  761.0000
9.111111  0.002296  0.020916  2.000000  771.0000
9.222222  0.002296  0.021171  2.000000  781.0000
9.333333  0.002296  0.021426  2.000000  791.0000
9.444444  0.002296  0.021681  2.000000  801.0000
9.555556  0.002296  0.021937  2.000000  811.0000
9.666667  0.002296  0.022192  2.000000  821.0000
9.777778  0.002296  0.022447  2.000000  831.0000
9.888889  0.002296  0.022702  2.000000  841.0000
END FTABLE  7
FTABLE      8
 90    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.002296  0.000000  2.000000  0.000000
0.111111  0.002296  0.000255  2.000000  0.000000
0.222222  0.002296  0.000510  2.000000  0.000000
0.333333  0.002296  0.000765  2.000000  0.000000
0.444444  0.002296  0.001020  2.000000  0.000000
0.555556  0.002296  0.001275  2.000000  0.000000
0.666667  0.002296  0.001530  2.000000  11.00000
0.777778  0.002296  0.001786  2.000000  21.00000
0.888889  0.002296  0.002041  2.000000  31.00000
1.000000  0.002296  0.002296  2.000000  41.00000
1.111111  0.002296  0.002551  2.000000  51.00000
1.222222  0.002296  0.002806  2.000000  61.00000
1.333333  0.002296  0.003061  2.000000  71.00000
1.444444  0.002296  0.003316  2.000000  81.00000
1.555556  0.002296  0.003571  2.000000  91.00000
1.666667  0.002296  0.003826  2.000000  101.0000
1.777778  0.002296  0.004081  2.000000  111.0000
```

1.888889	0.002296	0.004336	2.000000	121.0000
2.000000	0.002296	0.004591	2.000000	131.0000
2.111111	0.002296	0.004846	2.000000	141.0000
2.222222	0.002296	0.005102	2.000000	151.0000
2.333333	0.002296	0.005357	2.000000	161.0000
2.444444	0.002296	0.005612	2.000000	171.0000
2.555556	0.002296	0.005867	2.000000	181.0000
2.666667	0.002296	0.006122	2.000000	191.0000
2.777778	0.002296	0.006377	2.000000	201.0000
2.888889	0.002296	0.006632	2.000000	211.0000
3.000000	0.002296	0.006887	2.000000	221.0000
3.111111	0.002296	0.007142	2.000000	231.0000
3.222222	0.002296	0.007397	2.000000	241.0000
3.333333	0.002296	0.007652	2.000000	251.0000
3.444444	0.002296	0.007907	2.000000	261.0000
3.555556	0.002296	0.008162	2.000000	271.0000
3.666667	0.002296	0.008418	2.000000	281.0000
3.777778	0.002296	0.008673	2.000000	291.0000
3.888889	0.002296	0.008928	2.000000	301.0000
4.000000	0.002296	0.009183	2.000000	311.0000
4.111111	0.002296	0.009438	2.000000	321.0000
4.222222	0.002296	0.009693	2.000000	331.0000
4.333333	0.002296	0.009948	2.000000	341.0000
4.444444	0.002296	0.010203	2.000000	351.0000
4.555556	0.002296	0.010458	2.000000	361.0000
4.666667	0.002296	0.010713	2.000000	371.0000
4.777778	0.002296	0.010968	2.000000	381.0000
4.888889	0.002296	0.011223	2.000000	391.0000
5.000000	0.002296	0.011478	2.000000	401.0000
5.111111	0.002296	0.011733	2.000000	411.0000
5.222222	0.002296	0.011989	2.000000	421.0000
5.333333	0.002296	0.012244	2.000000	431.0000
5.444444	0.002296	0.012499	2.000000	441.0000
5.555556	0.002296	0.012754	2.000000	451.0000
5.666667	0.002296	0.013009	2.000000	461.0000
5.777778	0.002296	0.013264	2.000000	471.0000
5.888889	0.002296	0.013519	2.000000	481.0000
6.000000	0.002296	0.013774	2.000000	491.0000
6.111111	0.002296	0.014029	2.000000	501.0000
6.222222	0.002296	0.014284	2.000000	511.0000
6.333333	0.002296	0.014539	2.000000	521.0000
6.444444	0.002296	0.014794	2.000000	531.0000
6.555556	0.002296	0.015049	2.000000	541.0000
6.666667	0.002296	0.015305	2.000000	551.0000
6.777778	0.002296	0.015560	2.000000	561.0000
6.888889	0.002296	0.015815	2.000000	571.0000
7.000000	0.002296	0.016070	2.000000	581.0000
7.111111	0.002296	0.016325	2.000000	591.0000
7.222222	0.002296	0.016580	2.000000	601.0000
7.333333	0.002296	0.016835	2.000000	611.0000
7.444444	0.002296	0.017090	2.000000	621.0000
7.555556	0.002296	0.017345	2.000000	631.0000
7.666667	0.002296	0.017600	2.000000	641.0000
7.777778	0.002296	0.017855	2.000000	651.0000
7.888889	0.002296	0.018110	2.000000	661.0000
8.000000	0.002296	0.018365	2.000000	671.0000
8.111111	0.002296	0.018621	2.000000	681.0000
8.222222	0.002296	0.018876	2.000000	691.0000
8.333333	0.002296	0.019131	2.000000	701.0000
8.444444	0.002296	0.019386	2.000000	711.0000
8.555556	0.002296	0.019641	2.000000	721.0000
8.666667	0.002296	0.019896	2.000000	731.0000
8.777778	0.002296	0.020151	2.000000	741.0000
8.888889	0.002296	0.020406	2.000000	751.0000
9.000000	0.002296	0.020661	2.000000	761.0000
9.111111	0.002296	0.020916	2.000000	771.0000
9.222222	0.002296	0.021171	2.000000	781.0000
9.333333	0.002296	0.021426	2.000000	791.0000
9.444444	0.002296	0.021681	2.000000	801.0000
9.555556	0.002296	0.021937	2.000000	811.0000

```
9.666667  0.002296  0.022192  2.000000  821.0000
9.777778  0.002296  0.022447  2.000000  831.0000
9.888889  0.002296  0.022702  2.000000  841.0000
END FTABLE  8
FTABLE      9
 90    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.002296  0.000000  2.000000  0.000000
0.111111  0.002296  0.000255  2.000000  0.000000
0.222222  0.002296  0.000510  2.000000  0.000000
0.333333  0.002296  0.000765  2.000000  0.000000
0.444444  0.002296  0.001020  2.000000  0.000000
0.555556  0.002296  0.001275  2.000000  0.000000
0.666667  0.002296  0.001530  2.000000  11.00000
0.777778  0.002296  0.001786  2.000000  21.00000
0.888889  0.002296  0.002041  2.000000  31.00000
1.000000  0.002296  0.002296  2.000000  41.00000
1.111111  0.002296  0.002551  2.000000  51.00000
1.222222  0.002296  0.002806  2.000000  61.00000
1.333333  0.002296  0.003061  2.000000  71.00000
1.444444  0.002296  0.003316  2.000000  81.00000
1.555556  0.002296  0.003571  2.000000  91.00000
1.666667  0.002296  0.003826  2.000000  101.0000
1.777778  0.002296  0.004081  2.000000  111.0000
1.888889  0.002296  0.004336  2.000000  121.0000
2.000000  0.002296  0.004591  2.000000  131.0000
2.111111  0.002296  0.004846  2.000000  141.0000
2.222222  0.002296  0.005102  2.000000  151.0000
2.333333  0.002296  0.005357  2.000000  161.0000
2.444444  0.002296  0.005612  2.000000  171.0000
2.555556  0.002296  0.005867  2.000000  181.0000
2.666667  0.002296  0.006122  2.000000  191.0000
2.777778  0.002296  0.006377  2.000000  201.0000
2.888889  0.002296  0.006632  2.000000  211.0000
3.000000  0.002296  0.006887  2.000000  221.0000
3.111111  0.002296  0.007142  2.000000  231.0000
3.222222  0.002296  0.007397  2.000000  241.0000
3.333333  0.002296  0.007652  2.000000  251.0000
3.444444  0.002296  0.007907  2.000000  261.0000
3.555556  0.002296  0.008162  2.000000  271.0000
3.666667  0.002296  0.008418  2.000000  281.0000
3.777778  0.002296  0.008673  2.000000  291.0000
3.888889  0.002296  0.008928  2.000000  301.0000
4.000000  0.002296  0.009183  2.000000  311.0000
4.111111  0.002296  0.009438  2.000000  321.0000
4.222222  0.002296  0.009693  2.000000  331.0000
4.333333  0.002296  0.009948  2.000000  341.0000
4.444444  0.002296  0.010203  2.000000  351.0000
4.555556  0.002296  0.010458  2.000000  361.0000
4.666667  0.002296  0.010713  2.000000  371.0000
4.777778  0.002296  0.010968  2.000000  381.0000
4.888889  0.002296  0.011223  2.000000  391.0000
5.000000  0.002296  0.011478  2.000000  401.0000
5.111111  0.002296  0.011733  2.000000  411.0000
5.222222  0.002296  0.011989  2.000000  421.0000
5.333333  0.002296  0.012244  2.000000  431.0000
5.444444  0.002296  0.012499  2.000000  441.0000
5.555556  0.002296  0.012754  2.000000  451.0000
5.666667  0.002296  0.013009  2.000000  461.0000
5.777778  0.002296  0.013264  2.000000  471.0000
5.888889  0.002296  0.013519  2.000000  481.0000
6.000000  0.002296  0.013774  2.000000  491.0000
6.111111  0.002296  0.014029  2.000000  501.0000
6.222222  0.002296  0.014284  2.000000  511.0000
6.333333  0.002296  0.014539  2.000000  521.0000
6.444444  0.002296  0.014794  2.000000  531.0000
6.555556  0.002296  0.015049  2.000000  541.0000
6.666667  0.002296  0.015305  2.000000  551.0000
6.777778  0.002296  0.015560  2.000000  561.0000
```

```
6.888889  0.002296  0.015815  2.000000  571.0000
7.000000  0.002296  0.016070  2.000000  581.0000
7.111111  0.002296  0.016325  2.000000  591.0000
7.222222  0.002296  0.016580  2.000000  601.0000
7.333333  0.002296  0.016835  2.000000  611.0000
7.444444  0.002296  0.017090  2.000000  621.0000
7.555556  0.002296  0.017345  2.000000  631.0000
7.666667  0.002296  0.017600  2.000000  641.0000
7.777778  0.002296  0.017855  2.000000  651.0000
7.888889  0.002296  0.018110  2.000000  661.0000
8.000000  0.002296  0.018365  2.000000  671.0000
8.111111  0.002296  0.018621  2.000000  681.0000
8.222222  0.002296  0.018876  2.000000  691.0000
8.333333  0.002296  0.019131  2.000000  701.0000
8.444444  0.002296  0.019386  2.000000  711.0000
8.555556  0.002296  0.019641  2.000000  721.0000
8.666667  0.002296  0.019896  2.000000  731.0000
8.777778  0.002296  0.020151  2.000000  741.0000
8.888889  0.002296  0.020406  2.000000  751.0000
9.000000  0.002296  0.020661  2.000000  761.0000
9.111111  0.002296  0.020916  2.000000  771.0000
9.222222  0.002296  0.021171  2.000000  781.0000
9.333333  0.002296  0.021426  2.000000  791.0000
9.444444  0.002296  0.021681  2.000000  801.0000
9.555556  0.002296  0.021937  2.000000  811.0000
9.666667  0.002296  0.022192  2.000000  821.0000
9.777778  0.002296  0.022447  2.000000  831.0000
9.888889  0.002296  0.022702  2.000000  841.0000
END FTABLE  9
FTABLE     10
 90    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.002296  0.000000  2.000000  0.000000
0.111111  0.002296  0.000255  2.000000  0.000000
0.222222  0.002296  0.000510  2.000000  0.000000
0.333333  0.002296  0.000765  2.000000  0.000000
0.444444  0.002296  0.001020  2.000000  0.000000
0.555556  0.002296  0.001275  2.000000  0.000000
0.666667  0.002296  0.001530  2.000000  11.00000
0.777778  0.002296  0.001786  2.000000  21.00000
0.888889  0.002296  0.002041  2.000000  31.00000
1.000000  0.002296  0.002296  2.000000  41.00000
1.111111  0.002296  0.002551  2.000000  51.00000
1.222222  0.002296  0.002806  2.000000  61.00000
1.333333  0.002296  0.003061  2.000000  71.00000
1.444444  0.002296  0.003316  2.000000  81.00000
1.555556  0.002296  0.003571  2.000000  91.00000
1.666667  0.002296  0.003826  2.000000  101.0000
1.777778  0.002296  0.004081  2.000000  111.0000
1.888889  0.002296  0.004336  2.000000  121.0000
2.000000  0.002296  0.004591  2.000000  131.0000
2.111111  0.002296  0.004846  2.000000  141.0000
2.222222  0.002296  0.005102  2.000000  151.0000
2.333333  0.002296  0.005357  2.000000  161.0000
2.444444  0.002296  0.005612  2.000000  171.0000
2.555556  0.002296  0.005867  2.000000  181.0000
2.666667  0.002296  0.006122  2.000000  191.0000
2.777778  0.002296  0.006377  2.000000  201.0000
2.888889  0.002296  0.006632  2.000000  211.0000
3.000000  0.002296  0.006887  2.000000  221.0000
3.111111  0.002296  0.007142  2.000000  231.0000
3.222222  0.002296  0.007397  2.000000  241.0000
3.333333  0.002296  0.007652  2.000000  251.0000
3.444444  0.002296  0.007907  2.000000  261.0000
3.555556  0.002296  0.008162  2.000000  271.0000
3.666667  0.002296  0.008418  2.000000  281.0000
3.777778  0.002296  0.008673  2.000000  291.0000
3.888889  0.002296  0.008928  2.000000  301.0000
4.000000  0.002296  0.009183  2.000000  311.0000
```

```
4.111111  0.002296  0.009438  2.000000  321.0000
4.222222  0.002296  0.009693  2.000000  331.0000
4.333333  0.002296  0.009948  2.000000  341.0000
4.444444  0.002296  0.010203  2.000000  351.0000
4.555556  0.002296  0.010458  2.000000  361.0000
4.666667  0.002296  0.010713  2.000000  371.0000
4.777778  0.002296  0.010968  2.000000  381.0000
4.888889  0.002296  0.011223  2.000000  391.0000
5.000000  0.002296  0.011478  2.000000  401.0000
5.111111  0.002296  0.011733  2.000000  411.0000
5.222222  0.002296  0.011989  2.000000  421.0000
5.333333  0.002296  0.012244  2.000000  431.0000
5.444444  0.002296  0.012499  2.000000  441.0000
5.555556  0.002296  0.012754  2.000000  451.0000
5.666667  0.002296  0.013009  2.000000  461.0000
5.777778  0.002296  0.013264  2.000000  471.0000
5.888889  0.002296  0.013519  2.000000  481.0000
6.000000  0.002296  0.013774  2.000000  491.0000
6.111111  0.002296  0.014029  2.000000  501.0000
6.222222  0.002296  0.014284  2.000000  511.0000
6.333333  0.002296  0.014539  2.000000  521.0000
6.444444  0.002296  0.014794  2.000000  531.0000
6.555556  0.002296  0.015049  2.000000  541.0000
6.666667  0.002296  0.015305  2.000000  551.0000
6.777778  0.002296  0.015560  2.000000  561.0000
6.888889  0.002296  0.015815  2.000000  571.0000
7.000000  0.002296  0.016070  2.000000  581.0000
7.111111  0.002296  0.016325  2.000000  591.0000
7.222222  0.002296  0.016580  2.000000  601.0000
7.333333  0.002296  0.016835  2.000000  611.0000
7.444444  0.002296  0.017090  2.000000  621.0000
7.555556  0.002296  0.017345  2.000000  631.0000
7.666667  0.002296  0.017600  2.000000  641.0000
7.777778  0.002296  0.017855  2.000000  651.0000
7.888889  0.002296  0.018110  2.000000  661.0000
8.000000  0.002296  0.018365  2.000000  671.0000
8.111111  0.002296  0.018621  2.000000  681.0000
8.222222  0.002296  0.018876  2.000000  691.0000
8.333333  0.002296  0.019131  2.000000  701.0000
8.444444  0.002296  0.019386  2.000000  711.0000
8.555556  0.002296  0.019641  2.000000  721.0000
8.666667  0.002296  0.019896  2.000000  731.0000
8.777778  0.002296  0.020151  2.000000  741.0000
8.888889  0.002296  0.020406  2.000000  751.0000
9.000000  0.002296  0.020661  2.000000  761.0000
9.111111  0.002296  0.020916  2.000000  771.0000
9.222222  0.002296  0.021171  2.000000  781.0000
9.333333  0.002296  0.021426  2.000000  791.0000
9.444444  0.002296  0.021681  2.000000  801.0000
9.555556  0.002296  0.021937  2.000000  811.0000
9.666667  0.002296  0.022192  2.000000  821.0000
9.777778  0.002296  0.022447  2.000000  831.0000
9.888889  0.002296  0.022702  2.000000  841.0000
END FTABLE 10
FTABLE     11
 90    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.002296  0.000000  2.000000  0.000000
0.111111  0.002296  0.000255  2.000000  0.000000
0.222222  0.002296  0.000510  2.000000  0.000000
0.333333  0.002296  0.000765  2.000000  0.000000
0.444444  0.002296  0.001020  2.000000  0.000000
0.555556  0.002296  0.001275  2.000000  0.000000
0.666667  0.002296  0.001530  2.000000  11.00000
0.777778  0.002296  0.001786  2.000000  21.00000
0.888889  0.002296  0.002041  2.000000  31.00000
1.000000  0.002296  0.002296  2.000000  41.00000
1.111111  0.002296  0.002551  2.000000  51.00000
1.222222  0.002296  0.002806  2.000000  61.00000
```

1.333333	0.002296	0.003061	2.000000	71.00000
1.444444	0.002296	0.003316	2.000000	81.00000
1.555556	0.002296	0.003571	2.000000	91.00000
1.666667	0.002296	0.003826	2.000000	101.0000
1.777778	0.002296	0.004081	2.000000	111.0000
1.888889	0.002296	0.004336	2.000000	121.0000
2.000000	0.002296	0.004591	2.000000	131.0000
2.111111	0.002296	0.004846	2.000000	141.0000
2.222222	0.002296	0.005102	2.000000	151.0000
2.333333	0.002296	0.005357	2.000000	161.0000
2.444444	0.002296	0.005612	2.000000	171.0000
2.555556	0.002296	0.005867	2.000000	181.0000
2.666667	0.002296	0.006122	2.000000	191.0000
2.777778	0.002296	0.006377	2.000000	201.0000
2.888889	0.002296	0.006632	2.000000	211.0000
3.000000	0.002296	0.006887	2.000000	221.0000
3.111111	0.002296	0.007142	2.000000	231.0000
3.222222	0.002296	0.007397	2.000000	241.0000
3.333333	0.002296	0.007652	2.000000	251.0000
3.444444	0.002296	0.007907	2.000000	261.0000
3.555556	0.002296	0.008162	2.000000	271.0000
3.666667	0.002296	0.008418	2.000000	281.0000
3.777778	0.002296	0.008673	2.000000	291.0000
3.888889	0.002296	0.008928	2.000000	301.0000
4.000000	0.002296	0.009183	2.000000	311.0000
4.111111	0.002296	0.009438	2.000000	321.0000
4.222222	0.002296	0.009693	2.000000	331.0000
4.333333	0.002296	0.009948	2.000000	341.0000
4.444444	0.002296	0.010203	2.000000	351.0000
4.555556	0.002296	0.010458	2.000000	361.0000
4.666667	0.002296	0.010713	2.000000	371.0000
4.777778	0.002296	0.010968	2.000000	381.0000
4.888889	0.002296	0.011223	2.000000	391.0000
5.000000	0.002296	0.011478	2.000000	401.0000
5.111111	0.002296	0.011733	2.000000	411.0000
5.222222	0.002296	0.011989	2.000000	421.0000
5.333333	0.002296	0.012244	2.000000	431.0000
5.444444	0.002296	0.012499	2.000000	441.0000
5.555556	0.002296	0.012754	2.000000	451.0000
5.666667	0.002296	0.013009	2.000000	461.0000
5.777778	0.002296	0.013264	2.000000	471.0000
5.888889	0.002296	0.013519	2.000000	481.0000
6.000000	0.002296	0.013774	2.000000	491.0000
6.111111	0.002296	0.014029	2.000000	501.0000
6.222222	0.002296	0.014284	2.000000	511.0000
6.333333	0.002296	0.014539	2.000000	521.0000
6.444444	0.002296	0.014794	2.000000	531.0000
6.555556	0.002296	0.015049	2.000000	541.0000
6.666667	0.002296	0.015305	2.000000	551.0000
6.777778	0.002296	0.015560	2.000000	561.0000
6.888889	0.002296	0.015815	2.000000	571.0000
7.000000	0.002296	0.016070	2.000000	581.0000
7.111111	0.002296	0.016325	2.000000	591.0000
7.222222	0.002296	0.016580	2.000000	601.0000
7.333333	0.002296	0.016835	2.000000	611.0000
7.444444	0.002296	0.017090	2.000000	621.0000
7.555556	0.002296	0.017345	2.000000	631.0000
7.666667	0.002296	0.017600	2.000000	641.0000
7.777778	0.002296	0.017855	2.000000	651.0000
7.888889	0.002296	0.018110	2.000000	661.0000
8.000000	0.002296	0.018365	2.000000	671.0000
8.111111	0.002296	0.018621	2.000000	681.0000
8.222222	0.002296	0.018876	2.000000	691.0000
8.333333	0.002296	0.019131	2.000000	701.0000
8.444444	0.002296	0.019386	2.000000	711.0000
8.555556	0.002296	0.019641	2.000000	721.0000
8.666667	0.002296	0.019896	2.000000	731.0000
8.777778	0.002296	0.020151	2.000000	741.0000
8.888889	0.002296	0.020406	2.000000	751.0000
9.000000	0.002296	0.020661	2.000000	761.0000

```
9.111111  0.002296  0.020916  2.000000  771.0000
9.222222  0.002296  0.021171  2.000000  781.0000
9.333333  0.002296  0.021426  2.000000  791.0000
9.444444  0.002296  0.021681  2.000000  801.0000
9.555556  0.002296  0.021937  2.000000  811.0000
9.666667  0.002296  0.022192  2.000000  821.0000
9.777778  0.002296  0.022447  2.000000  831.0000
9.888889  0.002296  0.022702  2.000000  841.0000
END FTABLE 11
FTABLE     12
 90    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.002296  0.000000  2.000000  0.000000
0.111111  0.002296  0.000255  2.000000  0.000000
0.222222  0.002296  0.000510  2.000000  0.000000
0.333333  0.002296  0.000765  2.000000  0.000000
0.444444  0.002296  0.001020  2.000000  0.000000
0.555556  0.002296  0.001275  2.000000  0.000000
0.666667  0.002296  0.001530  2.000000  11.00000
0.777778  0.002296  0.001786  2.000000  21.00000
0.888889  0.002296  0.002041  2.000000  31.00000
1.000000  0.002296  0.002296  2.000000  41.00000
1.111111  0.002296  0.002551  2.000000  51.00000
1.222222  0.002296  0.002806  2.000000  61.00000
1.333333  0.002296  0.003061  2.000000  71.00000
1.444444  0.002296  0.003316  2.000000  81.00000
1.555556  0.002296  0.003571  2.000000  91.00000
1.666667  0.002296  0.003826  2.000000  101.0000
1.777778  0.002296  0.004081  2.000000  111.0000
1.888889  0.002296  0.004336  2.000000  121.0000
2.000000  0.002296  0.004591  2.000000  131.0000
2.111111  0.002296  0.004846  2.000000  141.0000
2.222222  0.002296  0.005102  2.000000  151.0000
2.333333  0.002296  0.005357  2.000000  161.0000
2.444444  0.002296  0.005612  2.000000  171.0000
2.555556  0.002296  0.005867  2.000000  181.0000
2.666667  0.002296  0.006122  2.000000  191.0000
2.777778  0.002296  0.006377  2.000000  201.0000
2.888889  0.002296  0.006632  2.000000  211.0000
3.000000  0.002296  0.006887  2.000000  221.0000
3.111111  0.002296  0.007142  2.000000  231.0000
3.222222  0.002296  0.007397  2.000000  241.0000
3.333333  0.002296  0.007652  2.000000  251.0000
3.444444  0.002296  0.007907  2.000000  261.0000
3.555556  0.002296  0.008162  2.000000  271.0000
3.666667  0.002296  0.008418  2.000000  281.0000
3.777778  0.002296  0.008673  2.000000  291.0000
3.888889  0.002296  0.008928  2.000000  301.0000
4.000000  0.002296  0.009183  2.000000  311.0000
4.111111  0.002296  0.009438  2.000000  321.0000
4.222222  0.002296  0.009693  2.000000  331.0000
4.333333  0.002296  0.009948  2.000000  341.0000
4.444444  0.002296  0.010203  2.000000  351.0000
4.555556  0.002296  0.010458  2.000000  361.0000
4.666667  0.002296  0.010713  2.000000  371.0000
4.777778  0.002296  0.010968  2.000000  381.0000
4.888889  0.002296  0.011223  2.000000  391.0000
5.000000  0.002296  0.011478  2.000000  401.0000
5.111111  0.002296  0.011733  2.000000  411.0000
5.222222  0.002296  0.011989  2.000000  421.0000
5.333333  0.002296  0.012244  2.000000  431.0000
5.444444  0.002296  0.012499  2.000000  441.0000
5.555556  0.002296  0.012754  2.000000  451.0000
5.666667  0.002296  0.013009  2.000000  461.0000
5.777778  0.002296  0.013264  2.000000  471.0000
5.888889  0.002296  0.013519  2.000000  481.0000
6.000000  0.002296  0.013774  2.000000  491.0000
6.111111  0.002296  0.014029  2.000000  501.0000
6.222222  0.002296  0.014284  2.000000  511.0000
```

```
  6.333333  0.002296  0.014539  2.000000  521.0000
  6.444444  0.002296  0.014794  2.000000  531.0000
  6.555556  0.002296  0.015049  2.000000  541.0000
  6.666667  0.002296  0.015305  2.000000  551.0000
  6.777778  0.002296  0.015560  2.000000  561.0000
  6.888889  0.002296  0.015815  2.000000  571.0000
  7.000000  0.002296  0.016070  2.000000  581.0000
  7.111111  0.002296  0.016325  2.000000  591.0000
  7.222222  0.002296  0.016580  2.000000  601.0000
  7.333333  0.002296  0.016835  2.000000  611.0000
  7.444444  0.002296  0.017090  2.000000  621.0000
  7.555556  0.002296  0.017345  2.000000  631.0000
  7.666667  0.002296  0.017600  2.000000  641.0000
  7.777778  0.002296  0.017855  2.000000  651.0000
  7.888889  0.002296  0.018110  2.000000  661.0000
  8.000000  0.002296  0.018365  2.000000  671.0000
  8.111111  0.002296  0.018621  2.000000  681.0000
  8.222222  0.002296  0.018876  2.000000  691.0000
  8.333333  0.002296  0.019131  2.000000  701.0000
  8.444444  0.002296  0.019386  2.000000  711.0000
  8.555556  0.002296  0.019641  2.000000  721.0000
  8.666667  0.002296  0.019896  2.000000  731.0000
  8.777778  0.002296  0.020151  2.000000  741.0000
  8.888889  0.002296  0.020406  2.000000  751.0000
  9.000000  0.002296  0.020661  2.000000  761.0000
  9.111111  0.002296  0.020916  2.000000  771.0000
  9.222222  0.002296  0.021171  2.000000  781.0000
  9.333333  0.002296  0.021426  2.000000  791.0000
  9.444444  0.002296  0.021681  2.000000  801.0000
  9.555556  0.002296  0.021937  2.000000  811.0000
  9.666667  0.002296  0.022192  2.000000  821.0000
  9.777778  0.002296  0.022447  2.000000  831.0000
  9.888889  0.002296  0.022702  2.000000  841.0000
  END FTABLE 12
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO      1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   O       1 1        1      WDM   1001 FLOW     ENGL      REPL
RCHRES   1 HYDR   O       2 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE   1 1        1      WDM   1003 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN    1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN    1 1     48.4      WDM    801 FLOW     ENGL      REPL
RCHRES   2 HYDR   RO      1 1        1      WDM   1004 FLOW     ENGL      REPL
RCHRES   2 HYDR   O       1 1        1      WDM   1005 FLOW     ENGL      REPL
RCHRES   2 HYDR   O       2 1        1      WDM   1006 FLOW     ENGL      REPL
RCHRES   2 HYDR   STAGE   1 1        1      WDM   1007 STAG     ENGL      REPL
RCHRES   3 HYDR   RO      1 1        1      WDM   1008 FLOW     ENGL      REPL
RCHRES   3 HYDR   O       1 1        1      WDM   1009 FLOW     ENGL      REPL
RCHRES   3 HYDR   O       2 1        1      WDM   1010 FLOW     ENGL      REPL
RCHRES   3 HYDR   STAGE   1 1        1      WDM   1011 STAG     ENGL      REPL
RCHRES   4 HYDR   RO      1 1        1      WDM   1012 FLOW     ENGL      REPL
RCHRES   4 HYDR   O       1 1        1      WDM   1013 FLOW     ENGL      REPL
RCHRES   4 HYDR   O       2 1        1      WDM   1014 FLOW     ENGL      REPL
RCHRES   4 HYDR   STAGE   1 1        1      WDM   1015 STAG     ENGL      REPL
RCHRES   5 HYDR   RO      1 1        1      WDM   1016 FLOW     ENGL      REPL
RCHRES   5 HYDR   O       1 1        1      WDM   1017 FLOW     ENGL      REPL
RCHRES   5 HYDR   O       2 1        1      WDM   1018 FLOW     ENGL      REPL
```

```
RCHRES   5 HYDR   STAGE  1 1         1      WDM   1019 STAG     ENGL      REPL
RCHRES   6 HYDR   RO     1 1         1      WDM   1020 FLOW     ENGL      REPL
RCHRES   6 HYDR   O      1 1         1      WDM   1021 FLOW     ENGL      REPL
RCHRES   6 HYDR   O      2 1         1      WDM   1022 FLOW     ENGL      REPL
RCHRES   6 HYDR   STAGE  1 1         1      WDM   1023 STAG     ENGL      REPL
RCHRES   7 HYDR   RO     1 1         1      WDM   1024 FLOW     ENGL      REPL
RCHRES   7 HYDR   O      1 1         1      WDM   1025 FLOW     ENGL      REPL
RCHRES   7 HYDR   O      2 1         1      WDM   1026 FLOW     ENGL      REPL
RCHRES   7 HYDR   STAGE  1 1         1      WDM   1027 STAG     ENGL      REPL
RCHRES   8 HYDR   RO     1 1         1      WDM   1028 FLOW     ENGL      REPL
RCHRES   8 HYDR   O      1 1         1      WDM   1029 FLOW     ENGL      REPL
RCHRES   8 HYDR   O      2 1         1      WDM   1030 FLOW     ENGL      REPL
RCHRES   8 HYDR   STAGE  1 1         1      WDM   1031 STAG     ENGL      REPL
RCHRES   9 HYDR   RO     1 1         1      WDM   1032 FLOW     ENGL      REPL
RCHRES   9 HYDR   O      1 1         1      WDM   1033 FLOW     ENGL      REPL
RCHRES   9 HYDR   O      2 1         1      WDM   1034 FLOW     ENGL      REPL
RCHRES   9 HYDR   STAGE  1 1         1      WDM   1035 STAG     ENGL      REPL
RCHRES  10 HYDR   RO     1 1         1      WDM   1036 FLOW     ENGL      REPL
RCHRES  10 HYDR   O      1 1         1      WDM   1037 FLOW     ENGL      REPL
RCHRES  10 HYDR   O      2 1         1      WDM   1038 FLOW     ENGL      REPL
RCHRES  10 HYDR   STAGE  1 1         1      WDM   1039 STAG     ENGL      REPL
RCHRES  11 HYDR   RO     1 1         1      WDM   1040 FLOW     ENGL      REPL
RCHRES  11 HYDR   O      1 1         1      WDM   1041 FLOW     ENGL      REPL
RCHRES  11 HYDR   O      2 1         1      WDM   1042 FLOW     ENGL      REPL
RCHRES  11 HYDR   STAGE  1 1         1      WDM   1043 STAG     ENGL      REPL
RCHRES  12 HYDR   RO     1 1         1      WDM   1044 FLOW     ENGL      REPL
RCHRES  12 HYDR   O      1 1         1      WDM   1045 FLOW     ENGL      REPL
RCHRES  12 HYDR   O      2 1         1      WDM   1046 FLOW     ENGL      REPL
RCHRES  12 HYDR   STAGE  1 1         1      WDM   1047 STAG     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>             <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17

  MASS-LINK       18
RCHRES     OFLOW  OVOL   2                 COPY           INPUT  MEAN
  END MASS-LINK   18


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

Legal Notice

This program and accompanying documentation are provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc. be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions Inc. or their authorized representatives have been advised of the possibility of such damages. Software Copyright © by : Clear Creek Solutions, Inc. 2005-2025; All Rights Reserved.

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

Appendix C Geotechnical Report

Columbia West Geotechnical Report

Follow Up Explorations

Geotechnical Site Investigation

Landing on the Cowlitz

Castle Rock, Washington

March 30, 2023

Geotechnical ■ Environmental ■ Special Inspections
Columbia West
Engineering, Inc

11917 NE 95th Street
Vancouver, Washington
98682
Phone: 360-823-2900

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

GEOTECHNICAL SITE INVESTIGATION
LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

Prepared For:

CT6, LLC
Attn: Janette Pipkin
PO Box 1419
Battle Ground, Washington 98604

Site Location:

2542 SW Larson Lane
Parcel Nos. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031
Castle Rock, Washington

Prepared By:

Columbia West Engineering, Inc.
11917 NE 95th Street
Vancouver, Washington 98682
Phone: 360-823-2900

Date Prepared:

March 30, 2023

EXECUTIVE SUMMARY

This executive summary presents the primary geotechnical considerations associated with the proposed Landing on the Cowlitz project located in Castle Rock, Washington. Our conclusions and recommendations are based upon the subsurface information presented in this report and proposed development information provided by the design team. Detailed discussion of the geotechnical considerations summarized here is presented in respective sections of the report.

- Based on subsurface exploration and testing, liquefiable soil is present at the site. Maximum total liquefaction settlement is estimated to range from approximately 4 to 7 inches. Differential settlement is estimated to be approximately one-half of the total over a 50-foot span. Detailed discussion of site liquefaction potential is presented in Section 6.1, *Liquefaction*.
- Review of *Table 12.13-3* of *ASCE 7-16* indicates that anticipated seismic differential settlement will be near the upper bound, tolerable limit for typical structures that may be proposed on the site. Provided that proposed structures can tolerate the estimated seismic settlement, the buildings can be supported on conventional spread footings bearing on firm native soil or engineered structural fill. Shallow foundations, if proposed, will require foundations ties if differential settlement exceeds one-quarter of the thresholds presented in *Table 12.13-3*. Ground improvement or deep foundations may be necessary if buildings cannot tolerate the estimated seismic settlement or if project stakeholders desire to minimize risk of building damage following a seismic event.
- Groundwater was observed in site explorations at depths ranging from 9 to 35 feet below ground surface (bgs). The shallow depth to groundwater may impact site cuts for foundations, utilities, pump stations, and stormwater detention ponds. Dewatering should be assumed where proposed excavations extend more than a few feet below existing grade. Significant excavation depths for the proposed pump station and potential for rapid groundwater flow through permeable sand and gravel deposits will dictate the need for a robust dewatering plan designed by a licensed professional engineer.
- Based on groundwater conditions and expected site grading, cut off drains may be required to intercept water in areas of significant cut. Our experience indicates that installation of cut-off drains prior to site grading activity will assist in dewatering during site construction, particularly during the wet-weather season.
- Perimeter building foundation drains can reduce the potential for water intrusion below structures. Perimeter footing drains are recommended for shallow foundations constructed 5 or more feet below existing site grades. Foundations constructed less than 5 feet below existing grades do not require drains, however,

it may be prudent to install foundations drains to collect incidental or perched water. The final decision for foundations drains should be made by the owner and architect.

- Moisture conditioning will be required to use onsite soil as structural fill. If moisture conditioning is not feasible due to weather conditions or other factors, soils may require cement-amendment to be used as structural fill.
- Near-surface native soils will be sensitive to disturbance and softening when at a moisture content that is above optimum. Haul roads and staging areas will be necessary to minimize damage to exposed subgrade soils during construction. Subgrade protection is discussed in Section 8.2, *Construction Traffic and Staging*.
- Design and construction of proposed stormwater management facilities should account for shallow groundwater conditions observed at the site.
- This report has been prepared to provide general recommendations for overall site development. We recommend additional explorations and geotechnical reports be completed for specific developments/structures prior to design and construction.

TABLE OF CONTENTS

LIST OF FIGURES ii
LIST OF APPENDICES iii
1.0 INTRODUCTION 1
1.1 General Site Information 1
1.2 Project Understanding 1
1.3 Site Background Information 1
2.0 SCOPE OF SERVICES 2
3.0 REGIONAL GEOLOGY AND SOIL CONDITIONS 3
4.0 REGIONAL SEISMOLOGY 4
5.0 GEOTECHNICAL AND GEOLOGIC FIELD INVESTIGATION 5
5.1 Surface Investigation and Site Description 5
5.2 Subsurface Conditions 6
6.0 SEISMIC HAZARDS 8
6.1 Liquefaction 8
6.2 Lateral Spreading 9
7.0 DESIGN RECOMMENDATIONS 10
7.1 Shallow Foundation Support 10
7.2 Seismic Design Considerations 12
7.3 Retaining Structures 13
7.4 Pavement Design 14
7.5 Drainage 16
8.0 CONSTRUCTION RECOMMENDATIONS 18
8.1 Site Preparation and Grading 18
8.2 Construction Traffic and Staging 18
8.3 Cut and Fill Slopes 19
8.4 Excavation 20
8.5 Dewatering 20
8.6 Materials 21
8.7 Erosion Control Measures 26
9.0 CONCLUSION AND LIMITATIONS 27
REFERENCES
FIGURES
APPENDICES

LIST OF FIGURES

Number	Title
1	Site Location Map
2	Exploration Location Map
3	Preliminary Master Development Plan
4	Phase I Rough Grading Plan
5	Surcharge-Induced Lateral Earth Pressures
6	Typical Perimeter Footing Drain Detail
7	Typical Perforated Drainpipe Trench Detail
8	Typical Drainage Mat Detail
9	Typical Cut and Fill Slope Cross-Section
10	Minimum Foundation Slope Setback Detail

LIST OF APPENDICES

Number	Title
A	Subsurface Exploration Logs
B	Soil Classification Information
C	Pertinent Subsurface Information Collected by Others
D	Report Limitations and Important Information

GEOTECHNICAL SITE INVESTIGATION
LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

1.0 INTRODUCTION

Columbia West Engineering, Inc. (Columbia West) was retained by CT6, LLC to conduct a geotechnical site investigation for the proposed Landing on the Cowlitz master development project located in Castle Rock, Washington. The purpose of the investigation was to provide geotechnical engineering recommendations for use during design and construction of the proposed development. This report summarizes the investigation and provides field assessment documentation. This report is subject to the limitations expressed in Section 9.0, *Conclusion and Limitations*, and Appendix D, *Report Limitations and Important Information*.

1.1 General Site Information

As indicated on Figures 1 and 2, the subject site is located at 2542 Larson Lane in Castle Rock, Washington. The site is comprised of tax parcels 3092824, 3040258, 3040259, 3040322, 3014867, and 3045031 totaling approximately 118.2 acres. The approximate latitude and longitude are N 45° 15' 25" and W 122° 53' 30", and the legal description includes portions of the SE ¼ of Section 14, the NE ¼ of Section 23, and the NW ¼ of Section 24, T9N, R2W, Willamette Meridian. The regulatory jurisdictional agency is the City of Castle Rock.

1.2 Project Understanding

Based on client correspondence and review of the preliminary master development plan shown on Figure 3, Columbia West understands that proposed development consists of a mixed-use district with approximately 7.8 acres of residential zoning, 9.5 acres of commercial zoning, 18.3 acres of recreational zoning, and 55.9 acres of light industrial and office space zoning. Proposed development also includes public roadway construction, installation of underground utilities, and stormwater management facilities. A sanitary sewer pump station is also proposed approximately 35 feet below ground surface. The *Phase 1 Rough Grading Plan*, presented on Figure 4, includes cuts and fills up to 10 feet.

Lot- and zoning-specific building plans were not available at the time this report was prepared. In general, buildings on the site are expected to be lightly-loaded and less than three stories in height. We anticipate that commercial, recreational, and light industrial areas will include concrete tilt-up or metal-framed buildings. Residential structures will likely be of wood-framed construction. We should be contacted to revise our recommendations if the assumptions stated above are incorrect.

1.3 Site Background Information

Columbia West was retained by CT6, LLC in October, 2022 to provide on-call geotechnical construction monitoring and material testing services during Phase I rough grading as shown

on Figure 4. On-call geotechnical services conducted between October, 2022 and January, 2023 included organic stripping observations, moisture-density testing of structural fill, proof-roll observations, bearing probe analysis, and laboratory testing. Field reports documenting Phase I grading activity were submitted to project team members under separate cover. Columbia West also prepared preliminary grading recommendations for the Phase I rough grading plan which is presented in a technical memorandum dated November 8, 2022 (Columbia West, 2022). At the time this report was prepared, Phase I rough grading was in progress with expected completion in summer of 2023.

To characterize site groundwater conditions and facilitate stormwater management design by others, Columbia West oversaw five borings at the site with piezometer installations (BP-1 through BP-5) on January 31, February 1, and February 2, 2023. Piezometers extended up to 35 feet below existing grade, were backfilled with silica sand, sealed with bentonite, and completed with flush mount monuments. Monitoring of the piezometers commenced in February, 2023 and continues on a bi-weekly basis at the direction of the design team. Piezometer monitoring results are discussed in greater detail in Section 5.2.2, *Groundwater*.

Prior to Phase I rough grading, a geotechnical due-diligence study of the site was conducted by others in 2020. Field exploration and testing conducted as part of the due-diligence study included six test pits (TP-1 through TP-6), two borings (B-1 and B-2), and five cone penetration tests (CPT-1 through CPT-5) extending to a maximum depth of 81.5 feet bgs. Exploration locations are shown on Figure 2. Exploration logs and CPT soundings are presented in Appendix C, *Pertinent Subsurface Information Collected by Others*. Subsurface conditions observed by others during the due-diligence study are discussed in Section 5.2.1, *Soil Type Description*.

2.0 SCOPE OF SERVICES

Columbia West's scope of services was outlined in a proposal dated November 8, 2022. In accordance with our proposal, we performed the following geotechnical services:

- Reviewed information available in our files from previous geological and geotechnical studies conducted at and in the vicinity of the site. Our review included the following site explorations conducted by others and presented in Appendix C, *Pertinent Subsurface Information Collected by Others*:
    - Five CPT soundings explored to a maximum depth of 35.43 feet bgs.
    - Two borings explored to a maximum depth of 81.5 feet bgs.
    - Six test pits explored to a maximum depth of 13 feet bgs.
- Reviewed the preliminary master development plan, the Phase I rough grading plan, and a conceptual stormwater management plan provided by the design team.
- Conducted subsurface exploration at the site, to include:
    - Drilled five borings to a maximum depth of 45 feet bgs and installed piezometers in each borehole.
- Classified and logged observed soil and groundwater conditions.

- Prepared this geotechnical site investigation report for the proposed development, which includes:
  - Summary of soil index properties, regional geology, soil conditions, and observed groundwater conditions
  - Summary of geologic and seismic literature research used to evaluate relevant seismic risks, including locations of faults, earthquake magnitudes, and seismic factors from the *2018 IBC* and *ASCE 7-16*
  - Liquefaction analysis, predicted seismic settlement, and mitigation discussion
  - Foundation settlement potential
  - Geotechnical design and construction recommendations for:
    - Shallow foundations
    - Slab subgrade preparation
    - Retaining walls, including drainage, backfill, and lateral earth pressures
    - Site preparation and grading, organic stripping, fill placement and compaction, over-excavation, wet/dry weather earthwork, and construction monitoring and testing
    - Structural fill materials, onsite soil suitability, and import aggregate specifications
    - Utility trench excavation and backfill
    - Drainage and management of groundwater conditions
    - Asphaltic concrete pavement construction for private access roads and parking lots, including section thicknesses for base aggregate and asphalt layers
    - Portland cement concrete pavement construction for loading docks, including section thicknesses for base aggregate and PCC layers
    - Code-based seismic design parameters in accordance with *ASCE 7-16*

3.0 REGIONAL GEOLOGY AND SOIL CONDITIONS

The subject site lies within the Cowlitz River drainage basin, a physiographic river valley flanked to the east and west by mountainous foothills of the western Cascade Range. The site is located along the east bank of the Cowlitz River, approximately 11 miles north of the confluence with the Columbia River in Longview, Washington.

According to the *Geologic Map of the Mount St. Helens Quadrangle, Washington and Oregon* (Phillips, USGS Open File Report 87-4, 1987), near-surface soils are expected to consist of Quaternary-aged alluvium of silt, sand, and gravel deposited by the Cowlitz River. The Cowlitz Formation is mapped below the alluvium and consists of Eocene-aged sandstone, siltstone, and shale with interbeds of basalt and conglomerate.

In areas proposed for development, the *Web Soil Survey* (USDA, NRCS, 2023 Website) identifies various loamy sands, fine sandy loams, and gravelly sands of the Newberg, Carrolls, Pilchuck, Panamaker, and Cowlitz soil series. The mapped soils generally consist of silts, sands, and gravels with moderately rapid to rapid permeability, low to moderate

water capacity, and low shrink-swell potential. These soils exhibit a slight to severe erosion hazard based primarily on slope grade. As discussed in Section 1.3, *Site Background Information*, surface soils at the site have been disturbed, moved, or manipulated as part of Phase I rough grading activity and may no longer be representative of the NRCS soil survey mapping.

4.0 REGIONAL SEISMOLOGY

Recent research and subsurface mapping investigations within the Pacific Northwest appear to suggest the historic potential risk for a large earthquake event with strong localized ground movement may be underestimated. Past earthquakes in the Pacific Northwest appear to have caused landslides and ground subsidence, in addition to severe flooding near coastal areas. Earthquakes may also induce soil liquefaction, which occurs when elevated horizontal ground acceleration and velocity cause soil particles to interact as a fluid as opposed to a solid. Liquefaction of soil can result in lateral spreading and temporary loss of bearing capacity and shear strength. Liquefaction is discussed later in Section 5.9, *Liquefaction*.

Three scenario earthquakes are possible with the local seismic setting. Two of the possible earthquake sources are associated with the CSZ, and the third event is a shallow, local crustal earthquake that could occur in the North American Plate. The three earthquake scenarios are discussed below.

Cascadia Subduction Zone

The Cascadia Subduction Zone is a potential source of strong earthquake activity in the Portland/Vancouver Basin. This phenomenon is the result of the earth's large tectonic plate movement. Geologic evidence indicates that volcanic ocean floor activity along the Juan de Fuca ridge in the Pacific Ocean causes the Juan de Fuca Plate to perpetually move east and subduct under the North American Continental Plate. The subduction zone results in historic volcanic and potential earthquake activity in proximity to the plate interface, believed to lie approximately 20 to 50 miles west of the general location of the Oregon and Washington coast (Geomatrix Consultants, 1995).

Evidence suggests that this subduction zone has generated eight great earthquakes in the last 4,000 years, with the most recent event occurring approximately 300 years ago (Weaver and Shedlock, 1991).

Two types of subduction zone earthquakes are possible and considered in this report:

1. An interface event earthquake on the seismogenic part of the interface between the Juan de Fuca Plate and the North American Plate on the CSZ. This source is capable of generating earthquakes with a moment magnitude of 9.0.
2. A deep intraplate earthquake on the seismogenic part of the subducting Juan de Fuca Plate. These events typically occur at depths of between 30 and 60 km. This source is capable of generating an event with a moment magnitude of up to 8.0.

Crustal Events

An earthquake could also occur on a local fault within the North American Plate. The nearest mapped crustal faults are more than 40 miles from the site, and based on deaggregation at the anticipated fundamental period of planned structures, contribute less than one percent of the overall seismic hazard at the site. Therefore, significant ground shaking as a result of crustal faults is anticipated to be minimal.

5.0 GEOTECHNICAL AND GEOLOGIC FIELD INVESTIGATION

This geotechnical site investigation is based upon five borings drilled by Columbia West (BP-1 through BP-5), visual site reconnaissance, construction monitoring observations as previously described, and review of pertinent subsurface information collected by others. Borings BP-1 through BP-5 were explored with a track-mounted drill rig on January 31, February 1, and February 2, 2023. Subsurface soil profiles were logged in accordance with Unified Soil Classification System (USCS) specifications. Disturbed soil samples were collected at representative depth intervals. Exploration locations are shown on Figure 2. Subsurface exploration logs are presented in Appendix A, *Subsurface Exploration Logs*. Soil descriptions and classification information are provided in Appendix B, *Soil Classification Information*.

Subsurface information collected by others and reviewed as part of this investigation included six test pit logs (TP-1 through TP-6), two boring logs (B-1 and B-2), and results from five cone penetrations tests (CPT-1 through CPT-5). As reported on the logs provided in Appendix C, *Pertinent Subsurface Information Collected by Others*, test pits TP-1 through TP-6 were explored with a mini-excavator on January 14, 2020. Borings B-1 and B-2 were explored with a truck-mounted, mud-rotary drill rig on February 13 and 14, 2020. CPT-1 through CPT-5 were explored on January 13 and 14, 2020 with a cone penetrometer rig.

5.1 Surface Investigation and Site Description

The approximate 108.2-acre subject site consists of six tax parcels located at 2542 Larson Lane in Castle Rock, Washington. The site is generally flat to gently rolling and situated on an alluvial plain between the Cowlitz River and Interstate 5. As discussed in Section 1.3, *Site Background Information*, the site is currently under construction and being actively graded per the Phase I rough grading plan shown on Figure 4.

Surface conditions in large portions of the site consist of exposed sand and gravel associated with recent cuts and fills throughout the property. Other areas of the site remain unstripped and covered with grass. Observed trees on the site were generally limited to the site perimeter or wetland area. In the central portion of the site, a single-family residential structure and several agricultural outbuildings were observed. Stockpiles of soil, organic material, and demolition debris were observed in the vicinity of the existing structures.

As indicated on Figures 3 and 4, the proposed stormwater conveyance channel along the southern and eastern portion of the site is currently under construction. Surface water flow was observed in the channel during drilling of BP-1 through BP-5. Surface water flow appeared to trend east and north towards a temporary sediment pond located adjacent to

the wetland. Standing water was observed within the pond cells at the time of drilling. Stockpiles of organic material and disturbed soil were also observed near the temporary ponds.

5.2 Subsurface Conditions

Borings were advanced to a maximum depth of 81.5 feet bgs. CPTs were advanced to a maximum depth of 35.43 feet bgs. Test pits were advanced to a maximum depth of 13 feet bgs. Exploration locations are shown on Figure 2. Field logs and observed stratigraphy for encountered materials are presented in Appendix A, *Subsurface Exploration Logs* and Appendix C*, Pertinent Subsurface Information Collected by Others*.

5.2.1 Soil Type Description

As previously described, large portions of the site have been stripped of vegetation as part of Phase I rough grading activity. Boring BP-1 was explored through fill material consisting of sand with gravel. Borings BP-2, BP-3, and BP-5 were explored through apparent native soil consisting of sand with gravel. Boring BP-4 was explored through grass and a three-inch-thick root zone underlain by approximately 12 inches of topsoil. Below surface soil, fill material, and the topsoil layer, alluvial silt, sand, and gravel was observed to an approximate depth 45 feet. Review of boring logs B-1 and B-2 indicates that the alluvium extends up to 81.5 feet bgs. Subsurface lithology may generally be described by the soil units identified in the following text.

Topsoil

Topsoil below the vegetation root zone generally consists of silty sand with a low organic content. Review of test pits logs TP-1 through TP-6 indicates that organic topsoil may extend up to 36 inches below existing grade in unstripped portions of the site.

Structural Fill

Structural fill associated with Phase I rough grading is present on the site and generally consists of dense sand with gravel. The depth of fill is variable and actively changing during site improvements construction. Upon completion of Phase I rough grading, fill thickness, site topography, and finished grade elevations may be represented by the contours shown on Figure 4. As the on-call construction monitoring and material testing firm for the project, Columbia West has conducted moisture-density testing, proof-roll observations, and third-party oversight during Phase I rough grading. Observed and tested fill materials meet typical specifications for engineering structural fill and were placed in general conformance with the recommendations outlined in Columbia West's preliminary grading memorandum (Columbia West, 2022).

Upper Sand

Underlying surface soils, topsoil layers, and structural fill, loose to medium dense sand was encountered and extended to approximate depths of 17 to 35 feet bgs. The sand is moist to wet and contains interbedded layers and lenses of silt and clay. The silt and clay interbeds range from very soft to medium stiff in consistency.

Upper Gravel

The upper sand layer is underlain by medium dense to very dense gravel with varying proportions of sand, silt, and clay. The gravel is wet and rounded to sub-rounded. Review of boring logs B-1 and B-2 indicate that the gravel layer is approximately 20 to 25 feet thick and extends to depths of 38 to 40 feet bgs in the drilled locations. Cone penetration tests CPT-1 through CPT-5 encountered practical refusal on the upper gravel unit.

Lower Sand and Gravel

The upper gravel layer is underlain by medium dense to dense sand with gravel and trace silt. The sand is fine-textured and wet and extends to depths of 66 and 55.5 feet bgs respectively in borings B-1 and B-2. The sand is underlain by dense to very dense gravel with sand and trace silt. The gravel extends to the maximum explored depth of 81.5 feet bgs in B-1 and to a depth of 63.5 feet bgs in B-2.

Silt

Underlying the lower gravel layer in B-2, medium stiff to very stiff silt was encountered and extended to the maximum explored depth of 81.5 feet bgs. The silt is wet with trace clay and organic debris.

5.2.2 Groundwater

Groundwater was encountered in borings BP-1 through BP-5 at depths ranging from 15 to 35 feet bgs. Groundwater was reported at depths between 9 and 15 feet bgs on the exploration logs prepared by others and presented in Appendix C, *Pertinent Subsurface Information Collected by Others*. As discussed in Section 1.3, *Site Background Information*, Columbia West installed open standpipe piezometers in BP-1 through BP-5 to further characterize site groundwater conditions. Monitoring of the piezometers commenced in February, 2023 and continues on a bi-weekly basis at the direction of the design team. Groundwater monitoring results collected to date are presented in Table 1. Groundwater elevations are based upon piezometer rim survey data provided by Mackay Sposito. Upon completion of groundwater monitoring, the piezometers should be decommissioned by a licensed contractor in accordance with Washington Department of Ecology regulations.

Table 1. Piezometer Monitoring Data

Location	Measurement Date			
	2-13-23	2-20-23	3-2-23	3-20-23
BP-1	18.8 ft bgs Elev. 27.6 ft	18.1 ft bgs Elev. 28.3 ft	18.0 ft bgs Elev. 28.4 ft	18.0 ft bgs Elev. 28.4 ft
BP-2	36.5 ft bgs Elev. 28.1 ft	36.6 ft bgs Elev. 28.0 ft	36.6 ft bgs Elev. 28.0 ft	37.7 ft bgs Elev. 26.9 ft
BP-3	12.3 ft bgs Elev. 28.4 ft	12.4 ft bgs Elev. 28.3 ft	12.3 ft bgs Elev. 28.4 ft	12.2 ft bgs Elev. 28.5 ft

BP-4	12.1 ft bgs Elev. 29.3 ft	12.3 ft bgs Elev. 29.1 ft	12.5 ft bgs Elev. 28.9 ft	12.5 ft bgs Elev. 28.9 ft
BP-5	18.8 ft bgs Elev. 27.4 ft	17.3 ft bgs Elev. 28.9 ft	16.3 ft bgs Elev. 29.9 ft	17.3 ft bgs Elev. 28.9 ft

Note that groundwater levels are subject to seasonal variance and may rise during extended periods of increased precipitation. Groundwater elevations may also be influenced by fluctuations of the adjacent Cowlitz River. Perched groundwater may also be present in localized areas. Seeps and springs may become evident during site grading, primarily along slopes or in areas cut below existing grade. Structures, pavements, and drainage design should be planned accordingly.

6.0 SEISMIC HAZARDS

6.1 Liquefaction

Liquefaction is caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. Granular soil, which relies on interparticle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. In general, loose, saturated sand with low silt and clay content is most susceptible to liquefaction. Silty soil with low plasticity is moderately susceptible to liquefaction under relatively higher levels of ground shaking.

Liquefaction analysis at the site was performed by evaluating CPT data in the upper sand layer and standard penetration test (SPT) data in the lower sand layer. Results were combined to estimate the total anticipated seismic settlement. Analysis was conducted using methods developed by Boulanger and Idriss (2014) and Robertson (2009) with application of the depth weighting method published by Cetin (2009). A static groundwater level of 9 feet bgs was used in the liquefaction analysis.

Liquefaction analysis indicates that the upper sand layer and portions of the lower sand layer are susceptible to liquefaction under design levels of ground shaking. Total estimated seismic settlement at ground surface in the locations of CPT-1 through CPT-3 and CPT-5 is 4 to 5 inches. Total estimated seismic settlement at the location of CPT-4 is 7 inches. Differential settlement is estimated to be approximately one-half of the total settlement over a 50-foot span. Most of the seismic settlement is in the upper sand layer with the lower sand layer contributing approximately 0.5 to 1.0 inch to the total estimate. Note that the increased magnitude of settlement at CPT-4 reflects that the upper sand layer was observed to be approximately 10 to 15 feet thicker than elsewhere on the site.

Total seismic settlement estimates are likely near the upper bound tolerable limit for typical buildings that may be proposed on the site. Differential settlement thresholds for various building types and risk categories are provided in *Table 12.13-3* of *ASCE 7-16*. The thresholds presented in *Table 12.13-3* are code-specified minimum requirements and buildings may remain susceptible to damage if designed near the upper limits. Structural engineers on the project should calculate the allowable settlement tolerance and expected

performance based upon the specific building types proposed. Provided a building can tolerate the seismic settlement presented above, the structure may be supported by conventional spread footings bearing on firm native soil or engineered structural fill. Shallow foundations, if proposed, will require foundation ties if differential seismic settlement exceeds one-quarter of the thresholds presented in *Table 12.13-3*.

6.1.1 Liquefaction Mitigation

If proposed buildings cannot tolerate the estimated seismic settlement or project stakeholders desire to minimize risk of building damage, the upper sand layer may be improved to reduce the total seismic settlement. Rammed aggregate piers (RAPs) that extend to, and bear on the upper gravel layer are a viable option for ground improvement. RAPs are proprietary technology that are designed and constructed by design-build specialty contractors. The RAPs would need to be at least 17 to 35 feet long to penetrate through the upper sand layer and bear on the upper gravel unit. Additionally, the design-build contractor should provide analysis that shows rammed aggregate piers will support the structures when surrounding soil strength is reduced as a result of liquefaction. A design-build contractor should be contacted to provide the actual RAP configurations based on building serviceability and performance requirements. We anticipate that a RAP foundation system can be installed to meet the settlement criteria for site buildings. Installation of driven grout piles or standard steel or concrete piles may also be considered to mitigate seismic settlement at the site.

Soil improvements may reduce potential seismic settlement to an acceptable level of risk. If ground improvement utilizing RAPs is selected, additional in-situ testing and liquefaction analysis should be conducted following installation to determine the level of improvement achieved. Improved seismic settlement in the upper sand layer should be combined with results from the unimproved lower sand layer to determine the total seismic settlement following mitigation.

Selection of an appropriate mitigation plan may depend upon site planning, architectural, and structural engineering factors in addition to geotechnical concerns. All parties involved should work closely together to develop a suitable improvement plan with a clear understanding of the risks.

6.2 Lateral Spreading

Lateral spreading is a liquefaction-related seismic hazard that occurs on gently sloping or flat sites underlain by liquefiable sediment adjacent to an open face, such as a riverbank. Liquefied soil adjacent to an open face can flow toward the open face, resulting in lateral ground displacement.

Due to the presence of liquefiable soils at the site, lateral spreading is possible near the Cowlitz River. The magnitude of lateral spreading will be based on the depth of the river channel and distance between proposed structural improvements and the river. Tolerable lateral spread limits for shallow foundations in specific risk categories are presented in *ASCE 7-16, Table 12.13-2*. Lateral spreading is not anticipated to be a design consideration within approximately 300 feet of the riverbank because structures are not proposed in this

area. If structures are planned within 300 feet of the riverbank, Columbia West should be contacted to conduct additional analysis.

7.0 DESIGN RECOMMENDATIONS

The geotechnical site investigation suggests the proposed development is generally compatible with surface and subsurface soils, provided the recommendations presented in this report are incorporated in design and implemented during construction. The primary geotechnical considerations for the project were summarized previously in the *Executive Summary*. Specific design and construction recommendations are presented in the following sections.

7.1 Shallow Foundation Support

As discussed in Section 1.2, *Project Understanding*, lot- and zoning-specific building plans were not available at the time this report was prepared. We anticipate that future buildings will be lightly-loaded, less than three stories in height, and will consist of metal-framed, wood-framed, or concrete tilt-up construction. Provided that proposed buildings can tolerate the seismic settlement estimates presented in Section 6.1, *Liquefaction*, structures may be supported by shallow foundations bearing on firm native soil or engineered structural fill.

We anticipate maximum column and wall loads for future buildings will be less than 200 kips and 5 kips per foot, respectively. Floor slab loading is expected to be less than 200 psf. If actual loading exceeds anticipated loading, additional analysis should be conducted for the specific load conditions and proposed footing dimensions.

Foundations should not be supported by topsoil, agricultural till zones, or undocumented fill material. If encountered, these materials should be improved or removed and replaced with structural fill. If footings are constructed during wet-weather conditions or when footing subgrade soils are above their optimum moisture content, we recommend that a minimum of 6 inches of compacted aggregate be placed over exposed subgrade soils. The aggregate pad should extend 6 inches beyond the edge of the foundations and consist of imported granular material as described in Section 8.1.1, *Structural Fill*. Columbia West should observe exposed subgrade conditions prior to placement of crushed aggregate to verify adequate subgrade support.

Perimeter foundation drains are recommended for shallow foundations constructed five or more feet below existing site grades. Foundation drainage is discussed later in Section 7.5, *Drainage*.

7.1.1 Footing Dimensions and Bearing Capacity

Continuous perimeter wall and isolated spread footings should have minimum width dimensions of 18 and 24 inches, respectively. The base of exterior footings should bear at least 18 inches below the lowest adjacent exterior grade. The base of interior footings should bear at least 12 inches below the base of the floor slab.

Footings bearing on subgrade prepared as recommended above should be sized based on an allowable bearing pressure of 2,500 psf. As the allowable bearing pressure is a net bearing pressure, the weight of the footing and associated backfill may be ignored when

calculating footing sizes. The recommended allowable bearing pressure applies to the total of dead plus long-term live loads and may be increased by 50 percent for transient lateral forces such as seismic or wind.

7.1.2 Shallow Foundation Settlement

Foundation settlement is a significant structural design consideration. Provided subgrade soils are prepared as described in Section 8.1, *Site Preparation and Grading*, we anticipate that total post-construction static foundation settlement will be less than approximately 1 inch. Differential settlement between comparably-loaded footing elements is not expected to exceed approximately 0.5 inch over a span of 50 feet.

Estimated post-construction settlement assumes that settlement will occur after site grading and slab construction and before establishing structural connections between the building roof and foundation elements. In areas of large column spacing (greater than 50 feet) or where building footprints span significant differences in cut and fill, the potential for differential settlement exceeding the predicted settlement should be understood.

As discussed in Section 6.1, *Liquefaction*, site soils are also susceptible to settlement during a seismic event. Total seismic settlement at the analyzed locations is expected to range from 4 to 7 inches. Differential settlement is estimated to be approximately one-half the total settlement over a 50-foot span. If shallow foundations are proposed and meet the differential settlement thresholds of ASCE 7-16, project stakeholders and the structural engineer should discuss risk associated with seismic settlement and be willing to accept the potential for building damage during a seismic event. If the risk of damage cannot be accepted, liquefaction mitigation through soil improvements or deep foundations will be required.

7.1.3 Resistance to Sliding

Lateral foundation loads can be resisted by passive earth pressure on the sides of the footing and by friction at the base of the footings. Recommended passive earth pressure for footings confined by native soil or engineered structural fill is 350 pcf. The upper 12 inches of soil should be neglected when calculating passive pressure resistance. Adjacent floor slabs and pavement, if present, should also be neglected from the analysis. The recommended passive pressure resistance assumes that a minimum horizontal clearance of 10 feet is maintained between the footing face and adjacent downgradient slopes.

The estimated coefficient of friction between in situ native soil or engineered structural fill and in-place poured concrete is 0.35. The estimated coefficient of friction between compacted crushed aggregate and in-place poured concrete is 0.4.

7.1.4 Subgrade Observation

Footing and floor slab subgrade soils should be evaluated by Columbia West prior to placing forms or reinforcing bar to verify subgrade support conditions are as anticipated in this report. Subgrade observation should confirm that all disturbed material, organic debris, unsuitable fill, remnant topsoil zones, and softened subgrades (if present) have been removed. Over-excavation of footing subgrade soils may be required to remove deleterious material, particularly if footings are constructed during wet-weather conditions.

7.1.5 Floor Slabs

Floor slabs can be supported on firm, competent, native soil or engineered structural fill prepared as described in this report. Disturbed soils and unsuitable fills in proposed slab locations, if encountered, should be removed and replaced with structural fill.

To reduce slab shifting and moisture transmission, slabs should be underlain by at least 6 inches of compacted crushed aggregate. Geotextile may be used below the crushed aggregate layer to increase subgrade support. Recommendations for floor slab base aggregate and subgrade geotextile are discussed in Section 8.6, *Materials*.

Elevated soil moisture was observed within near-surface soil at the time of exploration. In areas where moisture-sensitive flooring will be installed, slab waterproofing or a vapor barrier should be installed according to the flooring manufacturers' recommendations. In our experience, 10- to 15-mil vapor barriers are often required by flooring manufacturers to maintain product warranties. Selection and design of an appropriate vapor barrier should be determined by architectural and structural design team members.

Slab thickness and reinforcement should be designed by an experienced structural engineer in accordance with anticipated loads. Load-bearing concrete slabs with maximum loading of 200 psf may be designed assuming a modulus of subgrade reaction, k, of 150 pci. If slab subgrade soil is cement-amended to a minimum depth of 12 inches, the modulus of subgrade reaction can be increased to 200 pci.

7.2 Seismic Design Considerations

Seismic design for proposed structures is prescribed by *ASCE 7-16.* Based upon site-specific test results, site soils meet the criteria for Site Class E. Seismic design parameters for Site Class E are presented in Table 2.

Table 2. ASCE 7-16 Seismic Design Parameters[1]

	Short Period (T_s = 0.2 s)	1 Second Period (T_1 = 1.0 s)
MCE Spectral Acceleration	0.84	0.40
Site Class	E[2]	
Site Coefficient	Fa = 1.3	Fv = 2.4
Adjusted Spectral Response Acceleration	S_{MS} = 1.1	S_{M1} = 0.96
Design Spectral Response Acceleration	S_{DS} = 0.73	S_{D1} = 0.64

1. The structural engineer should evaluate *ASCE 7-16* code requirements and exceptions to determine if these parameters are valid for design.
2. Seismic site class, site coefficients, and spectral acceleration parameters assume that the fundamental period for proposed structures will be less than 0.5 second.

For Site Class E sites with mapped maximum considered earthquake spectral response acceleration parameter S_S greater than or equal to 1.0 or S_1 greater than or equal to 0.2, a ground motion hazard analysis may be required according to *ASCE 7-16, Section 11.4.8* unless exemption criteria are met. According to *ASCE 7-16, Section 11.4.8 Exception 3,* a ground

motion hazard analysis is not required for Site Class E sites with S_1 greater than or equal to 0.2, provided that T is less than or equal to T_S, where T is the fundamental period of the structure and T_S is equal to the design spectral response acceleration parameter at a one second period (SD_1) divided by the design spectral response acceleration parameter at short periods (SD_S).

Columbia West recommends that structural engineers on the project evaluate code requirements and exceptions to determine if a site-specific ground motion hazard evaluation will be required for proposed structures.

Due to the presence of liquefiable soils at the site and potential for bearing capacity loss at ground surface, Site Class F criteria may be met if the fundamental period of vibration for proposed structures is greater than 0.5 second. If Site Class F criteria is met, a site-specific ground motion response analysis is required in accordance with *Section 21.1* of *ASCE 7-16*. If structures have a fundamental period of less than 0.5 second, seismic design parameters may be determined using the pre-liquefaction seismic site class. In our experience, conventional structures less than three-stories in height will likely have a fundamental period less than 0.5 second, and seismic design parameters may be based on the pre-liquefaction site class designation as provided in Table 2.

7.3 Retaining Structures

Lateral earth pressures should be considered during design of retaining walls and below-grade structures. Hydrostatic pressure and additional surcharge loading should also be considered. Wall foundation construction and bearing capacity should adhere to specifications provided previously in Section 7.1, *Shallow Foundation Support*.

Permanent retaining walls that are not restrained from rotation should be designed for active earth pressures using an equivalent fluid pressure of 35 pcf. Walls that are restrained from rotation should be designed for an at-rest, equivalent fluid pressure of 55 pcf. The recommended earth pressures assume a maximum wall height of 10 feet with well-drained, level backfill. These values also assume that adequate drainage is provided behind retaining walls to prevent hydrostatic pressures from developing. Lateral earth pressures induced by surcharge loads may be estimated using the criteria presented on Figure 5.

Seismic forces may be calculated by superimposing a uniform lateral force of $7H^2$ pounds per lineal foot of wall, where H is the total wall height in feet. The force should be applied as a distributed load with the resultant located at 0.6H from the base of the wall.

7.3.1 Wall Drainage and Backfill

A minimum 6-inch-diameter, perforated collector pipe should be placed at the base of retaining walls. The pipe should be embedded in a minimum 2-foot-wide zone of angular drain rock that is wrapped in a drainage geotextile fabric and extends up the back of the wall to within 1 foot of finished grade. The drain rock and geotextile drainage fabric should meet the specifications provided in Section 8.6, *Materials*. The perforated collector pipes should discharge at an appropriate location away from the base of the wall. The discharge pipe(s) should not be tied directly into stormwater drainage systems, unless measures are taken to prevent backflow into the drainage system of the wall.

Backfill material placed behind the walls and extending a horizontal distance of ½ H, where H is the height of the retaining wall, should consist of select granular material placed and compacted as described in Section 8.6.1, *Structural Fill.*

Settlement of up to 1 percent of the wall height commonly occurs immediately adjacent to the wall as the wall rotates and develops active lateral earth pressures. Consequently, we recommend that construction of flatwork adjacent to retaining walls be delayed at least four weeks after placement of wall backfill, unless survey data indicates that settlement is complete prior to that time.

7.4 Pavement Design

7.4.1 Design Parameters and Traffic

Private asphalt concrete access drives and parking areas may be proposed on individual lots within the master development. Columbia West recommends adherence to City of Castle Rock roadway standards for street improvements in the public right-of-way. Pavement should be installed on firm, competent native subgrade soil or engineered structural fill prepared as described in this report. Our recommendations for private pavement are based on the following design parameters and assumptions:

- 12 inches of subgrade soil directly below the pavement sections are compacted to at least 95 percent of maximum dry density, as determined by *ASTM D1557*.
- Resilient moduli for subgrade soil and aggregate base materials were assumed to be 4,500 psi and 20,000 psi, respectively.
- Pavement design life of 20 years with no expected traffic growth.
- Initial and terminal serviceability indices of 4.2 and 2.5, respectively.
- Reliability of 85 percent and standard deviation of 0.4.
- Pavement may be exposed to a fire apparatus load of 75,000 pounds on an infrequent basis.

The specific type and frequency of traffic was not available at the time we prepared this report. Based on experience, we assume that heavy truck traffic will consist of approximately 40 percent FHWA Class Group 7 type trucks (4-axle, single unit) and 60 percent FHWA Class Group 8 type trucks (tractor/trailer 2- to 3-axle). Lightly-loaded drive aisles and parking stalls are expected to service typical passenger vehicle traffic.

7.4.2 Asphaltic Concrete (AC) Pavement Design Sections

Design recommendations for private pavement across a range of traffic conditions and loading scenarios are presented in Table 3. Material properties and compaction recommendations for asphalt surfacing and crushed aggregate base layers are presented in Section 8.6, *Materials*.

Table 3. Recommended AC Pavement Sections Constructed over Native Soil or Engineered Fill

Traffic	Trucks Per Day	Equivalent Single-Axle Loads (ESALs)	AC Thickness (in)	Base Aggregate Thickness (in)
Passenger Vehicle Parking	0	10,000	2.5	8
Passenger Vehicle Drive Aisles	0	20,000	3	9
Heavy Truck Areas	10	92,000	4	10.5
	25	229,000	4.5	12.5
	50	458,000	5	14
	100	916,000	5.5	16.5

Pavement sections may be reduced in areas where subgrade soils are cement-amended to a minimum depth of 12 inches with a minimum of 6 percent cement by weight. Provided the cement-amended subgrade soil achieves a seven-day unconfined compressive strength of 100 psi, AC pavement sections may be constructed as presented in Table 4.

Table 4. Recommended AC Pavement Sections Constructed over Cement-Amended Subgrade Soil

Traffic	Trucks Per Day	Equivalent Single-Axle Loads (ESALs)	AC Thickness (in)	Base Aggregate Thickness (in)	Cement-Amendment Thickness (in)
Passenger Vehicle Parking	0	10,000	2.5	4	**12**
Passenger Vehicle Drive Aisles	0	20,000	3	4	
Heavy Truck Areas	10	92,000	4	4	
	25	229,000	4.5	4	
	50	458,000	5	4.5	
	100	916,000	5.5	6.5	

7.4.3 Portland Cement Concrete (PCC) Pavement Design Sections

Portland cement concrete pavements may be proposed in future loading dock areas. Loading docks are expected to primarily service heavy truck traffic. Material properties and recommendations for PCC, base aggregate, and cement-amended subgrade layers are presented in Section 8.6, *Materials*. Pavement design recommendations for PCC loading docks constructed over firm native soil or engineered structural fill are presented in Table 5.

Table 5. Recommended PCC Pavement Sections Constructed over Native Soil or Engineered Fill

Traffic	Trucks Per Day	PCC Thickness (in)	Base Aggregate Thickness (in)
Loading Dock Areas	Up to 25	6.5	7
	Up to 50	7	8
	Up to 100	7.5	8

Recommended PCC pavement sections constructed over cement-amended soil meeting the treatment depth, cement content, and strength requirements outlined above are presented in Table 6.

Table 6. Recommended PCC Pavement Sections Constructed over Cement-Amended Subgrade Soil

Traffic	Trucks Per Day	PCC Thickness (in)	Base Aggregate Thickness (in)	Cement-Amendment Thickness (in)
Loading Dock Areas	Up to 25	6.5	4	**12**
	Up to 50	7	4	
	Up to 100	7.5	4	

7.4.4 General Pavement Recommendations

Recommended pavement section thicknesses are intended to be minimum acceptable values and do not include construction traffic loading. The recommendations assume that pavement construction will be completed during an extended period of warm, dry weather. Wet weather construction may require an increased thickness of base aggregate as discussed later in Section 8.2, *Construction Traffic and Staging*.

Cement-amended soil should be allowed to cure for at least four days prior to aggregate base placement or exposure to construction traffic. Prior to construction traffic access, the cement-amended subgrade should be protected by a minimum 4-inch-thick layer of compacted crushed aggregate. Construction traffic should be limited to dedicated haul roads or non-structural, unpaved portions of the site. Construction traffic should not be permitted on new pavement, unless accounted for in the pavement design section. Base aggregate and cement-amended soils supporting pavement are also not intended for construction traffic. Haul roads and staging areas supporting construction traffic are discussed later in Section 8.2, *Construction Traffic and Staging*.

Asphalt paving is generally not recommended during cold weather conditions where ambient air temperatures are less than 40 degrees Fahrenheit. Compacting asphalt in low-temperature conditions can result in low relative density of the asphalt layer and premature pavement distress.

Asphalt mix designs have a recommended compaction temperature range that is specific to the AC binder used. In low-temperature conditions, maintaining the temperature of the AC mix is difficult as heat can be lost during transport, placement, and compaction. The ambient air temperature during paving should be at least 40 degrees Fahrenheit for a lift thickness greater than 2.5 inches and at least 50 degrees Fahrenheit for a lift thickness between 2 and 2.5 inches. If AC paving must take place during cold-weather construction as defined in this section, the contractor and design team should discuss options for minimizing risk to pavement serviceability.

7.5 Drainage

At a minimum, site drainage should include surface water collection and conveyance to properly designed stormwater management structures and facilities. Drainage design in

general should conform to City of Castle Rock regulations. Finished site grading should be conducted with positive drainage away from structures at a minimum 2 percent slope for a distance of at least 10 feet. Depressions or shallow areas that may retain ponding water should be avoided.

Recommendations for foundation drains, subdrains, and drainage mats are presented in the following sections. Drain rock and geotextile drainage fabric should meet the requirements presented in Section 8.6, *Materials*. Drains should be closely monitored after construction to assess their effectiveness. If additional surface or shallow subsurface seeps become evident, the drainage provisions may require modification or additional drains. We should be consulted to provide appropriate recommendations.

7.5.1 Foundation Drains

Roof drains are recommended for all structures. Perimeter building foundation drains can reduce the potential for water intrusion below structures. Perimeter footing drains are recommended for shallow foundations constructed 5 or more feet below existing site grades. Foundations constructed less than 5 feet below existing grades do not require drains, however, it may be prudent to install foundations drains to collect incidental or perched water. The final decision for foundations drains should be made by the owner and architect.

Foundation and roof drains, where installed, should consist of separate systems that gravity flow away from foundations to an approved discharge location. Perimeter foundation drains, where installed, should consist of 4-inch perforated PVC pipe surrounded by a minimum 2-foot-wide zone of clean, washed drain rock wrapped with geotextile drainage fabric. The wrapped drain rock zone should extend up the sides of embedded walls to within 12 inches of proposed finished grade. Foundation drains should be constructed with a minimum slope of ½ percent. The drainpipe's invert elevation should be at least 18 inches below the elevation of the floor slab. Figure 6 presents a typical foundation drain detail.

7.5.2 Subdrains

Subdrains should be considered if portions of the site are cut below surrounding grades. Shallow groundwater, springs, or seeps should be conveyed via drainage channel or perforated pipe into an approved discharge. Recommendations for design and installation of perforated drainage pipe may be performed on a case-by-case basis by Columbia West during construction. Failure to provide adequate surface and sub-surface drainage may result in soil slumping or unanticipated settlement of structures exceeding tolerable limits. A typical perforated drainpipe trench detail is presented in Figure 7.

7.5.3 Drainage Mat

Site improvements construction in some areas may occur at or near the shallow groundwater table, particularly if work is conducted during wet-weather conditions. Dewatering may be necessary, and a drainage mat may be required to achieve sufficient elevation for fill placement. A typical drainage mat is shown on Figure 8. Columbia West should determine drainage mat location, extent, and thickness when subsurface conditions are exposed.

Drainage mats may need to be constructed in conjunction with subdrains to convey captured water to an approved discharge location.

8.0 CONSTRUCTION RECOMMENDATIONS

8.1 Site Preparation and Grading

Vegetation, organic material, unsuitable fill, and deleterious material that may be encountered should be cleared from areas identified for structures and site grading. Vegetation, root zones, organic material, and debris should be removed from the site. Stripped topsoil should also be removed, or used only as landscape fill in nonstructural areas with slopes less than 25 percent. The stripping depth for sod and highly organic topsoil is anticipated to be approximately 4 inches. Following removal of surface vegetation and topsoil, underlying low-organic till zone soils, if present, may be acceptable for stockpiling and reuse as structural fill. Actual stripping depths and suitability of till zone soil for reuse should be determined based upon visual observations made during construction when soil conditions are exposed. The post-construction maximum depth of landscape fill placed or spread at any location onsite should not exceed one foot.

Previously disturbed soil, debris, or undocumented fill encountered during grading or construction activities should be removed completely and thoroughly from structural areas. This includes old remnant foundations, basement walls, utilities, associated soft soils, and debris. Excavation areas should be backfilled with engineered structural fill.

Trees, stumps, and associated roots should also be removed from structural areas, individually and carefully. Resulting cavities and excavation areas should be backfilled with engineered structural fill.

Site grading activities should be performed in accordance with requirements specified in the *2018 International Building Code* (IBC), Chapter 18 and Appendix J, with exceptions noted in the text herein. Site preparation, soil stripping, and grading activities should be observed and documented by Columbia West.

8.1.1 Subgrade Evaluation

Upon completion of stripping and prior to the placement of structural fill or pavement improvements, exposed subgrade soil should be evaluated by proof rolling with a fully-loaded dump truck or similar heavy, rubber tire construction equipment. When the subgrade is too wet for proof rolling, a foundation probe may be used to identify areas of soft, loose, or unsuitable soil. Subgrade evaluation should be performed by Columbia West. If soft or yielding subgrade areas are identified during evaluation, we recommend the subgrade be over-excavated and backfilled with compacted imported granular fill.

8.2 Construction Traffic and Staging

Near-surface silty soil will be easily disturbed during construction. If not carefully executed, site preparation, excavation, and grading can create extensive soft areas resulting in significant repair costs. Earthwork planning should include considerations for minimizing subgrade disturbance, particularly during wet-weather conditions.

If construction occurs during wet-weather conditions, or if the moisture content of the surficial soil is more than a few percentage points above optimum, site stripping and cutting may need to be accomplished using track-mounted equipment. Under these conditions, granular haul roads and staging areas will also be necessary provide a firm support base and sustain construction equipment.

The recommended base aggregate thickness for pavement sections is intended to support post-construction design traffic loads and will not provide adequate support for construction traffic. Staging areas and haul roads will require an increased base thickness during wet weather conditions. The configuration of staging and haul road areas, as well as the required thickness of granular material, will vary with the contractor's means and methods. Therefore, design and construction of staging areas and haul roads should be the responsibility of the contractor. Based on our experience, between 12 and 18 inches of imported granular material is generally required in staging areas and between 18 and 24 inches in haul road areas. In areas of heavy construction traffic, geotextile separation fabric may be placed between the subgrade soil and imported granular material to increase subgrade support and minimize silt migration into the base aggregate layer.

As an alternative to thickened aggregate sections, haul roads and staging areas may be constructed using a combination of cement-amended subgrade and crushed aggregate surfacing. If cement-amendment is used, the base aggregate thickness for staging areas and haul roads can typically be reduced to between 6 and 9 inches, respectively. This recommendation is based on a minimum seven-day unconfined compressive strength of 100 psi for the cement-amended soil with a treatment depth of 12 to 16 inches. Based on experience, 6 to 7 percent cement by weight is typically required to achieve the indicated compressive strength.

Project stakeholders should understand that wet weather construction is risky and costly. Proper construction methods and techniques are critical to overall project integrity and should be observed and documented by Columbia West.

8.3 Cut and Fill Slopes

Fill slopes should consist of structural fill material as discussed in Section 8.1.1, *Structural Fill*. Fill placed on existing grades steeper than 5H:1V should be horizontally benched at least 10 feet into the slope. Fill slopes greater than six feet in height should be vertically keyed into existing subsurface soil. A typical fill slope cross-section is shown in Figure 9. Drainage implementations, including subdrains or perforated drainpipe trenches, may also be necessary in proximity to cut and fill slopes if seeps or springs are encountered. Drainage design may be performed on a case-by-case basis. Extent, depth, and location of drainage may be determined in the field by Columbia West during construction when soil conditions are exposed. Failure to provide adequate drainage may result in soil sloughing, settlement, or erosion.

Final cut or fill slopes at the site should not exceed 2H:1V or 20 feet in height without individual slope stability analysis. The values above assume a minimum horizontal setback for loads of 10 feet from top of cut or fill slope face or overall slope height divided by three

(H/3), whichever is greater. A minimum slope setback detail for structures is presented in Figure 10.

Concentrated drainage or water flow over the face of slopes should be prohibited, and adequate protection against erosion is required. Fill slopes should be overbuilt, compacted, and trimmed at least two feet horizontally to provide adequate compaction of the outer slope face. Proper cut and fill slope construction is critical to overall project stability and should be observed and documented by Columbia West.

8.4 Excavation

The site was explored by Columbia West and others to a maximum depth of 81.5 feet with a drill rig. Conventional earthmoving equipment in proper working condition should be capable of making necessary site excavations.

Groundwater was encountered at depths ranging from 9 and 35 feet bgs in site explorations. Perched groundwater at shallower depths may also be present. Recommendations as described in Section 8.5, *Dewatering,* should be considered where subsurface construction activities intersect the shallow groundwater table.

Excavations in near-surface sandy soil will likely slough and cave, even at shallow depths. Open-cut excavation techniques may be used to excavate trenches between 4 and 8 feet deep, provided the walls of the excavation are cut at a maximum slope of 1H:1V and groundwater seepage is not present. Excavation slopes should be reduced to 1.5H:1V or 2H:1V if excessive sloughing or raveling occurs.

Shoring may be required if open-cut excavations are infeasible or if excavations are proposed adjacent to existing infrastructure. Typical methods for stabilizing excavations consist of solider piles and timber lagging, sheet pile walls, tiebacks and shotcrete, or pre-fabricated hydraulic shoring. As a wide variety of shoring and dewatering systems are available, we recommend that the contractor be responsible for selecting the appropriate shoring and dewatering systems.

The contractor should be held responsible for site safety, sloping, and shoring. All excavation activity should be conducted in accordance with applicable OSHA requirements. Columbia West is not responsible for contractor activities and in no case should excavation be conducted in excess of applicable local, state, and federal laws.

8.5 Dewatering

Based on site observations and piezometer monitoring data, groundwater will likely be encountered in utility trenches, pump station excavations, and in areas of significant cut. Generalized recommendations for temporary construction dewatering are presented in the following section.

8.5.1 Construction Dewatering

The contractor should be responsible for temporary drainage of surface water, perched water, and groundwater. Dewatering should be performed to the extent necessary to prevent standing water and/or erosion of exposed site soils. During rough and finished grading of

building pad areas, the contractor should keep all footing excavations and slab subgrade soils free of standing water.

The contractor's proposed dewatering plan should be capable of maintaining groundwater levels at least two feet below the base of proposed excavations. Without adequate excavation dewatering, running soil, caving, and sloughing will increase backfill volumes and may result in damage to adjacent structures or utilities. Significant pumping and dewatering may be required to temporarily reduce the groundwater elevation to the recommended depth. Dewatering via a sump within excavation zones may be insufficient to control groundwater and provide excavation side slope stability. Dewatering may be more feasibly conducted by installing a system of temporary well points and pumps around proposed excavation areas or utility trenches.

As indicated previously, a sanitary sewer pump station is proposed up to 35 feet below existing grade. Due to the significant depth of excavation and potential for rapid groundwater flow through permeable sand and gravel deposits, the contractor should be required to prepare and present a detailed dewatering plan. The contractor should consult with a licensed professional engineer to provide an adequate dewatering plan for site conditions. If additional subsurface information not provided in this geotechnical report is necessary to complete the dewatering plan, the contractor shall be responsible for securing all the required information necessary for the design of the system.

If groundwater is present at the base of excavations, we recommend placing 18 to 24 inches of stabilization material at the base of the excavation. Subgrade geotextile placed directly over trench subgrade soils may reduce the required thickness of the stabilization material. The actual thickness of stabilization material should be determined at the time of construction based on observed field conditions. The stabilization material should be placed in one lift and compacted until well keyed. Stabilization material and geotextile fabric should meet the requirements presented in Section 8.6, *Materials*.

8.6 Materials

8.6.1 Structural Fill

Areas proposed for fill placement should be appropriately prepared as described in Section 8.1, *Site Preparation and Grading*. Engineered fill placement should be observed by Columbia West. Compaction of engineered structural fill should be verified by nuclear gauge field compaction testing performed in accordance with *ASTM D6938*. Field compaction testing should be performed for each vertical foot of engineered fill placed.

Various materials may be acceptable for use as structural fill. Structural fill should be free of organic material or other unsuitable material and meet specifications provided in the following sections. Representative samples of proposed engineered structural fill should be submitted for laboratory analysis and approval by Columbia West prior to placement.

8.6.1.1 Onsite Soil

Most onsite native soil (silt, sand, and gravel) will be suitable for use as structural fill if adequately dried or moisture-conditioned to achieve recommended compaction

specifications. Moisture conditioning will likely be necessary to achieve the optimum moisture content required for compaction. In addition, near-surface silty soil will be moisture sensitive and difficult to compact during wet weather conditions. Therefore, structural fill placement using onsite soil should be performed during dry summer months if possible. Onsite soil may also require addition of moisture during extended periods of dry weather.

Onsite soil used as structural fill should be placed in loose lifts not exceeding 8 inches in depth and compacted using standard conventional compaction equipment. The soil moisture content should be within a few percentage points of optimum conditions. The soil should be compacted to at least 95 percent of maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).* Compacted onsite fill soils should be covered shortly after placement.

Onsite soil will likely expand during excavation and transport and consolidate during compaction. Development of site-specific expansion and consolidation factors is beyond the scope of this investigation. We can provide site-specific factors upon request.

8.6.1.2 Imported Granular Material

Imported granular material should consist of pit- or quarry-run rock, crushed rock, or crushed gravel and sand meeting *WSDOT 9-03.14(1)* specifications for *Gravel Borrow*. Imported granular material should be placed in loose lifts not exceeding 12 inches in depth and compacted to at least 95 percent of maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).* During wet-weather conditions or where wet subgrade conditions are present, the initial loose lift of granular fill should be approximately 18 inches thick and should be compacted with a smooth-drum roller operating in static mode.

8.6.1.3 Stabilization Material

Stabilization material should consist of durable, 4- or 6-inch-minus pit- or quarry-run rock, crushed rock, or crushed gravel and sand that is free of organics and other deleterious material. The material should have a maximum particle size of 6 inches with less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve. The material should have at least two mechanically-fractured faces.

Stabilization material should be placed in loose lifts between 12 and 24 inches thick and be compacted to a firm, unyielding condition. Equipment with vibratory action should not be used when compacting stabilization material over wet, fine-textured soils. If stabilization material is used to stabilize soft subgrade below pavement or construction haul roads, a subgrade geotextile should be placed as a separation barrier between the soil subgrade and the stabilization material.

8.6.1.4 Trench Backfill

Trench backfill placed below, adjacent to, and up to at least 12 inches above utility lines (i.e., the pipe zone) should consist of well-graded granular material meeting *WSDOT 9-03.12(3)* specifications for *Gravel Backfill for Pipe Zone Bedding.* Pipe zone backfill should be compacted to at least 90 percent of maximum dry density, as determined by the modified

Proctor moisture-density relationship test *(ASTM D1557),* or as required by the local jurisdictional agency or pipe manufacturer.

Within structural areas (below pavement and building pads), trench backfill above the pipe zone should consist of *WSDOT 9-03.19 Bank Run Gravel for Trench Backfill* or *WSDOT 9-03.14(2) Select Borrow* with a maximum particle size of 2 ½-inches. Trench backfill material within 18 inches of the top of utility pipes should be hand compacted (i.e., no heavy compaction equipment). Remaining trench backfill should be compacted to at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557),* or as required by the local jurisdictional agency or pipe manufacturer.

Outside of structural areas, trench backfill placed above the pipe zone should be compacted to at least 90 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557),* or as required by the local jurisdictional agency or pipe manufacturer.

8.6.1.5 Floor Slab Base Aggregate

Base aggregate for building floor slabs should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. Slab base aggregate should be compacted to at least at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).*

8.6.1.6 Pavement Base Aggregate

Base aggregate for pavement should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. Pavement base aggregate should be compacted to at least at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).*

8.6.1.7 Retaining Wall Backfill

Backfill material placed behind retaining walls and extending a horizontal distance of ½ H, where H is the height of the retaining wall, should consist of free-draining granular material meeting *WSDOT 9-03.12(2)* specifications for *Gravel Backfill for Walls*. The wall backfill should be separated from structural fill, native soil, and/or topsoil using a geotextile fabric that meets the specifications provided below for drainage geotextiles.

Wall backfill located within a horizontal distance of 3 feet from the face of a retaining wall should be compacted to 90 percent of the maximum dry density, as determined by *ASTM D1557*. Backfill placed within 3 feet of the wall should be compacted in loose lifts less than 6 inches thick using hand-operated tamping equipment (such as a jumping jack or vibratory plate compactor). Remaining wall backfill should be compacted to at least 95 percent of the maximum dry density, as determined by *ASTM D1557*.

8.6.1.8 Retaining Wall Leveling Pad

Crushed aggregate used as a leveling pad for retaining wall footings should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. The leveling pad material should be compacted to at least 95 percent of the

maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).*

8.6.1.9 Drain Rock

Drain rock should consist of open-graded, angular aggregate meeting WSDOT 9-03.12(4), *Gravel Backfill for Drains*. Drain rock should be free of roots, organic debris, and other unsuitable material and should have at least two mechanically-fractured faces. Drain rock should be compacted to a firm, unyielding condition. Drain rock should be completely wrapped in a geotextile drainage fabric meeting the requirements presented below.

8.6.2 Geotextile Fabric

8.6.2.1 Subgrade Geotextile

Subgrade geotextile should meet the specifications provided in *WSDOT 9-33.2(1), Table 3, Geotextile for Separation or Soil Stabilization*. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles. All stabilization material should be underlain by a subgrade geotextile.

8.6.2.2 Drainage Geotextile

Subgrade geotextile should meet the specifications provided in *WSDOT 9-33.2(1), Table 2, Geotextile for Underground Drainage Filtration Properties*. The AOS should be between the No. 70 and No. 100 sieve. The water permittivity should be greater than 1.5/sec. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles.

8.6.3 Soil Amendment with Cement

The on-site soil can be amended with Portland cement to obtain suitable properties for use as wet-weather structural fill or subbase for pavement. The effectiveness of soil amendment is highly dependent on proper mixing techniques, soil moisture conditioning, and the quantity of cement. The quantity of cement applied during amendment should be based on an assumed dry unit weight of 100 pcf for site soil.

8.6.3.1 Subbase Stabilization

Specific recommendations for soil amendment should be based on exposed site conditions at the time of construction. For preliminary design purposes, we recommend cement-amended subgrade for building pads and pavement subbase (below the base aggregate layer) achieve a target strength of 100 psi. The quantity of cement required to achieve the target strength will vary with moisture content and soil type. Laboratory testing of cement-amended soil should be used to confirm design expectations.

Based on our experience, near-surface silt and sand will require approximately 6 to 7 percent cement by weight to achieve the target strength of 100 psi. This cement percentage assumes that the soil moisture content does not exceed 20 percent at the time of amendment. If the soil moisture content is in the range of 25 to 35 percent, 7 to 8 percent cement by weight may be required to achieve the target strength. The amount of cement

added to the soil at the time of construction should be based on observed field conditions and subgrade performance. During extended periods of dry weather, water may need to be applied during the amendment and tilling process to achieve the optimum moisture content required for compaction.

Cement-amendment equipment should have balloon tires to minimize softening, rutting, and disturbance of fine-grained site soil. A sheepsfoot or segmented pad roller with a minimum static weight of 40,000 pounds should be used for initial compaction. Rollers with vibratory action should not be used to compact fine-grained, cement-amended soil. Final compaction should be conducted with a smooth-drum roller with a minimum applied linear force of 700 pounds per inch. The amended soil should be compacted to at least 95 percent of the maximum dry density as determined by *ASTM D558*.

Following cement amendment, a minimum curing time of four days is required prior to exposure to construction traffic. Construction traffic should not be allowed on unprotected, cement-amended subgrade. To protect cement-amended areas from damage, the finished surface should be covered with 4 to 6 inches of imported granular material. The protective layer of crushed rock often becomes contaminated with soil during construction, particularly in staging and haul road areas. Contaminated aggregate, where present, should be removed and replaced with clean crushed aggregate prior to construction of pavement or other permanent site improvements supported by base aggregate.

Cement amendment should not be attempted during moderate to heavy precipitation or when the ambient air temperature is below 40 degrees Fahrenheit. Cement should not be placed in areas of standing water or where saturated subgrade conditions exist.

8.6.3.2 Cement-Amended Structural Fill

If adequate compaction is not achievable with onsite soil due to moisture or weather conditions, the soil may be cement-amended and placed as general structural fill. Prior to placement of cement-amended fill, subgrade soils should be prepared as described in Section 8.1, *Site Preparation and Grading*. Where multiple lifts of cement-amended fill are necessary to meet finished grade, consecutive lifts may be placed immediately following amendment and compaction of the underlying lift. However, where the final lift of cement-amended fill will serve as building pad or pavement subbase material, the four-day cure period as discussed above is recommended.

8.6.3.3 QA/QC Testing and Inspection

Cement-amendment of site soils should be observed and tested by Columbia West to document conformance with design recommendations. Cement spread rate should be verified with a pan sample test conducted at one random location per lift per 20,000 square-feet of cement-amended fill. Treatment depth should be verified through excavation of a small test pit and measurement at one random location per lift of cement-amended fill. Adequate compaction and moisture content should be verified by conducting nuclear gauge density testing at a frequency of approximately one test per 5,000 square feet of cement-amended fill in accordance with ASTM D6938. At least one representative sample should be collected per day of cement-amendment, cured for 7 days, and tested for

unconfined compressive strength in accordance with ASTM D1633. The tested samples should have a minimum 7-day, unconfined compressive strength of 100 psi.

8.6.3.4 Drainage Considerations

Cement-amended soil will be poorly-drained and will not be suitable for planting areas. The material may also be difficult to excavate with light-duty landscaping equipment. Proposed landscape areas should not be cement-amended unless accommodations are made for drainage and planting.

Cement-amendment within building pad areas should consider the potential for trapped water below the floor slab. Columbia West should be consulted to provide appropriate recommendations if cement-amendment is proposed within building pad areas.

8.6.4 Pavement

8.6.4.1 Asphaltic Concrete

Asphaltic concrete should consist of HMA Class ½" adhering to *WSDOT 9-03.8(6), HMA Proportions of Materials*. The asphalt binder should consist of PG 58-22 meeting *WSDOT 9-02.1(4), Performance Graded (PG) Asphalt Binder*. Asphalt should be compacted to 91 percent of the theoretical maximum density as determined by *ASTM D2041*. Minimum and maximum asphalt lift thicknesses should be 2 and 3 inches, respectively. Nuclear gauge density testing should be conducted to verify adherence to recommended specifications. Testing frequency should be in accordance with WSDOT and City of Castle Rock specifications.

8.6.4.2 Portland Cement Concrete

Portland cement concrete should meet *WSDOT 5-05, Cement Concrete Pavement* with a minimum 28-day compressive strength of 4,000 psi and an air content between 3 and 7 percent. PCC should be placed in general accordance with *WSDOT 5-05.3(7), Placing, Spreading, and Compacting Concrete*. Dowel bars and placement should adhere to *WSDOT 5-05.3(10), Tie Bars and Corrosion Resistant Dowel Bars*. Joints should be constructed in general accordance with *WSDOT 5-05.3(8), Joints* with a maximum transverse joint spacing of 15 feet. The length-to-width ratio for any PCC panel should be between 0.80 and 1.25.

Concrete should be tested during installation in accordance with ASTM C171, C138, C231, C143, C1064, and C31. This includes casting of cylinder specimen at a frequency of four cylinders per 100 cubic yards of poured concrete. Recommended field concrete testing includes slump, air entrainment, temperature, and unit weight.

8.7 Erosion Control Measures

Soil at this site is susceptible to erosion by wind and water; therefore, erosion control measures should be carefully planned and installed. Surface water runoff should be collected and directed away from sloped areas to prevent water from running down the slope face. Measures that can be employed to reduce erosion include the use of silt fences, hay bales, buffer zones of natural growth, sedimentation ponds, and granular haul roads. All erosion control methods should be in accordance with local jurisdiction standards.

9.0 CONCLUSION AND LIMITATIONS

This geotechnical site investigation report was prepared in accordance with accepted standard conventional principles and practices of geotechnical engineering. This investigation pertains only to material tested and observed as of the date of this report and is based upon proposed site development as described in the text herein. This report is a professional opinion containing recommendations established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. Soil conditions may differ between tested locations or over time. Slight variations may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent QA/QC construction observation and testing to verify soil conditions are as anticipated in this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Columbia West cannot accept responsibility for deviations from recommendations described in this report. Future performance of structural facilities is often related to the degree of construction observation by qualified personnel. These services should be performed to the full extent recommended.

This report is not an environmental assessment and should not be construed as a representative warranty of site subsurface conditions. The discovery of adverse environmental conditions, or subsurface soils that deviate from those described in this report, should immediately prompt further investigation. The above statements are in lieu of all other statements expressed or implied.

This report was prepared solely for the client and is not to be reproduced without prior authorization from Columbia West. Final engineering plans and specifications for the project should be reviewed and approved by Columbia West as they relate to geotechnical and grading issues prior to final design approval. Columbia West is not responsible for independent conclusions or recommendations made by other parties based upon information presented in this report. Unless a particular service was expressly included in the scope, it was not performed and there should be no assumptions based upon services not provided. Additional report limitations and important information about this document are presented in Appendix D, *Report Limitations and Important Information*. This information should be carefully read and understood by the client and other parties reviewing this document.

Sincerely,

COLUMBIA WEST ENGINEERING, Inc.

Lance V. Lehto, PE, GE
President

LANCE V. LEHTO
STATE OF WASHINGTON
36301
REGISTERED
PROFESSIONAL ENGINEER

3-30-2023

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

REFERENCES

Annual Book of ASTM Standards, Soil and Rock (I), v04.08, American Society for Testing and Materials, 1999.

ASCE 7-16, Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers, 2016.

Beeson, M.H., Tolan, T.L., Madin, I.P., *Geologic Map of the Lake Oswego Quadrangle, Clackamas, Multnomah, and Washington Counties, Oregon*; Oregon Department of Geology and Mineral Industries; Geological Map Series GMS-59, 1989.

Cetin, et al., *Probabilistic Model for the Assessment of Cyclically Induced Reconsolidation (Volumetric) Settlements*, Journal of Geotechnical and Environmental Engineering, ASCE, March, 2009.

Columbia West Engineering, Inc., *Preliminary Grading Recommendations, Landing on the Cowlitz, Castle Rock, Washington,* November 8, 2022.

Geomatrix Consultants, *Seismic Design Mapping, State of Oregon*, January 1995.

International Building Code: *2018 International Building Code, 2018 edition*, International Code Council, 2018.

Idriss, I.M and Boulanger, R.W, CPT and SPT Based Liquefaction Triggering Procedures, Center for Geotechnical Modeling, Report No. UCD/CGM-14/01, April, 2014.

Phillips, W. M., *Geologic Map of the Mount St. Helens Quadrangle, Washington and Oregon*, USGS Open File Report 87-4, 1987.

Robertson, P.K., 2009*. CPT interpretation – a unified approach, Canadian Geotechnical Journal, 46: 1-19*

Safety and Health Regulations for Construction, 29 CFR Part 1926, Occupational Safety and Health Administration (OSHA), revised July 1, 2001.

State of Washington Department of Ecology, *Washington State Well Log Viewer (apps.exy.wa.gov/wellog/).*

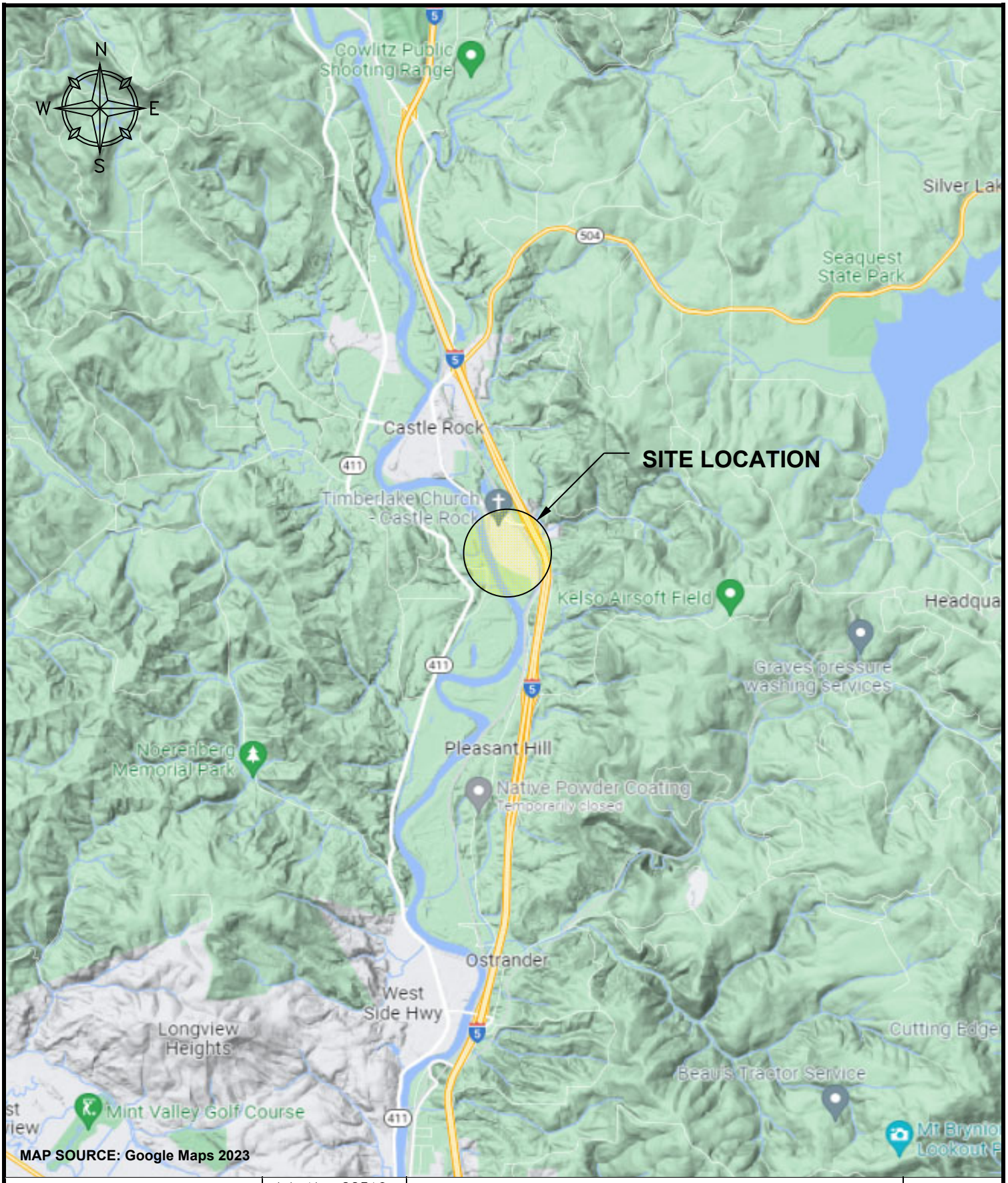
USGS, *Geologic Map of the Greater Portland Metropolitan Area and Surrounding Region, Oregon and Washington*, Scientific Investigations Map 3443, 2020.

Washington Department of Transportation (WSDOT), *Standard Specifications for Road, Bridge, and Municipal Construction*, 2023

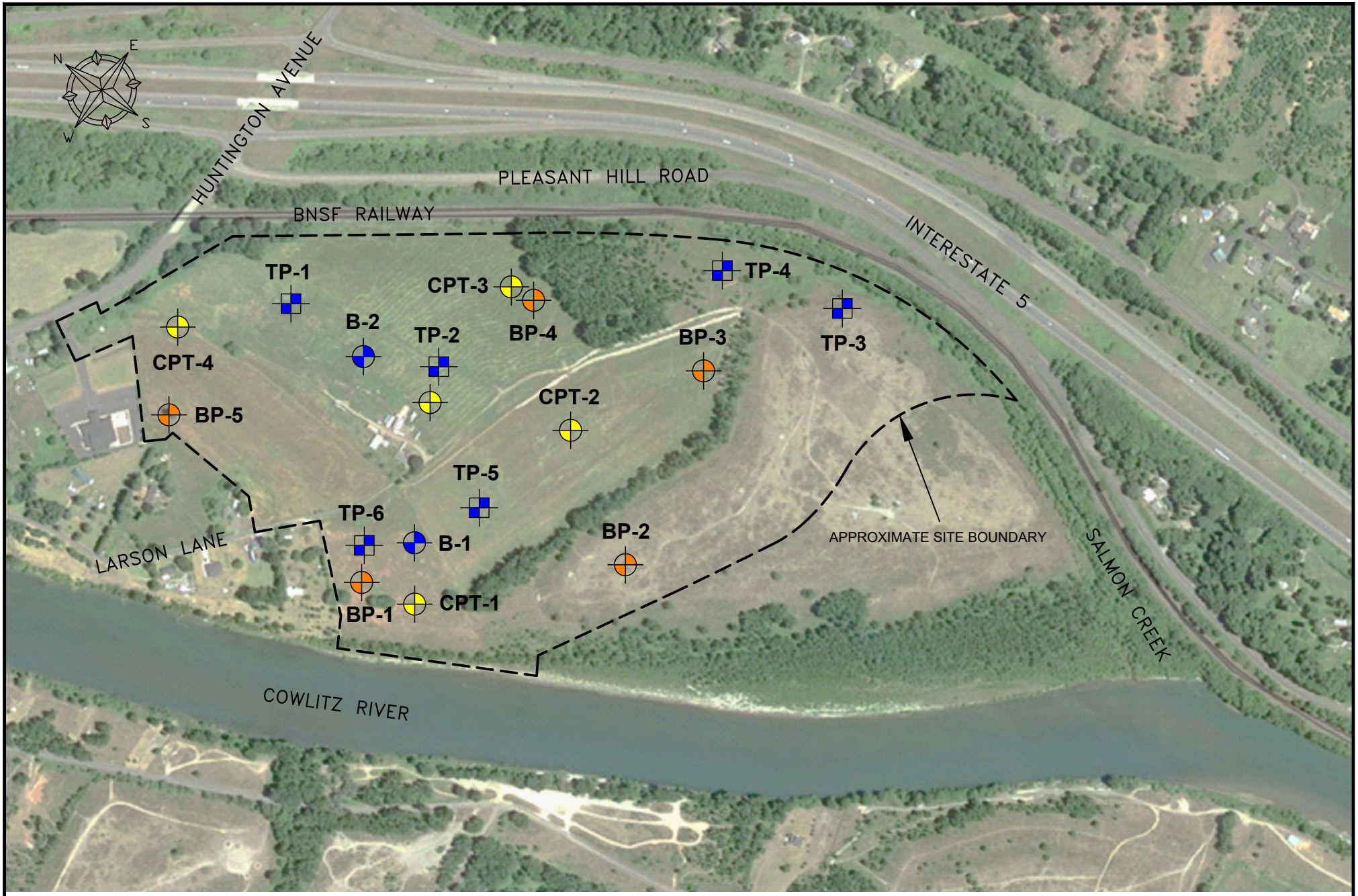
Web Soil Survey, Natural Resources Conservation Service, United States Department of Agriculture, website (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm).

Wong, Ivan, et al, *Earthquake Scenario and Probabilistic Earthquake Ground Shaking Maps for the Portland, Oregon, Metropolitan Area*, IMS-16, Oregon Department of Geology and Mineral Industries, 2000.

FIGURES



Geotechnical ▪ Environmental ▪ Special Inspections Columbia West Engineering, Inc	Job No: 22310 Date: 03/17/23 Drawn: GLW Checked: LVL	SITE LOCATION MAP LANDING ON THE COWLITZ CASTLE ROCK, WASHINGTON	FIGURE 1



BORING AND PIEZOMETER (COLUMBIA WEST, 2023) | BORING (BY OTHERS, 2020) | CONE PENETRATION TEST (BY OTHERS, 2020) | TEST PIT (BY OTHERS, 2020)

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

Project: 22310
Date: 03/17/23
Drawn: GLW
Checked: LVL

EXPLORATION LOCATION MAP
LANDING ON THE COWLITZ

NOTES:
1. SITE LOCATION: 2542 SW LARSON LANE, CASTLE ROCK, WASHINGTON.
2. SITE CONSISTS OF PORTIONS OF TAX PARCEL NOS. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031 TOTALING APPROXIMATELY 118.2 ACRES.
3. DRAWING IS NOT TO SCALE.
4. BASE MAP OBTAINED FROM GOOGLE EARTH, 2023.
5. EXPLORATION LOCATIONS ARE APPROXIMATE AND NOT SURVEYED.
6. BORINGS BP-1 THROUGH BP-5 COMPLETED WITH PIEZOMETER INSTALLATIONS AND FLUSH MOUNT MONUMENTS ON JANUARY 31, FEBRUARY 1, AND FEBRUARY 2, 2023.

FIGURE
2

LEGEND

- RECREATIONAL
- RESIDENTIAL
- COMMERCIAL
- EMPLOYMENT
- FLEX (COM/IND)
- COMMERCIAL OVERLAY
- OPEN SPACE
- DRAINAGE/UTILITIES
- WETLAND BUFFER
- WETLAND
- DEVELOPMENT BOUNDARY
- D.N.R. PROPERTY BOUNDARY
- PROPOSED LOT LINE
- ORDINARY HIGH WATER MARK
- ORDINARY HIGH WATER MARK BUFFER
- CRITICAL AREAS BUFFER

LAND USE SYNOPSIS

	COMMERCIAL	EMPLOYMENT	RES	FLEX	REC	DRAIN	ROW	TOTAL
TOTAL ACREAGE	9.0 - 9.5	46.4	7.8	9.5	18.3			
# OF LOTS	N/A	13	1	4	N/A	N/A	N/A	

LANDING ON THE COWLITZ - DYNAMIC MASTER PLAN

OCTOBER 2022

MacKay Sposito

ENERGY PUBLIC WORKS LAND DEVELOPMENT

www.mackaysposito.com

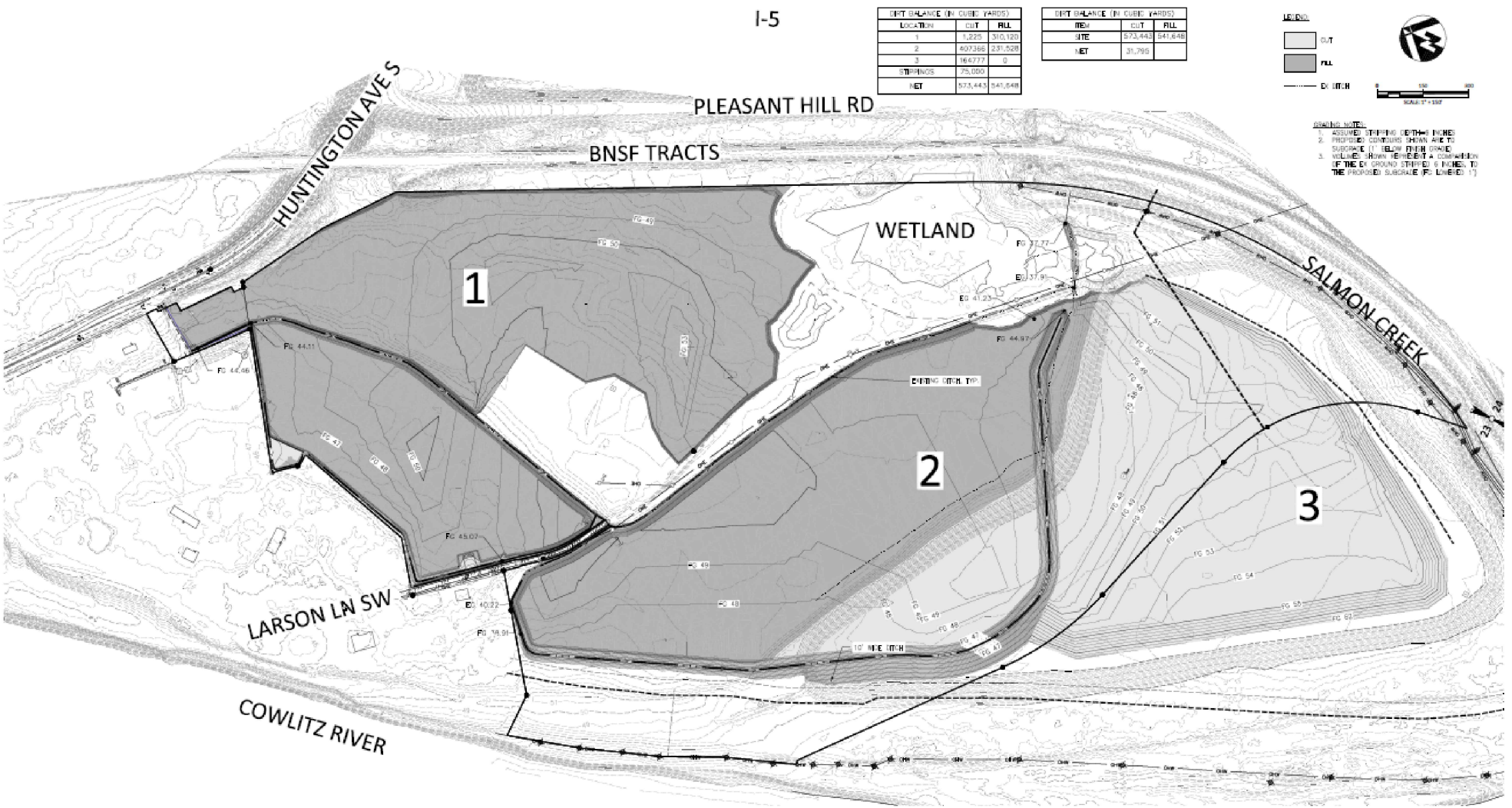
Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

Project: 22310
Date: 03/20/23
Drawn: GLW
Checked: LVL

PRELIMINARY MASTER DEVELOPMENT PLAN
LANDING ON THE COWLITZ

NOTES:
1. SITE LOCATION: 2542 SW LARSON LANE, CASTLE ROCK, WASHINGTON.
2. SITE CONSISTS OF PORTIONS OF TAX PARCEL NOS. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031 TOTALING APPROXIMATELY 118.2 ACRES.
3. DRAWING IS NOT TO SCALE.
4. BASE MAP PROVIDED BY CLIENT.

FIGURE 3



CASTLE ROCK LANDING ON THE COWLITZ - PHASE 1 ROUGH GRADING PLAN

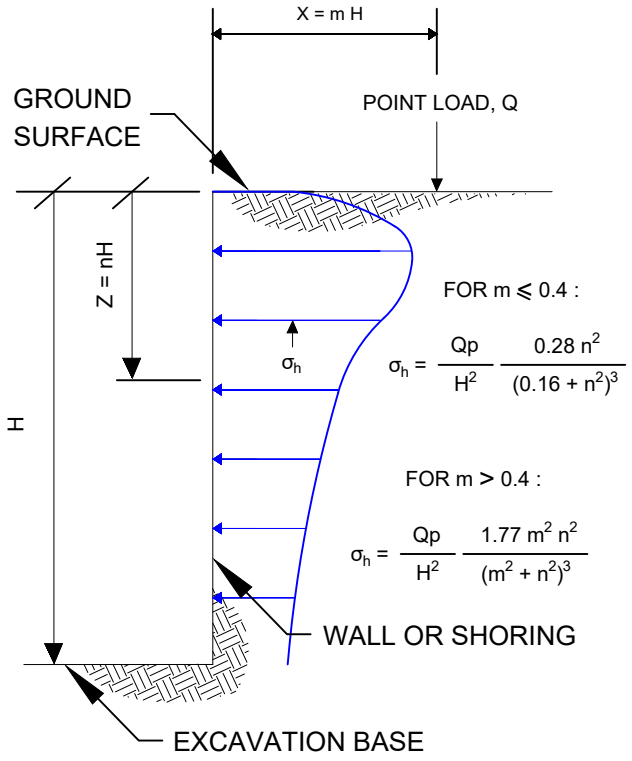
MacKay Sposito

ENERGY PUBLIC WORKS LAND DEVELOPMENT

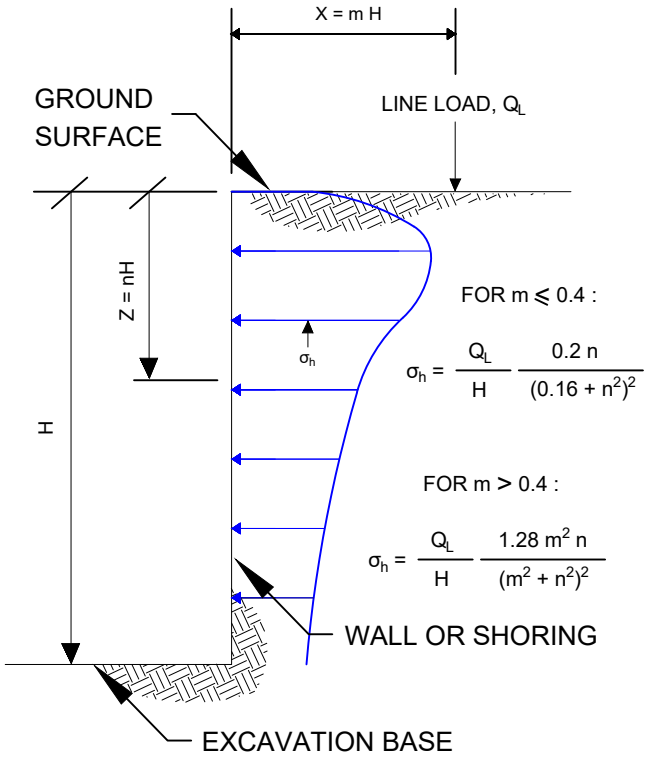
www.mackayposito.com

Geotechnical ▪ Environmental ▪ Special Inspections Columbia West Engineering, Inc	Project: 22310 Date: 03/23/23 Drawn: GLW Checked: LVL	PHASE I ROUGH GRADING PLAN LANDING ON THE COWLITZ	NOTES: 1. SITE LOCATION: 2542 SW LARSON LANE, CASTLE ROCK, WASHINGTON. 2. SITE CONSISTS OF PORTIONS OF TAX PARCEL NOS. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031 TOTALING APPROXIMATELY 118.2 ACRES. 3. DRAWING IS NOT TO SCALE. 4. BASE MAP PROVIDED BY CLIENT.	FIGURE 4

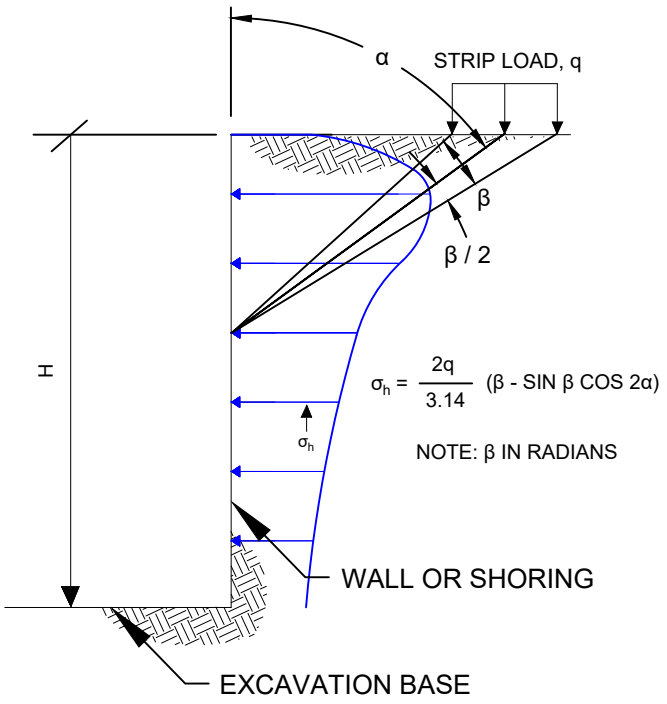
VERTICAL POINT LOAD



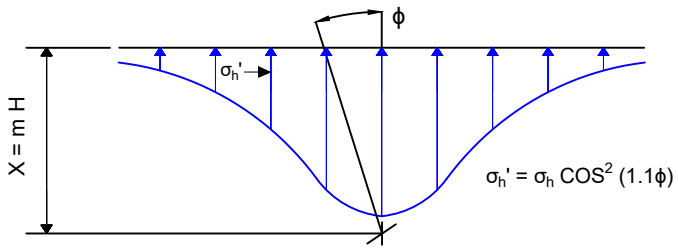
LINE LOAD PARALLEL TO WALL



STRIP LOAD PARALLEL TO WALL

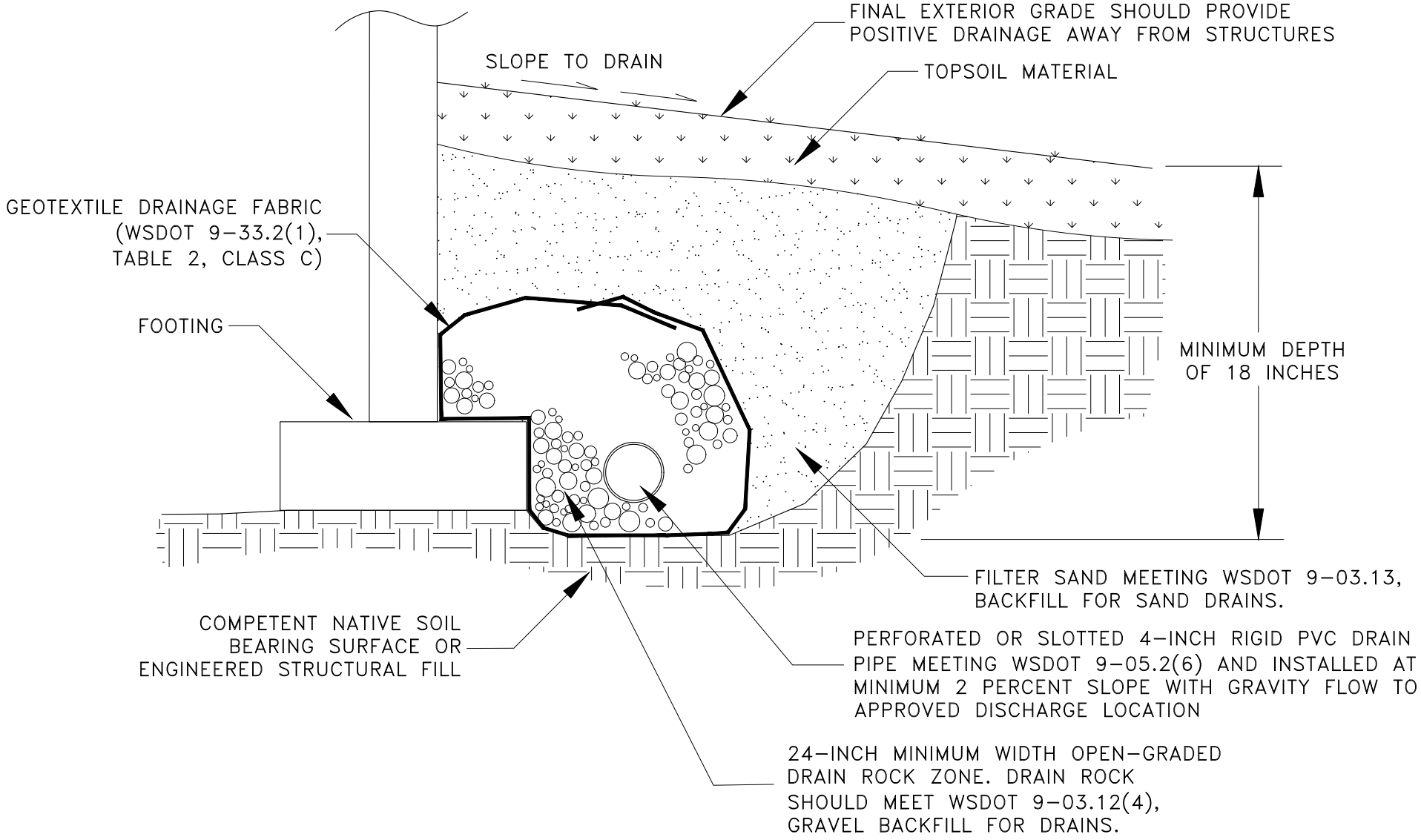


VERTICAL POINT LOAD HORIZONTAL PRESSURE DISTRIBUTION



NOTES:

1. FIGURE SHOULD BE USED JOINTLY WITH RECOMMENDATIONS PRESENTED IN THE REPORT TEXT.
2. LATERAL EARTH PRESSURES ASSUME RIGID WALLS WITH BACKFILL MATERIALS HAVING A POISSON'S RATIO OF 0.5.
3. TOTAL LATERAL EARTH PRESSURES RESULTING FROM COMBINED LOADS MAY BE CALCULATED USING SUPERPOSITION.
4. DRAWING IS NOT TO SCALE.

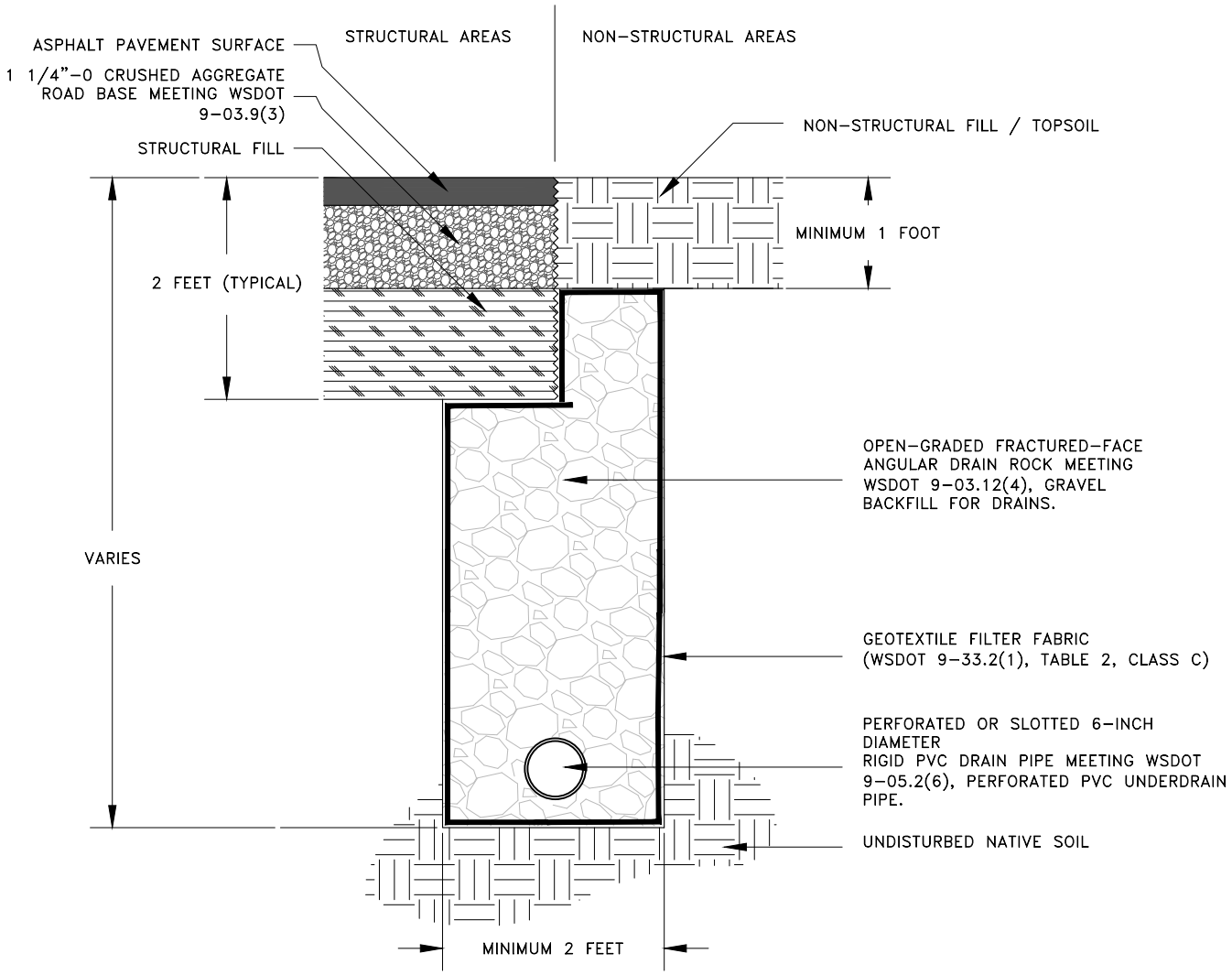


Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

TYPICAL PERIMETER FOOTING DRAIN DETAIL

NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL PERIMETER FOOTING DRAIN DETAIL AND MAY NOT BE SITE-SPECIFIC.

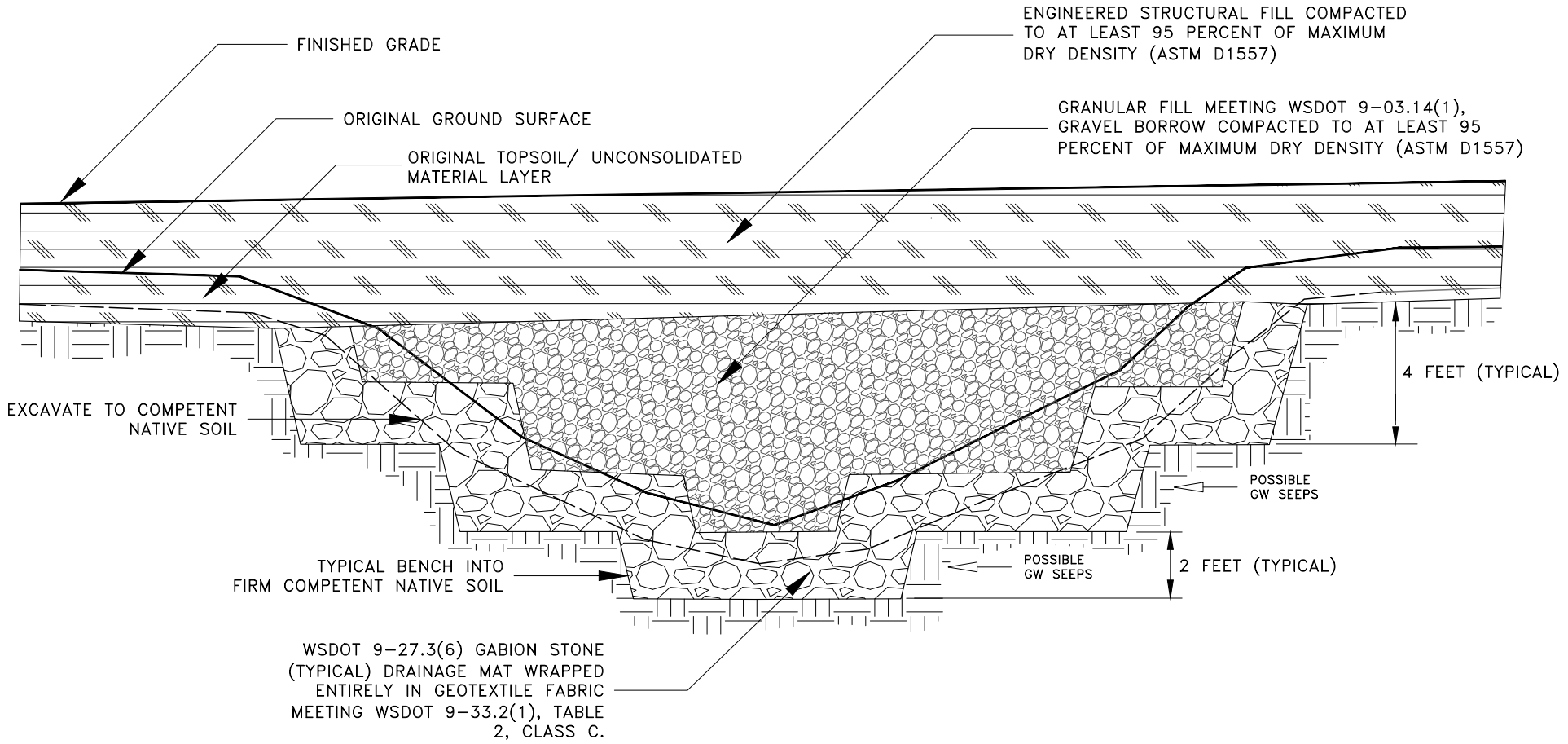
FIGURE 6



NOTE: LOCATION, INVERT ELEVATION, DEPTH OF TRENCH, AND EXTENT OF PERFORATED PIPE REQUIRED MAY BE MODIFIED BY THE GEOTECHNICAL ENGINEER DURING CONSTRUCTION BASED UPON FIELD OBSERVATION AND SITE-SPECIFIC SOIL CONDITIONS.

Geotechnical ▪ Environmental ▪ Special Inspections Columbia West Engineering, Inc	TYPICAL PERFORATED DRAINPIPE TRENCH DETAIL	NOTES: 1. DRAWING IS NOT TO SCALE. 2. DRAWING REPRESENTS TYPICAL PERFORATED DRAIN PIPE TRENCH DETAIL AND MAY NOT BE SITE-SPECIFIC.	FIGURE 7

TYPICAL DRAINAGE MAT CROSS-SECTION

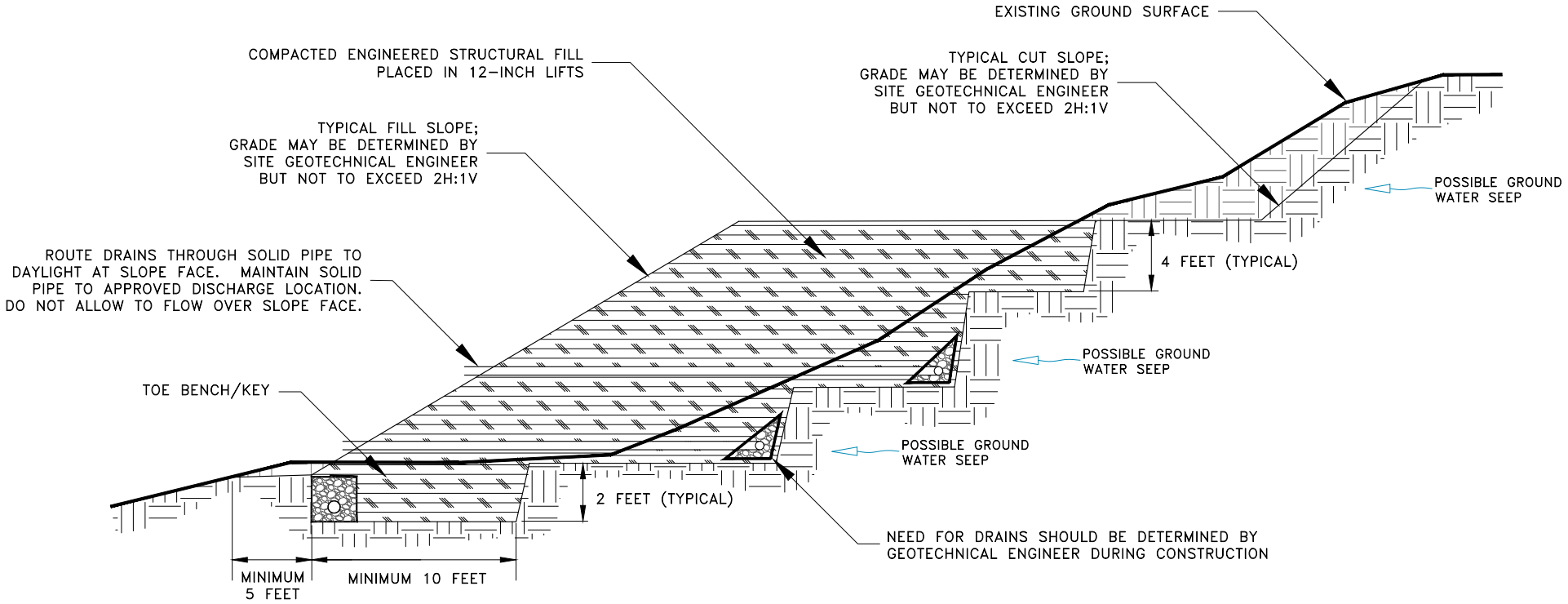


Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

TYPICAL DRAINAGE MAT CROSS SECTION

NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL DRAINAGE MAT SECTION AND MAY NOT BE SITE-SPECIFIC.

FIGURE 8



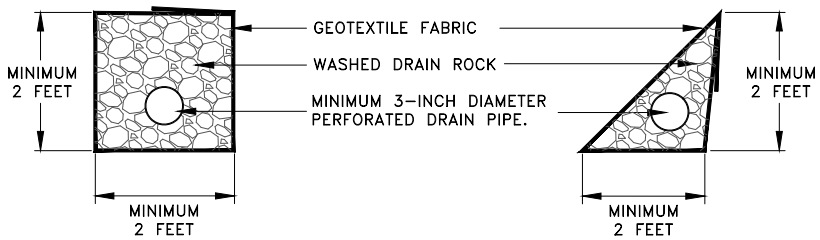
DRAIN SPECIFICATIONS

GEOTEXTILE FABRIC SHALL MEET WSDOT 9–33.2(1), TABLE 2, CLASS C.

WASHED DRAIN ROCK SHALL BE OPEN–GRADED ANGULAR DRAIN ROCK MEETING WSDOT 9–03.12(4), GRAVEL BACKFILL FOR DRAINS.

DRAIN PIPE SHOULD MEET WSDOT 9–05.2(6), PERFORATED PVC UNDERDRAIN PIPE.

TYPICAL DRAIN SECTION DETAIL

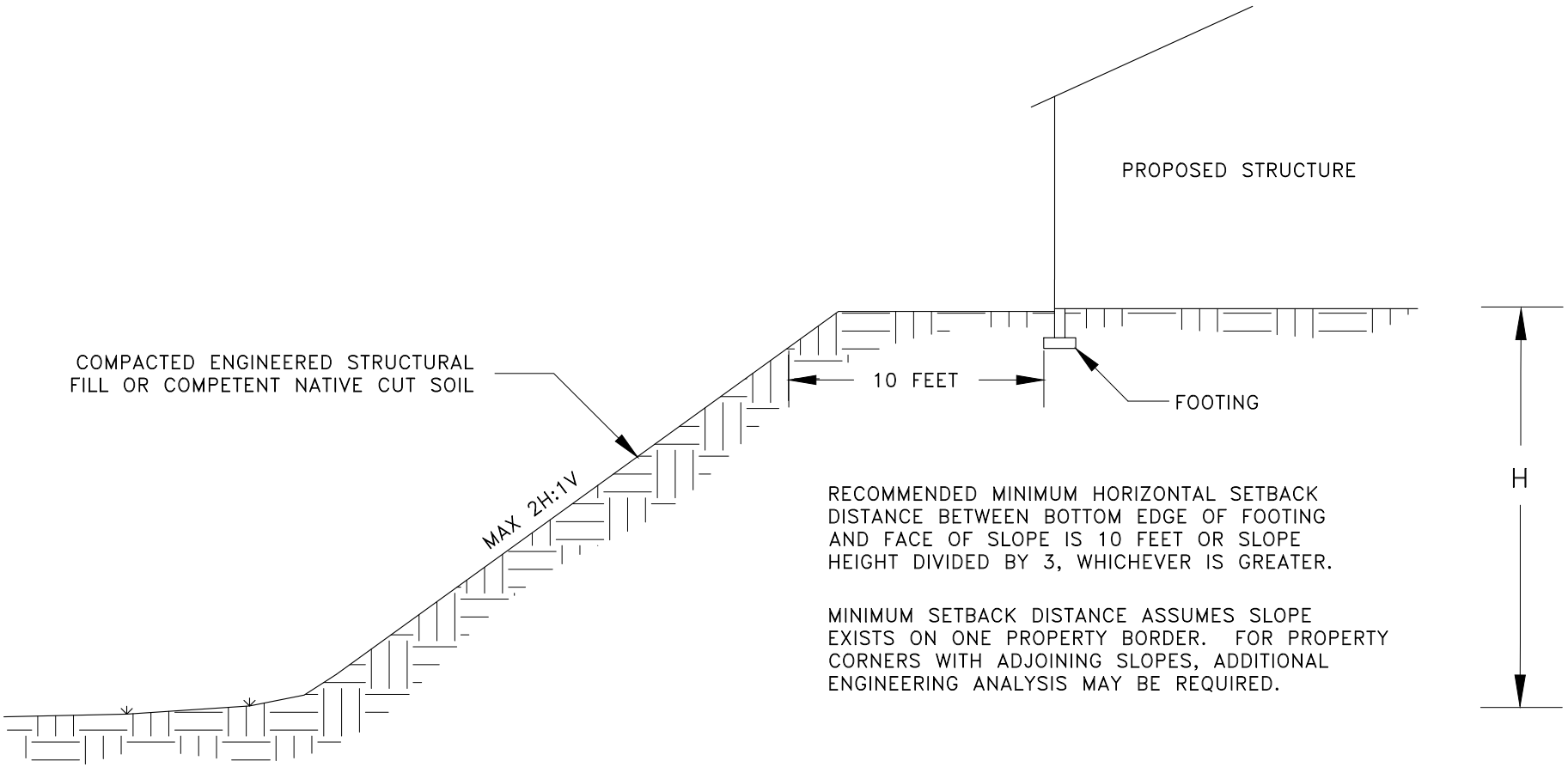


Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

TYPICAL CUT AND FILL SLOPE CROSS SECTION

NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL CUT AND FILL SLOPE CROSS SECTION AND MAY NOT BE SITE–SPECIFIC.

FIGURE 9



Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

TYPICAL MINIMUM FOUNDATION SLOPE SETBACK DETAIL

NOTES:
1. DRAWING IS NOT TO SCALE.
2. SLOPES AND PROFILES SHOWN ARE APPROXIMATE.
3. DRAWING REPRESENTS TYPICAL FOUNDATION SETBACK DETAIL AND MAY NOT BE SITE-SPECIFIC.

FIGURE 10

APPENDIX A
SUBSURFACE EXPLORATION LOGS

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

BORING LOG

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Landing on the Cowlitz	CT6, LLC		22310	BP-1
PROJECT LOCATION	**DRILLING CONTRACTOR**	**DRILL RIG**	**TECHNICIAN**	**PAGE NO.**
Castle Rock, Washington	Western States	CME Track	MAC	1 of 1
BORING LOCATION	**DRILLING METHOD**	**SAMPLING METHOD**	**START DATE**	**START TIME**
See Figure 2	HSA	SPT	1/31/23	0900
REMARKS	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**FINISH DATE**	**FINISH TIME**
None	Not surveyed	20 feet bgs on 1/31/23	1/31/23	1030

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0			SP-SM			Fill. Gray poorly-graded SAND with silt and trace gravel, moist, fine-textured.					
6	SPT BP1.1	5	SP-SM			Brown poorly-graded SAND with silt, loose, moist, fine-textured.					
10	SPT BP1.2	4				Becomes very loose.					
16	SPT BP1.3	9				Becomes loose.					
20	SPT BP1.4	16				Becomes medium dense, wet.					
30						Bottom of boring at 30 feet bgs. Groundwater encountered at 20 feet bgs on 1/31/23. Piezometer installed at 30 feet and completed with flush mount monument on 1/31/23.					

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

BORING LOG

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Landing on the Cowlitz	CT6, LLC		22310	BP-2
PROJECT LOCATION	**DRILLING CONTRACTOR**	**DRILL RIG**	**TECHNICIAN**	**PAGE NO.**
Castle Rock, Washington	Western States	CME Track	MAC	1 of 1
BORING LOCATION	**DRILLING METHOD**	**SAMPLING METHOD**	**START DATE**	**START TIME**
See Figure 2	HSA	SPT	1/31/23	1200
REMARKS	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**FINISH DATE**	**FINISH TIME**
None	Not surveyed	35 feet bgs on 1/31/23	1/31/23	1600

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0			SP-SM			Brown poorly-graded SAND with silt, moist, fine-textured.					
20	SPT BP2.1	57				Becomes very dense with reduced silt content and trace to some gravel.					
26	SPT BP2.2	11				Becomes medium dense, very moist.					
30	SPT BP2.3	10									
35			GP-GM			Gray to reddish gray poorly-graded GRAVEL with silt and sand, medium dense, wet.					
36	SPT BP2.4	30									
40	SPT BP2.5	REFUSAL 50(3")				Becomes very dense.					
45						Bottom of soil boring at 45 feet bgs. Groundwater encountered at 35 feet bgs on 1/31/23. Piezometer installed at 45 feet and completed with flush mount monument on 1/31/23.					

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

BORING LOG

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Landing on the Cowlitz	CT6, LLC		22310	BP-3
PROJECT LOCATION	**DRILLING CONTRACTOR**	**DRILL RIG**	**TECHNICIAN**	**PAGE NO.**
Castle Rock, Washington	Western States	CME Track	MAC	1 of 1
BORING LOCATION	**DRILLING METHOD**	**SAMPLING METHOD**	**START DATE**	**START TIME**
See Figure 2	HSA	SPT	2/1/23	0900
REMARKS	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**FINISH DATE**	**FINISH TIME**
None	Not surveyed	15 feet bgs on 2/1/23	2/1/23	1245

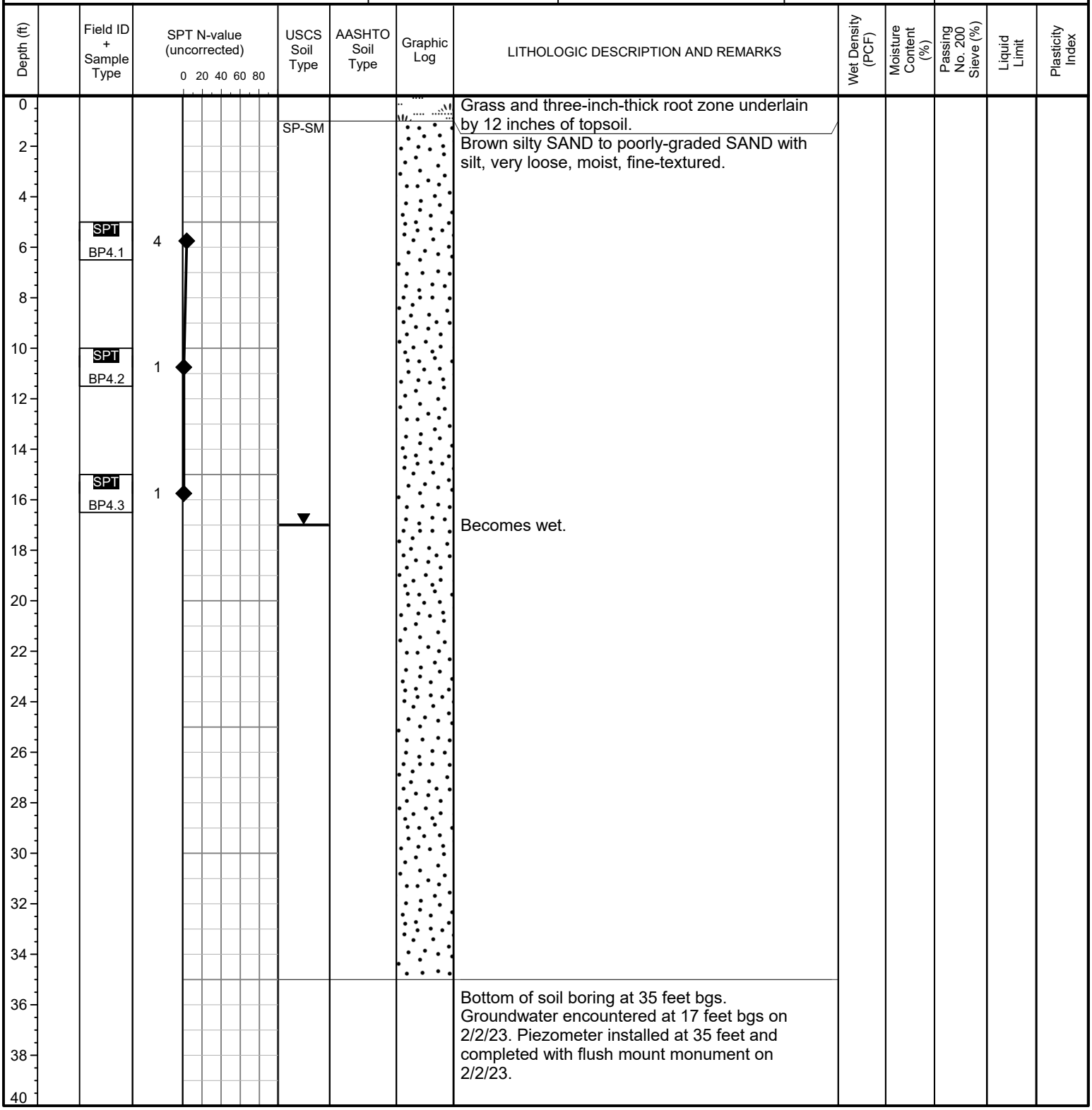
Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0			SP-SM			Brown poorly-graded SAND with silt, loose, moist, fine-textured.					
2											
4											
6	SPT BP3.1	6									
8											
10	SPT BP3.2	0				Becomes very loose.					
12											
14											
16	SPT BP3.3	1	ML			Dark gray SILT with sand, very soft, wet, low plasticity.					
18											
20	SPT BP3.4	37	SP			Gray poorly-graded SAND, medium dense, wet.					
22											
24											
26						Bottom of soil boring at 25 feet bgs. Groundwater encountered at 15 feet bgs on 2/1/23. Piezometer installed at 25 feet and completed with flush mount monument on 2/1/23.					
28											
30											

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

BORING LOG

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Landing on the Cowlitz	CT6, LLC		22310	BP-4
PROJECT LOCATION	**DRILLING CONTRACTOR**	**DRILL RIG**	**TECHNICIAN**	**PAGE NO.**
Castle Rock, Washington	Western States	CME Track	MAC	1 of 1
BORING LOCATION	**DRILLING METHOD**	**SAMPLING METHOD**	**START DATE**	**START TIME**
See Figure 2	HSA	SPT	2/1/23	1300
REMARKS	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**FINISH DATE**	**FINISH TIME**
None	Not surveyed	17 feet bgs on 2/2/23	2/2/23	1045



11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

BORING LOG

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Landing on the Cowlitz	CT6, LLC		22310	BP-5
PROJECT LOCATION	**DRILLING CONTRACTOR**	**DRILL RIG**	**TECHNICIAN**	**PAGE NO.**
Castle Rock, Washington	Western States	CME Track	MAC	1 of 1
BORING LOCATION	**DRILLING METHOD**	**SAMPLING METHOD**	**START DATE**	**START TIME**
See Figure 2	HSA	SPT	2/2/23	1100
REMARKS	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**FINISH DATE**	**FINISH TIME**
None	Not surveyed	17.5 feet bgs on 2/2/23	2/2/23	1600

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0			SP-SM			Brown poorly-graded SAND with silt, loose, moist, fine-textured.					
2											
4											
6	SPT BP5.1	7									
8											
10	SPT BP5.2	10				Becomes medium dense.					
12											
14											
16	SPT BP5.3	5				Becomes loose.					
18						Becomes wet.					
20	SPT BP5.4	REFUSAL 50(3")	GP-GM			Gray to reddish gray poorly-graded GRAVEL with silt and sand, very dense, wet.					
22											
24											
26	SPT BP5.5	REFUSAL 50(5")									
28											
30	SPT BP5.6	16				Becomes medium dense.					
32						Bottom of soil boring at 31.5 feet bgs. Groundwater encountered at 17.5 feet bgs on 2/2/23. Piezometer installed at 30 feet and completed with flush mount monument on 2/2/23.					
34											
36											

APPENDIX B
SOIL CLASSIFICATION INFORMATION

SOIL DESCRIPTION AND CLASSIFICATION GUIDELINES

Particle-Size Classification

COMPONENT	ASTM/USCS		AASHTO	
	size range	sieve size range	size range	sieve size range
Cobbles	> 75 mm	greater than 3 inches	> 75 mm	greater than 3 inches
Gravel	75 mm – 4.75 mm	3 inches to No. 4 sieve	75 mm – 2.00 mm	3 inches to No. 10 sieve
Coarse	75 mm – 19.0 mm	3 inches to 3/4-inch sieve	-	-
Fine	19.0 mm – 4.75 mm	3/4-inch to No. 4 sieve	-	-
Sand	4.75 mm – 0.075 mm	No. 4 to No. 200 sieve	2.00 mm – 0.075 mm	No. 10 to No. 200 sieve
Coarse	4.75 mm – 2.00 mm	No. 4 to No. 10 sieve	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve
Medium	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve	-	-
Fine	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve
Fines (Silt and Clay)	< 0.075 mm	Passing No. 200 sieve	< 0.075 mm	Passing No. 200 sieve

Consistency for Cohesive Soil

CONSISTENCY	SPT N-VALUE (BLOWS PER FOOT)	D&M N-VALUE (BLOWS PER FOOT)	POCKET PENETROMETER (UNCONFINED COMPRESSIVE STRENGTH, tsf)
Very Soft	Less than 2	Less than 3	less than 0.25
Soft	2 to 4	3 to 6	0.25 to 0.50
Medium Stiff	4 to 8	6 to 12	0.50 to 1.0
Stiff	8 to 15	12 to 25	1.0 to 2.0
Very Stiff	15 to 30	25 to 65	2.0 to 4.0
Hard	30 to 60	65 to 145	greater than 4.0
Very Hard	greater than 60	greater than 145	-

RELATIVE DENSITY	SPT N-VALUE (BLOWS PER FOOT)	D&M N-VALUE (BLOWS PER FOOT)
Very Loose	0 to 4	0 to 11
Loose	4 to 10	11 to 26
Medium Dense	10 to 30	26 to 74
Dense	30 to 50	74 to 120
Very Dense	more than 50	More than 120

Relative Density for Granular Soil

Moisture Designations

TERM	FIELD IDENTIFICATION
Dry	No moisture. Dusty or dry.
Damp	Some moisture. Cohesive soils are usually below plastic limit and are moldable.
Moist	Grains appear darkened, but no visible water is present. Cohesive soils will clump. Sand will bulk. Soils are often at or near plastic limit.
Wet	Visible water on larger grains. Sand and silt exhibit dilatancy. Cohesive soil can be readily remolded. Soil leaves wetness on the hand when squeezed. Soil is much wetter than optimum moisture content and is above plastic limit.

Additional Constituents

Percent	Silt and Clay In:		Percent	Sand and Gravel In:	
	Fine-Grained Soil	Coarse-Grained Soil		Fine-Grained Soil	Coarse-Grained Soil
< 5	trace	trace	< 5	trace	trace
5 – 12	minor	with	5 – 15	minor	minor
> 12	some	silty/clayey	15 – 30	with	with
			> 30	sandy/gravelly	with Indicate approx. percentage

AASHTO SOIL CLASSIFICATION SYSTEM

TABLE 1. Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35 Percent or Less Passing .075 mm)				Silt-Clay Materials (More than 35 Percent Passing 0.075)		
Group Classification	A-1	A-3	A-2	A-4	A-5	A-6	A-7
Sieve analysis, percent passing:							
2.00 mm (No. 10)	-	-	-				
0.425 mm (No. 40)	50 max	51 min	-	-	-	-	-
0.075 mm (No. 200)	25 max	10 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)							
Liquid limit				40 max	41 min	40 max	41 min
Plasticity index	6 max	N.P.		10 max	10 max	11 min	11 min
General rating as subgrade	Excellent to good				Fair to poor		

Note: The placing of A-3 before A-2 is necessary in the "left to right elimination process" and does not indicate superiority of A-3 over A-2.

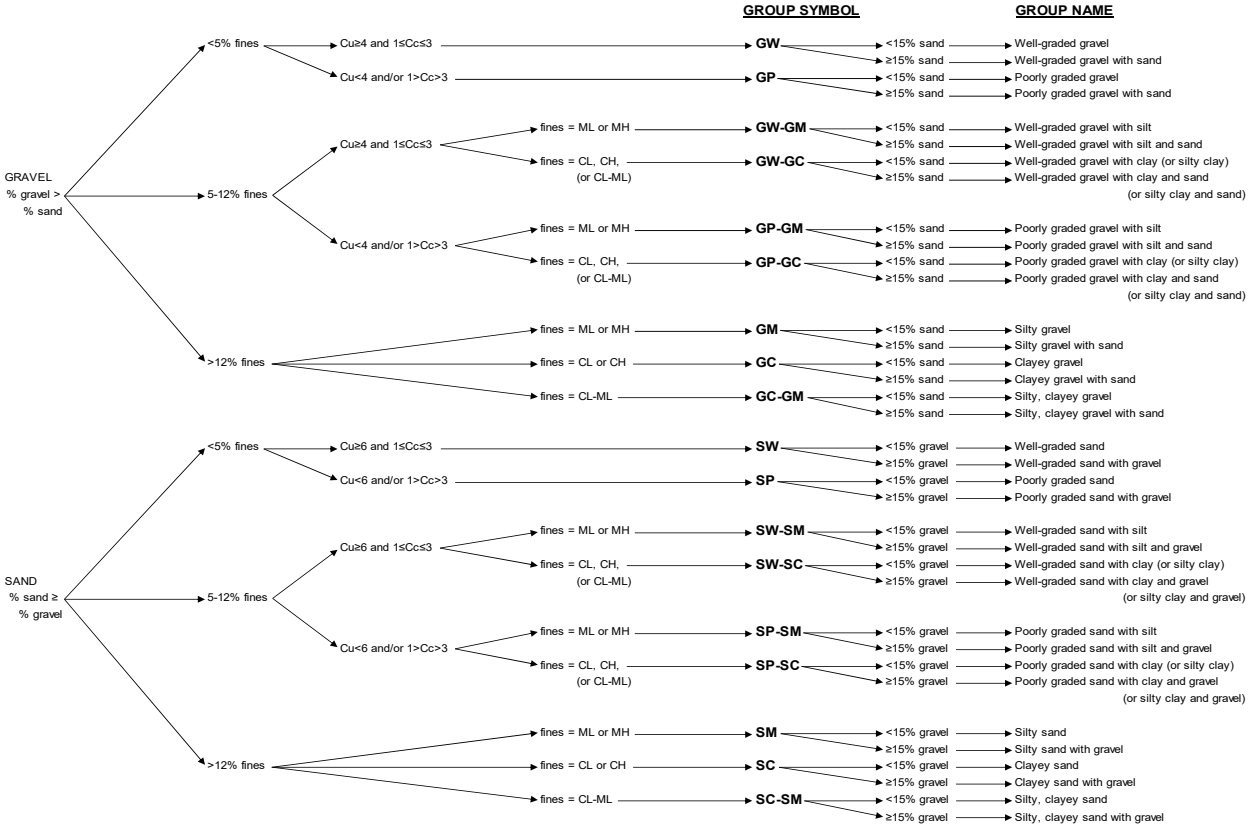
TABLE 2. Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35 Percent or Less Passing 0.075 mm)							Silt-Clay Materials (More than 35 Percent Passing 0.075 mm)			
	A-1			A-2							A-7
Group Classification	A-1-a	A-1-b	A-3	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7-5, A-7-6
Sieve analysis, percent passing:											
2.00 mm (No. 10)	50 max	-	-	-	-	-	-	-	-	-	-
0.425 mm (No. 40)	30 max	50 max	51 min	-	-	-	-	-	-	-	-
0.075 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)											
Liquid limit				40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11min
Usual types of significant constituent materials	Stone fragments, gravel and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
General ratings as subgrade	Excellent to Good							Fair to poor			

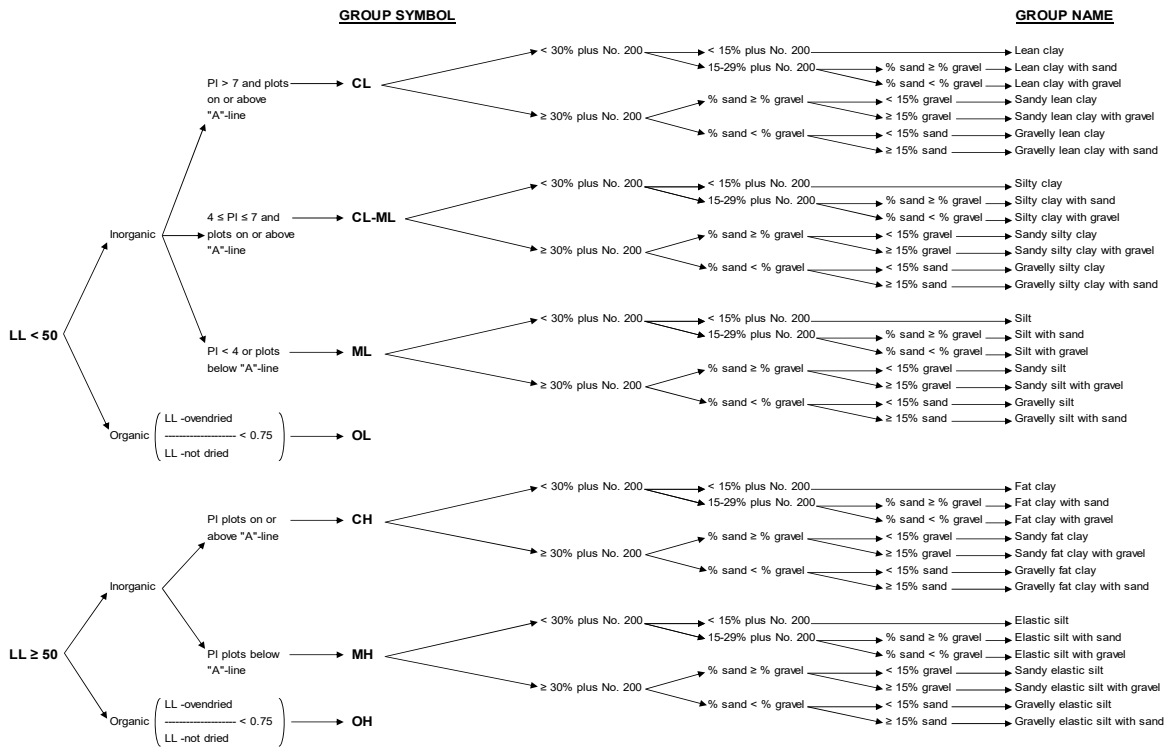
Note: Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30 (see Figure 2).

AASHTO = American Association of State Highway and Transportation Officials

USCS SOIL CLASSIFICATION SYSTEM



Flow Chart for Classifying Coarse-Grained Soils (More Than 50% Retained on No. 200 Sieve)

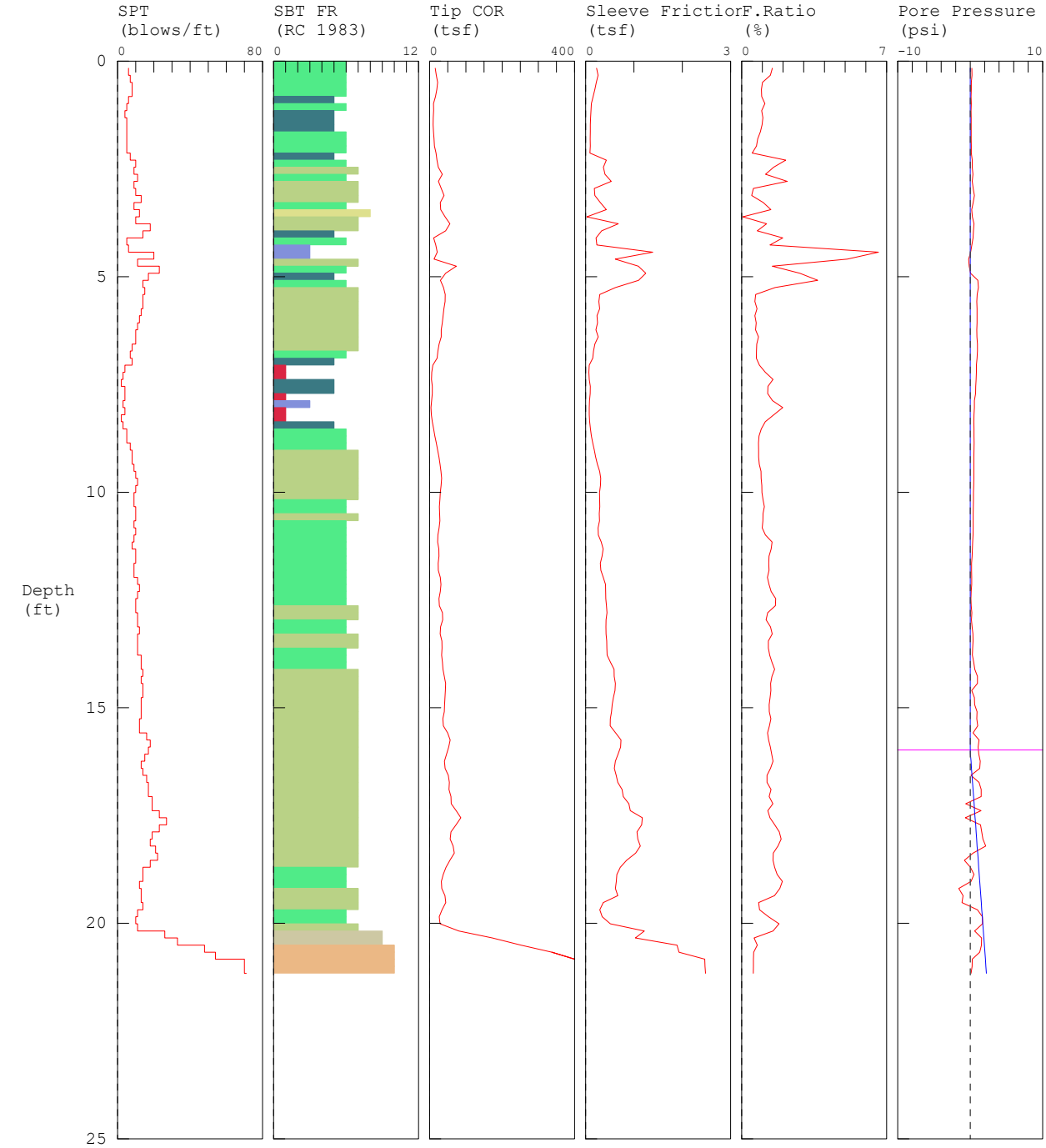


Flow Chart for Classifying Fine-Grained Soil (50% or More Passes No. 200 Sieve)

APPENDIX C
PERTINENT SUBSURFACE INFORMATION COLLECTED BY OTHERS

GeoDesign / CPT-1 / SW Larson Lane Castle Rock

OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-1
TEST DATE: 1/13/2020 10:33:34 AM
TOTAL DEPTH: 21.161 ft

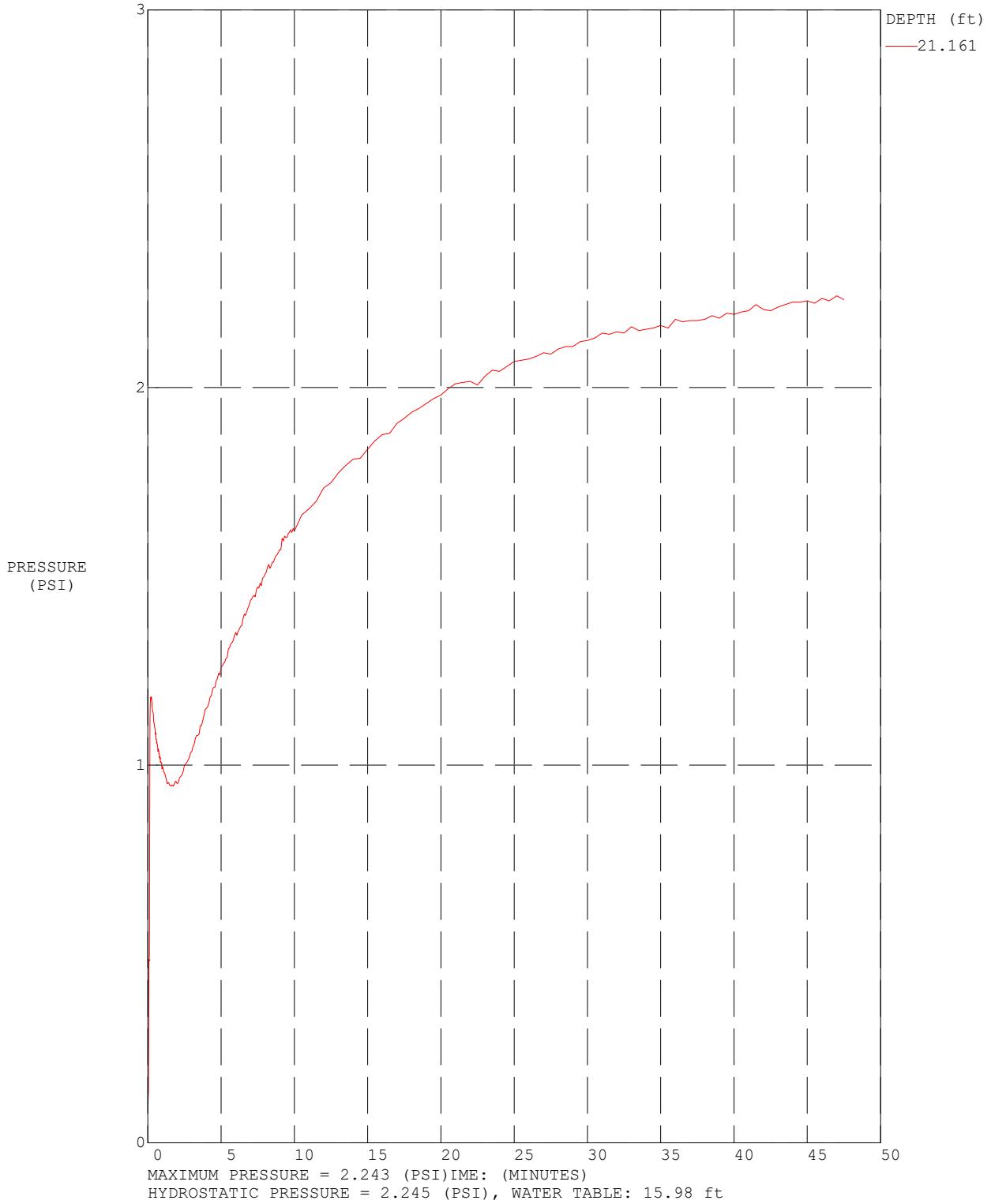


1 sensitive fine gra
2 organic materia
3 clay
4 silty clay to cl
5 clayey silt to silt
6 sandy silt to claye
7 silty sand to sandy
8 sand to silty sa
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

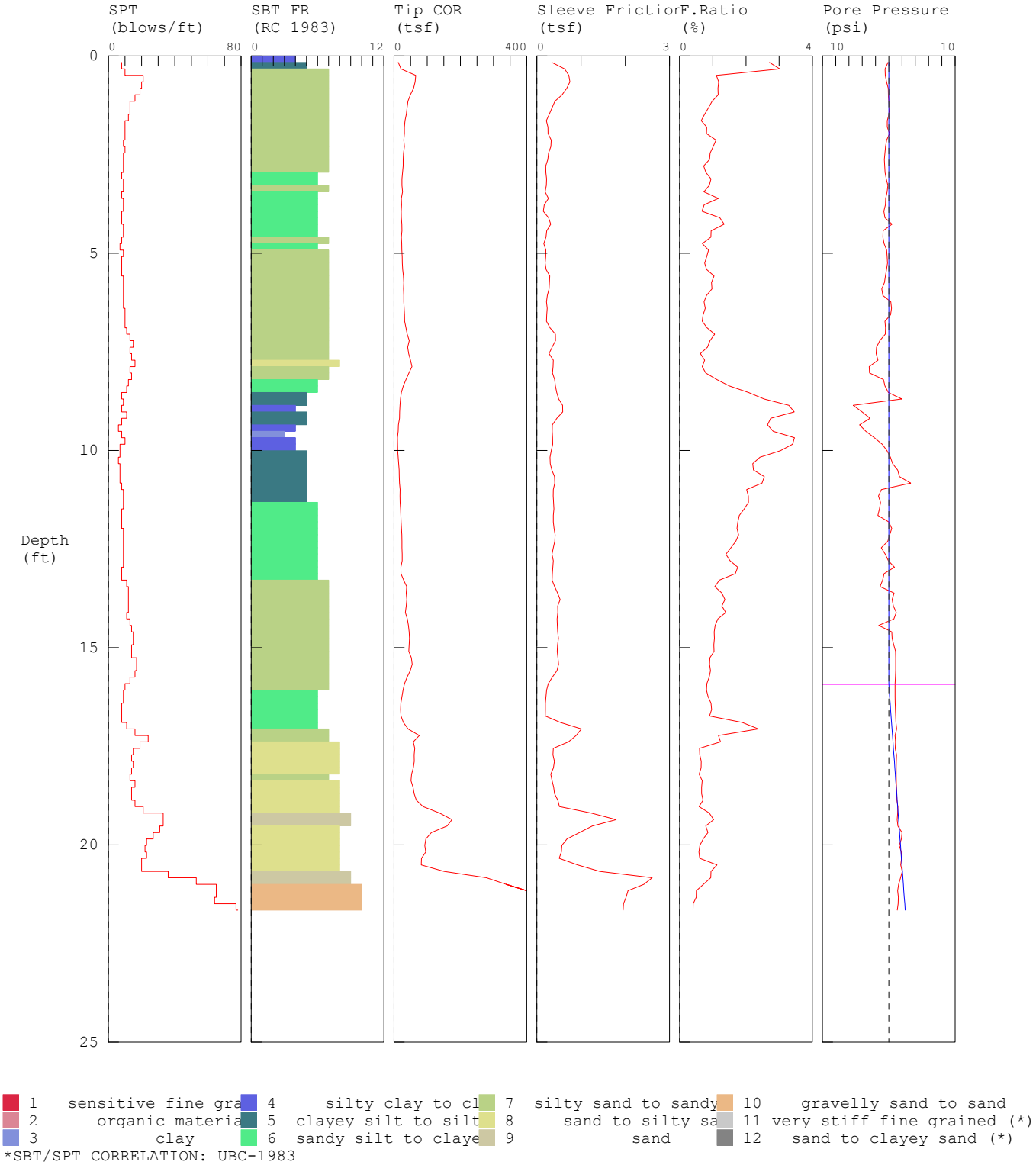
COMMENT: GeoDesign / CPT-1 / SW Larson Lane Castle Rock

TEST DATE: 1/13/2020 10:33:34 AM



GeoDesign / CPT-2 / SW Larson Lane Castle Rock

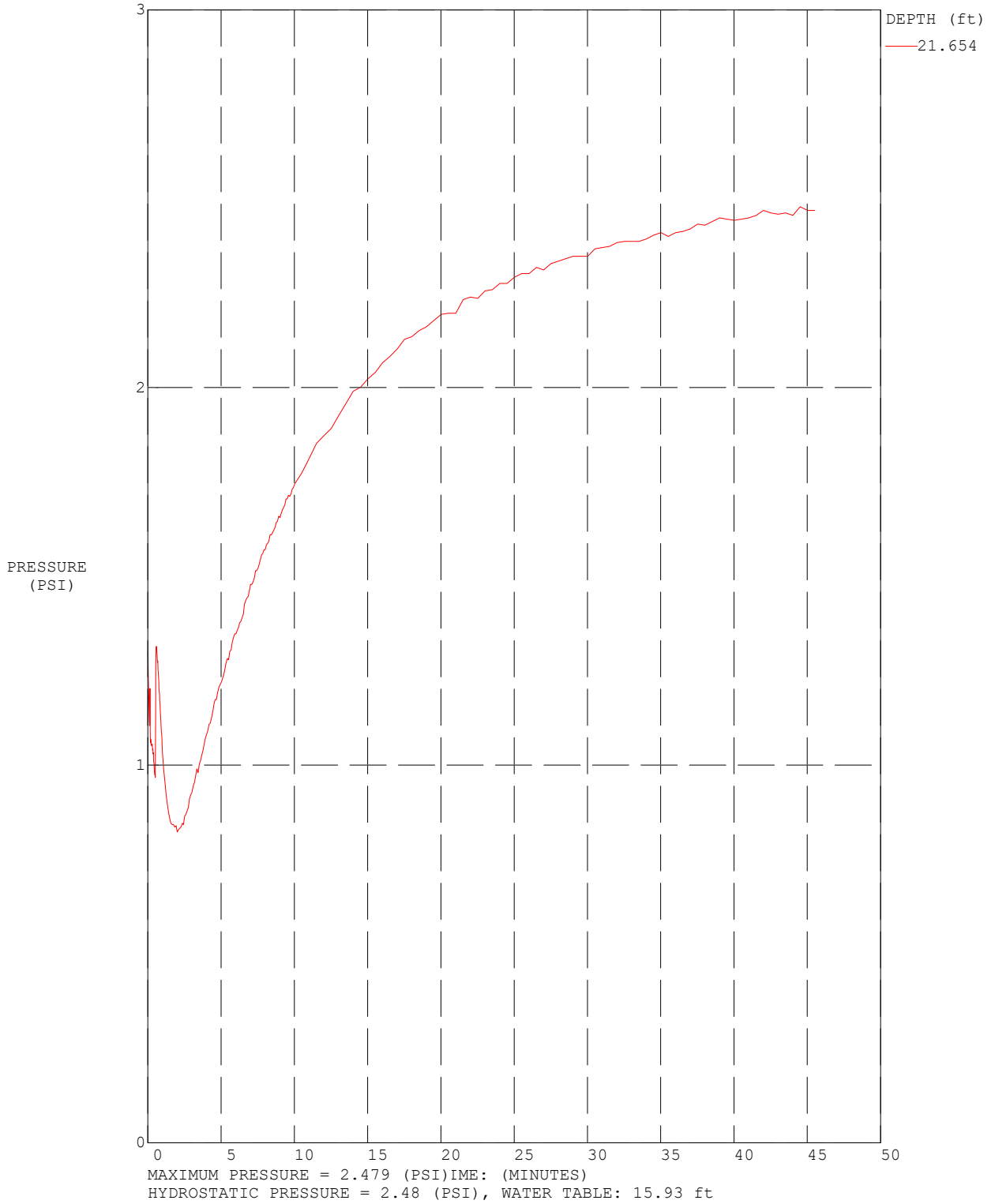
OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-2
TEST DATE: 1/13/2020 12:14:29 PM
TOTAL DEPTH: 21.654 ft



*SBT/SPT CORRELATION: UBC-1983

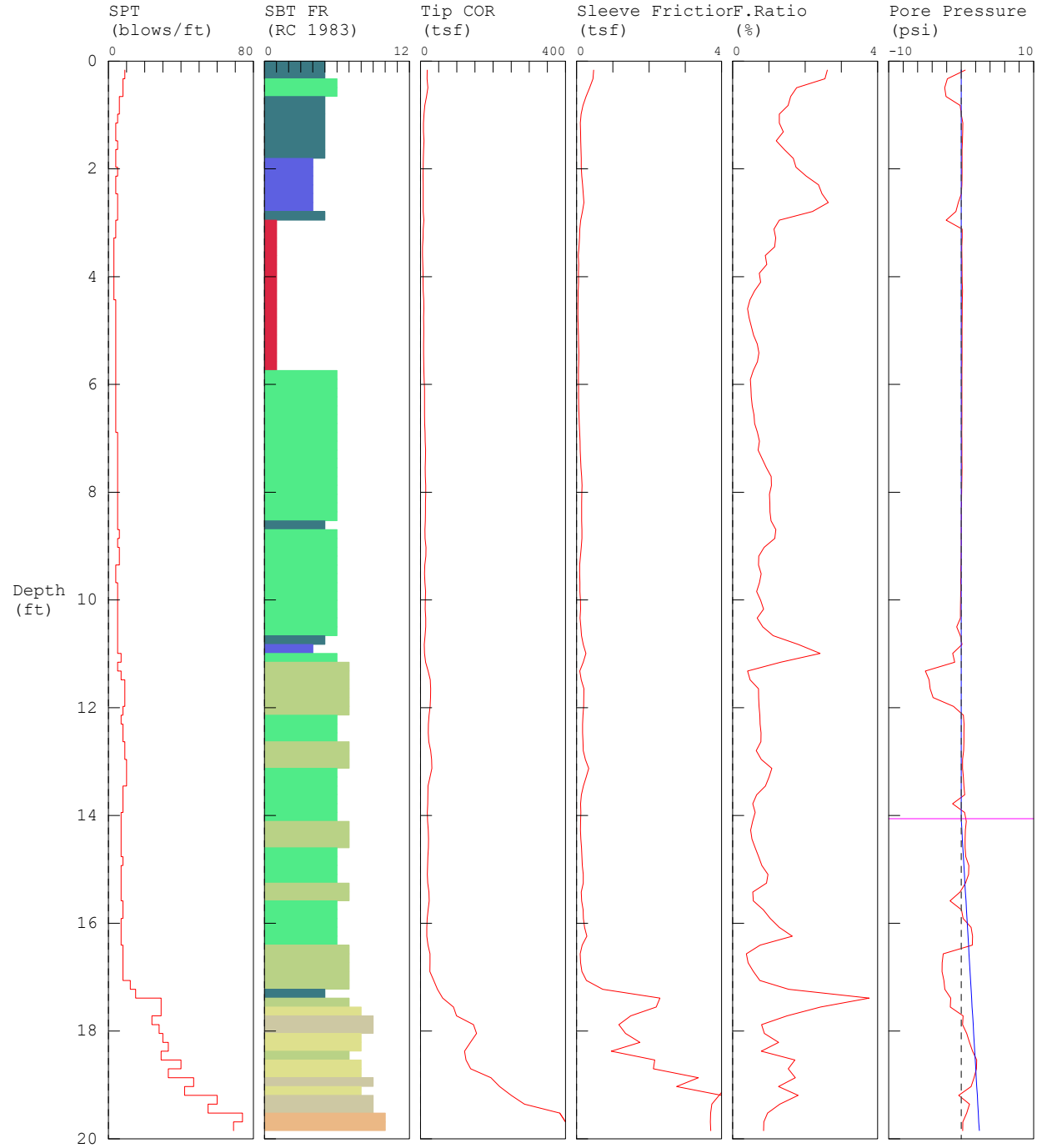
COMMENT: GeoDesign / CPT-2 / SW Larson Lane Castle Rock

TEST DATE: 1/13/2020 12:14:29 PM



GeoDesign / CPT-3 / SW Larson Lane Castle Rock

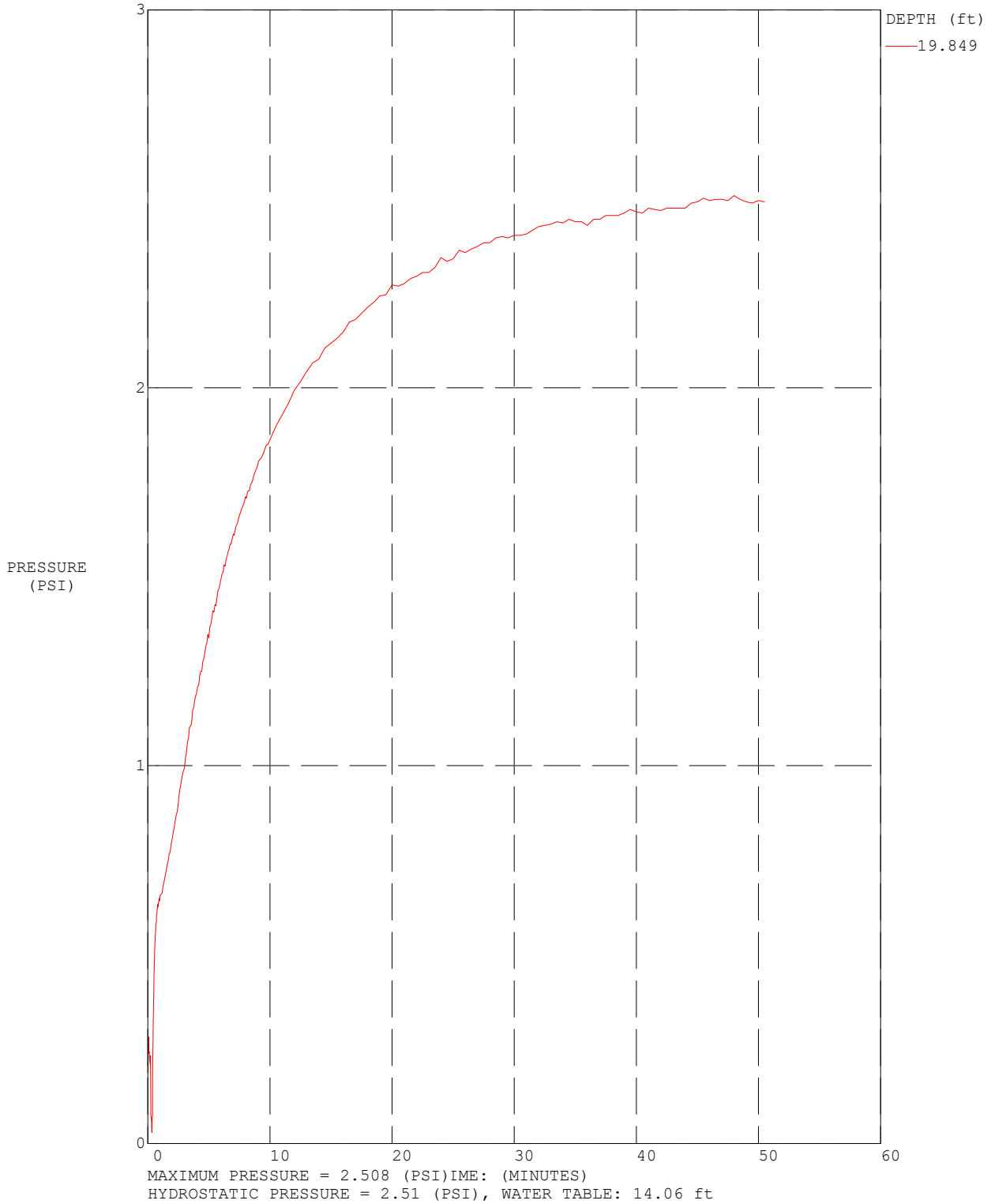
OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-3
TEST DATE: 1/13/2020 1:40:18 PM
TOTAL DEPTH: 19.849 ft



*SBT/SPT CORRELATION: UBC-1983

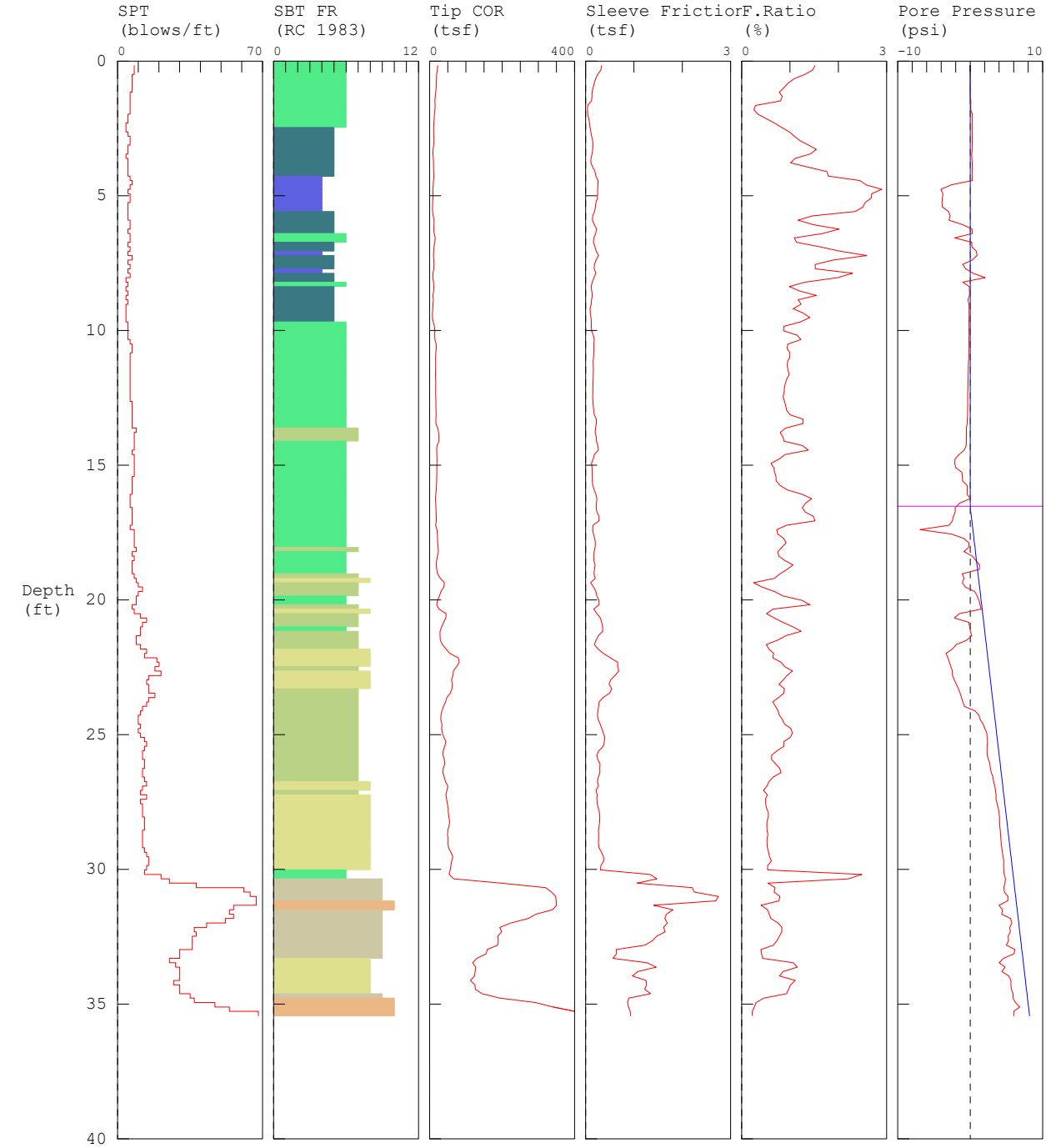
COMMENT: GeoDesign / CPT-3 / SW Larson Lane Castle Rock

TEST DATE: 1/13/2020 10:33:34 AM



GeoDesign / CPT-4 / SW Larson Lane Castle Rock

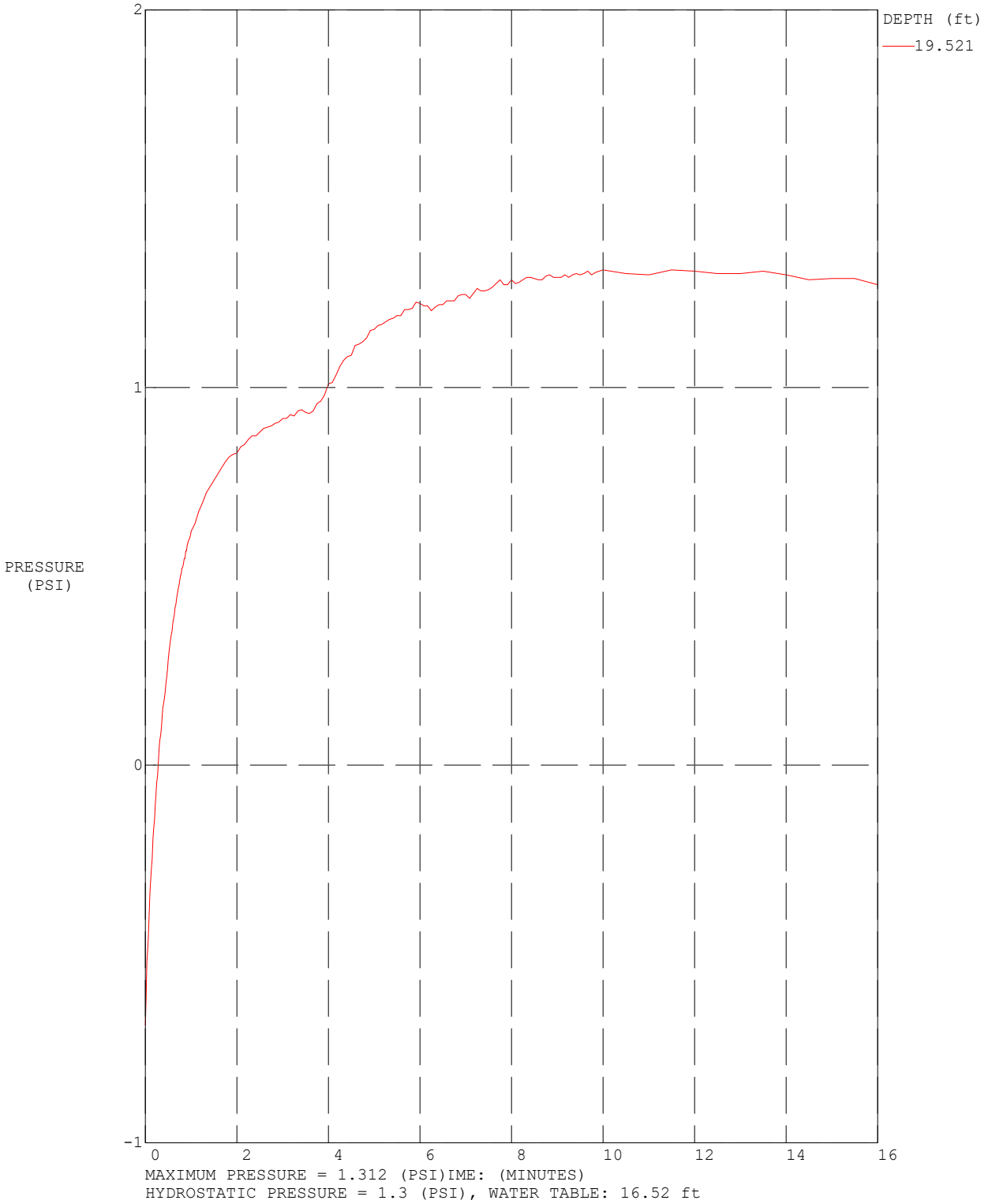
OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-4
TEST DATE: 1/13/2020 3:11:15 PM
TOTAL DEPTH: 35.433 ft



*SBT/SPT CORRELATION: UBC-1983

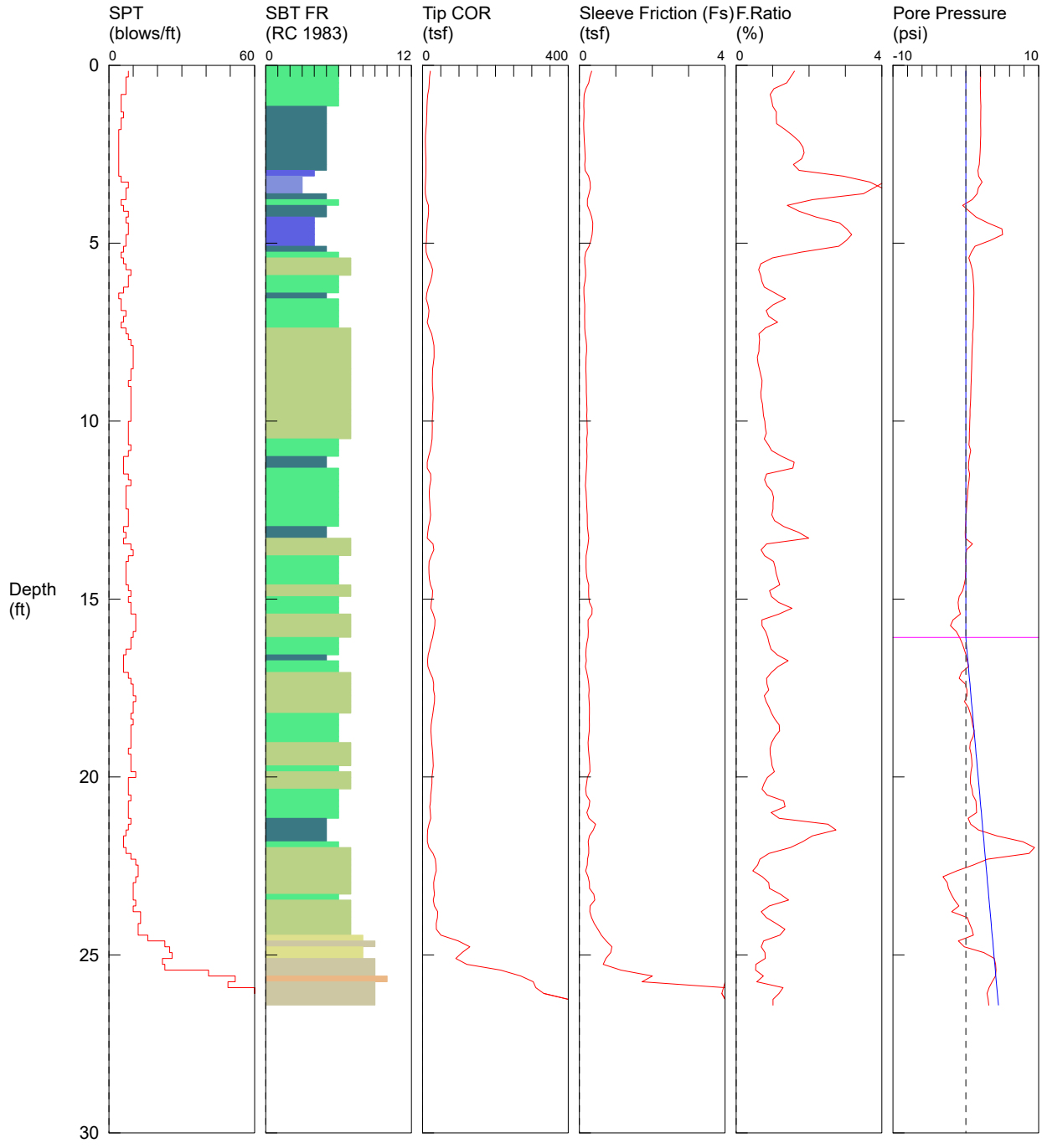
COMMENT: GeoDesign / CPT-4 / SW Larson Lane Castle Rock

TEST DATE: 1/13/2020 3:11:15 PM



GeoDesign / CPT-5 / SW Larson Lane Castle Rock

OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-5
TEST DATE: 1/14/2020 8:44:26 AM
TOTAL DEPTH: 26.411 ft

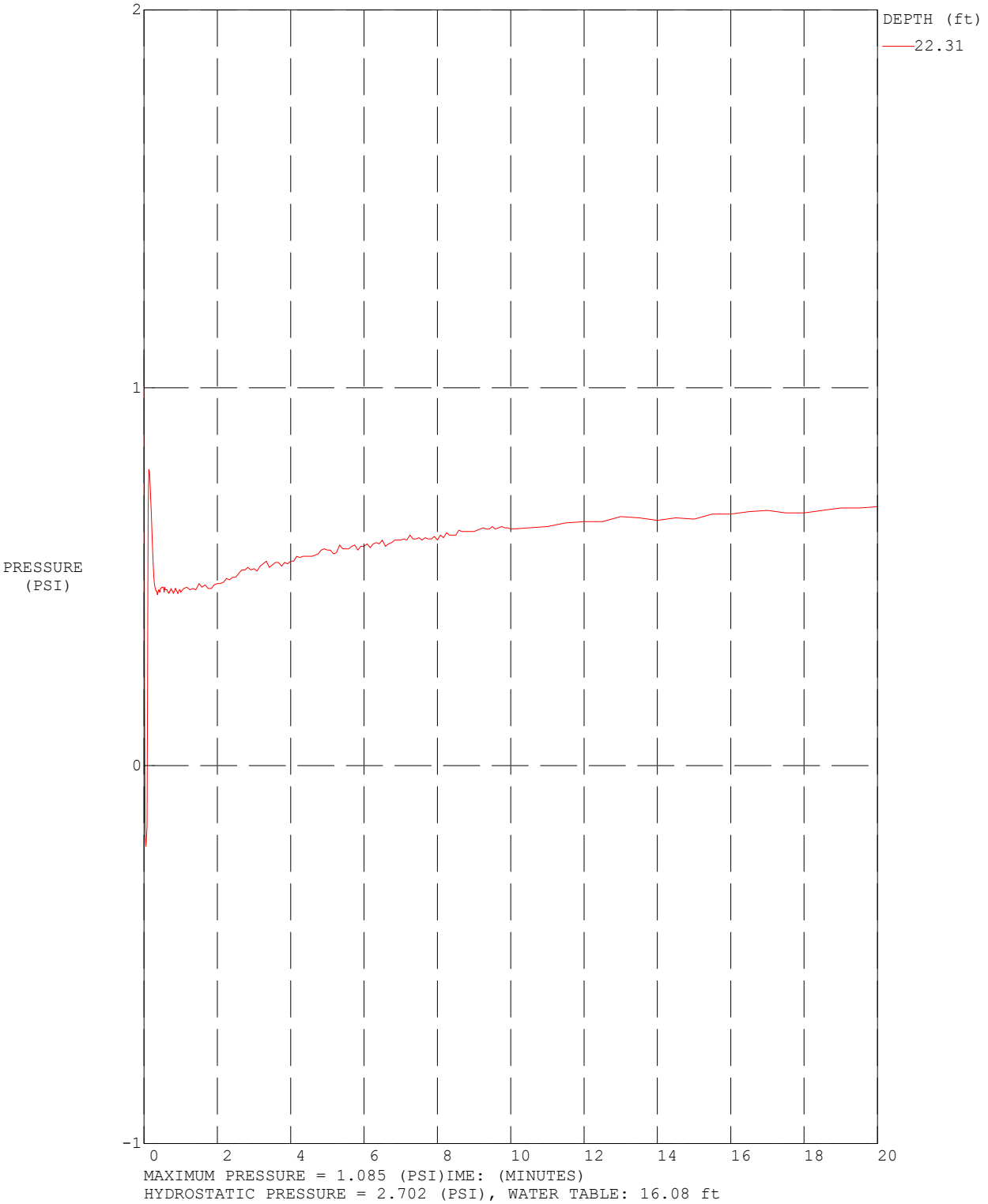


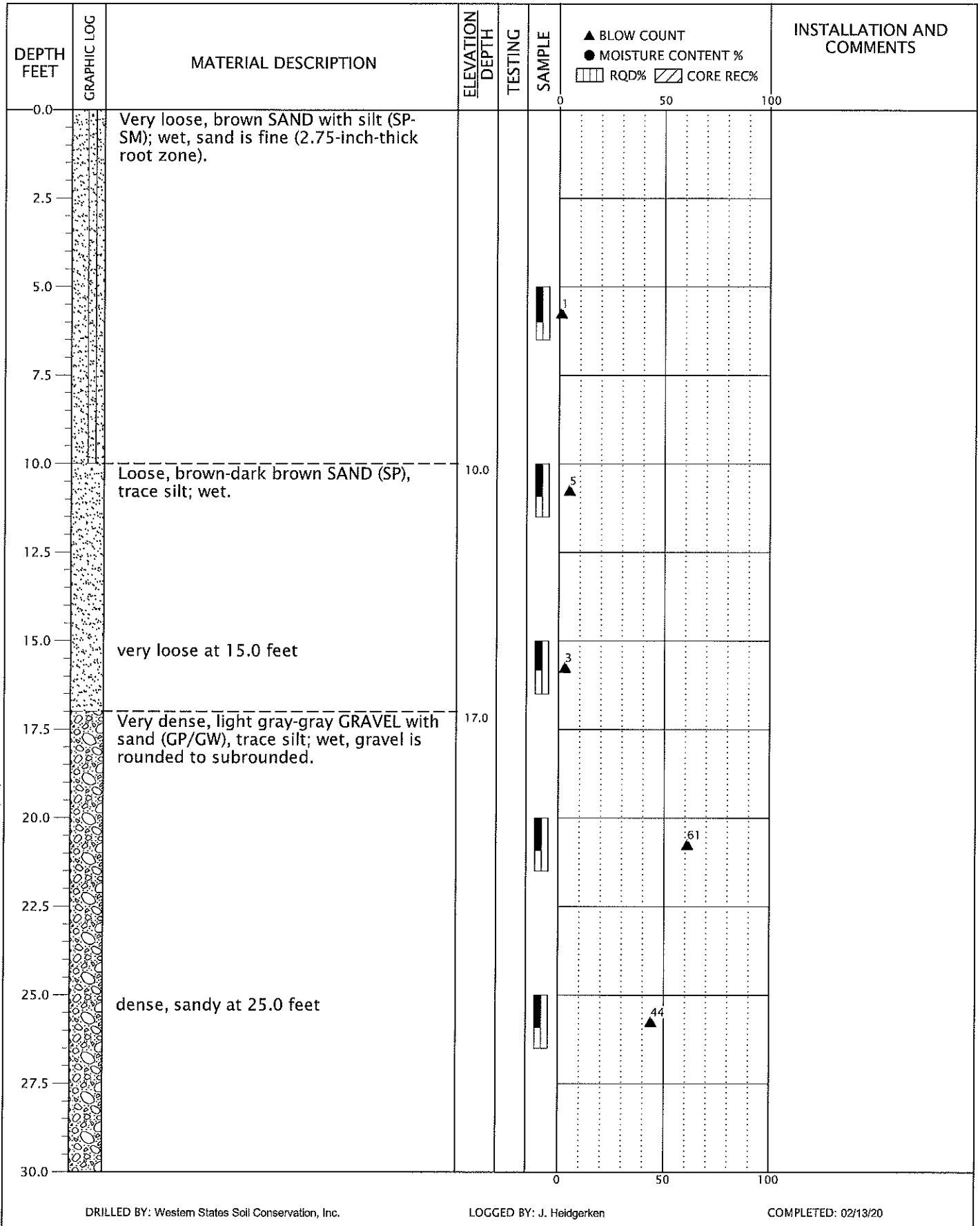
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

COMMENT: GeoDesign / CPT-5 / SW Larson Lane Castle Rock

TEST DATE: 1/14/2020 8:44:26 AM





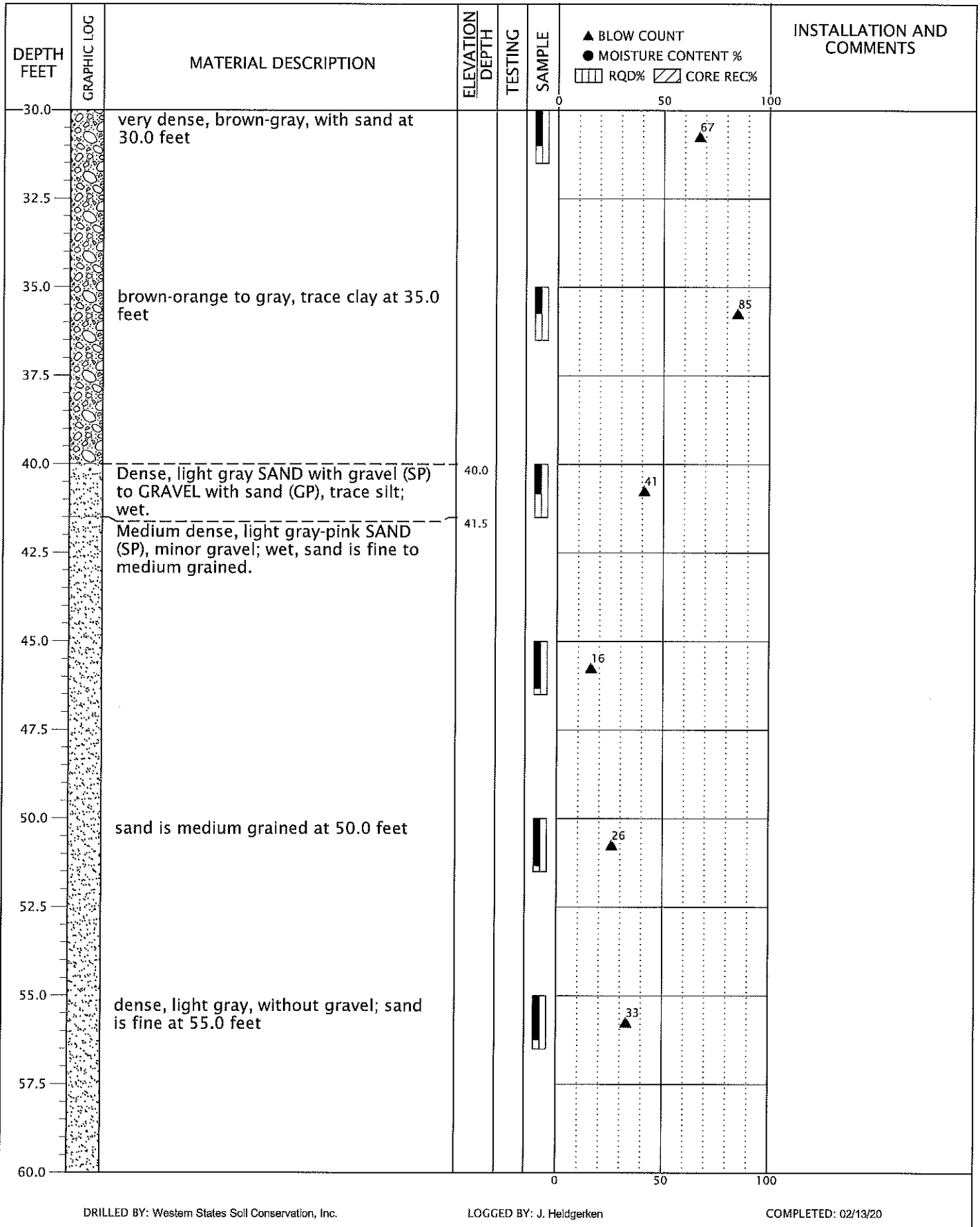
DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: J. Heidgerken COMPLETED: 02/13/20

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER: 4 7/8 inches

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01	**BORING B-1**	
FEBRUARY 2020	LARSON LANE SITE CASTLE ROCK, WA	**FIGURE A-1**

BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM



DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: J. Heldgerken COMPLETED: 02/13/20

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER: 4 7/8 inches

BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM

GEODESIGN INC AN NV5 COMPANY

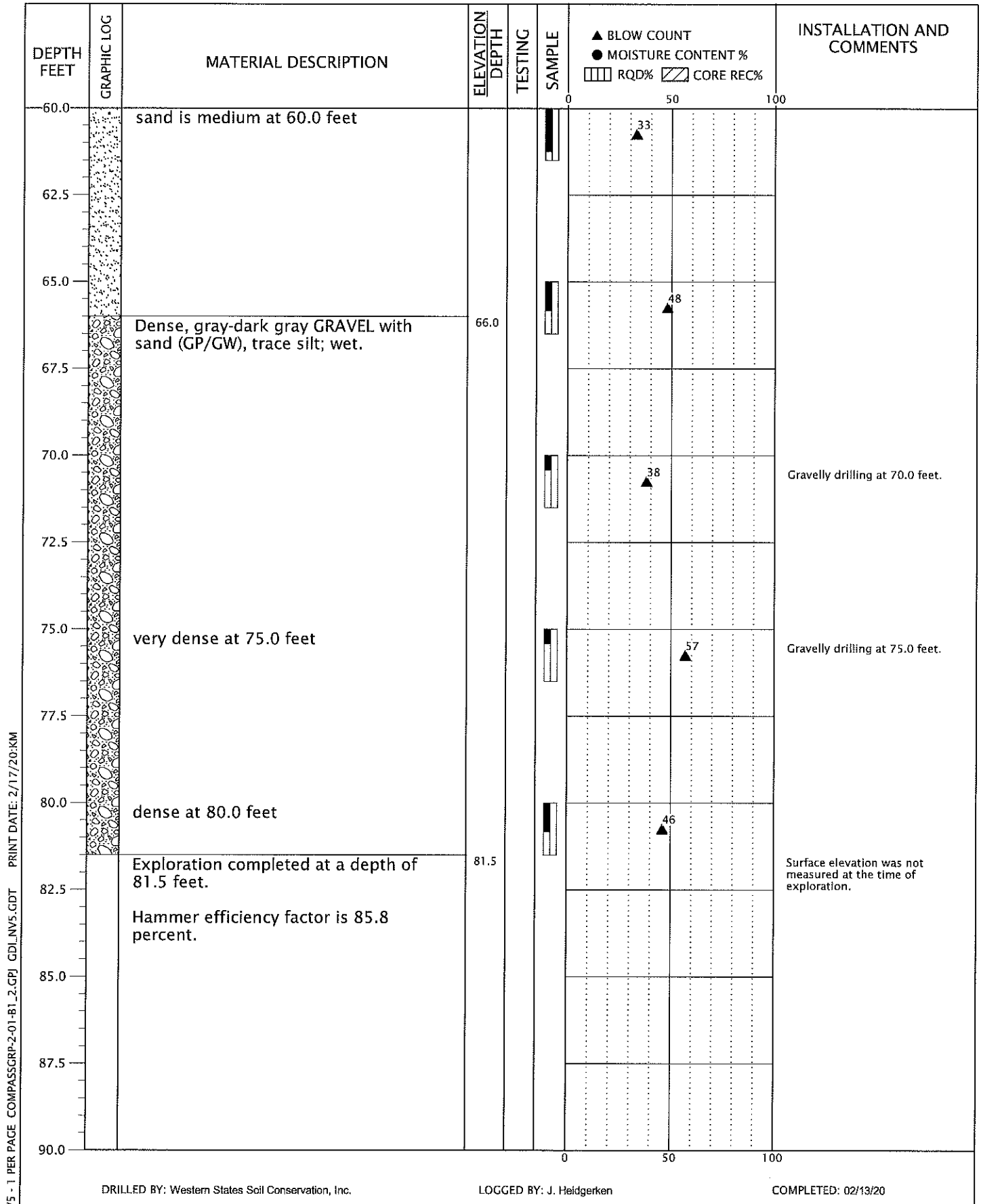
COMPASSGRP-2-01

BORING B-1
(continued)

FEBRUARY 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-1



DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: J. Heidgerken COMPLETED: 02/13/20

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER: 4 7/8 inches

GEODESIGN INC
AN NV5 COMPANY

COMPASSGRP-2-01

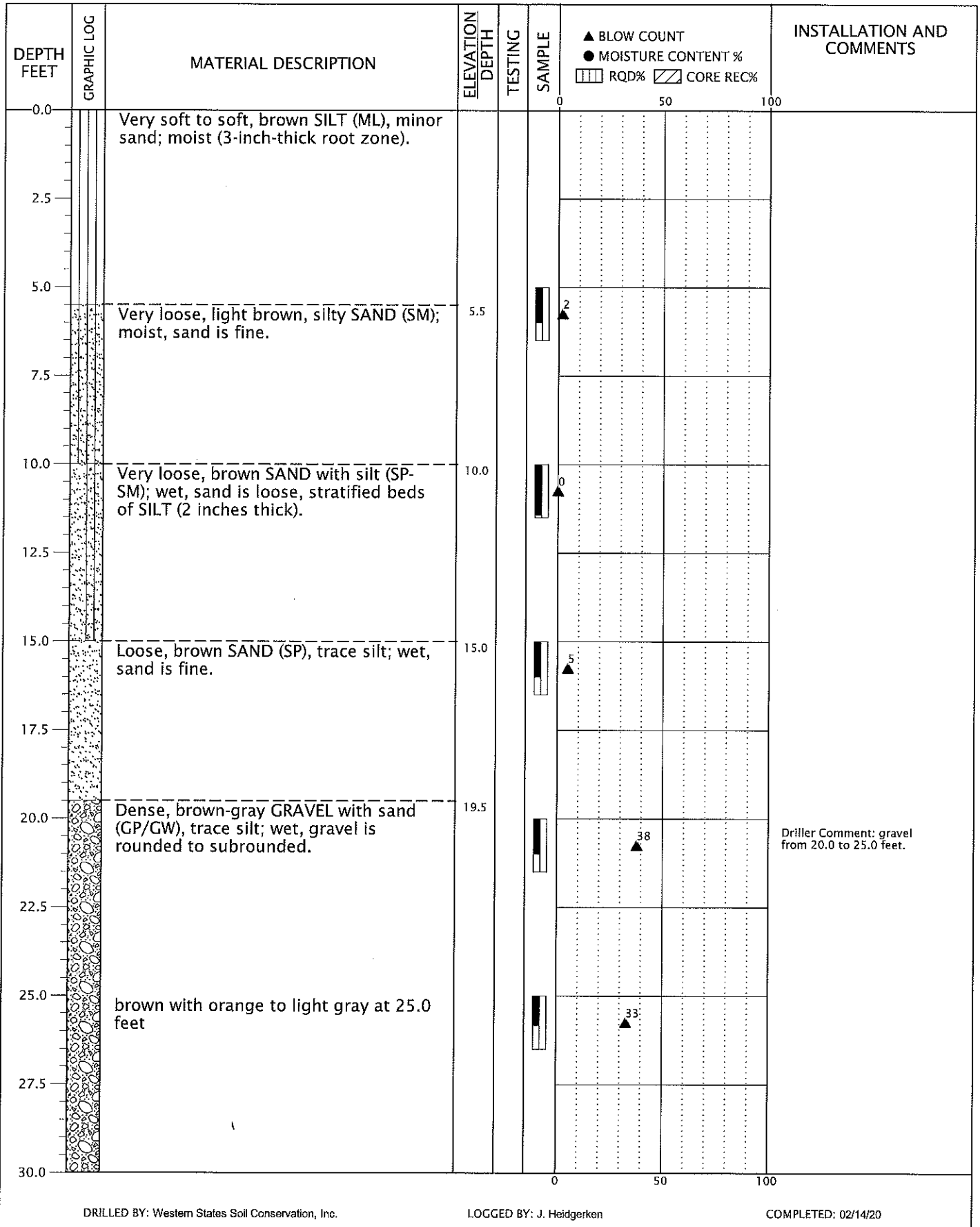
FEBRUARY 2020

BORING B-1
(continued)

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-1

BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM



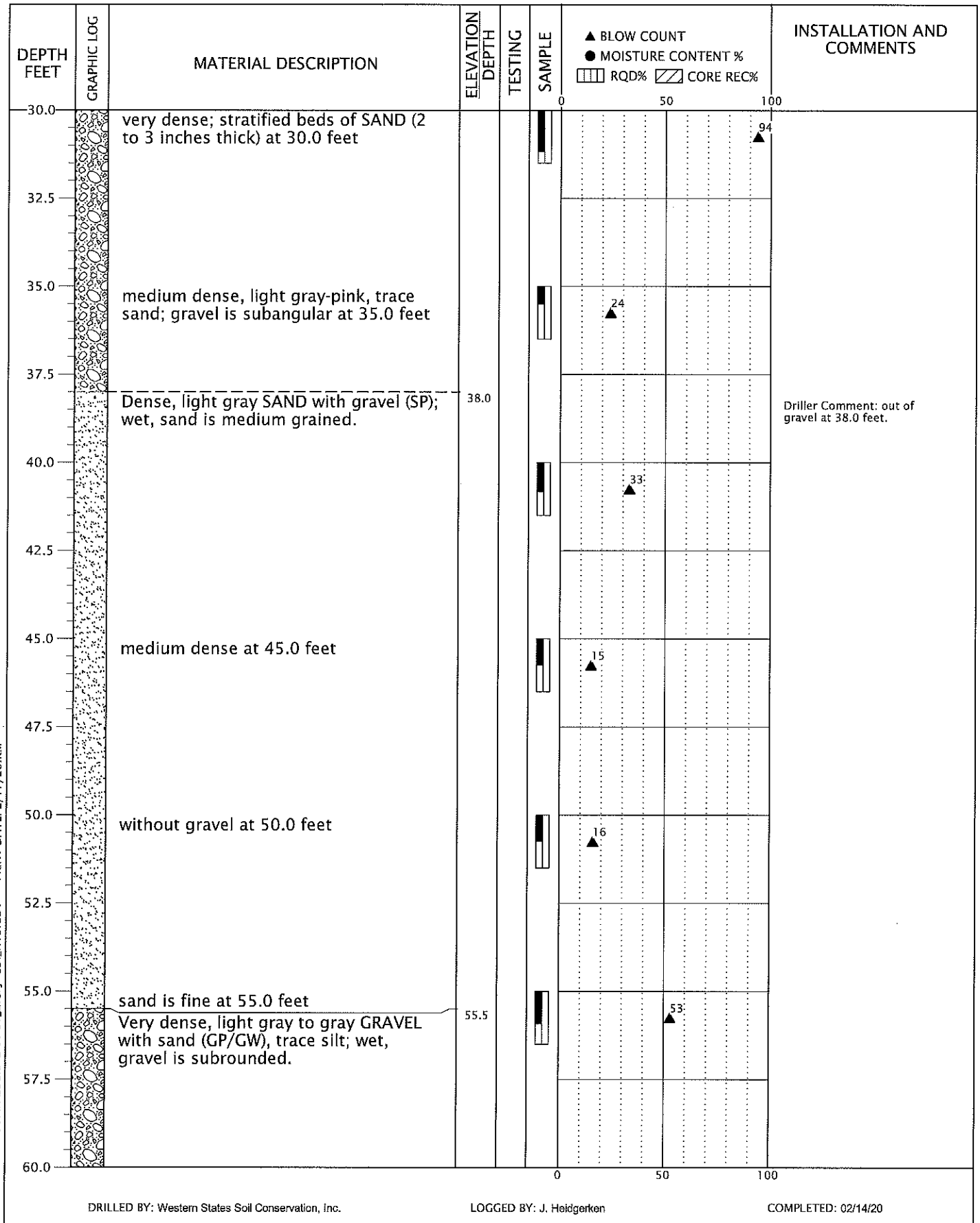
DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: J. Heidgerken COMPLETED: 02/14/20

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER: 4 7/8 inches

GEODESIGN INC
AN NV5 COMPANY

COMPASSGRP-2-01	**BORING B-2**	
FEBRUARY 2020	LARSON LANE SITE CASTLE ROCK, WA	**FIGURE A-2**

BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: J. Heidgerken

COMPLETED: 02/14/20

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 4 7/8 inches

GeoDesign Inc
AN NV5 COMPANY

COMPASSGRP-2-01

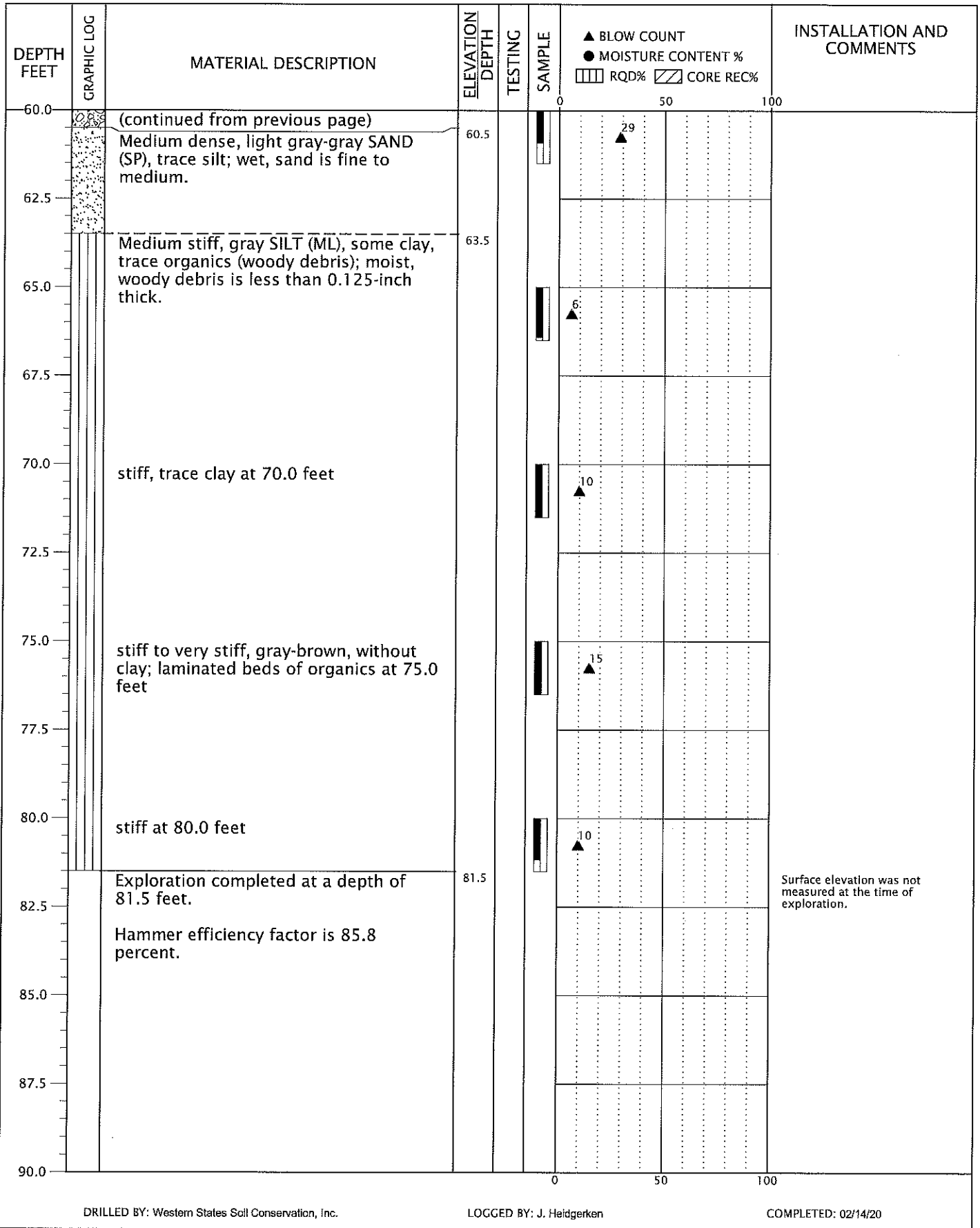
FEBRUARY 2020

BORING B-2
(continued)

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-2

BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM



DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: J. Heidgerken COMPLETED: 02/14/20

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER: 4 7/8 inches

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01

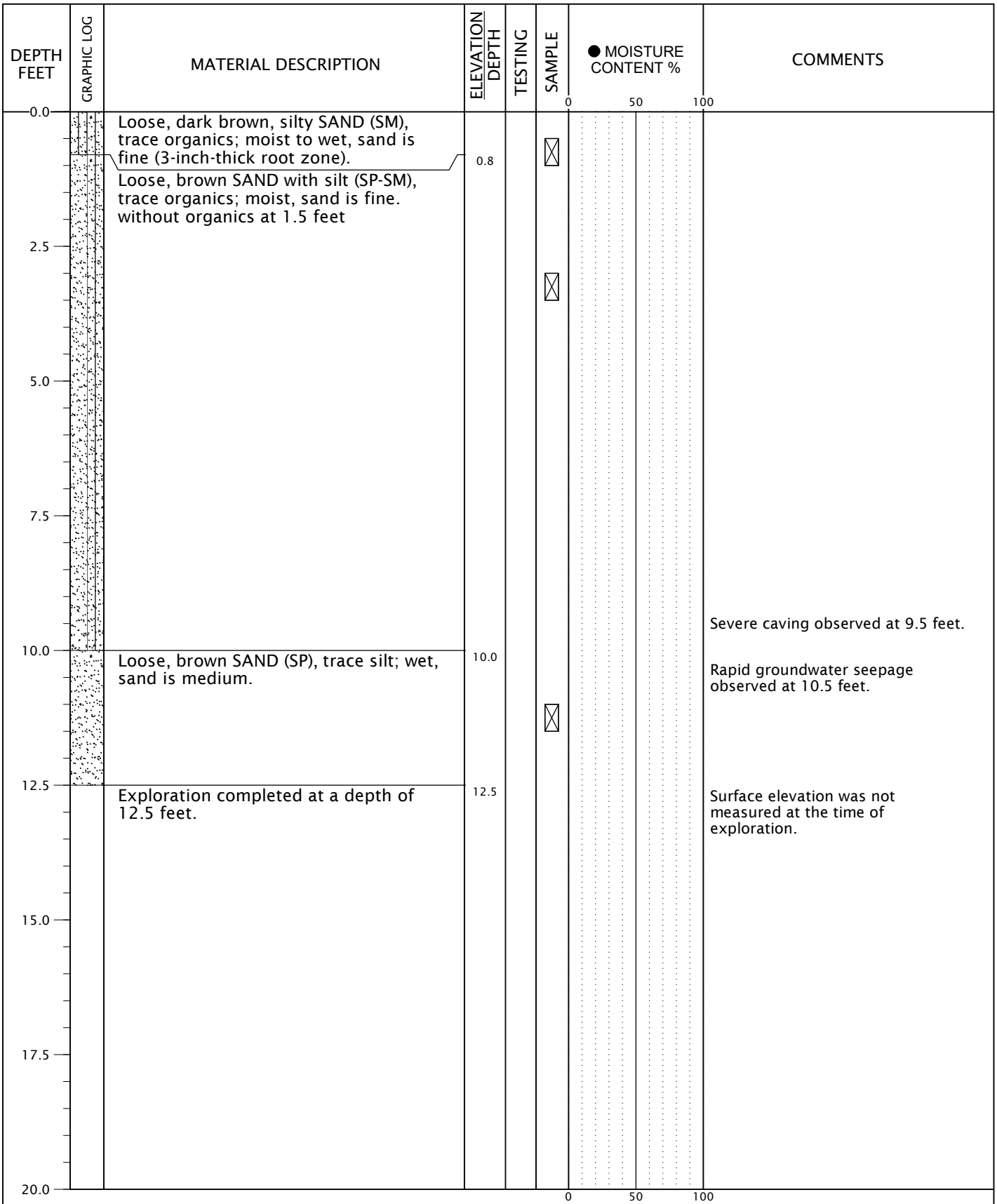
BORING B-2
(continued)

FEBRUARY 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-2

BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM


DEPTH FEET
GRAPHIC LOG
MATERIAL DESCRIPTION
ELEVATION / DEPTH
TESTING
SAMPLE
MOISTURE CONTENT %
COMMENTS
0.0
Loose, dark brown, silty SAND (SM), trace organics; moist to wet, sand is fine (3-inch-thick root zone).
0.8
Loose, brown SAND with silt (SP-SM), trace organics; moist, sand is fine.
without organics at 1.5 feet
2.5
5.0
7.5
Severe caving observed at 9.5 feet.
10.0
Loose, brown SAND (SP), trace silt; wet, sand is medium.
10.0
Rapid groundwater seepage observed at 10.5 feet.
12.5
Exploration completed at a depth of 12.5 feet.
12.5
Surface elevation was not measured at the time of exploration.
15.0
17.5
20.0
0
50
100
EXCAVATED BY: Tapani, Inc.
LOGGED BY: J. Guenther
COMPLETED: 01/14/20
EXCAVATION METHOD: mini excavator (see document text)
GEODESIGN INC
AN NV5 COMPANY
COMPASSGRP-2-01
TEST PIT TP-1
MARCH 2020
LARSON LANE SITE
CASTLE ROCK, WA
FIGURE A-3
TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Loose, dark brown, silty SAND (SM), trace organics; moist, sand is fine (3-inch-thick root zone).			☒		
		Loose, light brown SAND with silt (SP-SM), trace organics; moist, sand is fine.	1.5				
2.5		without organics at 2.5 feet			☒		
5.0							
7.5							Severe caving observed at 8.2 feet.
10.0							
12.5		Loose, brown SAND (SP), trace silt; moist, sand is medium.	11.5		☒		
		Exploration completed at a depth of 13.0 feet.	13.0				No groundwater seepage observed to the depth explored. Surface elevation was not measured at the time of exploration.
15.0							
17.5							
20.0							

EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20

EXCAVATION METHOD: mini excavator (see document text)

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01	TEST PIT TP-2	
MARCH 2020	LARSON LANE SITE CASTLE ROCK, WA	FIGURE A-4

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Medium dense, dark brown SAND with silt (SP-SM), trace gravel and organics; moist to wet, sand is fine to coarse, gravel is fine and subrounded (4-inch-thick root zone).			☒		Minor caving observed between 1.0 and 4.0 feet.
2.5		gray-brown, minor gravel; sand is medium to coarse at 0.4 foot without organics at 1.5 feet			☒		
5.0		gray at 5.5 feet			☒		
7.5					☒		Slow groundwater seepage observed at 9.0 feet.
10.0					☒		
		Stiff, dark brown, sandy SILT (MH), trace organics; moist, silt has medium plasticity, sand is fine.	10.5				
		Exploration completed at a depth of 11.5 feet.	11.5				Surface elevation was not measured at the time of exploration.
12.5							
15.0							
17.5							
20.0							

EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20

EXCAVATION METHOD: mini excavator (see document text)

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01

TEST PIT TP-3

MARCH 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-5

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Very loose to loose, gray-brown SAND with silt (SP-SM), minor gravel, trace organics; moist to wet, sand is medium to coarse.					Severe caving observed from 0.0 to 10.5 feet.
		without organics at 1.5 feet			☒		
2.5							
5.0							
7.5							
		gray at 9.5 feet			☒		Slow groundwater seepage observed at 10.0 feet.
10.0		Medium stiff, dark brown, sandy SILT (MH), trace organics; moist, silt has medium plasticity, sand is fine.	10.5		☒		
12.5		Exploration completed at a depth of 12.0 feet.	12.0				Surface elevation was not measured at the time of exploration.
15.0							
17.5							
20.0						0 50 100	

EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20

EXCAVATION METHOD: mini excavator (see document text)

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01

TEST PIT TP-4

MARCH 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-6

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Loose, gray-brown SAND with silt (SP-SM), minor gravel, trace organics; moist to wet, sand is fine to coarse, gravel is fine to coarse and subrounded (4-inch-thick root zone).					Severe caving observed from 0.0 to 8.0 feet.
		without organics at 1.5 feet			☒		
7.5		Soft to very soft, dark brown, sandy SILT (MH), trace organics; moist, silt has medium plasticity, sand is fine.	7.5		☒		Numerous sticks and roots from 8.0 to 9.0 feet.
							Moderate groundwater seepage observed at 12.0 feet.
12.5		Exploration completed at a depth of 13.0 feet.	13.0				Surface elevation was not measured at the time of exploration.
20.0							

EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20

EXCAVATION METHOD: mini excavator (see document text)

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01

TEST PIT TP-5

MARCH 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-7

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Medium dense to dense, gray-brown SAND with silt (SP-SM), minor gravel, trace organics; moist to wet, sand is fine to coarse, gravel is fine to coarse and subrounded.					Severe caving observed from 0.0 to 11.0 feet.
2.5					☒		
		brown, without gravel and organics; sand is fine at 3.0 feet					
5.0					☒		
7.5							
10.0		Loose, dark brown SAND (SP), trace silt; wet, sand is medium.	10.0		☒		Rapid groundwater seepage observed at 10.0 feet.
		Exploration terminated at a depth of 11.0 feet due to caving.	11.0				Surface elevation was not measured at the time of exploration.
12.5							
15.0							
17.5							
20.0							

EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20

EXCAVATION METHOD: mini excavator (see document text)

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01

TEST PIT TP-6

MARCH 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-8

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

APPENDIX D
REPORT LIMITATIONS AND IMPORTANT INFORMATION

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

Date: March 30, 2023
Project: Landing on the Cowlitz
Castle Rock, Washington

Geotechnical and Environmental Report Limitations and Important Information

Report Purpose, Use, and Standard of Care

This report has been prepared in accordance with standard fundamental principles and practices of geotechnical engineering and/or environmental consulting, and in a manner consistent with the level of care and skill typical of currently practicing local engineers and consultants. This report has been prepared to meet the specific needs of specific individuals for the indicated site. It may not be adequate for use by other consultants, contractors, or engineers, or if change in project ownership has occurred. It should not be used for any other reason than its stated purpose without prior consultation with Columbia West Engineering, Inc. (Columbia West). It is a unique report and not applicable for any other site or project. If site conditions are altered, or if modifications to the project description or proposed plans are made after the date of this report, it may not be valid. Columbia West cannot accept responsibility for use of this report by other individuals for unauthorized purposes, or if problems occur resulting from changes in site conditions for which Columbia West was not aware or informed.

Report Conclusions and Preliminary Nature

This geotechnical or environmental report should be considered preliminary and summary in nature. The recommendations contained herein have been established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. The exploration and associated laboratory analysis of collected representative samples identifies soil conditions at specific discreet locations. It is assumed that these conditions are indicative of actual conditions throughout the subject property. However, soil conditions may differ between tested locations at different seasonal times of the year, either by natural causes or human activity. Distinction between soil types may be more abrupt or gradual than indicated on the soil logs. This report is not intended to stand alone without understanding of concomitant instructions, correspondence, communication, or potential supplemental reports that may have been provided to the client.

Because this report is based upon observations obtained at the time of exploration, its adequacy may be compromised with time. This is particularly relevant in the case of natural disasters, earthquakes, floods, or other significant events. Report conclusions or interpretations may also be subject to revision if significant development or other manmade impacts occur within or in proximity to the subject property. Groundwater conditions, if presented in this report, reflect observed conditions at the time of investigation. These conditions may change annually, seasonally or as a result of adjacent development.

Additional Investigation and Construction QA/QC

Columbia West should be consulted prior to construction to assess whether additional investigation above and beyond that presented in this report is necessary. Even slight variations in soil or site conditions may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent QA/QC construction observation and testing to verify soil conditions do not differ materially or significantly from the interpreted conditions utilized for preparation of this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Actual subsurface conditions are more readily observed and discerned during the earthwork phase of construction when soils are exposed. Columbia West cannot accept responsibility for deviations from recommendations described in this report or future

performance of structural facilities if another consultant is retained during the construction phase or Columbia West is not engaged to provide construction observation to the full extent recommended.

Collected Samples

Uncontaminated samples of soil or rock collected in connection with this report will be retained for thirty days. Retention of such samples beyond thirty days will occur only at client's request and in return for payment of storage charges incurred. All contaminated or environmentally impacted materials or samples are the sole property of the client. Client maintains responsibility for proper disposal.

Report Contents

This geotechnical or environmental report should not be copied or duplicated unless in full, and even then only under prior written consent by Columbia West, as indicated in further detail in the following text section entitled *Report Ownership*. The recommendations, interpretations, and suggestions presented in this report are only understandable in context of reference to the whole report. Under no circumstances should the soil boring or test pit excavation logs, monitor well logs, or laboratory analytical reports be separated from the remainder of the report. The logs or reports should not be redrawn or summarized by other entities for inclusion in architectural or civil drawings, or other relevant applications.

Report Limitations for Contractors

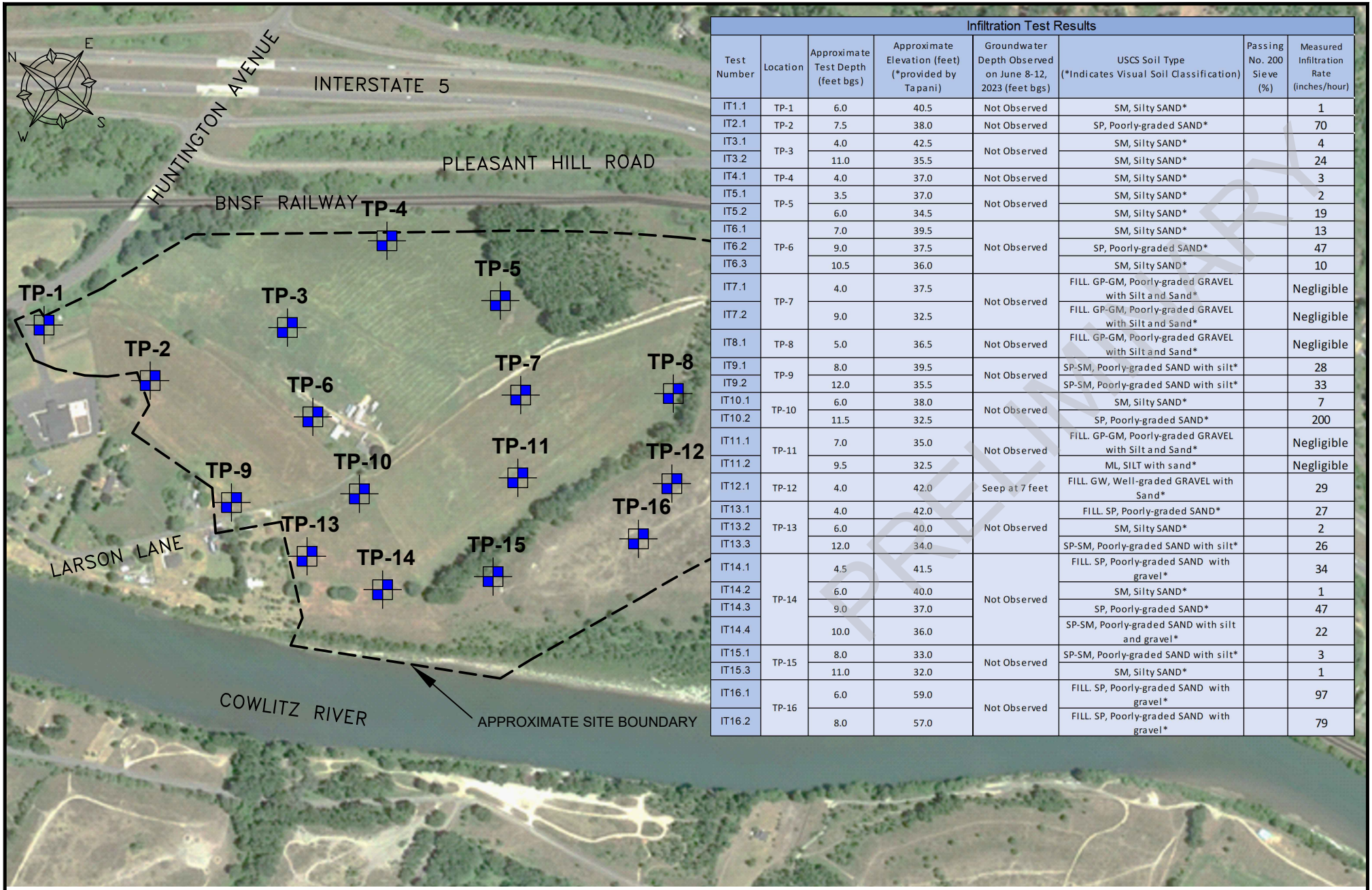
Geotechnical or environmental reports, unless otherwise specifically noted, are not prepared for the purpose of developing cost estimates or bids by contractors. The extent of exploration or investigation conducted as part of this report is usually less than that necessary for contractor's needs. Contractors should be advised of these report limitations, particularly as they relate to development of cost estimates. Contractors may gain valuable information from this report, but should rely upon their own interpretations as to how subsurface conditions may affect cost, feasibility, accessibility and other components of the project work. If believed necessary or relevant, contractors should conduct additional exploratory investigation to obtain satisfactory data for the purposes of developing adequate cost estimates. Clients or developers cannot insulate themselves from attendant liability by disclaiming accuracy for subsurface ground conditions without advising contractors appropriately and providing the best information possible to limit potential for cost overruns, construction problems, or misunderstandings.

Report Ownership

Columbia West retains the ownership and copyright property rights to this entire report and its contents, which may include, but may not be limited to, figures, text, logs, electronic media, drawings, laboratory reports, and appendices. This report was prepared solely for the client, and other relevant approved users or parties, and its distribution must be contingent upon prior express written consent by Columbia West. Furthermore, client or approved users may not use, lend, sell, copy, or distribute this document without express written consent by Columbia West. Client does not own nor have rights to electronic media files that constitute this report, and under no circumstances should said electronic files be distributed or copied. Electronic media is susceptible to unauthorized manipulation or modification, and may not be reliable.

Consultant Responsibility

Geotechnical and environmental engineering and consulting is much less exact than other scientific or engineering disciplines, and relies heavily upon experience, judgment, interpretation, and opinion often based upon media (soils) that are variable, anisotropic, and non-homogenous. This often results in unrealistic expectations, unwarranted claims, and uninformed disputes against a geotechnical or environmental consultant. To reduce potential for these problems and assist relevant parties in better understanding of risk, liability, and responsibility, geotechnical and environmental reports often provide definitive statements or clauses defining and outlining consultant responsibility. The client is encouraged to read these statements carefully and request additional information from Columbia West if necessary.



Infiltration Test Results

Test Number	Location	Approximate Test Depth (feet bgs)	Approximate Elevation (feet) (*provided by Tapani)	Groundwater Depth Observed on June 8-12, 2023 (feet bgs)	USCS Soil Type (*Indicates Visual Soil Classification)	Passing No. 200 Sieve (%)	Measured Infiltration Rate (inches/hour)
IT1.1	TP-1	6.0	40.5	Not Observed	SM, Silty SAND*		1
IT2.1	TP-2	7.5	38.0	Not Observed	SP, Poorly-graded SAND*		70
IT3.1	TP-3	4.0	42.5	Not Observed	SM, Silty SAND*		4
IT3.2		11.0	35.5		SM, Silty SAND*		24
IT4.1	TP-4	4.0	37.0	Not Observed	SM, Silty SAND*		3
IT5.1	TP-5	3.5	37.0	Not Observed	SM, Silty SAND*		2
IT5.2		6.0	34.5		SM, Silty SAND*		19
IT6.1	TP-6	7.0	39.5	Not Observed	SM, Silty SAND*		13
IT6.2		9.0	37.5		SP, Poorly-graded SAND*		47
IT6.3		10.5	36.0		SM, Silty SAND*		10
IT7.1	TP-7	4.0	37.5	Not Observed	FILL. GP-GM, Poorly-graded GRAVEL with Silt and Sand*		Negligible
IT7.2		9.0	32.5		FILL. GP-GM, Poorly-graded GRAVEL with Silt and Sand*		Negligible
IT8.1	TP-8	5.0	36.5	Not Observed	FILL. GP-GM, Poorly-graded GRAVEL with Silt and Sand*		Negligible
IT9.1	TP-9	8.0	39.5	Not Observed	SP-SM, Poorly-graded SAND with silt*		28
IT9.2		12.0	35.5		SP-SM, Poorly-graded SAND with silt*		33
IT10.1	TP-10	6.0	38.0	Not Observed	SM, Silty SAND*		7
IT10.2		11.5	32.5		SP, Poorly-graded SAND*		200
IT11.1	TP-11	7.0	35.0	Not Observed	FILL. GP-GM, Poorly-graded GRAVEL with Silt and Sand*		Negligible
IT11.2		9.5	32.5		ML, SILT with sand*		Negligible
IT12.1	TP-12	4.0	42.0	Seep at 7 feet	FILL. GW, Well-graded GRAVEL with Sand*		29
IT13.1	TP-13	4.0	42.0	Not Observed	FILL. SP, Poorly-graded SAND*		27
IT13.2		6.0	40.0		SM, Silty SAND*		2
IT13.3		12.0	34.0		SP-SM, Poorly-graded SAND with silt*		26
IT14.1	TP-14	4.5	41.5	Not Observed	FILL. SP, Poorly-graded SAND with gravel*		34
IT14.2		6.0	40.0		SM, Silty SAND*		1
IT14.3		9.0	37.0		SP, Poorly-graded SAND*		47
IT14.4		10.0	36.0		SP-SM, Poorly-graded SAND with silt and gravel*		22
IT15.1	TP-15	8.0	33.0	Not Observed	SP-SM, Poorly-graded SAND with silt*		3
IT15.3		11.0	32.0		SM, Silty SAND*		1
IT16.1	TP-16	6.0	59.0	Not Observed	FILL. SP, Poorly-graded SAND with gravel*		97
IT16.2		8.0	57.0		FILL. SP, Poorly-graded SAND with gravel*		79

PRELIMINARY

TEST PIT WITH INFILTRATION TESTING

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

Project: 22310
Date: 06/20/23
Drawn: MAC
Checked: GLW

EXPLORATION LOCATION MAP
LANDING ON THE COWLITZ

NOTES:
1. SITE LOCATION: 2542 SW LARSON LANE, CASTLE ROCK, WASHINGTON.
2. SITE CONSISTS OF PORTIONS OF TAX PARCEL NOS. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031 TOTALING APPROXIMATELY 118.2 ACRES.
3. DRAWING IS NOT TO SCALE.
4. BASE MAP OBTAINED FROM GOOGLE EARTH, 2023.
5. EXPLORATION LOCATIONS ARE APPROXIMATE AND NOT SURVEYED.
6. TEST PITS BACKFILLED LOOSELY WITH ONSITE SOILS ON JUNE 8, JUNE 9, AND JUNE 12, 2023.

FIGURE 2

A1
k = 18 in/hr at 6 feet
Sand with silt layer: 5 to 12 feet BGS

A2
k = 20 in/hr at 9 feet
Sand with silt layer: 9 to 12 feet BGS

A3
No IT conducted.
SILT profile observed

A13
k = 60 in/hr at 9 feet
Sand layer: 9 to 13 feet BGS

A12
No IT conducted.
Poorly drained profile.

A11
No IT conducted.
Poorly drained profile.

Not explored. Canal area.

A8
No IT conducted.
~13 feet of FILL.

A4
k = 65 in/hr at 10 feet
Sand with silt layer: 8 to 13 feet BGS

A5
No IT conducted.
~13 feet of FILL over SILT

A6
No IT conducted.
~11 feet of FILL over SILT

A7
No IT conducted.
~11 feet of FILL. Groundwater at 11 feet BGS.

HUNTINGTON AVENUE S.
BNSF TRACKS
PLEASANT HILL ROAD
SALMON CREEK
LARSEN LN SW
COWLITZ RIVER
LANDING ON THE COWLITZ
COWLITZ PROPERTY
D.N.R. PROPERTY
COMMERCIAL
FLEX (EMP/COM)
OPEN SPACE
EMPLOYMENT
RESIDENTIAL
RECREATION
250' HABITAT BUFFER
200' SHORELINE PUBLIC ACCESS MGMT AREA
150' HIGH INTENSITY SHORELINE - OHWM BUFFER
SHORELINE
OHW

TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP8 TP9 TP10 TP11 TP12 TP13 TP14 TP15 TP16

A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13

0 150 300
SCALE: 1" = 150'

LEGEND

PROPERTY TESTED LOCATION

PROPOSED LOCATION

Know what's below. Call before you dig.

PRELIMINARY RESULTS FROM TESTING CONDUCTED ON MARCH 13, 2024

FILE: W:\17783 CASTLE ROCK ENVIRO AND FILL PERMITS\500 DESIGN\502 DRAWINGS\EXHIBITS\2024-03-06 ADDITIONAL INFILTRATION TEST LOCATIONS.DWG

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

LANDING ON THE COWLITZ
CASTLE ROCK, COWLITZ

INFILTRATION TEST LOCATIONS

REVISIONS:

JOB NO.:	23-463
DATE:	MARCH 2024
SCALE:	1" = 150'
DESIGNED BY:	MDR
DRAWN BY:	MDR
CHECKED BY:	TAW

EX1.0

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-17
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	0800	0905

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
				ML		Orange-tan sandy SILT, moist to wet, medium dense, sand is fine.					
5	TP17.1			SP-SM		Light brown poorly-graded SAND with silt, moist, loose, sand is medium-grained and subangular.					
10											
						Bottom of test pit at 12 feet bgs. Groundwater not encountered on 3/13/24.					
15						**Preliminary** 03/20/2024 3:58:36 PM					

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-18
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	0905	0935

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
				ML		Gray SILT with sand, moist, soft, sand is fine.					
				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-to medium-grained and subangular.					
5											
				SP-SM		Light brown poorly-graded SAND with silt, moist, loose, sand is medium-grained and subangular.					
10	TP18.1										
						Bottom of test pit at 12 feet bgs. Groundwater not encountered on 3/13/24.					
15											

Preliminary
03/20/2024 3:58:48 PM

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-19
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1010	1040

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						Organic strippings.					
				ML		Brown SILT, moist, soft, low to medium plasticity.					
5				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
10											
15						Bottom of test pit at 14.5 feet bgs. Groundwater not encountered on 3/13/24.					

Preliminary
03/20/2024 3:58:48 PM

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-20
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	0935	1010

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
5				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
10	TP20.1			SP-SM		Gray and brown poorly-graded SAND with silt, moist, loose, sand is medium-grained and subangular.					
15						Bottom of test pit at 13 feet bgs. Groundwater not encountered on 3/13/24.					

Preliminary
03/20/2024 3:58:48 PM

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-21
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1040	1105

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
5						FILL. Light gray, poorly-graded GRAVEL with silt and sand, moist, very dense dense.					
10						FILL. Gray poorly-graded SAND and gravel, dense.					
				OH		Black organic SILT, moist, soft.					
15						Bottom of test pit at 14.5 feet bgs. Groundwater not encountered on 3/13/24.					

Preliminary
03/20/2024 3:58:49 PM

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-22
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1105	1130

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
5						FILL. Light gray, poorly-graded GRAVEL with silt and sand, moist, very dense dense.					
10						FILL. Gray poorly-graded SAND and gravel, dense.					
				OH		Black organic SILT, moist, soft.					
15						Bottom of test pit at 13 feet bgs. Groundwater not encountered on 3/13/24.					

Preliminary
03/20/2024 3:58:49 PM

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-23
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Observed at 11 feet BGS	1330	1500

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						3 inch root zone contained in 10 inches of sandy silt topsoil.					
						FILL. Light gray, poorly-graded GRAVEL with silt and sand, moist, very dense dense.					
5											
10						Becomes wet.					▼
						Bottom of test pit at 11 feet bgs. Groundwater encountered at 11 feet on 3/13/24.					
15											

Preliminary
03/20/2024 3:58:49 PM

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-24
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1500	1555

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						3 inch root zone contained in 10 inches of sandy silt topsoil.					
						FILL. Light gray, poorly-graded GRAVEL with silt and sand, moist, very dense dense.					
5											
10											
						Bottom of test pit at 13 feet bgs. Groundwater not encountered on 3/13/24.					
15											

Preliminary
03/20/2024 3:58:49 PM

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-25
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1130	1215

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
5											
10											
						Bottom of test pit at 12 feet bgs. Groundwater not encountered on 3/13/24.					
15											

Preliminary
03/20/2024 3:58:49 PM

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-26
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1245	1330

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
5											
10											
						Bottom of test pit at 14.5 feet bgs. Groundwater not encountered on 3/13/24.					
15											

Preliminary
03/20/2024 3:58:49 PM

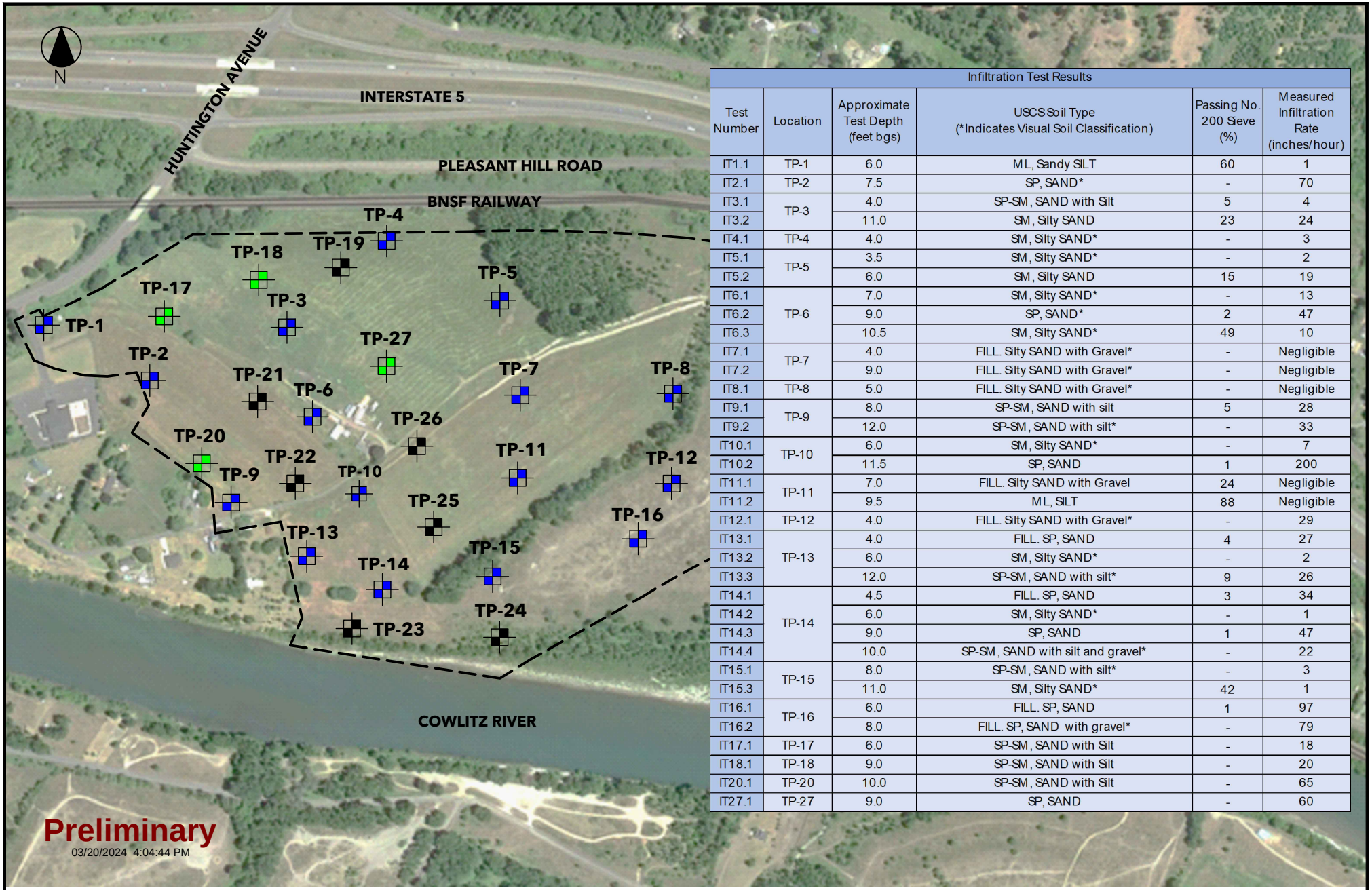
11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-27
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1215	1245

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
				ML		Orange-tan sandy SILT, moist to wet, medium dense, sand is fine.					
5				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
	TP27.1										
10				SP-SM		Gray and brown poorly-graded SAND with silt, moist, loose, sand is medium-grained and subangular.					
						Bottom of test pit at 13 feet bgs. Groundwater not encountered on 3/13/24.					
15						**Preliminary** 03/20/2024 3:58:49 PM					



Infiltration Test Results

Test Number	Location	Approximate Test Depth (feet bgs)	USCS Soil Type (*Indicates Visual Soil Classification)	Passing No. 200 Sieve (%)	Measured Infiltration Rate (inches/hour)
IT1.1	TP-1	6.0	ML, Sandy SILT	60	1
IT2.1	TP-2	7.5	SP, SAND*	-	70
IT3.1	TP-3	4.0	SP-SM, SAND with Silt	5	4
IT3.2		11.0	SM, Silty SAND	23	24
IT4.1	TP-4	4.0	SM, Silty SAND*	-	3
IT5.1	TP-5	3.5	SM, Silty SAND*	-	2
IT5.2		6.0	SM, Silty SAND	15	19
IT6.1	TP-6	7.0	SM, Silty SAND*	-	13
IT6.2		9.0	SP, SAND*	2	47
IT6.3		10.5	SM, Silty SAND*	49	10
IT7.1	TP-7	4.0	FILL. Silty SAND with Gravel*	-	Negligible
IT7.2		9.0	FILL. Silty SAND with Gravel*	-	Negligible
IT8.1	TP-8	5.0	FILL. Silty SAND with Gravel*	-	Negligible
IT9.1	TP-9	8.0	SP-SM, SAND with silt	5	28
IT9.2		12.0	SP-SM, SAND with silt*	-	33
IT10.1	TP-10	6.0	SM, Silty SAND*	-	7
IT10.2		11.5	SP, SAND	1	200
IT11.1	TP-11	7.0	FILL. Silty SAND with Gravel	24	Negligible
IT11.2		9.5	ML, SILT	88	Negligible
IT12.1	TP-12	4.0	FILL. Silty SAND with Gravel*	-	29
IT13.1	TP-13	4.0	FILL. SP, SAND	4	27
IT13.2		6.0	SM, Silty SAND*	-	2
IT13.3		12.0	SP-SM, SAND with silt*	9	26
IT14.1	TP-14	4.5	FILL. SP, SAND	3	34
IT14.2		6.0	SM, Silty SAND*	-	1
IT14.3		9.0	SP, SAND	1	47
IT14.4		10.0	SP-SM, SAND with silt and gravel*	-	22
IT15.1	TP-15	8.0	SP-SM, SAND with silt*	-	3
IT15.3		11.0	SM, Silty SAND*	42	1
IT16.1	TP-16	6.0	FILL. SP, SAND	1	97
IT16.2		8.0	FILL. SP, SAND with gravel*	-	79
IT17.1	TP-17	6.0	SP-SM, SAND with Silt	-	18
IT18.1	TP-18	9.0	SP-SM, SAND with Silt	-	20
IT20.1	TP-20	10.0	SP-SM, SAND with Silt	-	65
IT27.1	TP-27	9.0	SP, SAND	-	60

SITE BOUNDARY | TEST PIT WITH INFILTRATION TEST (2023) | TEST PIT WITH INFILTRATION TEST (2024) | TEST PIT (2024)

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

PROJECT: 22310
DATE: 03-20-24
DRAWN: GLW
CHECKED: NNP

EXPLORATION MAP
LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

NOTES:
1. SITE LOCATION: 2542 SW LARSON LANE, CASTLE ROCK, WASHINGTON.
2. SITE CONSISTS OF PORTIONS OF TAX PARCEL NOS. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031 TOTALING APPROXIMATELY 118.2 ACRES.
3. DRAWING IS NOT TO SCALE.
4. BASE MAP OBTAINED FROM GOOGLE EARTH, 2023.
5. EXPLORATION LOCATIONS ARE APPROXIMATE AND NOT SURVEYED.
6. TEST PITS TP-1 TO TP-16 BACKFILLED LOOSELY WITH ONSITE SOILS ON JUNE 8, JUNE 9, AND JUNE 12, 2023.
7. TEST PITS TP-17 TO TP-27 BACKFILLED LOOSELY WITH ONSITE SOILS ON MARCH 13, 2024.

FIGURE
2

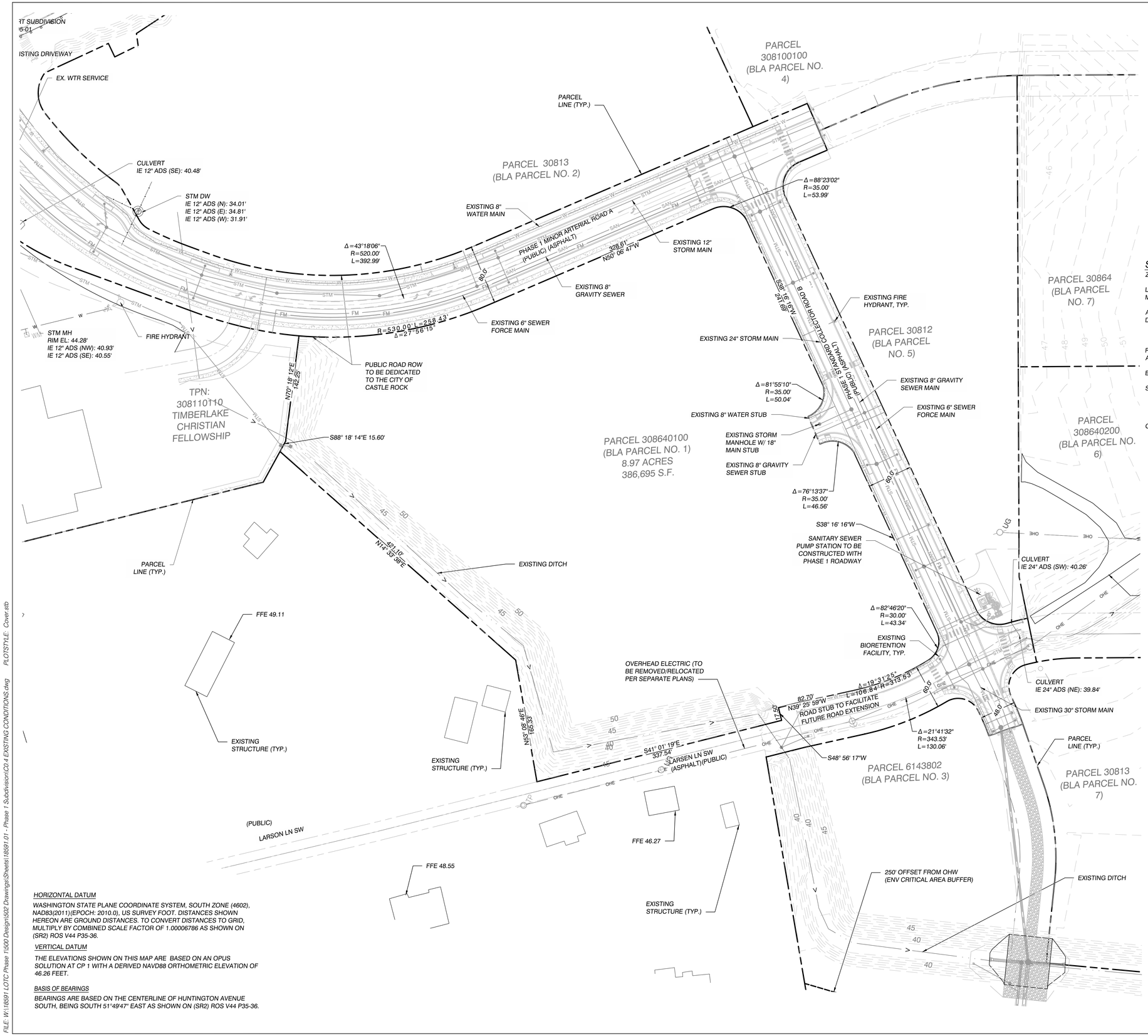
Appendix D Final Plans

Existing Conditions Plan

Grading & Erosion Control Plans

Street and Storm Plans

Street and Storm Profiles



SITE STATISTICS

ZONING:	*INDUSTRIAL*
LANDING ON THE COWLITZ (LOTC): MASTER PLAN DESIGNATION	*RESIDENTIAL*
APPLICABLE ZONING : DISTRICT STANDARDS	*HIGH DENSITY RESIDENTIAL (R-2) (LANDING ON THE COWLITZ CONDITIONS OF MATER PLAN APPROVAL, ITEM 2.C.)*
RECENT LAND USE DECISIONS : AFFECTING THE PROPERTY	*LANDING ON THE COWLITZ MASTER PLAN*
EXISTING USE OF PROPERTY:	*VACANT AND UNDEVELOPED*
SURROUNDING USES:	*RESIDENTIAL (NORTH); CHURCH (NORTHEAST); DEPARTMENT OF NATURAL RESOURCES (SOUTHEAST)*
CRITICAL AREA:	*THE EXISTING SITE AT THE TIME OF PRELIMINARY SUBDIVISION APPLICATION IS LOCATED WITHIN THE FEMA 100-YEAR FLOODPLAIN. HOWEVER, THE SUBDIVISION HAS BEEN DESINGED TO BE ABOVE THE BASE FLOOD ELEVATION (BFE) AT 50.8.*

NOTES

1. *EXISTING CONDITIONS SHOWN IN THIS PLAN SHALL BE THE EXISTING CONDITIONS FOLLOWING THE CONSTRUCTION OF THE PHASE 1 ACCESS AND UTILITIES, AS WELL AS THE LOTC OUTFALL. THIS CONSTRUCTION WILL BE COMPLETED PRIOR TO THE CONSTRUCTION OF THE RIVER'S EDGE SUBDIVISION.*
2. *REFER TO AFN 3762029 AND AFN 3763318 FOR FULL LEGAL DESCRIPTIONS OF THE EXISTING PARCELS REFERENCED IN THIS EXISTING CONDITIONS PLAN.*
3. *PORTIONS OF THE SITE CURRENTLY LIE WITHIN THE FEMA 100-YEAR FLOOD PLAIN BUT BUILDING PADS WILL BE PROPOSED A MINIMUM OF 1' ABOVE THE BASE FLOOD ELEVATION OF 48 FEET.*

SURVEY NOTE

THE BOUNDARY AND THE SUSEQUENT MATHEMATICAL SOLUTIONS USED IN THE ADJUSTED LEGAL DESCRIPTIONS HEREON ARE BASED ON BOUNDARY LINE ADJUSTMENT SURVEY RECORDED UNDER AUDITOR'S FILE NUMBER 3597924 IN CONJUNCTION WITH RECORD OF SURVEY BY MACKAY SPOSITIO, RECORDED UNDER AUDITOR'S FILE NUMBER 3732400, 34620229, AND 3763318.

HORIZONTAL DATUM

WASHINGTON STATE PLANE COORDINATE SYSTEM, SOUTH ZONE (4602), NAD83(2011)(EPOCH: 2010.0), US SURVEY FOOT. DISTANCES SHOWN HEREON ARE GROUND DISTANCES. TO CONVERT DISTANCES TO GRID, MULTIPLY BY COMBINED SCALE FACTOR OF 1.00006786 AS SHOWN ON (SR2) ROS V44 P35-36.

VERTICAL DATUM

THE ELEVATIONS SHOWN ON THIS MAP ARE BASED ON AN OPUS SOLUTION AT CP 1 WITH A DERIVED NAVD88 ORTHOMETRIC ELEVATION OF 46.26 FEET.

BASIS OF BEARINGS

BEARINGS ARE BASED ON THE CENTERLINE OF HUNTINGTON AVENUE SOUTH, BEING SOUTH 51°49'47" EAST AS SHOWN ON (SR2) ROS V44 P35-36.

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

PRELIMINARY

ALEXANDRE M. PHILLIPS
STATE OF WASHINGTON
22012357
REGISTERED
PROFESSIONAL ENGINEER

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

EXISTING CONDITIONS

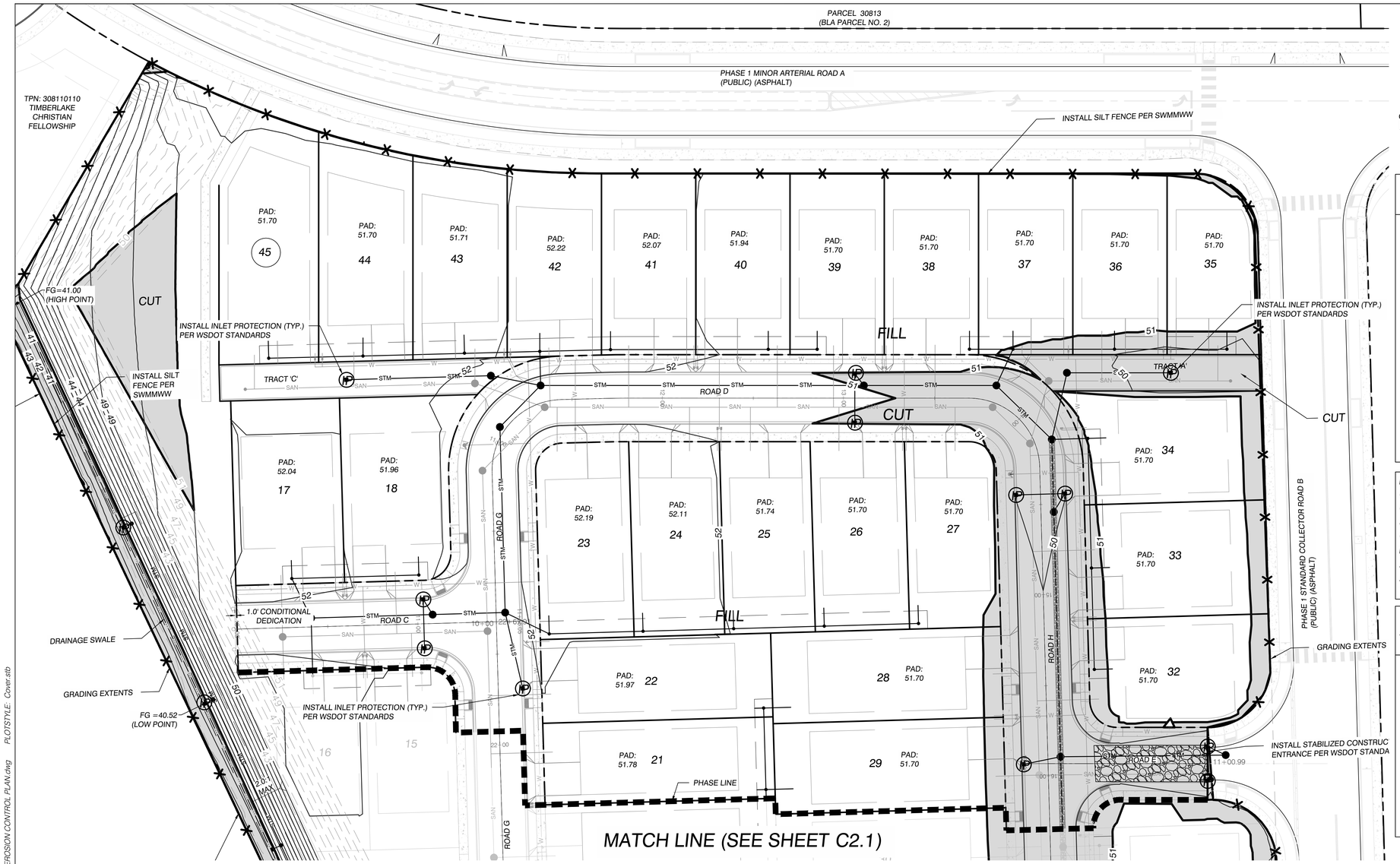
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1"= 60'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

C0.2

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591.01 - Phase 1 Subdivision\C0.4 EXISTING CONDITIONS.dwg PLOTSTYLE: Cover.stb



LEGEND

- 298 — FINISHED GRADE CONTOUR
- —298— EXISTING CONTOUR
- DRAINAGE SWALE
- AREA OF CUT
- AREA OF FILL
- IP — INLET PROTECTION
- STABALIZED CONSTRUCTION ENTRANCE
- SILT FENCE
- HIGH VISIBILITY FENCE

NOTE: DUE TO THE LIMITED EROSION CONTROL STANDARDS AVAILABLE BY THE CITY OF CASTLE ROCK, ALL EROSION AND SEDIMENT CONTROL DEVICES SHALL CONFORM WITH WSDOT STANDARDS. HOWEVER, CONTRACTOR MAY USE ALTERNATE DESIGNS IF THEY ARE APPROVED BY THE SITE INSPECTOR PRIOR TO INSTALLATION.

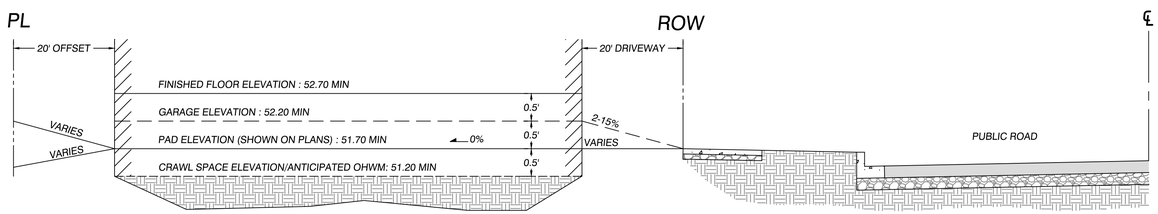
APPROXIMATE GRADING VOLUMES

CUT	2,000 CY
FILL	15,000 CY

NOTE: CUT AND FILL AREAS AND VOLUMES ARE CALCULATED FROM EXISTING GROUND TO FINISHED GRADE AND ARE NOT ADJUSTED FOR STRIPPINGS, TRENCH EXCAVATION, STRUCTURAL EXCAVATION OR SHRINK/SWELL. CONTRACTORS ARE SOLELY RESPONSIBLE FOR QUANTITY ESTIMATES FOR BIDDING PURPOSES.

CONSTRUCTION NOTES

1) ALL EROSION CONTROL DEVICES PROPOSED SHALL CONFORM WITH WSDOT STANDARDS.
2) CONTRACTOR TO CONSTRUCT EQUIPMENT AND PARKING AREA AT A SUITABLE LOCATION PRIOR TO BEGINNING GRADING ACTIVITIES. LOCATION TO BE DETERMINED PRIOR TO THE PRE-CONSTRUCTION CONFERENCE.
3) IF TRACKING OF SEDIMENT FROM THE SITE BECOMES A PROBLEM, A WHEEL WASH SHALL BE INSTALLED AT THE SITE ENTRANCE.
4) STOCKPILE AREAS PLACED ONSITE SHALL BE COORDINATED BY THE CONTRACTOR AND SURROUNDED WITH SILT FENCE AND COVERED WITH PLASTIC AS NECESSARY DURING CONSTRUCTION. MATERIAL NOT STOCKPILED ONSITE SHALL BE REMOVED TO AN APPROPRIATE IMPORT SITE.
5) ANY SLOPE LESS THAN 3:1 TO BE STABILIZED WITH SEEDING AND MULCH/STRAW.
6) CONTRACTOR IS RESPONSIBLE FOR IMPLEMENTING BMP T5.13.
7) EROSION CONTROL INSPECTION REQUIRED BEFORE YOU BEGIN ANY SITEWORK
8) THE BASE FLOOD ELEVATION IS 48.0 AND MINIMUM PAD ELEVATION (AS SHOWN ON PLAN) IS 51.70.



TYPICAL LOT SECTION

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

ANDREW W. MACKAY
STATE OF WASHINGTON
22012357
REGISTERED
PROFESSIONAL ENGINEER

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

GRADING AND EROSION CONTROL PLAN (PHASE 1)

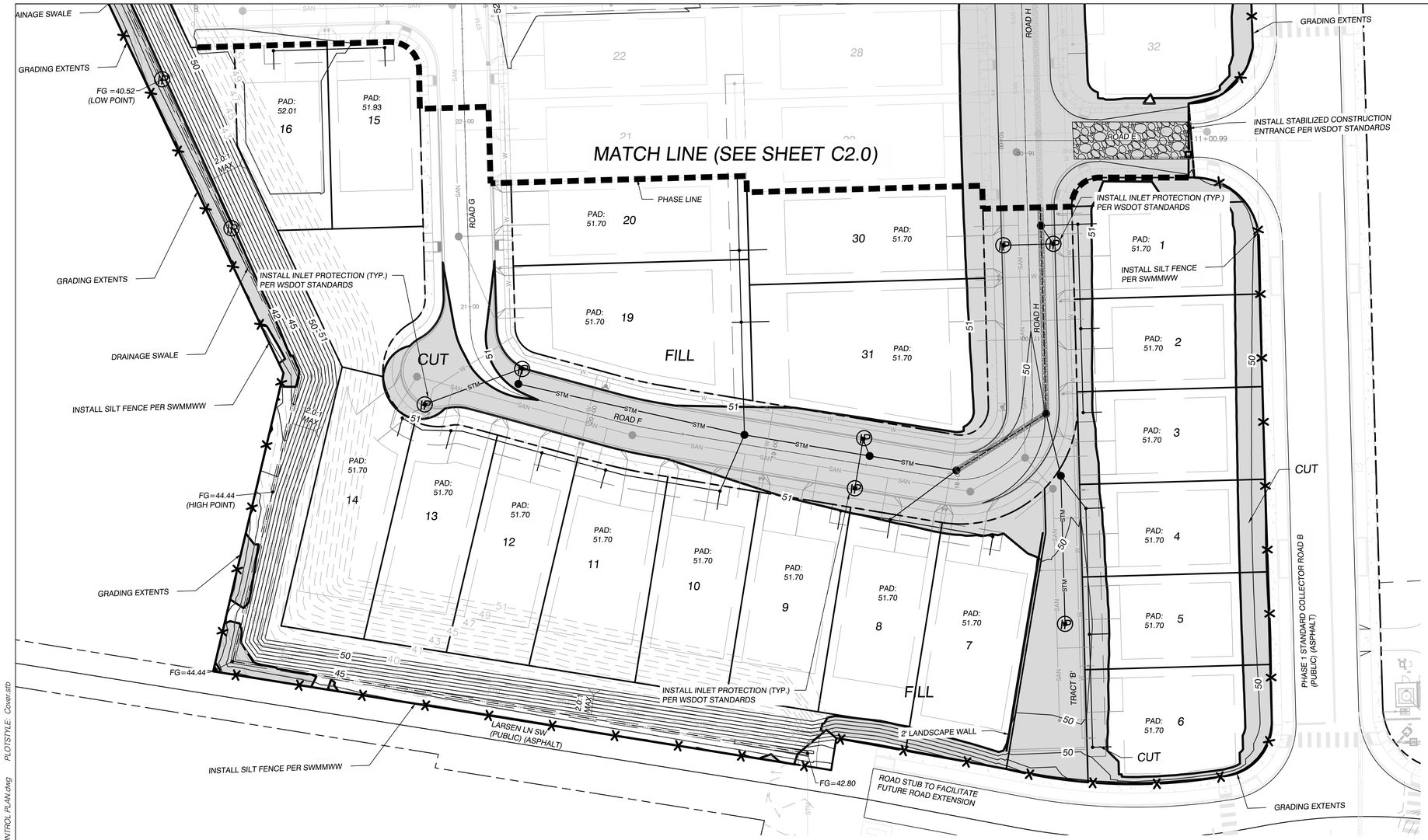
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 30'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

C2.0

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 01 - Phase 1 Subdivision\C2.0 GRADING AND EROSION CONTROL PLAN.dwg PLOTSTYLE: Cover.stb



LEGEND

- 298 — FINISHED GRADE CONTOUR
- 298 — EXISTING CONTOUR
- DRAINAGE SWALE
- AREA OF CUT
- AREA OF FILL
- INLET PROTECTION
- STABALIZED CONSTRUCTION ENTRANCE
- SILT FENCE
- HIGH VISIBILITY FENCE

NOTE: DUE TO THE LIMITED EROSION CONTROL STANDARDS AVAILABLE BY THE CITY OF CASTLE ROCK, ALL EROSION AND SEDIMENT CONTROL DEVICES SHALL CONFORM WITH WSDOT STANDARDS. HOWEVER, CONTRACTOR MAY USE ALTERNATE DESIGNS IF THEY ARE APPROVED BY THE SITE INSPECTOR PRIOR TO INSTALLATION.

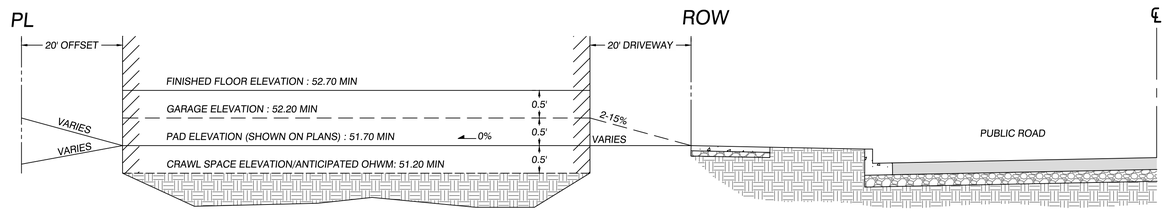
APPROXIMATE GRADING VOLUMES

CUT	2,000 CY
FILL	15,000 CY

NOTE: CUT AND FILL AREAS AND VOLUMES ARE CALCULATED FROM EXISTING GROUND TO FINISHED GRADE AND ARE NOT ADJUSTED FOR STRIPPINGS, TRENCH EXCAVATION, STRUCTURAL EXCAVATION OR SHRINK/SWELL. CONTRACTORS ARE SOLELY RESPONSIBLE FOR QUANTITY ESTIMATES FOR BIDDING PURPOSES.

CONSTRUCTION NOTES

1) ALL EROSION CONTROL DEVICES PROPOSED SHALL CONFORM WITH WSDOT STANDARDS.
2) CONTRACTOR TO CONSTRUCT EQUIPMENT AND PARKING AREA AT A SUITABLE LOCATION PRIOR TO BEGINNING GRADING ACTIVITIES. LOCATION TO BE DETERMINED PRIOR TO THE PRE-CONSTRUCTION CONFERENCE.
3) IF TRACKING OF SEDIMENT FROM THE SITE BECOMES A PROBLEM, A WHEEL WASH SHALL BE INSTALLED AT THE SITE ENTRANCE.
4) STOCKPILE AREAS PLACED ONSITE SHALL BE COORDINATED BY THE CONTRACTOR AND SURROUNDED WITH SILT FENCE AND COVERED WITH PLASTIC AS NECESSARY DURING CONSTRUCTION. MATERIAL NOT STOCKPILED ONSITE SHALL BE REMOVED TO AN APPROPRIATE IMPORT SITE.
5) ANY SLOPE LESS THAN 3:1 TO BE STABILIZED WITH SEEDING AND MULCH/STRAW.
6) CONTRACTOR IS RESPONSIBLE FOR IMPLEMENTING BMP T5.13.
7) EROSION CONTROL INSPECTION REQUIRED BEFORE YOU BEGIN ANY SITEWORK
8) THE BASE FLOOD ELEVATION IS 48.0 AND MINIMUM PAD ELEVATION (AS SHOWN ON PLAN) IS 51.70.



TYPICAL LOT SECTION

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

GRADING AND EROSION CONTROL PLAN (PHASE 2)

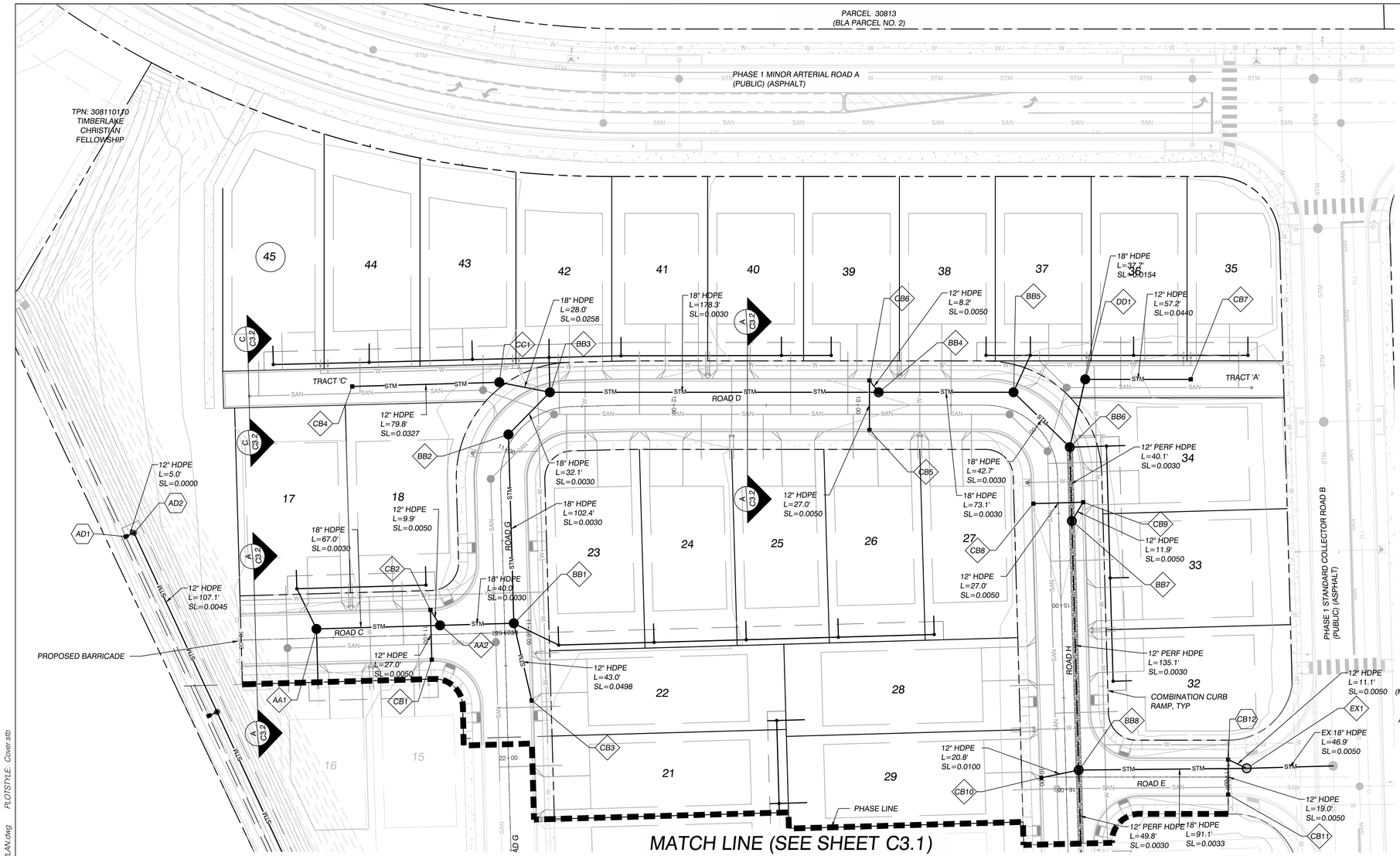
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 30'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

C2.1

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591.01 - Phase 1 Subdivision\C2.0 GRADING AND EROSION CONTROL PLAN.dwg PLOTSTYLE: Cover.stb



0 30 60

SCALE: 1" = 30'

LEGEND

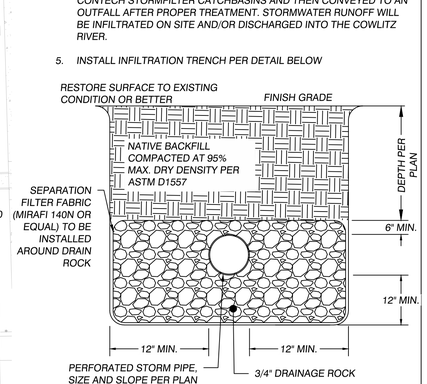
- PROPOSED ASPHALT
- PROPOSED CONCRETE
- PROPOSED INFILTRATION TRENCH
- BARRICADE
- STOP SIGN

NOTE:

1. HMA SECTIONS ARE TO BE CONSTRUCTED PER STREET SECTIONS, SHEET C3.2 .

STORMWATER:

1. ALL STORMWATER SYSTEMS WILL BE DESIGNED IN CONFORMANCE WITH CITY OF CASTLE ROCK STANDARDS AND THE STORMWATER MANAGEMENT MANUAL FOR WESTERN WASHINGTON.
2. ALL STORMWATER FACILITIES WILL BE PRIVATELY OWNED AND MAINTAINED WITH A BLANKET ACCESS AND INSPECTION EASEMENT OVER THE PROPERTY DEDICATED TO CITY OF CASTLE ROCK.
3. NATIVE SOILS ON THE SITE ARE CONSIDERED TO BE WWHM GROUP 1 (EXCESSIVELY DRAINED SOILS A & B).
4. STORMWATER RUNOFF FROM PAVED SURFACES WILL BE ROUTED TO CONTECH STORMFILTER CATCHBASINS AND THEN CONVEYED TO AN OUTFALL AFTER PROPER TREATMENT. STORMWATER RUNOFF WILL BE INFILTRATED ON SITE AND/OR DISCHARGED INTO THE COWLITZ RIVER.
5. INSTALL INFILTRATION TRENCH PER DETAIL BELOW



INFILTRATION TRENCH SECTION

NO SCALE

INLET DATA

STRUCTURE ID	STRUCTURE DATA
AD1	N: 346651.76 E: 1035084.69 INSTALL DITCH INLET RIM = 41.00 12" IE OUT = 41.00
AD2	N: 346650.47 E: 1035089.52 INSTALL 24" RISER W/ ATRIUM GRATE RIM = 43.03 12" IE IN = 41.00 12" IE OUT = 41.00
CB1	STA 11+03.05 (13.5' RT-SUBDIVISION ROAD C) INSTALL STM CB RIM = 51.26 12" IE OUT = 47.26
CB2	STA 11+03.05 (13.5' LT-SUBDIVISION ROAD C) INSTALL 1-CARTRIDGE(18") CONTECH STORMFILTER CB RIM = 51.26 12" IE IN = 47.12 12" IE OUT = 46.52
CB3	STA 22+30.73 (13.5' RT-SUBDIVISION MAIN CIRCULATION) INSTALL 1-CARTRIDGE (18") CONTECH STORMFILTER CB RIM = 51.33 12" IE OUT = 49.03

INLET DATA

STRUCTURE ID	STRUCTURE DATA
CB4	N: 346635.47 E: 1035231.28 INSTALL 1-CARTRIDGE(18") CONTECH STORMFILTER CB RIM = 51.17 12" IE OUT = 48.87
CB5	STA 13+06.00 (13.5' RT-SUBDIVISION MAIN CIRCULATION) INSTALL STM CB RIM = 50.87 12" IE OUT = 46.87
CB6	STA 13+06.00 (13.5' LT-SUBDIVISION MAIN CIRCULATION) INSTALL 1-CARTRIDGE(27") CONTECH STORMFILTER CB RIM = 50.87 12" IE IN = 46.73 12" IE OUT = 46.23
CB7	N: 346346.81 E: 1035582.67 INSTALL 1-CARTRIDGE(18") CONTECH STORMFILTER CB RIM = 49.45 12" IE OUT = 47.15
CB8	STA 14+44.27 (13.5' RT-SUBDIVISION MAIN CIRCULATION) INSTALL STM CB RIM = 50.02 12" IE OUT = 46.02

INLET DATA

STRUCTURE ID	STRUCTURE DATA
CB9	STA 14+44.27 (13.5' LT-SUBDIVISION MAIN CIRCULATION) INSTALL 1-CARTRIDGE(18") CONTECH STORMFILTER CB RIM = 50.02 12" IE IN = 45.89 12" IE OUT = 45.39
CB10	STA 15+93.00 (13.5' RT-SUBDIVISION MAIN CIRCULATION) INSTALL 1-CARTRIDGE(18") CONTECH STORMFILTER CB RIM = 49.52 12" IE OUT = 46.47
CB11	STA 11+00.99 (9.5' RT-SUBDIVISION ROAD E) INSTALL STM CB RIM = 49.35 12" IE OUT = 45.35
CB12	STA 11+00.99 (9.5' LT-SUBDIVISION ROAD E) INSTALL 1-CARTRIDGE(18") CONTECH STORMFILTER CB RIM = 49.35 12" IE IN = 45.25 12" IE OUT = 45.25

STORM MANHOLE DATA

STRUCTURE ID	STRUCTURE DATA
AA1	STA 10+41.00 (4.9' LT-SUBDIVISION ROAD C) INSTALL 48" STM MH RIM = 51.62 18" IE OUT = 46.67
AA2	STA 11+08.05 (5.0' LT-SUBDIVISION ROAD C) INSTALL 48" STM MH RIM = 51.43 18" IE IN = 46.47 12" IE IN = 46.47 18" IE OUT = 46.27
BB1	STA 10+04.98 (5.0' RT-SUBDIVISION MAIN CIRCULATION) INSTALL 48" STM MH RIM = 51.63 18" IE IN = 46.15 12" IE IN = 46.89 18" IE OUT = 45.95
BB2	STA 11+07.14 (3.1' LT-SUBDIVISION MAIN CIRCULATION) INSTALL 48" STM MH RIM = 51.88 18" IE IN = 45.64 18" IE OUT = 45.44
BB3	STA 11+34.94 (9.3' LT-SUBDIVISION MAIN CIRCULATION) INSTALL 48" STM MH RIM = 51.74 18" IE IN = 45.34 18" IE IN = 45.34 18" IE OUT = 45.14

STORM MANHOLE DATA

STRUCTURE ID	STRUCTURE DATA
BB4	STA 13+11.00 (7.0' LT-SUBDIVISION MAIN CIRCULATION) INSTALL 48" STM MH RIM = 50.97 18" IE IN = 44.60 12" IE IN = 46.19 18" IE OUT = 44.40
BB5	STA 13+81.38 (9.4' LT-SUBDIVISION MAIN CIRCULATION) INSTALL 48" STM MH RIM = 50.49 18" IE IN = 44.18 18" IE OUT = 43.98
BB6	STA 14+16.94 (9.5' LT-SUBDIVISION MAIN CIRCULATION) INSTALL 48" STM MH RIM = 50.27 18" IE IN = 43.85 18" IE IN = 43.85 12" IE OUT = 43.65
BB7	STA 14+54.27 (7.1' LT-SUBDIVISION MAIN CIRCULATION) INSTALL 48" STM MH RIM = 50.09 12" IE IN = 43.53 12" IE IN = 45.33 12" IE OUT = 43.33
BB8	STA 15+89.39 (7.0' LT-SUBDIVISION MAIN CIRCULATION) INSTALL 48" STM MH RIM = 49.71 12" IE IN = 42.92 12" IE IN = 42.92 12" IE IN = 46.26 18" IE OUT = 42.72

STORM MANHOLE DATA

STRUCTURE ID	STRUCTURE DATA
CC1	N: 346586.06 E: 1035393.91 INSTALL 48" STM MH RIM = 52.28 12" IE IN = 46.26 18" IE OUT = 46.06
DD1	N: 346393.60 E: 1035526.69 INSTALL 48" STM MH RIM = 50.62 12" IE IN = 44.63 18" IE OUT = 44.43
EX1	N: 346165.49 E: 1035470.66 INSTALL EX 48" STM MH RIM = 49.53 18" IE IN = 42.42 12" IE IN = 45.19 18" IE OUT = 42.22

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

ALEXANDER W. TAW
STATE OF WASHINGTON
22012357
REGISTERED
PROFESSIONAL ENGINEER

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

STREET AND STORM PLAN (PHASE 1)

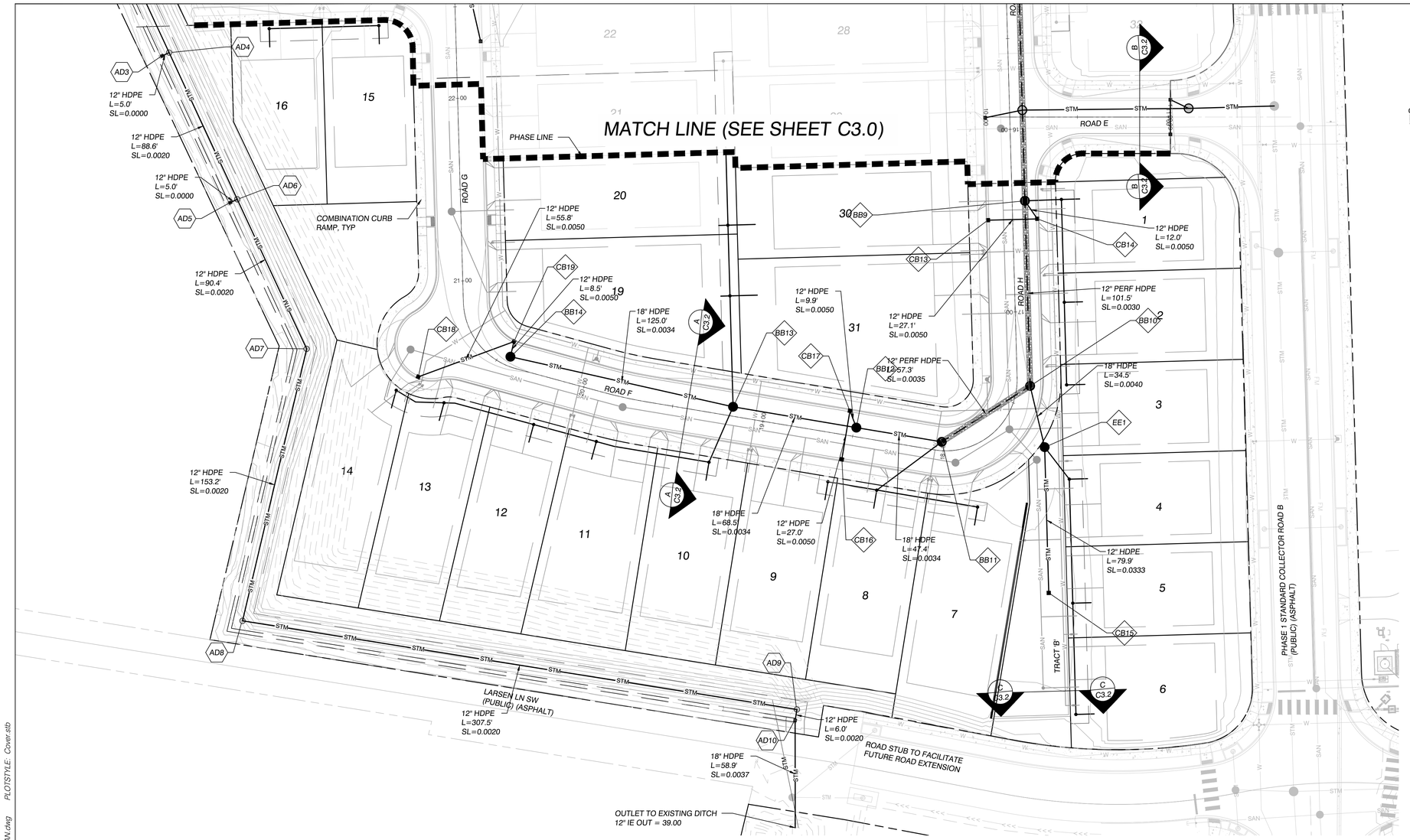
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 30'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

C3.0

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591.01 - Phase 1 Subdivision\C3.0 STREET AND STORM PLAN.dwg PLOTSTYLE: Cover.stb



0 30 60

SCALE: 1" = 30'

LEGEND

- PROPOSED ASPHALT
- PROPOSED CONCRETE
- PROPOSED INFILTRATION TRENCH
- BARRICADE
- STOP SIGN

NOTE:

1. *HMA SECTIONS ARE TO BE CONSTRUCTED PER STREET SECTIONS, SHEET C3.2 .*

STORMWATER:

1. *ALL STORMWATER SYSTEMS WILL BE DESIGNED IN CONFORMANCE WITH CITY OF CASTLE ROCK STANDARDS AND THE STORMWATER MANAGEMENT MANUAL FOR WESTERN WASHINGTON.*
2. *ALL STORMWATER FACILITIES WILL BE PRIVATELY OWNED AND MAINTAINED WITH A BLANKET ACCESS AND INSPECTION EASEMENT OVER THE PROPERTY DEDICATED TO CITY OF CASTLE ROCK.*
3. *NATIVE SOILS ON THE SITE ARE CONSIDERED TO BE WWHM GROUP 1 (EXCESSIVELY DRAINED SOILS A & B).*
4. *STORMWATER RUNOFF FROM PAVED SURFACES WILL BE ROUTED TO CONTECH STORMFILTER CATCHBASINS AND THEN CONVEYED TO AN OUTFALL AFTER PROPER TREATMENT. STORMWATER RUNOFF WILL BE INFILTRATED ON SITE AND/OR DISCHARGED INTO THE COWLITZ RIVER.*
5. *INSTALL INFILTRATION TRENCH PER DETAIL BELOW*

INLET DATA

STRUCTURE ID	STRUCTURE DATA
AD3	*N: 346548.33 E: 1035056.97* *INSTALL DITCH INLET* *RIM = 40.52* *12" IE OUT = 40.52*
AD4	*N: 346547.04 E: 1035061.80* *INSTALL 24" RISER W/ ATRIUM GRATE* *RIM = 42.92* *12" IE IN = 40.52* *12" IE OUT = 40.52*
AD5	*N: 346462.71 E: 1035034.03* *INSTALL DTCH INLET* *RIM = 40.88* *12" IE OUT = 40.34*
AD6	*N: 346461.42 E: 1035038.86* *INSTALL 24" RISER W/ ATRIUM GRATE* *RIM = 42.76* *12" IE IN = 40.34* *12" IE IN = 40.34* *12" IE OUT = 40.34*
AD7	*N: 346374.13 E: 1035015.47* *INSTALL 24" RISER W/ ATRIUM GRATE* *RIM = 42.54* *12" IE IN = 40.16* *12" IE OUT = 40.16*

INLET DATA

STRUCTURE ID	STRUCTURE DATA
AD8	*N: 346282.27 E: 103489.92* *INSTALL 24" RISER W/ ATRIUM GRATE* *RIM = 42.20* *12" IE IN = 39.85* *12" IE OUT = 39.85*
AD9	*N: 346050.26 E: 1035094.76* *INSTALL 24" AREA DRAIN W/ SOLID COVER* *RIM = 41.53* *12" IE IN = 39.23* *12" IE OUT = 39.23*
AD10	*N: 346046.36 E: 1035090.20* *INSTALL DITCH INLET* *RIM = 42.80* *12" IE IN = 39.22* *18" IE OUT = 39.22*
CB13	*STA 16+49.18 (13.5' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL STM CB* *RIM = 49.59* *12" IE OUT = 45.59*
CB14	*STA 16+49.25 (13.6' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 1-CARTRIDGE(27")* *CONTECH STORMFILTER CB* *RIM = 49.59* *12" IE IN = 45.45* *12" IE OUT = 44.95*

INLET DATA

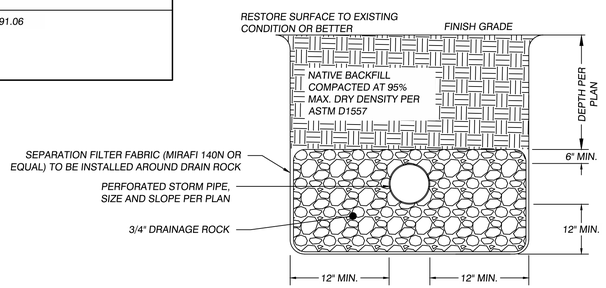
STRUCTURE ID	STRUCTURE DATA
CB15	*N: 346010.85 E: 1035241.56* *INSTALL 1-CARTRIDGE(18")* *CONTECH STORMFILTER CB* *RIM = 49.36* *12" IE OUT = 47.09*
CB16	*STA 18+53.78 (13.5' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL STM CB* *RIM = 50.20* *12" IE OUT = 46.20*
CB17	*STA 18+53.78 (13.5' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 1-CARTRIDGE(27")* *CONTECH STORMFILTER CB* *RIM = 50.20* *12" IE IN = 46.06* *12" IE OUT = 45.56*
CB18	*STA 20+66.47 (37.4' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL STM CB* *RIM = 50.36* *12" IE OUT = 46.36*
CB19	*STA 20+45.96 (13.5' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 1-CARTRIDGE(27")* *CONTECH STORMFILTER CB* *RIM = 50.78* *12" IE IN = 46.08* *12" IE OUT = 45.58*

STORM MANHOLE DATA

STRUCTURE ID	STRUCTURE DATA
BB9	*STA 16+39.18 (7.0' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 49.70* *12" IE IN = 43.27* *12" IE IN = 44.89* *12" IE OUT = 43.07*
BB10	*STA 17+39.92 (7.2' LT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 49.99* *12" IE IN = 43.77* *18" IE IN = 44.09* *12" IE OUT = 43.57*
BB11	*STA 18+00.88 (4.8' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 50.22* *18" IE IN = 44.17* *12" IE OUT = 43.97*
BB12	*STA 18+48.78 (5.0' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 50.36* *18" IE IN = 44.53* *12" IE IN = 45.51* *18" IE OUT = 44.33*
BB13	*STA 19+17.27 (5.1' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 50.56* *18" IE IN = 44.96* *18" IE OUT = 44.76*

STORM MANHOLE DATA

STRUCTURE ID	STRUCTURE DATA
BB14	*STA 20+43.64 (5.2' RT-SUBDIVISION MAIN CIRCULATION)* *INSTALL 48" STM MH* *RIM = 50.93* *12" IE IN = 45.54* *18" IE OUT = 45.38*
DD1	*STA 13+78.53 (55.9' RT-ROAD B)* *INSTALL 48" STM MH* *RIM = 49.53* *18" IE OUT = 42.22*
EE1	*N: 346073.60 E: 1035291.06* *INSTALL 48" STM MH* *RIM = 50.53* *12" IE IN = 44.43* *18" IE OUT = 44.23*



INFILTRATION TRENCH SECTION

NO SCALE

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

STREET AND STORM PLAN (PHASE 2)

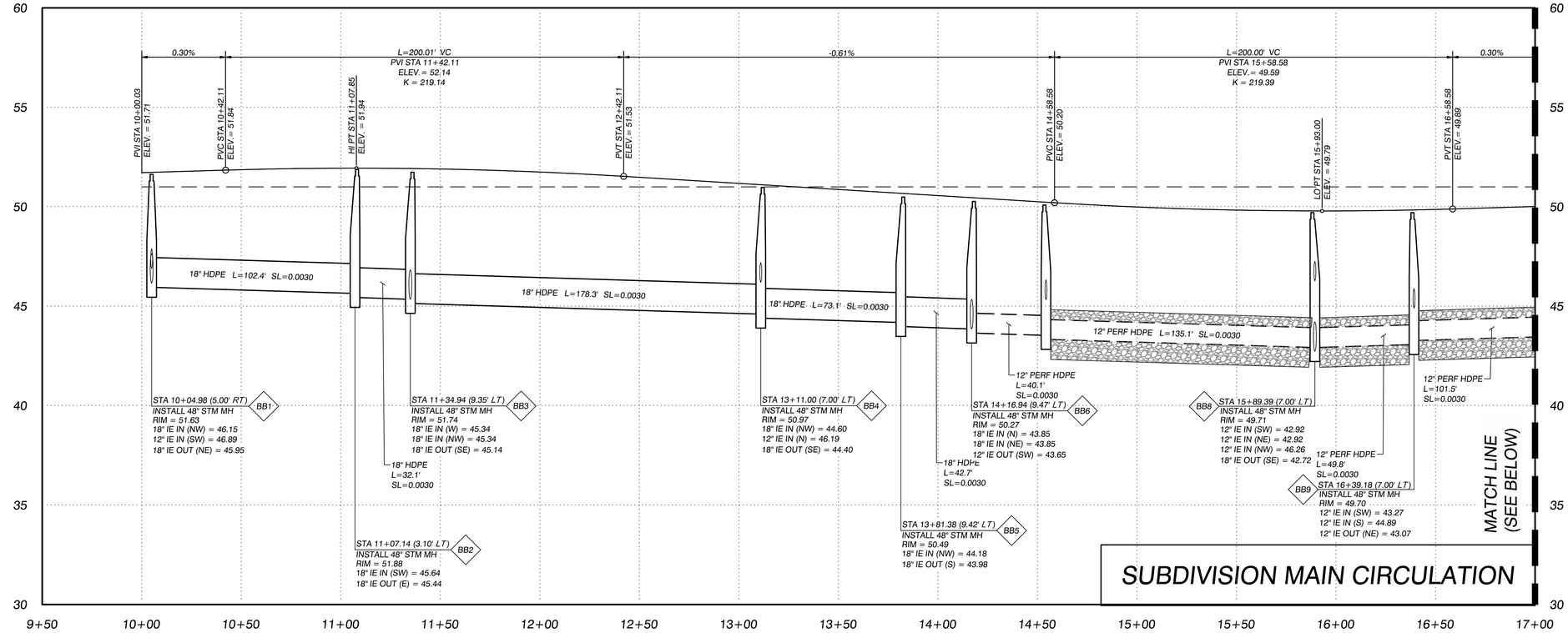
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 30'	V: N/A
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

PRELIMINARY

C3.1

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591.01 - Phase 1 Subdivision\C3.0 STREET AND STORM PLAN.dwg PLOTSTYLE: Cover.stb

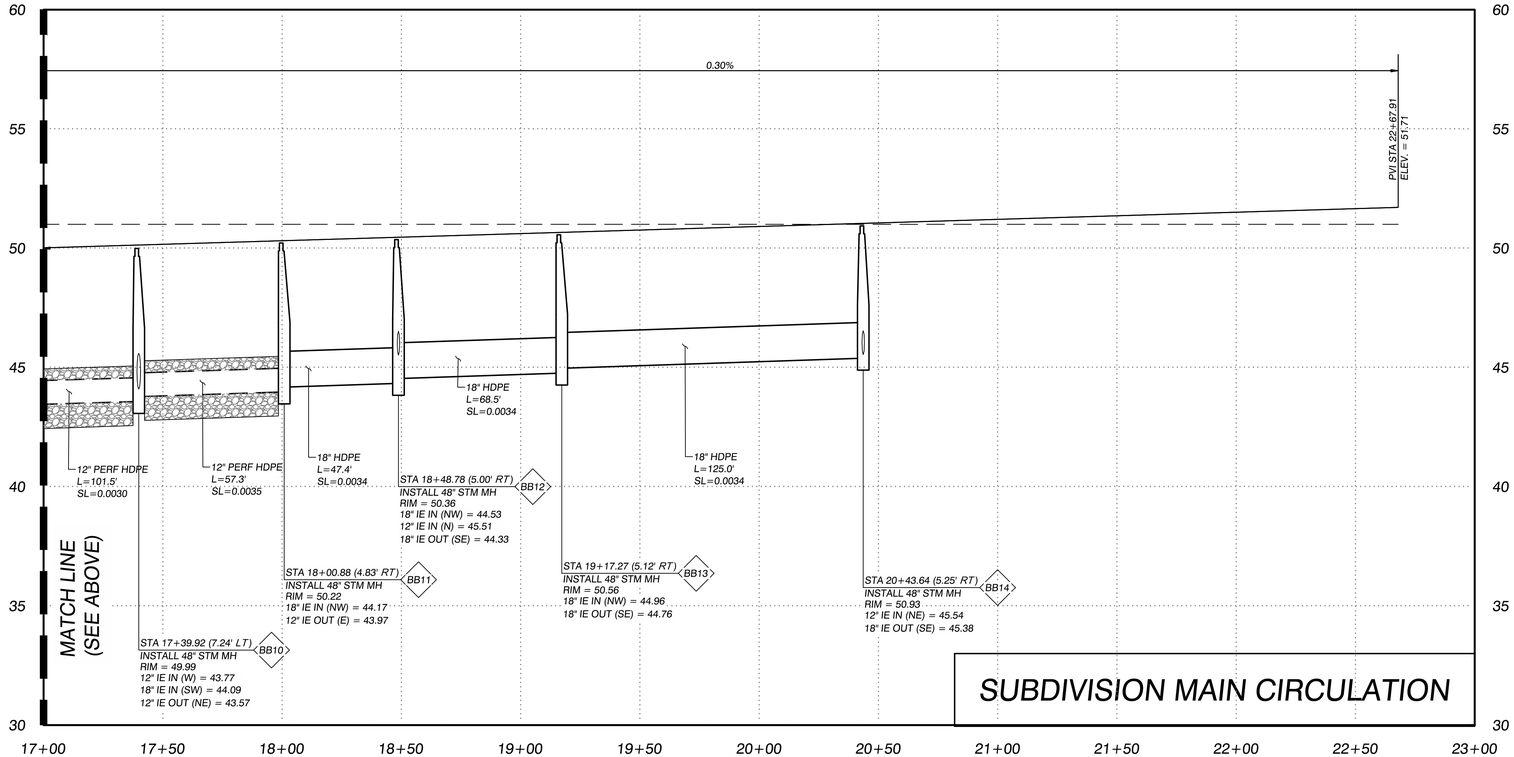


MAIN CIRCULATION PROFILE

STA 10+00 - STA 17+00

0 30 60

SCALE: 1" = 30'



MAIN CIRCULATION PROFILE

STA 17+00 - STA 22+67.91

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

TAW
22012357
REGISTERED
PROFESSIONAL ENGINEER
STATE OF WASHINGTON

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

MAIN CIRCULATION STREET AND STORM PROFILE

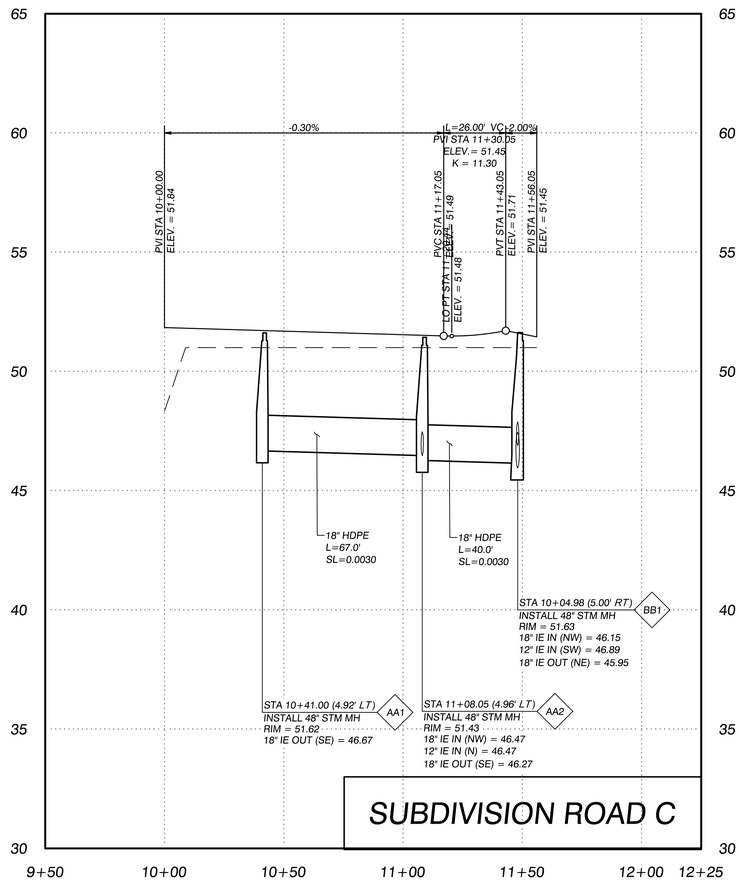
REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 30'	V: 5:1
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

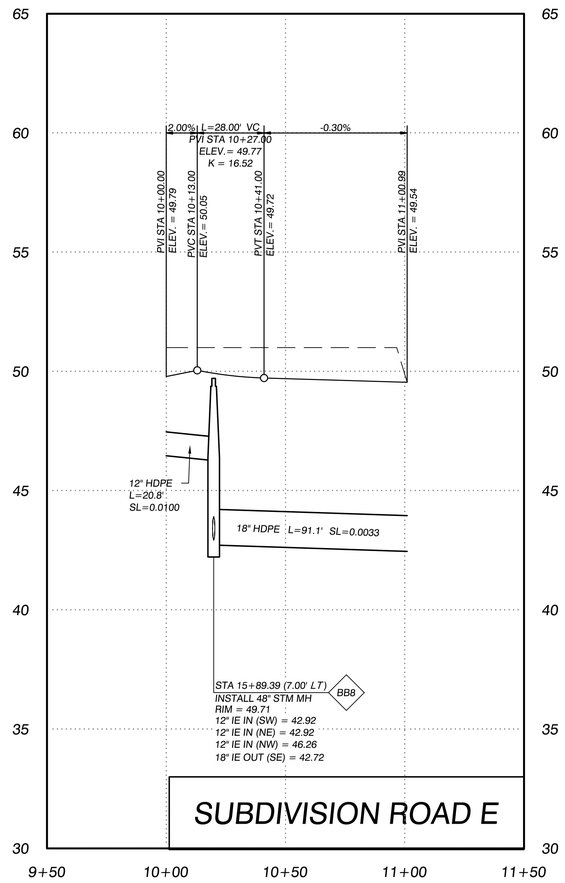
PRELIMINARY

C3.3

FILE: W:\18591 LOTC Phase 1500 Design\502 Drawings\Sheets\18591 01 - Phase 1 Subdivision\C3.3 ROAD PROFILES.dwg PLOTSTYLE: Cover.stb



ROAD C PROFILE



ROAD E PROFILE

0 30 60
SCALE: 1" = 30'

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

PRELIMINARY

3/27/2025

RIVER'S EDGE AT THE LANDING SUBDIVISION
CASTLE ROCK, WASHINGTON

ROAD C AND ROAD E STREET AND STORM PROFILES

REVISIONS:

JOB NO.:	18591
DATE:	3/27/2025
SCALE: H: 1" = 30'	V: 5:1
DESIGNED BY:	PJM
DRAWN BY:	PJM
CHECKED BY:	TAW

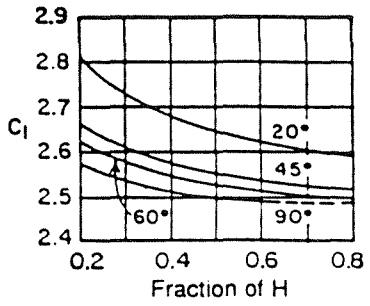
PRELIMINARY

C3.4

FILE: W:\18591 LOTC Phase 1\500 Design\502 Drawings\Sheets\18591 01 - Phase 1 Subdivision\C3.3 ROAD PROFILES.dwg PLOTSTYLE: Cover.stb

Appendix E Operation and Maintenance

Control Structures and Catch Basins (1992 SWMMPSB)



$Q = C_d(\text{Tan}(\Theta/2))H^{5/2}$, in cfs

Details

Standard control structure details are shown in Figures III-2.36 and III-2.37.

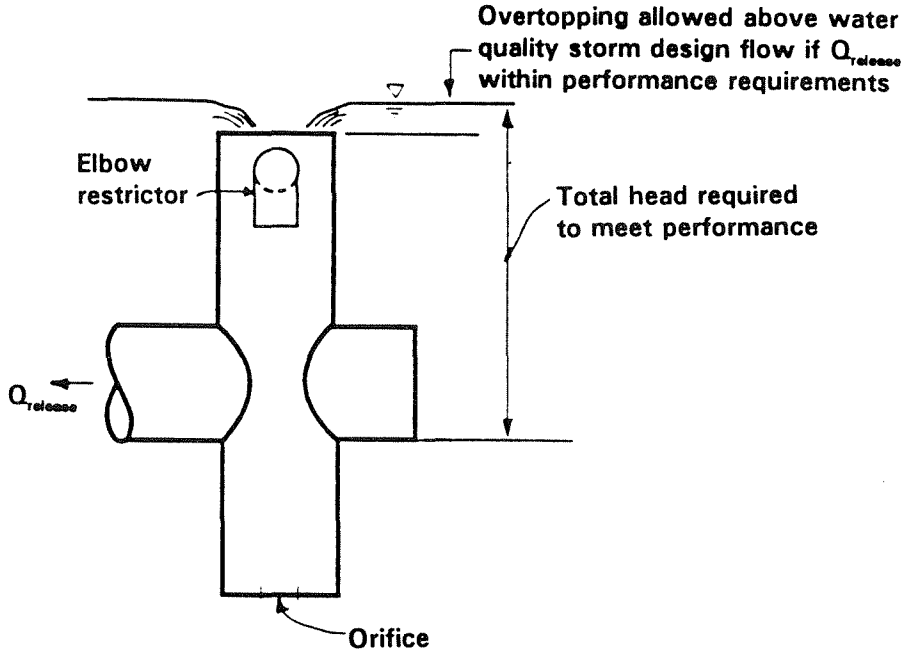
III-2.4.3 Maintenance of Control Structures

Control structures and catch basins have a history of maintenance-related problems and it is imperative that a good maintenance program be established for their proper functioning. A typical problem is that sediment builds up inside the structure which blocks or restricts flow to the inlet. To prevent this problem these structures should be routinely cleaned out a least twice per year. Regular inspections of control structures should be conducted to detect the need for non-routine cleanout, especially if construction or land-disturbing activities are occurring in the contributing drainage area.

A 15-foot wide access road to the control structure should be installed for inspection and maintenance.

Table III-2.10 provides maintenance recommendations for control structures and catch basins.

Figure III-2.36 Standard Control Structure Detail - Orifice Control



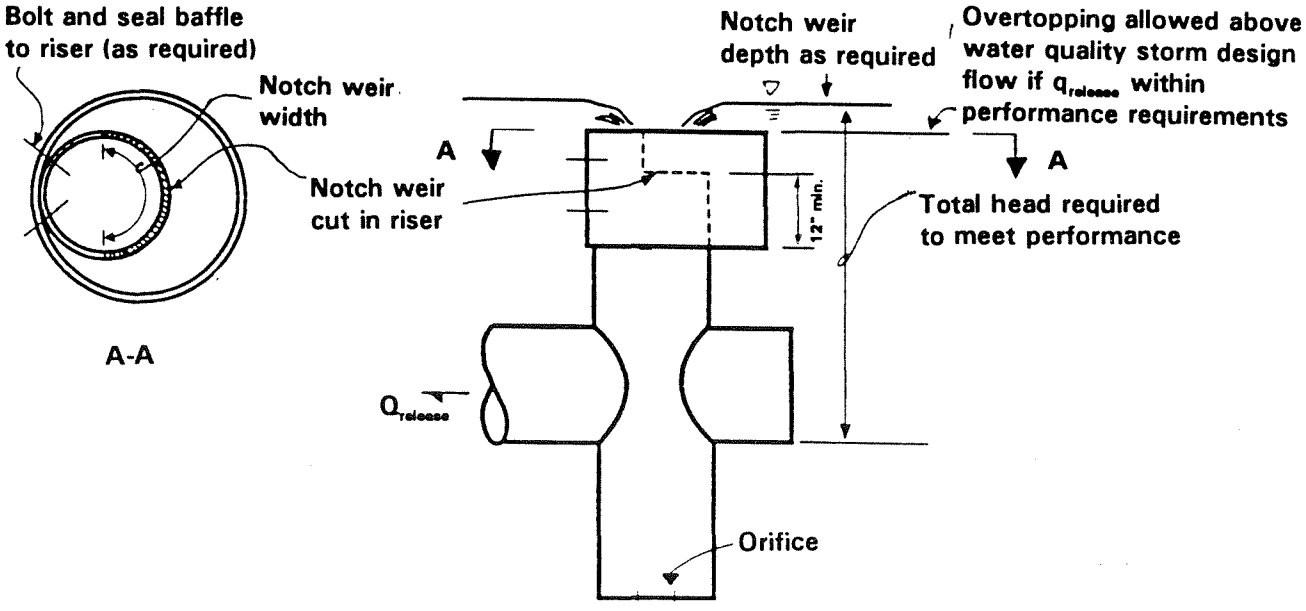
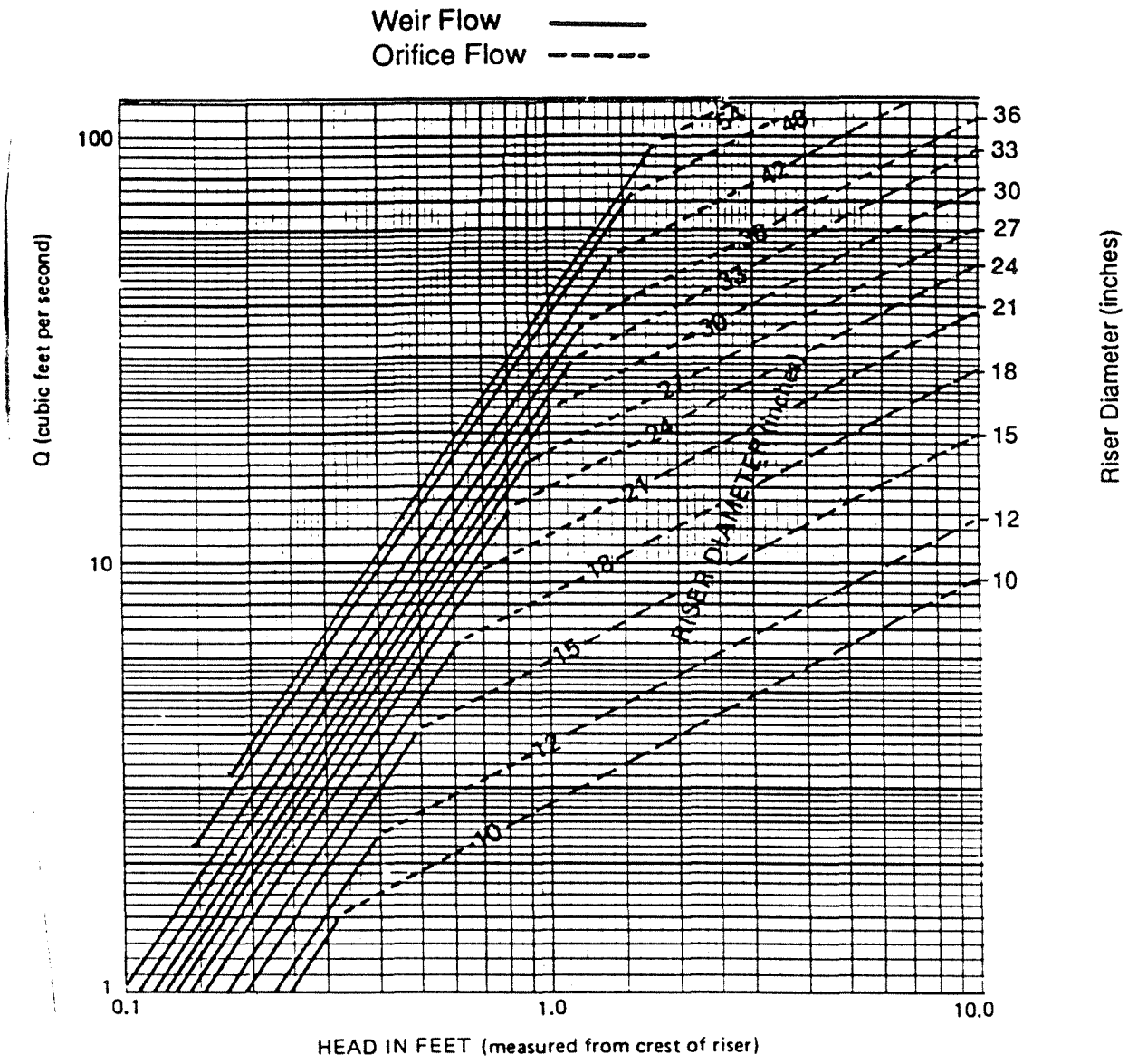


Figure III-2.37 Standard Control Structure Detail - Notch Control

Figure III-2.38 Riser Inflow Curves



SOURCE: USDA-SCS

$Q_{WIER} = 9.739\ DH^{3/2}$

$Q_{ORIFICE} = 3.782\ D^2H^{1/2}$

Q in cfs, D and H in feet

Table III-2.10 Maintenance of Control Structures and Catchbasins

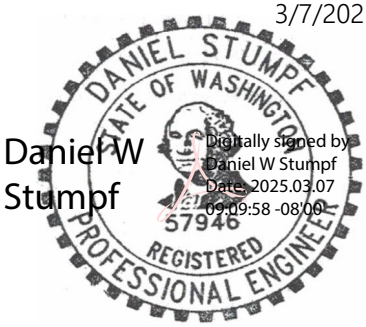
Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
I. Control Structure/ Flow Restrictor - General	Trash & Debris (includes sediment)	Distance between debris buildup & bottom of orifice is $< 1\frac{1}{2}$ feet.	All trash & debris removed.
	Structural Damage	Structure is not securely attached to manhole wall & outlet pipe structure should support at least 1000# of up or down pressure.	Structure securely attached to wall & outlet pipe.
		Structure is not in upright position (up to 10% from plumb allowed).	Structure in correct position.
		Connections to outlet pipe are not watertight & show signs of rust.	Connections to outlet pipe are watertight; structure repaired or replaced and works as designed.
		Any holes - other than designed holes - in structure.	Structure has no holes other than designed holes.
Cleanout Gate	Damaged or missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
		Gate cannot be moved up & down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain leading to gate is missing or damaged.	Chain is in place & works as designed.
		Gate is rusted over 50% of its surface area.	Gate is repaired or replaced to meet design standards.
	Obstructions	Trash, debris, sediment or vegetation blocking the plate.	Plate is free of all obstructions & works as designed.
Overflow Pipe	Obstructions	Trash or debris is blocking or potentially blocking the overflow pipe.	Pipe is free of all obstructions & works as designed.
Manhole		See "Pipes/Tanks" standard, Section III-4.6.1.	See "Pipes/Tanks" standard, Section III-4.6.1.
II. Catchbasins - General	Trash & Debris (includes sediment)	Trash & debris $\geq \frac{1}{2}$ ft.^{3} which is located immediately in front of the catchbasin opening of is blocking capacity by >10%.	No trash or debris immediately in front of the catchbasin opening.
		Trash or debris in the basin that exceeds $\frac{1}{6}$ the depth from the bottom of basin to the invert of the lowest pipe.	No trash or debris in the catchbasin.
		Trash or debris in any inlet or pipe blocking more than $\frac{1}{6}$ of its height.	Inlet & outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors or dangerous gases (e.g. methane).	No dead animals or vegetation present within the catchbasin.

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Catchbasins - General, con't.		No condition present which would attract or support the breeding of insects or rodents.	
	Structural Damage to Frame and/or Top Slab	Frame is even with curb.	
		Top slab is free of holes & cracks.	
		Frame is sitting flush on top slab.	
	Cracks in Basin Walls or Bottom	Basin repaired or replaced to design standards.	
		No cracks more than ¼ in. wide at the joint of inlet/outlet pipe.	
	Settlement/misalignment	Basin replaced or repaired to design standards.	
	Fire Hazard	No flammable chemicals present.	
	Vegetation	No vegetation blocking opening to basin.	
		No vegetation or root growth present.	
	Pollution	No pollution present other than surface film	
	68^F^Cider than ½ in. & longer than 1 ft. at the joint of any inlet or outlet pipe or any evidence of soil particles entering the catchbasin through cracks.		
	Basin has settled > 1 in. or has rotated > 2 in. out of alignment.		
	Presence of chemicals such as natural gas, oil and gasoline.		
	Vegetation growing across & blocking >10% of the basin opening.		

1130 SW Morrison St., Suite 318
Portland, OR 97205
503.248.0313
lancastermobley.com

Memorandum

3/7/2025



To: **Shane Tapani**
CT6, LLC

From: **Daniel Stumpf, PE**

Date: **March 7, 2025**

Subject: **River's Edge on the Landing Subdivision**
Transportation Compliance Letter

Introduction

This Transportation Compliance Letter (TCL) details a trip generation and accounting analysis for the proposed River's Edge on the Landing Subdivision, to be located within the Landing on the Cowlitz (LOTC) Master Plan area in Castle Rock, Washington. The project will develop a 45-lot residential subdivision a single property (tax parcel 308640100) in Castle Rock, Washington.

Since the proposed development will be located in the Landing on the Cowlitz Master Plan area, according to the LOTC Development Agreement all subsequent land use development applications in the LOTC Master Plan area are required to prepare a trip generation and accounting analysis to verify the following:

- Ensure total site trip generation of all existing/planned/proposed developments within the LOTC Master Plan area does not exceed the reserved number of PM peak hour trips.
- Determine if/when mitigation will be triggered at nearby transportation facilities based on the total PM peak hour trip generation of all existing/planned/proposed developments within the LOTC Master Plan area.

The City of Castle Rock has reserved transportation capacity for the LOTC development. The LOTC development has been granted an initial 1,000 PM peak hour trips for reservation. Additional transportation capacity, up to 1,750 PM peak hour trips, may be reserved when the development consumes 80% (800 PM peak hour trips) of the initial capacity as outlined in the Development Agreement.

Detailed trip generation calculations and supporting data are included as attachments to this memorandum.

Project Site Description

The project site is located southwest of Huntington Avenue S and east/northeast of Larson Lane SW in Castle Rock, Washington. The site consists of three properties (tax parcels 30813, 308120100, and 30812), all of which are currently undeveloped.

As described in the *Introduction*, the site will be redeveloped as a 45-lot residential subdivision consisting of single-family detached houses. Main access to the site will be provided via a proposed Minor Arterial connection to Huntington Avenue S.

Trip Generation Analysis

To estimate the number of trips that will be generated by the proposed use, trip rates from the *Trip Generation Manual*[1] were used. Data from the land use code 210, *Single-Family Detached Housing*, was used to estimate site trip generation based on the square footage of the gross building floor area.

In accordance with the *Landing on the Cowlitz Master Plan Transportation Impact Study* (TIS), dated November 13, 2023, the following internal capture rates were applied to the proposed development's trip generation:

- AM Peak Hour: Approximately 6% of the total site trips.
- PM Peak Hour & Average Weekday: Approximately 13% of the total site trips.

The trip generation calculations show that the proposed development is projected to generate the following:

- Total Trips (Excluding Internal Capture Trips): 30 AM peak hour trips, 37 PM peak hour trips, and 368 average weekday trips.
- Pass-by Trips (Excluding Internal Capture Trips): 0 AM peak hour trips, 0 PM peak hour trips, and 0 average weekday trips.
- Primary Trips (Excluding Internal Capture Trips): 30 AM peak hour trips, 37 PM peak hour trips, and 368 average weekday trips.

The trip generation estimates are summarized in Table 1. Detailed trip generation calculations are included as an attachment to this memorandum.

[1] Institute of Transportation Engineers (ITE), *Trip Generation Manual*, 11th Edition, 2021.

Table 1: Trip Generation Summary

Land Use Code		Size	AM Peak Hour			PM Peak Hour			Weekday Total
			Enter	Exit	Total	Enter	Exit	Total	
Single-Family Detached Housing	210	45 units	8	24	32	26	16	42	424
Pass-by Trips	-	*0% (0%)*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Total Primary Trips			8	24	32	26	16	42	424
Internal Trip Reduction (Total Trips)		*6% (13%)*	*0*	*2*	*2*	*3*	*2*	*5*	*56*
Internal Trip Reduction (Pass-by Trips)			*0*	*0*	*0*	*0*	*0*	*0*	*0*
Internal Trip Reduction (Primary Trips)			*0*	*2*	*2*	*3*	*2*	*5*	*56*
Total External Trips			**8**	**22**	**30**	**23**	**14**	**37**	**368**
Total External Pass-by Trips			**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total External Primary Trips			**8**	**22**	**30**	**23**	**14**	**37**	**368**

Table Notes: AM and PM/ADT internal and pass-by rates denoted as AM (PM/ADT).

Trip Accounting Analysis

As described above, the proposed development will be located within the LOTC Master Plan where per the LOTC Development Agreement a reserved number of PM peak hour trips are vested. Additionally, PM peak hour thresholds to determine when transportation mitigation at nearby facilities would be necessary were established. To determine if the proposed development will not exceed the vested trip thresholds or trigger the need for transportation mitigation, a trip accounting analysis was conducted.

LOTC Trip Accounting

The proposed River's Edge on the Landing Subdivision will be the first development application proposed in the LOTC Master Plan area, where currently the total remaining trips vested are 1,000 PM peak hour trips. After approval of the River's Edge on the Landing Subdivision application, 963 PM peak hour trips will remain available in the bank of trips. Table 2 below summarizes the remaining trips vested in the LOTC Master Plan area following approval of the proposed development application.

Table 2: Remaining Vested Trip Summary (Total Trips Generated)

Project Name	Total PM Peak Hour Trips Allocated	Total PM Peak Hour Trips Remaining in Bank	Cumulative PM Peak Hour Trips Consumed from Bank
LOTC Master Plan	-	1,000	-
River's Edge on the Landing	37	963	37

Mitigation Threshold Analysis

Per the *Landing on the Cowlitz Master Plan TIS*, three intersections were identified as requiring capacity related mitigation improvements at specific impact thresholds. These intersections include the following:

1. SR-411 at Westside Highway
    a. Mitigation required under 2043 conditions with or without impacts from the LOTC Master Plan area.
    b. The LOTC will impact the intersection with 15% of externally generated primary trips.
2. Site Access at Huntington Avenue
    a. Mitigation required once impacted by 657 PM peak hour trips.
    b. The LOTC will impact the intersection with 100% of externally generated primary trips and pass-by trips.
3. I-5 Northbound Ramps at Huntington Avenue
    a. Mitigation required once impacted by 384 PM peak hour trips.
    b. The LOTC will impact the intersection with the following:
        i. 10% of externally generated primary trips exiting the site.
        ii. 50% of externally generated primary trips entering the site.
        iii. 47.5% of externally generated pass-by trips.

Table 3 evaluates the PM peak hour trip thresholds of mitigation at nearby transportation facilities and if they will be necessary as part of this application.

Table 3: Mitigation Trip Impact Summary (Externally Generated PM Peak Hour Trips)

	Transportation Facility	Planned Mitigation	Mitigation Threshold	Prior Approved Development Impacts	Proposed Development Impacts	Total Trip Impact	Mitigation Threshold Exceeded?
Apply Externally Generated Primary Trip Impacts							
1	SR-411 at Westside Highway	TBD, Collect Proportionate Share Contributions	0	0	5	5	**Yes**
Apply Externally Generated Primary & Pass-by Trip Impacts							
2	Site Access at Huntington Avenue	Single Lane Roundabout with NEB Right-turn Bypass Lane	657	0	37	37	No
3	I-5 NB Ramps at Huntington Avenue	TBD	384	0	13	13	No

A trip assignment figure for the proposed development is included as an attachment to this TCL.

Analysis Summary

Based on Tables 2 and 3, the proposed development will not increase PM peak hour trip generation to a level that exceeds the number of trips vested in the LOTC Master Plan area. The threshold for improvements at the SR-411 at Westside Highway intersection are met; however, these improvements were triggered without impacts from the LOTC Master Plan project. No other mitigation is necessary or recommended as part of the River's Edge on the Landing Subdivision application.

Conclusions

The proposed River's Edge on the Landing Subdivision is projected to generate 30 total AM peak hour trips, 37 total PM peak hour trips, and 368 total average weekday trips. After approval of the development application, 963 PM peak hour trips will remain available in the bank of trips, and therefore, will not increase PM peak hour trip generation to a level that exceeds the number of trips vested in the LOTC Master Plan area.

The threshold for improvements at the SR-411 at Westside Highway intersection are met; however, these improvements were triggered without impacts from the LOTC Master Plan project. No other mitigation is necessary or recommended as part of the River's Edge on the Landing Subdivision application.

If you have any questions or concerns regarding the preparation of this Transportation Compliance Letter, please don't hesitate to contact us.

TRIP GENERATION CALCULATIONS
Source: Trip Generation Manual, 11th Edition

Land Use:	Single-Family Detached Housing
Land Use Code:	210
Land Use Subcategory:	All Sites
Setting/Location	General Urban/Suburban
Variable:	Dwelling Units
Trip Type:	Vehicle
Formula Type:	Rate
Variable Quantity:	45

AM PEAK HOUR

Trip Rate: 0.7

	Enter	Exit	Total
Directional Split	25%	75%	
Trip Ends	8	24	32

PM PEAK HOUR

Trip Rate: 0.94

	Enter	Exit	Total
Directional Split	63%	37%	
Trip Ends	26	16	42

WEEKDAY

Trip Rate: 9.43

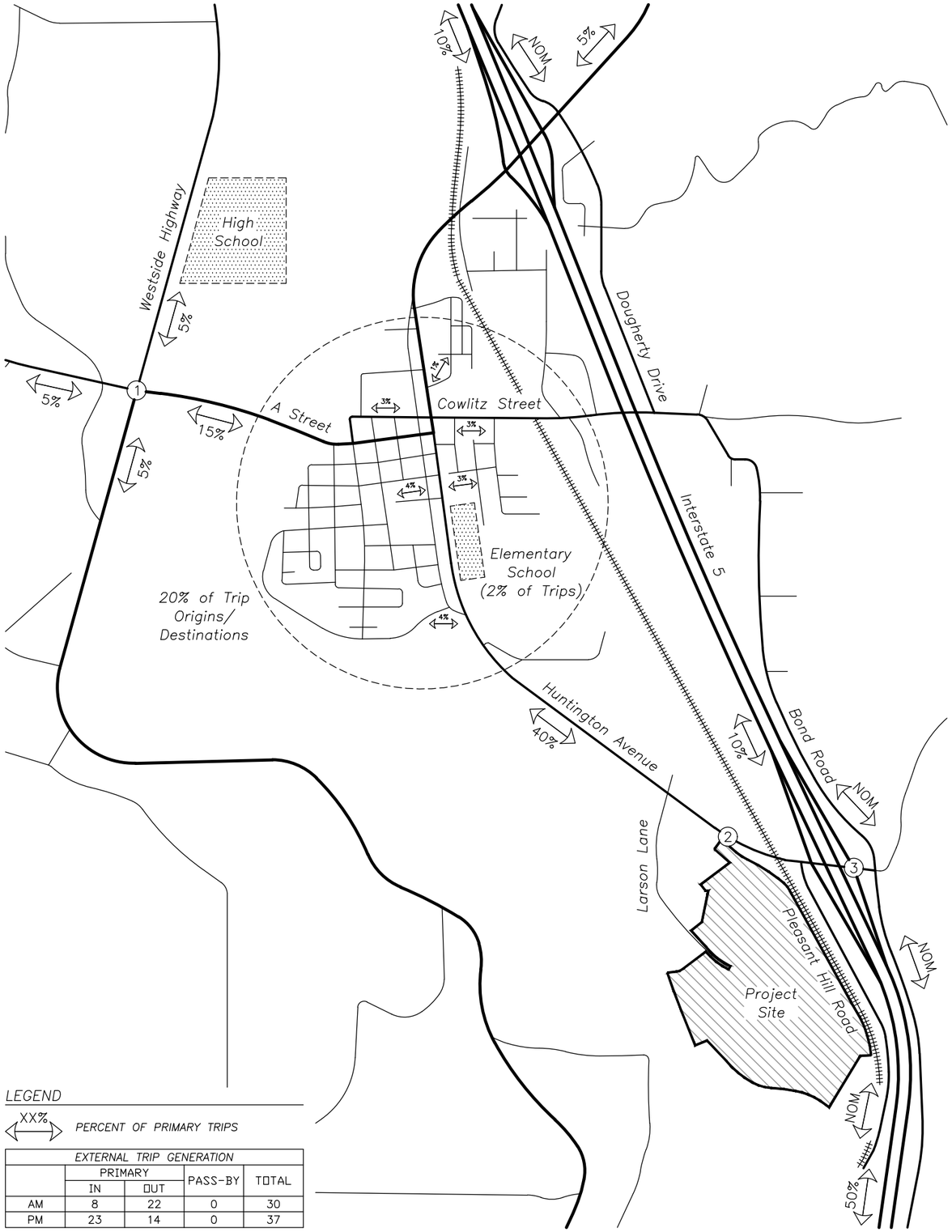
	Enter	Exit	Total
Directional Split	50%	50%	
Trip Ends	212	212	424

SATURDAY

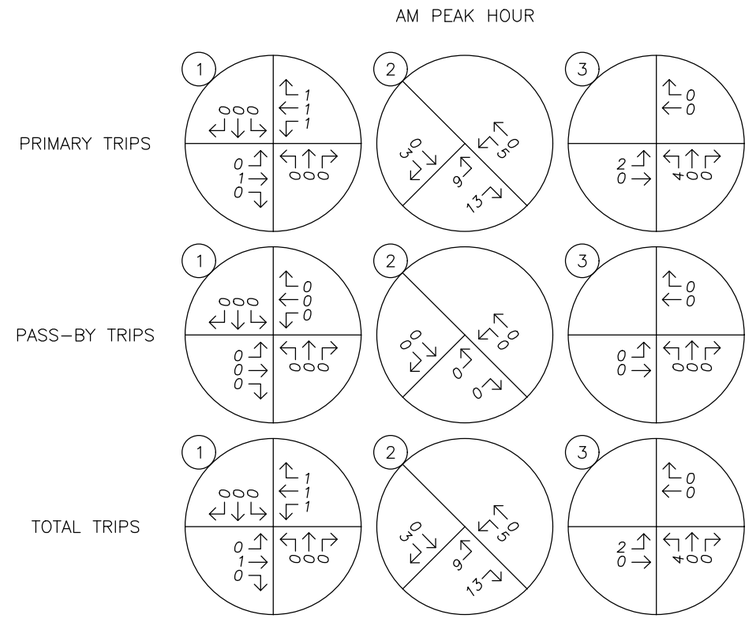
Trip Rate: 9.48

	Enter	Exit	Total
Directional Split	50%	50%	
Trip Ends	213	213	426

Source: Trip Generation Manual, 11th Edition



EXTERNAL TRIP GENERATION				
	PRIMARY		PASS-BY	TOTAL
	IN	OUT		
AM	8	22	0	30
PM	23	14	0	37



No Scale

SITE TRIP DISTRIBUTION & ASSIGNMENT

Proposed Development Plan - Total External Site Trips

AM & PM Peak Hours

lancaster mobley

Figure 1

River's Edge on the Landing Subdivision

3/7/2025

1130 SW Morrison St., Suite 318
Portland, OR 97205
503.248.0313
lancastermobley.com

Memorandum

To: **Shane Tapani**
CT6, LLC

From: **Daniel Stumpf, PE**

Date: **January 14, 2025**

Subject: **SR-411 at Westside Highway – Mitigation Analysis**
Due Diligence Analysis Memorandum

Introduction

This memorandum reports the findings of a due diligence analysis conducted for the Landing on the Cowlitz (LOTC) Master Plan area and subsequent development that will occur on-site. Specifically, this analysis reviews operation and potential mitigation at the intersection of SR-411 at Westside Highway. Prior study of the intersection was found it to exceed WSDOT mobility standards during the PM peak hour by year 2043 without impacts from the LOTC project.

Analysis items reviewed in this study include the following:

- Determine what year the intersection will operate in excess of WSDOT standards when considering both general traffic growth in the area in conjunction with added site trips.
- Review potential mitigation at the intersection that will allow for acceptable operation with full site buildout under year 2043 conditions.

The analysis conducted in this study focuses specifically on the PM peak hour since the intersection was found to operate acceptably during the AM peak hour under year 2043 conditions with full buildout of the project site. All potential mitigative measures reviewed in this study are not expected to worsen intersection operation during the AM peak hour to levels below WSDOT mobility standards.

Detailed information on traffic volume projections and level of service calculations are included as attachments to this memorandum.

Intersection Failure Year

The intersection of SR-411 at Westside Highway operates under the jurisdiction of WSDOT, where WSDOT mobility standards require the intersection operate at Level of Service (LOS) C or better. According to the *Landing on the Cowlitz Master Plan Development Agreement Transportation Impact Study* (TIS), dated November 13, 2023, the intersection of SR-411 at Westside Highway is projected to operate in excess of this LOS C standard during the PM peak hour by year 2043, without added impacts from the LOTC Master Plan area. To determine what year the intersection may exceed standards when considering both general traffic volume growth in the area and added impacts from future development withing LOTC Master Plan area, the following methodology was used:

- Traffic volumes, trip generation/distribution methodologies, and growth assumptions used in the 2023 TIS were referenced and utilized in developing volumes at the intersection of SR-411 at Westside Highway. These assumptions/data include the following:
    - PM peak hour counts were collected on Tuesday, October 17, 2023, from 4:00 PM to 6:00 PM.
    - A compounding annual growth rate of 2% per year over a 20-year period was applied to the collected 2023 traffic counts to estimate future year 2043 conditions.
    - With full buildout of the LOTC Master Plan area, the intersection is projected to be impacted by up to 174 PM peak hour trips.
    - Trips traveling between the intersection and project site will do so via SR-411 to the east. From the intersection approximately 5% of trips will travel to/from the north intersection leg, 5% of trips to/from the south leg, and 5% of trips to/from the west leg.
- Intersection volumes were estimated for each year between 2023 and 2043 by:
    - Applying a 2% compounding growth factor to the collected counts for each year after 2023.
    - Assuming 5% of the of the LOTC Master Plan area will be developed each year after 2023 until full buildout in 2043. The peak hour trips impacting the intersection were adjusted accordingly based on the percentage of site buildout.
- Intersection volumes for each year between 2023 and 2043 were inputted into a Trafficware Synchro/SimTraffic capacity analysis model to determine when the intersection will operate in excess of LOS C standards.

Based on the analysis findings, the SR-411 at Westside Highway intersection is projected to operate in excess of LOS C by year 2037 with approximately 70% of the LOTC Master Plan area developed.

The LOS, delay, and v/c results of the 2036 and 2037 capacity analyses are shown in Table 1 for the PM peak hour. The traffic volume projections and capacity reports are included as an attachment to this memorandum.

Table 1: 2036 and 2037 Intersection Capacity Analysis Summary

Analysis Scenario		PM Peak Hour		
Year	Percent of Site Buildout	LOS	Delay (s)	v/c
1. SR-411 at Westside Highway				
2036 Conditions	65%	C	23	0.81
2037 Conditions	70%	**D**	27	0.86

Table Notes: ***BOLDED*** *text indicates intersection operates in excess of agency standards.*

Mitigation Analysis

Under the existing lane and traffic control configuration, the intersection of SR-411 at Westside Highway was found to operate at LOS F during the PM peak hour under year 2043 conditions with full buildout of the site. In order to meet WSDOT's LOS C standard, three potential mitigative measures were considered and evaluated for the intersection. These measures include the following:

1. Add additional travel lanes at critical intersection approaches and turning movements.
2. Install a traffic signal with no revisions to intersection approach lanes.
3. Install a single-lane roundabout.

A fourth mitigative measure was initially considered which involved converting the all-way stop-controlled intersection to two-way stop-controlled by either removing the northbound/southbound stop signs or eastbound/westbound stop signs. Such mitigation was found infeasible given the highest volume intersection approaches during the PM peak hour were the northbound and westbound approaches, and no practical number of lane additions will allow the intersection to operate at LOS C or better.

Mitigation 1: Add Lanes

Focusing on the PM peak hour, the most critical and highest demand intersection approaches from greatest to least were 1) the westbound approach, 2) the northbound approach, 3) the southbound approach, and 4) the eastbound approach. Dedicated turn lanes were added to highest volume left or right turn movements of each approach until an LOS C result was obtained. The following intersection configuration was found to be necessary:

- Northbound and Westbound Approaches: Install a dedicated right-turn lane and revise the existing travel lane to serve both left-turn and through traffic.
- Southbound and Eastbound Approaches: No changes.

The aforementioned lane configuration is the most efficient design found to improve intersection operation to acceptable standards. However, alternative lane configuration designs that will still satisfy WSDOT standards are available. If obtaining adequate right-of-way or designing the intersection as described above in not practical, these alternative lane configuration designs can be further explored at your request.

Mitigation 2: Install a Traffic Signal

Based on a preliminary review of traffic signal Warrant 1 in the *Manual on Uniform Traffic Control Devices*, a traffic signal is projected to be warranted at the intersection by year 2037 with 70% of the LOTC Master Plan area development. Note the intersection is projected to trigger signal warrants by year 2043 without any added trips from the project site. Therefore, the installation of a signal at this intersection is reasonable.

Without revising the existing intersection lane configuration, the installation of a traffic signal will allow the intersection to operate at LOS B during the PM peak hour.

Mitigation 3: Install a Single-Lane Roundabout

The third reviewed mitigation would include reconstructing the intersection as a single-lane roundabout. The existing paved area of the intersection could potentially accommodate a roundabout with an outer radius of approximately 45 to 50 feet (90 to 100-foot inscribed diameter). This outer radius is sufficient to design either a mini-roundabout or a smaller roundabout with an inner radius of approximately 25 to 30 feet (50 to 60-foot diameter) with a circulating lane width of 20 feet.

Assuming the intersection is reconstructed as a single-lane roundabout, the intersection is projected to operate at LOS A during the PM peak hour.

Analysis Summary

The LOS, delay, and v/c results of each mitigation analysis scenario is shown in Table 2 for the PM peak hour. A figure depicting the 2043 buildout year volumes in the LOTC TIS is included in the attachments to this memorandum for reference purposes. The capacity reports for each mitigative analysis scenario and the preliminary signal warrant calculations are included in the attachments.

Table 2: Mitigation Capacity Analysis Summary

Analysis Scenario		PM Peak Hour		
Year	Mitigation	LOS	Delay (s)	v/c
1. SR-411 at Westside Highway				
2043 Site Buildout Conditions	None	**F**	60	1.11
2043 Site Buildout Conditions	Added NB & WB RT Lanes	C	21	0.68
2043 Site Buildout Conditions	Traffic Signal	B	12	-
2043 Site Buildout Conditions	Roundabout	A	9	0.59

Table Notes: ***BOLDED*** *text indicates intersection operates in excess of agency standards.*

Conclusions

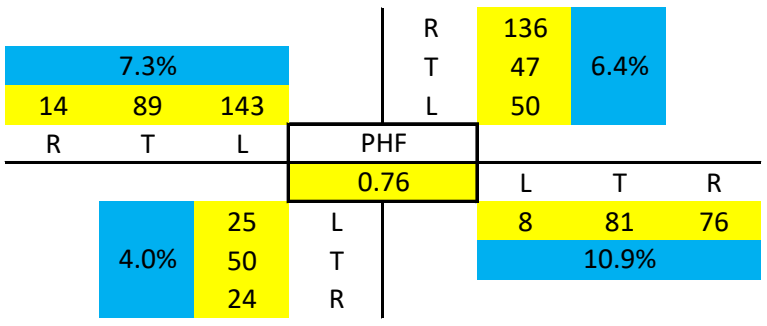
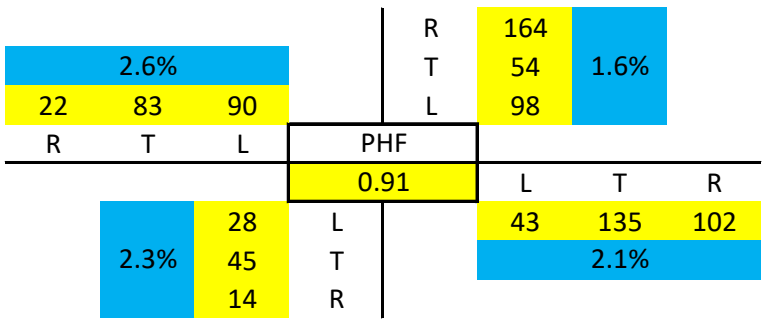
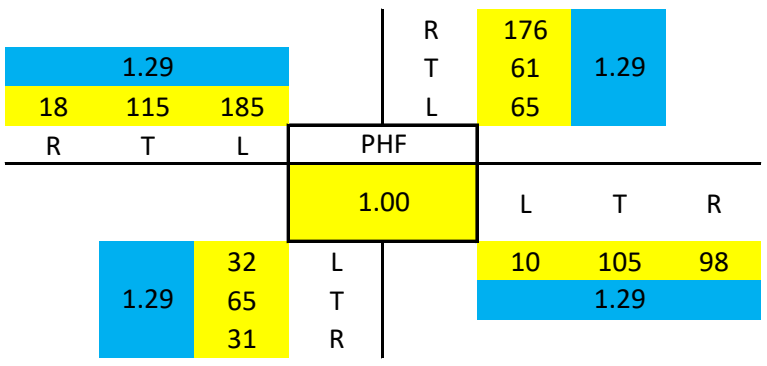
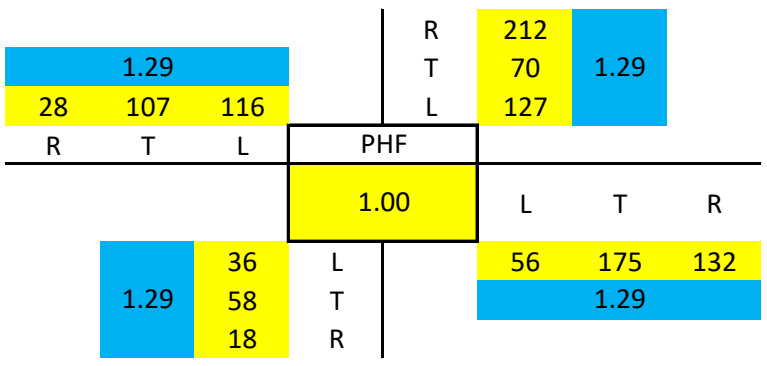
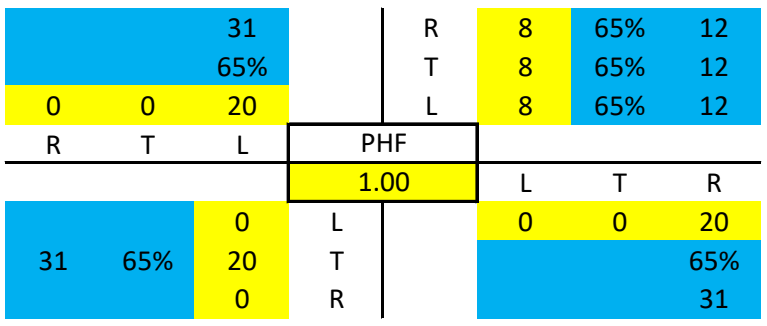
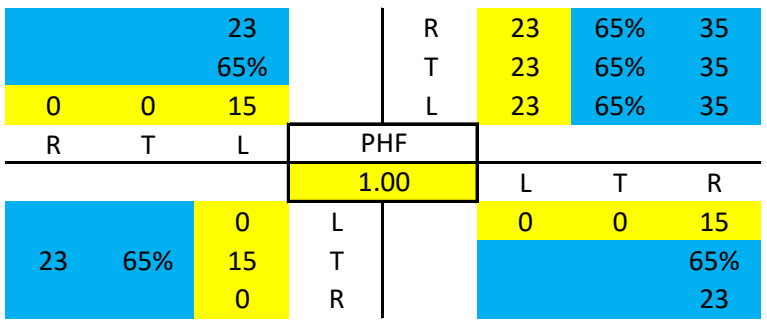
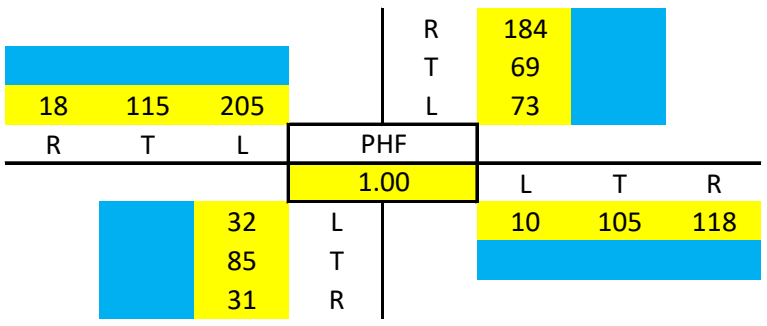
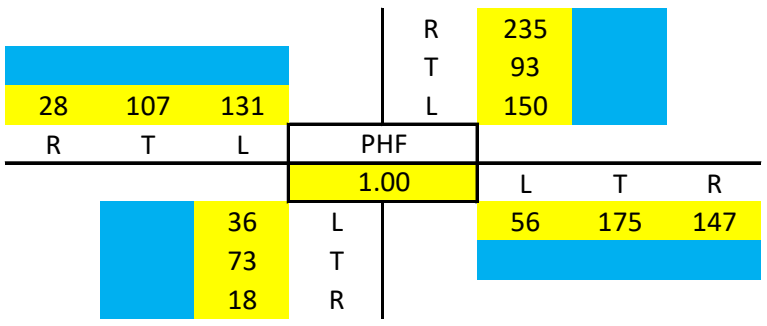
The intersection of SR-411 at Westside Highway is projected to operate in excess of WSDOT's LOS C standard by year 2037 with approximately 70% of the LOTC Master Plan area developed.

Potential mitigation that will allow the intersection to operate acceptably with full buildout of the LOTC Master Plan area may include the following:

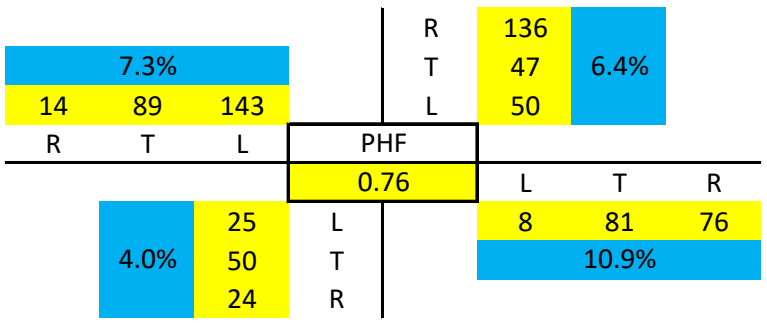
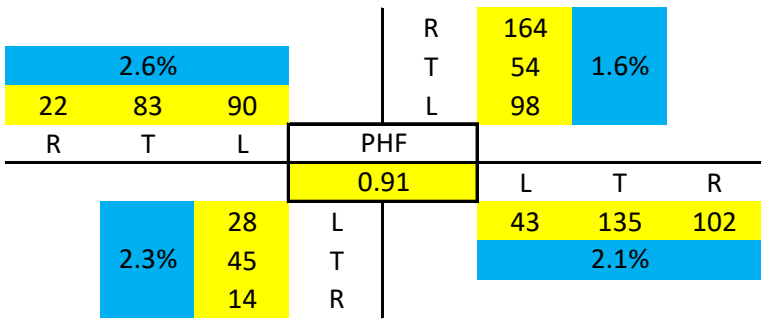
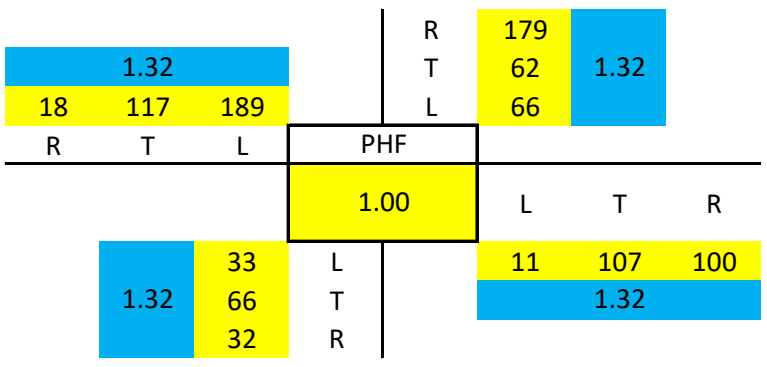
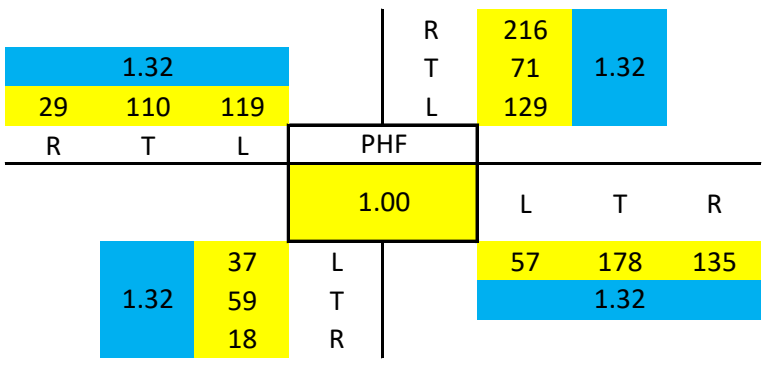
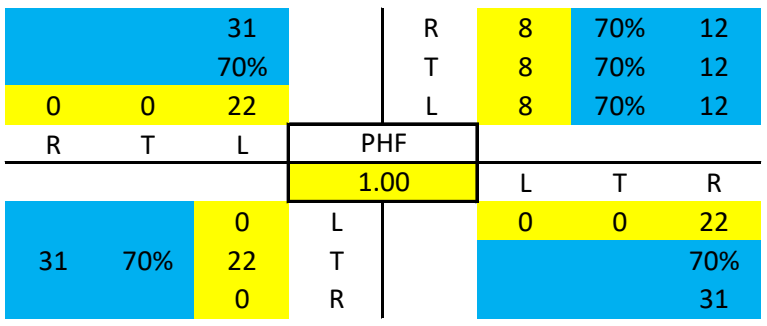
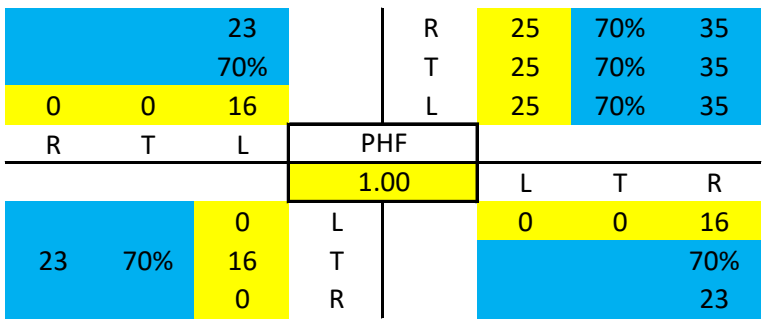
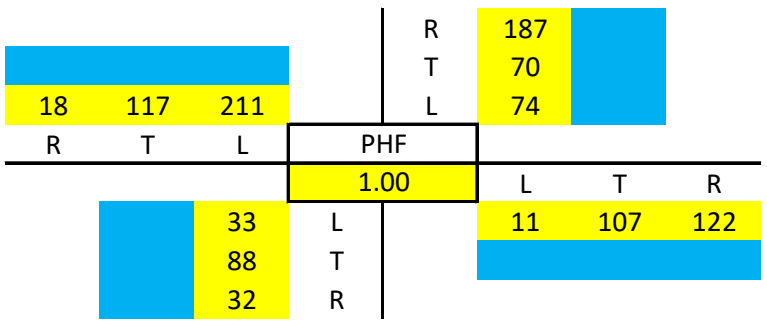
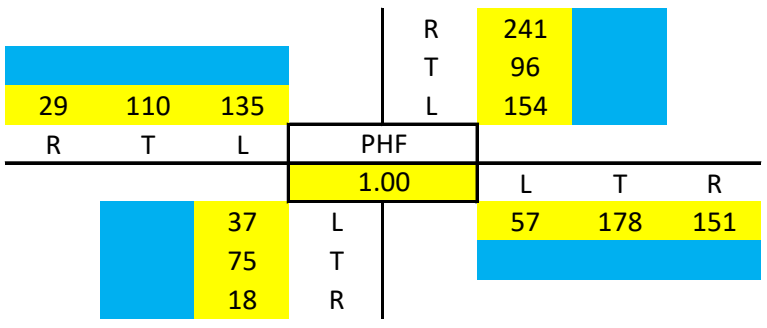
- Install dedicated right-turn lanes on the northbound and westbound intersection approaches. Note, alternative intersection lane configuration designs can be explored if this suggested design is not practical.
- Install a traffic signal at the intersection. No changes to intersection approach lanes or geometry are necessary.
- Reconstruct the intersection as either mini-roundabout or a smaller roundabout.

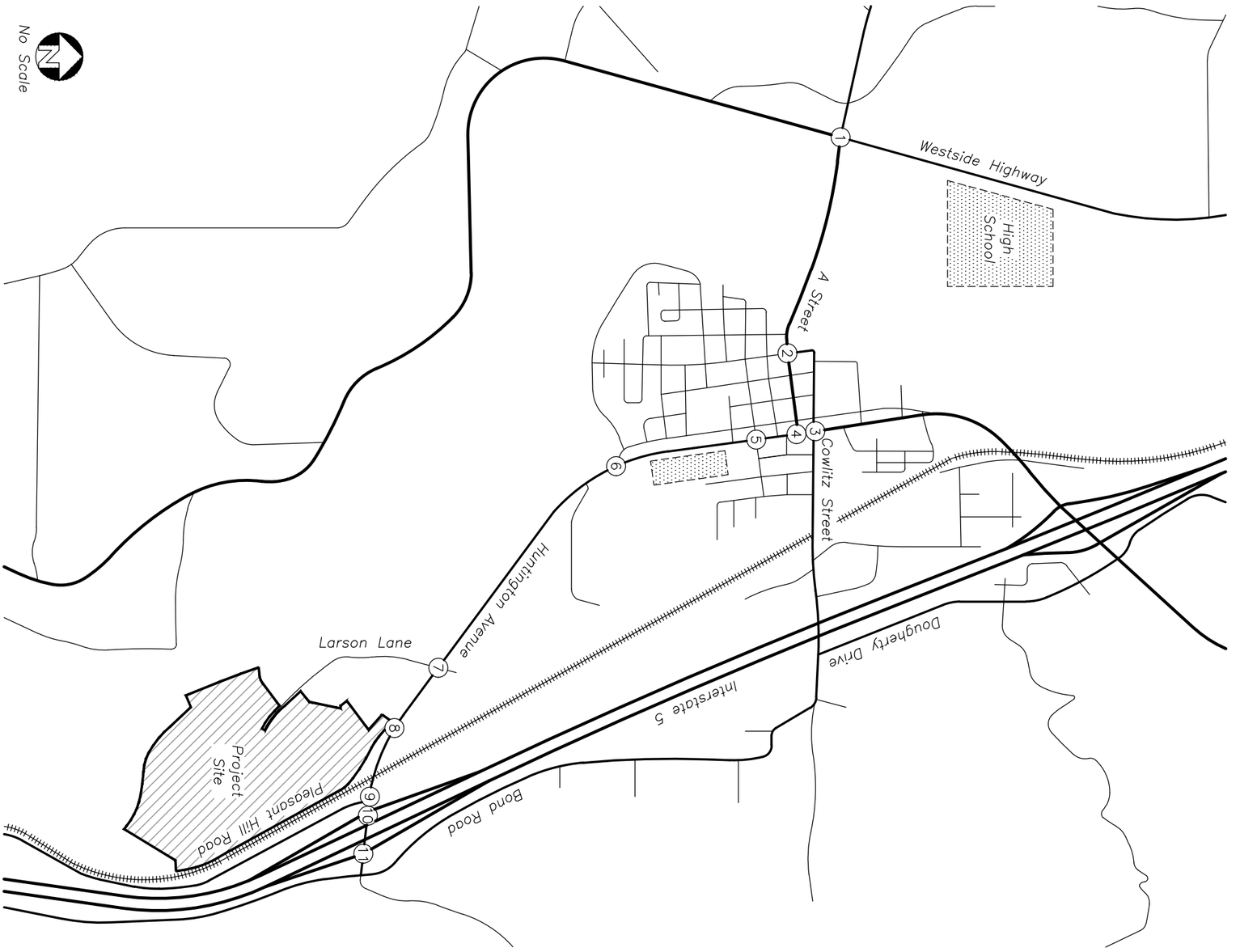
If you have any questions or concerns regarding this analysis, please don't hesitate to contact me.

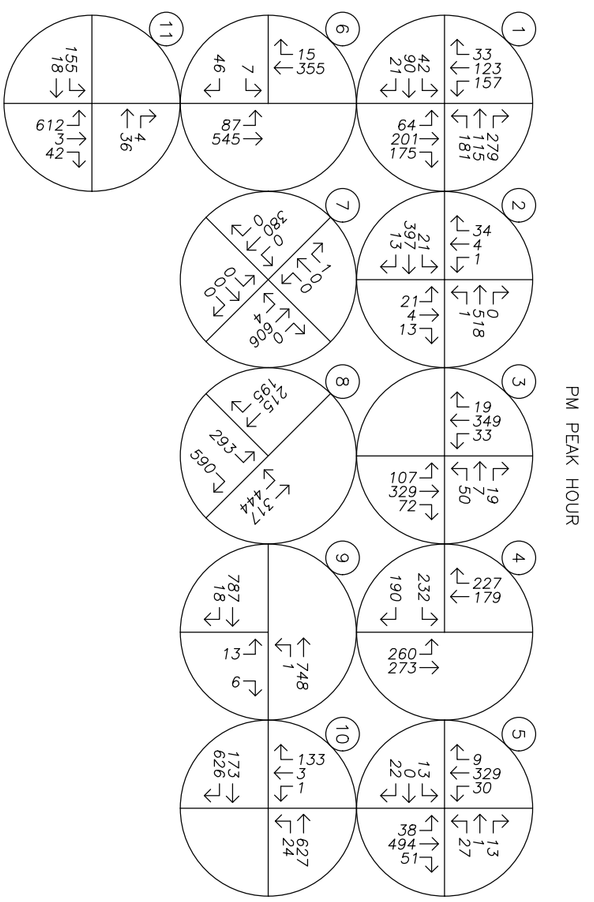
Year 2036 Traffic Volumes (13 Years of Growth and 65% Site Buildout)

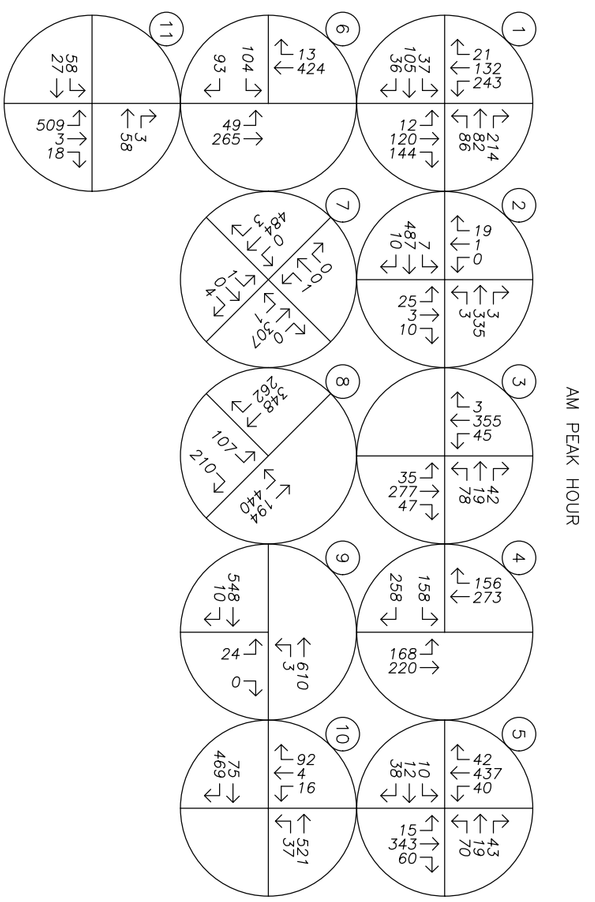
	1. SR-411 & Westside Highway AM Peak Hour	1. SR-411 & Westside Highway PM Peak Hour
Existing Conditions (Blue: Heavy Vehicle Percentages)		
Background Conditions (Blue: Growth Factor) Year? (1-20) 13 1.29360663		
External Site Trips (Blue: Full Buildout Trips and Assumed Percentage of Site Buildout) Year? (1-20) 13 % Built 65%		
Buildout Conditions		

Year 2037 Traffic Volumes (14 Years of Growth and 70% Site Buildout)

	1. SR-411 & Westside Highway AM Peak Hour	1. SR-411 & Westside Highway PM Peak Hour
Existing Conditions (Blue: Heavy Vehicle Percentages)		
Background Conditions (Blue: Growth Factor) Year? (1-20) 14 1.319478763		
External Site Trips (Blue: Full Buildout Trips and Assumed Percentage of Site Buildout) Year? (1-20) 14 % Built 70%		
Buildout Conditions		







TRAFFIC VOLUMES

Year 2043 Buildout Conditions

AM & PM Peak Hours

Figure 6

Landing on the Cowlitz Master Plan

11/13/2023

Traffic Signal Warrant Analysis

Project: SR-411 at Westside Highway Mitigation Analysis
Date: 1/13/2025
Scenario: 2037 Traffic Volumes (70% Site Buildout)

Major Street:	North/South Approaches	Minor Street:	East/West Approaches
Number of Lanes:	1	Number of Lanes:	1
PM Peak Hour Volumes:	660	PM Peak Hour Volumes:	431

Warrant Used:

_____	100 percent of standard warrants used
X	70 percent of standard warrants used due to 85th percentile speed in excess of 40 mph or isolated community with population less than 10,000.

Number of Lanes for Moving Traffic on Each Approach:		ADT on Major St. (total of both approaches)		ADT on Minor St. (higher-volume approach)	
WARRANT 1, CONDITION A		100%	70%	100%	70%
Major St.	Minor St.	Warrants	Warrants	Warrants	Warrants
1	1	8,850	6,200	2,650	1,850
2 or more	1	10,600	7,400	2,650	1,850
2 or more	2 or more	10,600	7,400	3,550	2,500
1	2 or more	8,850	6,200	3,550	2,500
WARRANT 1, CONDITION B					
1	1	13,300	9,300	1,350	950
2 or more	1	15,900	11,100	1,350	950
2 or more	2 or more	15,900	11,100	1,750	1,250
1	2 or more	13,300	9,300	1,750	1,250

Note: ADT volumes assume 8th highest hour is 5.6% of the daily volume

	Approach Volumes	Minimum Volumes	Is Signal Warrant Met?
Warrant 1			
Condition A: Minimum Vehicular Volume			
Major Street	6,600	6,200	
Minor Street*	4,310	1,850	**Yes**
Condition B: Interruption of Continuous Traffic			
Major Street	6,600	9,300	
Minor Street*	4,310	950	**No**
Combination Warrant			
Major Street	6,600	7,440	
Minor Street*	4,310	1,480	**No**

* Minor street right-turning traffic volumes reduced by 25%

Traffic Signal Warrant Analysis

Project: SR-411 at Westside Highway Mitigation Analysis
Date: 1/13/2025
Scenario: 2043 Traffic Volumes (0% Site Buildout)

Major Street:	North/South Approaches	Minor Street:	East/West Approaches
Number of Lanes:	1	Number of Lanes:	1
PM Peak Hour Volumes:	707	PM Peak Hour Volumes:	409

Warrant Used:

	100 percent of standard warrants used
X	70 percent of standard warrants used due to 85th percentile speed in excess of 40 mph or isolated community with population less than 10,000.

Number of Lanes for Moving Traffic on Each Approach:		ADT on Major St. (total of both approaches)		ADT on Minor St. (higher-volume approach)	
WARRANT 1, CONDITION A		100%	70%	100%	70%
Major St.	Minor St.	Warrants	Warrants	Warrants	Warrants
1	1	8,850	6,200	2,650	1,850
2 or more	1	10,600	7,400	2,650	1,850
2 or more	2 or more	10,600	7,400	3,550	2,500
1	2 or more	8,850	6,200	3,550	2,500
WARRANT 1, CONDITION B					
1	1	13,300	9,300	1,350	950
2 or more	1	15,900	11,100	1,350	950
2 or more	2 or more	15,900	11,100	1,750	1,250
1	2 or more	13,300	9,300	1,750	1,250

Note: ADT volumes assume 8th highest hour is 5.6% of the daily volume

	Approach Volumes	Minimum Volumes	Is Signal Warrant Met?
Warrant 1			
Condition A: Minimum Vehicular Volume			
Major Street	7,070	6,200	
Minor Street*	4,090	1,850	**Yes**
Condition B: Interruption of Continuous Traffic			
Major Street	7,070	9,300	
Minor Street*	4,090	950	**No**
Combination Warrant			
Major Street	7,070	7,440	
Minor Street*	4,090	1,480	**No**

* Minor street right-turning traffic volumes reduced by 25%

Intersection	
Intersection Delay, s/veh	23.1
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	36	73	18	150	93	235	56	175	147	131	107	28
Future Vol, veh/h	36	73	18	150	93	235	56	175	147	131	107	28
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	3	3	3
Mvmt Flow	36	73	18	150	93	235	56	175	147	131	107	28
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay, s/veh	12.9	30.6	21.4	16.8
HCM LOS	B	D	C	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	15%	28%	31%	49%
Vol Thru, %	46%	57%	19%	40%
Vol Right, %	39%	14%	49%	11%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	378	127	478	266
LT Vol	56	36	150	131
Through Vol	175	73	93	107
RT Vol	147	18	235	28
Lane Flow Rate	378	127	478	266
Geometry Grp	1	1	1	1
Degree of Util (X)	0.667	0.258	0.812	0.506
Departure Headway (Hd)	6.353	7.326	6.117	6.847
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	563	493	588	521
Service Time	4.438	5.326	4.194	4.942
HCM Lane V/C Ratio	0.671	0.258	0.813	0.511
HCM Control Delay, s/veh	21.4	12.9	30.6	16.8
HCM Lane LOS	C	B	D	C
HCM 95th-tile Q	5	1	8.1	2.8

Intersection	
Intersection Delay, s/veh	26.7
Intersection LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	37	75	18	154	96	241	57	178	151	135	110	29
Future Vol, veh/h	37	75	18	154	96	241	57	178	151	135	110	29
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	3	3	3
Mvmt Flow	37	75	18	154	96	241	57	178	151	135	110	29
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay, s/veh	13.4	37	24	18.2
HCM LOS	B	E	C	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	15%	28%	31%	49%
Vol Thru, %	46%	58%	20%	40%
Vol Right, %	39%	14%	49%	11%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	386	130	491	274
LT Vol	57	37	154	135
Through Vol	178	75	96	110
RT Vol	151	18	241	29
Lane Flow Rate	386	130	491	274
Geometry Grp	1	1	1	1
Degree of Util (X)	0.707	0.272	0.863	0.539
Departure Headway (Hd)	6.594	7.52	6.328	7.088
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	548	476	574	507
Service Time	4.624	5.59	4.35	5.149
HCM Lane V/C Ratio	0.704	0.273	0.855	0.54
HCM Control Delay, s/veh	24	13.4	37	18.2
HCM Lane LOS	C	B	E	C
HCM 95th-tile Q	5.6	1.1	9.5	3.2

Intersection	
Intersection Delay, s/veh	59.8
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	42	90	21	181	115	279	64	201	175	157	123	33
Future Vol, veh/h	42	90	21	181	115	279	64	201	175	157	123	33
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	3	3	3
Mvmt Flow	42	90	21	181	115	279	64	201	175	157	123	33
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay, s/veh	16.7	101.5	43.8	26.6
HCM LOS	C	F	E	D

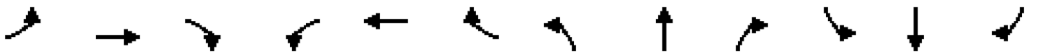
Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	15%	27%	31%	50%
Vol Thru, %	46%	59%	20%	39%
Vol Right, %	40%	14%	49%	11%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	440	153	575	313
LT Vol	64	42	181	157
Through Vol	201	90	115	123
RT Vol	175	21	279	33
Lane Flow Rate	440	153	575	313
Geometry Grp	1	1	1	1
Degree of Util (X)	0.874	0.357	1.117	0.674
Departure Headway (Hd)	7.584	8.849	6.995	8.229
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	480	409	518	441
Service Time	5.584	6.849	5.067	6.229
HCM Lane V/C Ratio	0.917	0.374	1.11	0.71
HCM Control Delay, s/veh	43.8	16.7	101.5	26.6
HCM Lane LOS	E	C	F	D
HCM 95th-tile Q	9.3	1.6	18.8	4.9

Intersection	
Intersection Delay, s/veh	20.5
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	42	90	21	181	115	279	64	201	175	157	123	33
Future Vol, veh/h	42	90	21	181	115	279	64	201	175	157	123	33
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	3	3	3
Mvmt Flow	42	90	21	181	115	279	64	201	175	157	123	33
Number of Lanes	0	1	0	0	1	1	0	1	1	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	1	1	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	2	1	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	1	2	1
HCM Control Delay, s/veh	16.3	20.6	17.8	26.3
HCM LOS	C	C	C	D

Lane	NBLn1	NBLn2	EBLn1	WBLn1	WBLn2	SBLn1
Vol Left, %	24%	0%	27%	61%	0%	50%
Vol Thru, %	76%	0%	59%	39%	0%	39%
Vol Right, %	0%	100%	14%	0%	100%	11%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	265	175	153	296	279	313
LT Vol	64	0	42	181	0	157
Through Vol	201	0	90	115	0	123
RT Vol	0	175	21	0	279	33
Lane Flow Rate	265	175	153	296	279	313
Geometry Grp	5	5	4b	5	5	4b
Degree of Util (X)	0.576	0.339	0.359	0.645	0.528	0.683
Departure Headway (Hd)	7.822	6.977	8.457	7.844	6.811	7.857
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	461	515	424	459	527	460
Service Time	5.59	4.745	6.55	5.612	4.579	5.926
HCM Lane V/C Ratio	0.575	0.34	0.361	0.645	0.529	0.68
HCM Control Delay, s/veh	20.8	13.3	16.3	23.9	17	26.3
HCM Lane LOS	C	B	C	C	C	D
HCM 95th-tile Q	3.6	1.5	1.6	4.5	3.1	5



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	42	90	21	181	115	279	64	201	175	157	123	33
Future Volume (veh/h)	42	90	21	181	115	279	64	201	175	157	123	33
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		0.99	0.99		0.99	0.99		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1856	1856	1856
Adj Flow Rate, veh/h	42	90	21	181	115	279	64	201	175	157	123	33
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	3	3	3
Cap, veh/h	244	477	97	295	174	335	153	292	228	315	222	48
Arrive On Green	0.45	0.45	0.45	0.45	0.45	0.45	0.34	0.34	0.34	0.34	0.34	0.34
Sat Flow, veh/h	300	1066	217	406	388	748	161	868	679	552	661	143
Grp Volume(v), veh/h	153	0	0	575	0	0	440	0	0	313	0	0
Grp Sat Flow(s),veh/h/ln	1583	0	0	1542	0	0	1708	0	0	1356	0	0
Q Serve(g_s), s	0.0	0.0	0.0	10.8	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	2.1	0.0	0.0	13.5	0.0	0.0	9.3	0.0	0.0	7.8	0.0	0.0
Prop In Lane	0.27		0.14	0.31		0.49	0.15		0.40	0.50		0.11
Lane Grp Cap(c), veh/h	819	0	0	804	0	0	673	0	0	586	0	0
V/C Ratio(X)	0.19	0.00	0.00	0.71	0.00	0.00	0.65	0.00	0.00	0.53	0.00	0.00
Avail Cap(c_a), veh/h	1132	0	0	1125	0	0	1042	0	0	876	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	6.9	0.0	0.0	10.0	0.0	0.0	12.3	0.0	0.0	11.5	0.0	0.0
Incr Delay (d2), s/veh	0.1	0.0	0.0	1.3	0.0	0.0	1.1	0.0	0.0	0.8	0.0	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	0.0	0.0	3.2	0.0	0.0	2.9	0.0	0.0	1.9	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	7.0	0.0	0.0	11.3	0.0	0.0	13.3	0.0	0.0	12.3	0.0	0.0
LnGrp LOS	A			B			B			B		
Approach Vol, veh/h		153			575			440			313	
Approach Delay, s/veh		7.0			11.3			13.3			12.3	
Approach LOS		A			B			B			B	

Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		18.5		23.2		18.5		23.2				
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5				
Max Green Setting (Gmax), s		23.5		27.5		23.5		27.5				
Max Q Clear Time (g_c+I1), s		11.3		4.1		9.8		15.5				
Green Ext Time (p_c), s		2.2		0.8		1.7		3.1				

Intersection Summary												
HCM 7th Control Delay, s/veh			11.7									
HCM 7th LOS			B									

Intersection	
Intersection Delay, s/veh	9.3
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	153	575	440	313
Demand Flow Rate, veh/h	156	587	449	323
Vehicles Circulating, veh/h	474	313	297	367
Vehicles Exiting, veh/h	216	433	333	533
Ped Vol Crossing Leg, #/h	10	0	0	5
Ped Cap Adj	0.999	1.000	1.000	0.999
Approach Delay, s/veh	6.2	11.6	8.6	7.6
Approach LOS	A	B	A	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
A (Intercept)	1380	1380	1380	1380
B (Slope)	1.02e-3	1.02e-3	1.02e-3	1.02e-3
Entry Flow, veh/h	156	587	449	323
Cap Entry Lane, veh/h	851	1003	1019	949
Entry HV Adj Factor	0.982	0.979	0.980	0.970
Flow Entry, veh/h	153	575	440	313
Cap Entry, veh/h	834	982	999	920
V/C Ratio	0.184	0.585	0.441	0.341
Control Delay, s/veh	6.2	11.6	8.6	7.6
LOS	A	B	A	A
95th %tile Queue, veh	1	4	2	2

After Recording Return To:

CT6, LLC
PO Box 1419
Battle Ground, WA 98604

MASTER DECLARATION OF COVENANTS, CONDITIONS, RESTRICTIONS AND EASEMENTS
LANDING ON THE COWLITZ MASTER PLAN
LANDING ON THE COWLITZ MASTER ASSOCIATION

DRAFT

4906-8558-6734.1

MASTER DECLARATION OF COVENANTS, CONDITIONS, RESTRICTIONS AND EASEMENTS
LANDING ON THE COWLITZ MASTER PLAN
LANDING ON THE COWLITZ MASTER ASSOCIATION

This Master Declaration of Covenants, Conditions, Restrictions and Easements is made by CT6, LLC, as the Declarant and owner of the Property described below.

A. Declarant is the owner of real property located in the Cowlitz County, Washington, described in **Exhibit A** and illustrated in **Exhibit A-1**, attached and incorporated by reference into this Declaration (Property). The Property is comprised of the real property legally described in **Exhibit A** and any other real property added by an amendment to this Declaration according to the procedures in this Declaration**.** Declarant is developing property within the master planned community (Master Community) on the Property in accordance with the Landing on the Cowlitz Master Plan (Master Plan) approved by the City of Castle Rock on November 8, 2021, and in accordance with the Development Agreement dated February 20, 2024, a memorandum of which was recorded on May 3, 2024, under Cowlitz County Auditor's File No. 3751162.

B. Declarant plans to develop, own and convey the Property subject to these covenants, conditions, restrictions and easements and subject to any other matters of record.

C. Declarant hereby declares that all of the Property will be held, leased, encumbered, used, occupied, improved, sold and conveyed subject to the following covenants, conditions, restrictions, reservations and easements, all and each of which are for the purpose of enhancing and perfecting the value, desirability, and attractiveness of the Property, in furtherance of a general plan for the protection of the Property. All and each of these covenants, conditions, restrictions, and easements are hereby imposed as equitable servitudes upon the Property. They will run with the Property, and every portion of the Property, will be binding on all parties having or acquiring any right, title or interest in the Property, and every portion of the Property, and their lessees, guests, heirs, successors and assigns, will inure to the benefit of every portion of the Property and any interest therein, will inure to the benefit of each Owner, and his or her heirs, successors and assigns, and may be enforced by the Owners, the Association and Declarant in accordance with the terms of this Declaration. Acceptance of any portion of the Property will be deemed acceptance of the terms and provisions of this Declaration.

DRAFT

NARRATIVE AND PURPOSE

The Landing on the Cowlitz Master Plan, adopted by the City of Castle Rock on November 8, 2021, in Ordinance 2021-10, encompasses a total area of approximately 118 acres. The approved Master Plan is for a large scale industrial, commercial, residential, and recreational mixed-used development. The goal of the Landing on the Cowlitz Master Plan is to provide a mixed-use community offering prospective owners a place to live, work and play.

The Landing on the Cowlitz Master Plan will include several different types of residential housing and industrial and commercial buildings. In addition, the area includes parks, open spaces, water quality facilities, pathways, and other recreational facilities that serve the entire community on a community-wide basis. These community-wide features, along with the diversity of housing and land use, require the adoption of this Master Declaration and other documents and the creation of an organization responsible for the management of all amenities and utilities deemed “community-wide” by the Declarant. Additionally, the Declarant finds that the creation of a master association will assist in the individual development of parcels throughout the Master Plan area at the direction of the Declarant.

Therefore, Declarant hereby declares the creation of the Landing on the Cowlitz Master Association (Master Association) and this Master Declaration for the purpose of providing governance for the Landing on the Cowlitz Master Plan Area subject to this Declaration and the active management of all regional amenities, utilities and facilities.

ARTICLE 1. DEFINITIONS

The following words, when used in this Declaration, and in any amendment to this Declaration, have the following meanings unless otherwise expressly provided in this Declaration or an amendment:

1.1 "Articles" means the Articles of Incorporation of the Association which have been or will be filed in the office of the Secretary of State of the State of Washington, as such Articles may be amended from time to time.

1.2 "Assessment(s)" means all assessments imposed pursuant this Declaration, including without limitation General Assessments, Capital Improvement Assessments, Special Assessments, and Reconstruction Assessments. Assessment does not include any assessments levied by a Sub Association, which assessments with be governed by the Sub Association’s Governing Documents.

1.3 "Assessment Period" means a calendar year for General Assessments, and such other period as determined by the Board for other Assessments.

1.4 "Association" means the Landing on the Cowlitz Master Association, a Washington non-profit corporation, its successors and assigns.

1.5 “Sub Association” means any other non-profit association governing a Development Parcel located within the Landing on the Cowlitz Master Plan.

1.6 "Association Lien" means a lien in favor of the Association imposed pursuant to this Declaration.

1.7 "Board of Directors" or "Board" means the Board of Directors of the Association.

1.8 "Budget" means the operating budget for the Association adopted pursuant to Section 4.4 below.

1.9 "Bylaws" mean the Bylaws of the Association, as adopted by the Board, and as may be amended from time to time.

1.10 "Capital Improvement Assessment(s)" means an Assessment imposed pursuant to Section 4.5 below.

1.11 "Capital Improvement Work" has the meaning ascribed to it in Section 4.5 below.

1.12 "Close of Escrow" means the date on which a deed conveying a Lot or Development Parcel is Recorded.

1.13 "Common Areas" mean all real property and Improvements: (a) owned, maintained or leased by the Association; (b) in which the Association has an easement for access or maintenance for the use, enjoyment, and benefit of the Members; and (c) in which the Members have a right of control by any written instrument, including this Declaration, the Master Plan or Plat, but excluding streets or other areas dedicated or conveyed to a governmental entity for public use. The Common Areas may be improved with certain common facilities and, if and when improved, will include such common facilities. If meeting the definition above, the Common Areas may include (where applicable, if and when improved) common greens and open space areas, including Improvements, street lights, street trees and other landscaping, Signs, recreational, picnic and athletic facilities, pedestrian and hiking paths and trails, bicycle paths, private alleys, irrigation systems located in public rights of way, drainage and storm water detention areas and sewer, water, storm drainage, and other utility systems located on or in the Common Areas. In addition, or specific to the above list, the Common Areas include the areas and facilities as determined by the Declarant or Board of Directors. At a minimum the Common Areas include the areas and facilities listed in **Exhibit B** in addition to the foregoing.

1.14 "Common Expenses" means all costs and expenses incurred by the Association, including, but not limited to, the following: (a) expenses of administration, maintenance, and operation, including, but not limited to, reasonable compensation to employees of the Association, (b) costs of maintenance, repair, replacement and capital improvement of the Common Areas and any Improvements, (c) premiums or deductibles for all insurance policies and bonds required or permitted by this Declaration, (d) all real property and other taxes and assessments on the Common Areas, (e) utility and service charges, (f) funding of reserves for anticipated operational shortfalls or for replacement of capital items, (g) funding of reserves for the replacement of the Common Areas and any improvements and community facilities therein, and start-up expenses and operating contingencies of a nonrecurring nature, (h) legal fees and costs, (i) the costs of recovering unpaid Assessments, including legal fees and other costs of foreclosure of an Association Lien, (j) expenses of administration, maintenance, operation, repair or replacement of landscaping performed by the Association or the

Association's agent on the Owners' Lots and Development Parcels, (k) costs payable under Section 3.5(b) below, (l) the cost of maintaining or repairing any storm water drainage system, and (m) any other costs and expenses determined from time to time as reasonably necessary by the Board to carry out the purposes of this Declaration, or as otherwise incurred by the Association pursuant to this Declaration.

1.15 "Declarant" means CT6, LLC, its successors or assigns and any Person to which it has been assigned, in whole or in part, any of its rights hereunder by an express written assignment or deed prior to the Turnover Date.

1.16 "Declaration" means this Declaration of Covenants, Conditions, Restrictions and Easements for Landing on the Cowlitz Master Association, as it may be amended from time to time.

1.17 "Development Parcel" means any division of land within the Landing on the Cowlitz Master Plan area proposed for future or current development of residential, industrial, or commercial Lots.

1.18 "Development Period" means the period of time from the date of Recording this Declaration until the Turnover Date.

1.19 "Development Rights" mean those rights of Declarant reserved throughout this Declaration. Declarant may exercise any and all Development Rights at any time during the Development Period in Declarant's sole discretion.

1.20 "General Assessment(s)" means Assessments imposed by the Association pursuant to Section 4.4 below.

1.21 "Governing Documents" means those documents identified in RCW 64.90.010(28).

1.22 "Improvement" means all structures and appurtenances thereto of every kind, whether above or below the land surface, including but not limited to, buildings dwellings, garages, utility systems, walkways, driveways, parking areas, loading areas, landscaping items, swimming pools, sports courts, fences, walls, decks, stairs, poles, landscaping vegetation, irrigation systems, Streets, Signs, exterior fixtures, playfields and appurtenant facilities, recreational facilities, play structures, picnic structures and any other structure of any kind.

1.23 "Institutional Lender" means one or more commercial or savings banks, savings and loan associations, trust companies, credit unions, industrial loan associations, insurance companies, pension funds or business trusts, including, but not limited to real estate investments trusts, any other lender regularly engaged in financing the purchase, construction, or Improvement of real estate, or any assignee of loans made by such a lender, or any private or governmental institution which has insured the loan of such a lender, including Federal Mortgage Agencies, or any combination of any of the foregoing entities.

DRAFT

1.24 "Lot" means each separate parcel, including in a recorded Plat or in a Development Parcel, to be used for construction of approved development and which is not a Common Area nor dedicated to the public.

1.25 "Majority Vote" means a vote of more than 50% of the Total Voting Power of the Association or Board.

1.26 “Map” or “Master Plan” means the Landing on the Cowlitz Master Plan and any amendments made to the Master Plan.

1.27 "Member" means every person or entity who or which holds a Membership in the Association, as provided in Section 3.8 below. "Membership" means the status of being a Member.

1.28 "Mortgage"— "Mortgagee"— "Mortgagor." A Mortgage means any recorded mortgage or deed of trust on a Lot or Development Parcel. A Mortgagee means any holder of a Mortgage and is deemed to include the beneficiary of a deed of trust. A Mortgagor means the borrower under a Mortgage and is deemed to include the trustor or grantor of a deed of trust.

1.29 "Occupant" means a tenant, lessee or licensee of an Owner or any other person or entity, other than an Owner, in lawful possession of a Lot or Development Parcel, or a portion thereof, with the permission of the Owner.

1.30 "Owner" means the Person(s), including Declarant, holding fee simple title of record to any Lot or Development Parcel, including purchasers under recorded executory contracts of sale. “Co-Owners” means more than one Owner. "Ownership" means the status of being an Owner. The Declarant is an Owner until it sells the last Lot and Development Parcel within the Property, including within additional properties added to this Declaration and the Association during the Development Period.

1.31 "Person" means a natural individual, partnership, limited liability company, company, corporation or any other entity with the legal right to hold title to real property.

1.32 "Plat" means the legally adopted and recorded subdivision of a Development Parcel within the Landing on the Cowlitz Master Plan area.

1.33 "Property" means all of the real property described in **Exhibit A** to this Declaration and all real property added by amendment of this Declaration and/or the Master Plan.

1.34 "Prorata Share" means, for any particular Owner, that portion of any Assessment it is responsible for paying.

DRAFT

1.35 "Reconstruction Assessment(s)" means an Assessment imposed pursuant to Section 11.1 below.

1.36 "Record" or "File" means, with respect to any document, the recordation thereof, and with respect to any map, the filing thereof, in the official Records of Cowlitz County, Washington.

1.37 "Signs" means any structure, device or contrivance, electric or non-electric, upon or within which any poster, bill, bulletin, printing, lettering, painting, device, or other advertising of any kind whatsoever is used placed, posted, tacked, nailed, or otherwise fastened or affixed.

1.38 "Special Assessment(s)" means an Assessment imposed as a Special Assessment pursuant to any provision of this Declaration.

1.39 "Street" means any public or private street, drive-way lane (if located in a public right of way or Common Area), place or other thoroughfare either as shown on the Master Plan or any recorded survey, plan or Plat of the Property, however designated, or as so used as a part of the Common Areas.

1.40 "Turnover Date" means the date the last of the Lots and Development Parcels have been conveyed by Declarant, including Lots and Development Parcels within additional properties added by Declarant to this Declaration prior to expiration of the Development Period; provided, however, that Declarant may accelerate the Turnover Date by recording a written notice surrendering Declarant's Development Rights arising under this Declaration.

ARTICLE 2. PHASED DEVELOPMENT; DEVELOPMENT RIGHTS

2.1 **Additional Properties**. Declarant reserves as a Development Right the right to add and subject additional properties to this Declaration at any time prior to termination of the Development Period. Declarant further reserves as a Development Right the right to withdraw Common Areas or any properties it owns from this Declaration at any time prior to termination of the Development Period. Each Owner appoints and constitutes the Declarant as his/her attorney-in-fact to unilaterally adopt and file amendments to this Declaration necessary to add or subtract such properties to and from this Declaration consistent with these Development Rights. The Declarant also has, as a Development Right, the right to extend existing easements and may create new easements over any Common Area or over any Development Parcel or Lot still within Declarant's control so as to provide access to and serve the additional properties. The rights reserved by Declarant in this Section may be exercised by Declarant at Declarant's sole discretion.

2.2 **Rights and Obligations**. The Owners of properties added to this Declaration will be Members of the Association and will be entitled to all benefits and subject to

all obligations of a Member, including, but not limited to, representation in the Association and the obligation to pay assessments as set forth in this Declaration.

2.3 **No Requirement to Include Additional Properties**. Nothing contained in this Declaration may be construed to require the Declarant to subject additional properties to this Declaration.

2.4 **Dedication to Governmental Entities**. Until the termination of the Development Period, Declarant reserves the right to dedicate, transfer or convey it to any state, county, municipal or other governmental entity the Common Areas, or any part of the Property it owns, or reserve the foregoing areas for Declarant's use and/or sale. The rights reserved by Declarant in this Section 2.4 may be exercised by Declarant at Declarant's sole discretion.

ARTICLE 3. THE ASSOCIATION

3.1 **Formation**. The Association has been, or will be, incorporated under the name of Landing on the Cowlitz Master Association, as a non-profit corporation under Revised Code of Washington, Chapter 24.03A. Declarant may change the name of the Association during the Development Period in its sole discretion.

3.1 **Development Period**. During the Development Period, the Declarant has no obligation to publish financial statements, hold meetings or otherwise account to or consent with the Members, except as required under Chapter 64.90 RCW and Chapter 24.03A RCW, or as expressly required in this Declaration. The Declarant will have full control of the Association until the Turnover Date. During the Development Period, the Declarant has the sole authority to (1) appoint or remove members of the Board of Directors who need not be Owners; (2) appoint or remove officers of Association who need not be Owners; (3) determine when to commence charging assessments; (4) veto or approve any action of the Board of Directors or Owners in its sole discretion; (5) unilaterally adopt and record amendments to this Declaration without any other Owner approval, including but not limited to amendments subjecting additional property to this Declaration, and any modified or additional restrictions; (6) adopting and amending Bylaws; (7) establishing Sub Associations and preparing, executing and recording Sub Associations' Governing Documents; and (8) adding or subtracting properties from this Declaration and the Association, as further provided in this Declaration. The Declarant's control of the Association during the Development Period is established in order to ensure that the Property and the Association will be adequately administered in the initial phases of development and to ensure an orderly transition of Association operations. Upon termination of the Development Period, administrative power and authority for management of the Common Areas will pass to the Board of Directors and Members as provided herein and in the Bylaws of the Association. RCW 64.90.300(9) and (10) regarding termination of Declarant's control of the Association apply.

DRAFT

3.2 **Bylaws**. Prior to the termination of the Development Period, the Declarant, acting pursuant to its authority to act on behalf of the Association, must adopt Bylaws.

3.3 **Board of Directors**. The Association will be managed by a Board of Directors, elected or appointed in accordance with this Declaration, the Articles, and the Bylaws of the Association.

3.4 **Delegation to Manager**. The Board may delegate any of its managerial duties, powers, or functions to any Person or entity unless prohibited by law. The Board members are not liable for any omission or improper exercise by the manager of any duty, power, or function so delegated by written instrument and entered into by the requisite vote of the Board.

3.5 **Duties and Powers of Association**. The duties and powers of the Association are those set forth in its Articles and Bylaws, together with its general and implied powers as a not for profit corporation, generally to do any and all things that a corporation organized under the laws of the State of Washington may lawfully do which are necessary or proper in operating for the peace, health, comfort, safety and general welfare of its Members, subject only to the limitations upon the exercise of such powers as are expressly set forth in its Articles, its Bylaws, the Plats, this Declaration, and the law.

(a) Purposes. Specifically, but not by way of limitation, the Association will effectuate the purposes of this Declaration, including but not limited to: (i) adopting and enforcing rules and regulations (through action of the Board pursuant to Section 3.5(c) below); (ii) adopting an operating and capital budget; (iii) controlling and administering the Association's funds, including the levy, collection, and disbursement of Assessments; and (iv) administering and enforcing this Declaration. The Association has the authority and obligation to establish, manage, repair, and administer the Common Areas. Subject to the approval of any applicable governmental agency, the Association may at any time, and from time to time, construct, reconstruct, improve, replace and/or restore any Improvement or portion thereof upon the Common Areas, and the Association may construct, reconstruct, improve and/or replace trees or other vegetation and plant trees, shrubs, ground cover and other landscaping upon the Common Areas. The Association may employ personnel necessary for the effective operation and maintenance of the Common Areas, including the employment of legal and accounting services.

(b) Operating Costs. The Association is responsible for the payment of power bills, maintenance, repair, and any other associated operating costs for the Common Areas and the Improvements thereon unless that responsibility is otherwise assigned by this Declaration, the Map or regulations of a governmental agency with jurisdiction over the same.

(c) Rules and Regulations. The Board has the power to adopt from time to time and to enforce rules and regulations governing the use of all Common Areas, whether or not expressly contemplated herein, provided that such rules and regulations are not inconsistent with this Declaration. The rules and regulations may not unreasonably differentiate among Owners. The Board may prescribe penalties for the violation of such rules and regulations,

including but not limited to suspension of the right to use the Common Areas or portions thereof, and the imposition of fines pursuant to a previously adopted schedule. Any such rules and regulations, and/or amendments, will become effective 30 days after promulgation and must be mailed to all Owners within 30 days after promulgation. A copy of the rules and regulations in force at any time will be retained by the secretary of the Association and must be available for inspection by any Owner during reasonable business hours. Such rules will have the same force and effect as if set forth in this Declaration.

3.6 **Association Priorities and Inconsistencies**. In the event of conflicts or inconsistencies between this Declaration and either the Articles or the Bylaws, the terms and provisions of this Declaration will prevail.

3.7 **Sub Association Subordination to Master Association**. Any and all Sub Associations created as part of a Development Parcel or approved Plat of a portion of the Property is automatically subordinate to the Master Association's Declaration, Bylaws and Articles unless as otherwise provided in writing by Declarant during the Development Period. In the event of conflicts or inconsistency between a Sub Association and a Master Association, the Master Association Governing Documents, as that term is defined in RCW 64.90.010(33), control. During the Development Period, the Declarant has the sole right in its discretion to create Sub Associations and prepare and execute any Governing Documents established for a Sub Association.

3.8 **Membership**. An Owner of a Lot or Development Parcel is automatically a Member of the Association and will remain a Member until such time as Ownership ceases for any reason, at which time such Membership will automatically cease. The Owners covenant and agree that the administration of the Property must be in accordance with the provisions of this Declaration, the Articles, the Bylaws and adopted Rules and Regulations. The rights, duties, privileges and obligations of all Members will be as set forth in this Declaration, the Articles, the Bylaws, the Rules and Regulations and applicable law.

3.9 **Transfer**. Membership held by any Owner may not be transferred, pledged or alienated in any way, except upon the sale or conveyance of such Owner's Lot or Development Parcel. Any attempt to make a prohibited transfer is void and will not be reflected upon the books and records of the Association.

3.10 **Voting Rights**.

(a) Voting Rights. The right to vote may not be severed or separated from any Lot or Development Parcel, and any sale, transfer or conveyance of a Lot or Development Parcel to a new Owner will operate to automatically transfer the appurtenant vote without the requirement of any expressed reference thereto. Notwithstanding the foregoing, the voting rights of any Member may be suspended as provided in this Declaration, the Articles, or the Bylaws. Member votes may be tabulated by mail, facsimile, email, or other electronic transmission.

(b) Vote Allocation. Each Lot is allocated one vote. For the purposes of the Lot that will be further divided into residential lots, that Lot is allocated one vote under this Declaration representing all future residential lots, with that vote to be cast as determined by the board of directors of the future residential subdivision homeowners association.

(c) Co-Owners. Co-Owners must, by written notice delivered to the Board, designate a voting representative for their voting rights. The Association will have no responsibility to accept any vote for a Lot or Development Parcel owned by Co-Owners, if such vote is disputed among the Co-Owners.

(d) Proxies. Members may vote at any meeting of the Association in person or by proxy as further detailed in the Bylaws.

ARTICLE 4. ASSESSMENTS

4.1 **Creation of the Lien and Personal Obligation of Assessments**. Each Owner of a Lot or Development Parcel by acceptance of a deed for the Lot or Development Parcel, whether or not it is so expressed in such deed, is deemed to covenant and agree to pay to the Association any Assessment duly levied by the Association directly or levied by a Sub Association as provided in this Declaration. Such Assessments, together with interest, costs, late charges and reasonable attorneys' fees, will also be a charge on the land and will be a continuing lien upon the Lot or Development Parcel against which each such Assessment is made. Each such Assessment, together with interest, costs, late charges, and attorneys' fees (including all such costs and fees incurred in connection with collection of the Assessment), will also be the personal obligation of the person who was the Owner of such Lot or Development Parcel at the time when the Assessment fell due. The personal obligation for delinquent Assessments will not pass to an Owner's successor in title unless the lien for such delinquent Assessments has been recorded prior to title transfer or unless expressly assumed by the successor in title; provided however, an Assessment lien need not be recorded to be a valid lien against the Lot or Development Parcel. When Ownership of a Lot or Development Parcel changes, Assessments which have been levied but are not yet due and payable in full will be prorated between the transferor and the transferee based on a 365-day year.

4.2 **Declarant's Liability for Assessments**. Declarant will not be obligated to pay any Assessment levied against any Lot or Development Parcel it owns until that Lot or Development Parcel is conveyed to a third party.

4.3 **Sub Association Liability for Collection and Payment**. Each Sub Association is responsible for the collection of Assessments due and owing under this Declaration from individual Lot or Development Parcel Owners within the jurisdiction of the Sub Association. Each Sub Association must collect the Assessments and transmit the Assessments that it has a responsibility to collect by check or wire transfer on a quarterly basis to the treasurer of the Association. Failure to collect and convey the full amount of the Assessments due from Lot or

Development Parcel Owners by the Sub Association within its jurisdiction will result in penalties as described in ARTICLE 5.

4.4 **Budget and General Assessments**.

(a) Association Budget. Except for the Initial Budget adopted by the Declarant, by October 1st of each year, the Board must prepare, or cause the preparation of, an operating budget (Budget) for the Association for each ensuing calendar year. Declarant may adopt the Initial Budget of the Association without Owner approval. Every Budget must set forth sums required by the Association, as estimated by the Board or Declarant, to meet its annual Common Expenses. Within 30 days after adoption by the Board or Declarant of any proposed regular or special Budget of the Association, the Board must set a date for a meeting of the Owners to consider ratification of the Budget not less than 14 nor more than 50 days after mailing of the summary. Unless at that meeting the Owners by a Majority Vote of the total voting power in the Association are allocated or any larger percentage specified in the Governing Documents reject the Budget, in person or by proxy, the Budget is ratified, whether or not a quorum is present. In the event the proposed Budget is rejected or the required notice is not given, the periodic Budget last ratified by the Owners will be continued until such time as the Owners ratify a subsequent Budget proposed by the Board. If during the year the Budget proves to be inadequate for any reason, including nonpayment of any assessments that a Sub Association is required to collect, the Board may prepare a supplemental Budget for the remainder of the year. A supplemental Budget that results in an increase in Assessments must be ratified by the Owners pursuant to this Section.

(b) Levy of General Assessment. In order to meet the costs and expenses projected in its Budget, the Board will determine and levy a General Assessment. Each General Assessment must be based on the gross acreage within each Sub Association's jurisdiction. Each Sub Association must then determine the amount of the Assessment that each Owner within its jurisdiction must pay as its Prorata Share of the General Assessment; provided, however that for single-family residential Sub Associations, the Assessment for each Owner will be based on the total amount of the General Assessment for the Sub Association divided by all Lots within the jurisdiction of the Sub Association multiplied by the number of Lots or Development Parcels each Owner owns. If a Lot or Development Parcel is not part of a Sub Association, the Association will directly bill the Owner of that Lot or Development Parcel its Prorata Share of the General Assessments.

(c) Payment of General Assessment. Except for Initial Assessments, General Assessments are payable in a lump sum annually on the date determined by the Board or may be billed on a quarterly or monthly basis, if the Board so elects. General Assessments will commence on all or any portion of the Property on the date determined by the Board in its sole discretion.

(d) Initial Assessment. At the time of the first transfer of title to a Lot or Development Parcel to an Owner other than Declarant, the Owner must pay to the Association

at the Close of Escrow, an Initial General Assessment. The Initial General Assessment is the Prorata amount of the current General Assessment applicable to a Lot or Development Parcel for the year in which the Lot or Development Parcel is purchased, as of the Close of Escrow, which amount must be prorated on a 365-day per year basis. The Declarant will not be responsible for paying the balance of the General Assessment which is not paid as the first Owner's Initial General Assessment. The Initial General Assessment will be considered Association funds.

(e) Amount of General Assessment. After ratification of the Budget by the Owners as set forth in Section 4.4 (a), the Board must notify the Sub Associations, or Owners of a Lot or Development Parcel not within a Sub Association, of the amount of the General Assessment payable by each Sub Association or Owner for an Assessment Period at least 30 days in advance of its due date; provided, however, that failure to notify a Sub Association or Owner of the amount of a General Assessment will not render such General Assessment void or invalid and each Sub Association and Owner are obligated for such General Assessment even if no notice is given, and/or notice is given late. Any failure by the Board, before the expiration of any Assessment Period, to fix the amount of the General Assessment for the next Assessment Period, will not be deemed a waiver or modification in any respect of the provisions hereof or a release of any Sub Association or Owner from the obligation to pay the General Assessment, or any installment, for that or any subsequent Assessment Period.

(f) Assessment Period. The amount of the General Assessment for the preceding Assessment Period will continue until a new Budget is approved. The Assessment Period for General Assessments is a calendar year, except that upon any revision of the Budget by a supplemental Budget, the Board will, if necessary, recalculate the General Assessment levied against the Owners and give notice of the same in the same manner as the initial levy of a General Assessment for the Assessment Period, which revision may be applicable within the current Assessment Period. The Assessment Period for any other Assessment will be as determined by the Board.

(g) Assessment Method. Association Assessments must be collected by each Sub Association through its duly adopted budget, which budget must be consistent with the General Assessment levied by the Board. Each Sub Association is required to include as a line item in their budget "Master Association Dues" equal to the amount adopted by the Board.

4.5 **Capital Improvement Assessments**.

(a) Capital Improvement Work. In addition to the General Assessments authorized by this Article, the Board may levy Capital Improvement Assessments at any time for the purpose of paying the cost of any installation, construction, reconstruction, repair or replacement of any capital improvements (Capital Improvement Work) in or on a Common Area, or for such other purposes as the Board may consider appropriate, and a Capital Improvement Assessment needs to be reflected in an adopted budget. Capital Improvement Assessments during the Development Period are at the sole discretion of the Declarant. Capital Improvement Assessments after the Turnover Date must require a Majority Vote of the Board. Each Owner's

Prorata Share of the Capital Improvement Assessment must be calculated and collected in the same manner as for General Assessments. Capital Improvement Assessments are payable in one lump sum, or in installments, as determined by the Board. The Association may charge interest on any Capital Improvement Assessment payable in installments, as determined by the Board, and such interest will become part of the installments due. Capital Improvement Assessments may be levied either before or after the Capital Improvement Work is done, at the discretion of the Board.

(b) Special Facilities. If the Association determines that costs incurred for Capital Improvement Work are in connection with facilities shared in common by one or more, but fewer than all, of the Lots and Development Parcels, then the Capital Improvement Assessment for such Capital Improvement Work will be assessed only against the Sub Associations, Lots and Development Parcels for Owners of the Lots and Development Parcels served by such facilities, and must be calculated and collected in same manner as General Assessments.

4.6 **Special Assessments**. The Association may levy Special Assessments against one or more Lots or Development Parcels to reimburse the Association for costs expended to bring a Lot or Development Parcel into compliance with this Declaration or for any benefit received by the Lot or Development Parcel that is not enjoyed by all Owners as a whole. Special assessments levied against less than all of the Lots or Development Parcels do not require a vote of the Owners but may be approved and assessed by the Board of Directors. Special Assessments are payable in one lump sum, or in installments, as determined by the Board. The Association may charge interest on any Special Assessment, as determined by the Board, and such interest will become part of the installments due. The Sub Association associated with each Special Assessment is responsible for collecting the Special Assessment and transmittal of the Assessments to the Association's treasurer.

4.7 **Accounts**. Any Assessments collected by the Association must be deposited in one or more federally insured institutional depository accounts established by the Board. The Board has exclusive control of such accounts and must maintain accurate records. No withdrawal may be made from the accounts except to pay for charges and expenses authorized by the Association's Governing Documents.

4.8 **Waiver of Homestead or exemption Rights Under Law**. Each Owner hereby waives, to the extent of any liens created pursuant to this Article, the benefit of any homestead or exemption law in effect at the time any Assessment or installment becomes due and payable pursuant to the terms of this Declaration.

4.9 **Records and Financial Statements**. The Board must prepare or cause to be prepared for any fiscal year in which the Association levies or collects any Assessments, a balance sheet and an operating (income/expense) statement for the Association which must include a schedule of delinquent Assessments identified by the Sub Association, and the name and address of the delinquent Owner; provided, however, such documents need not be prepared by a

certified public accountant unless requested by the Board. The annual financial statement of the Association need not be audited unless the total of all Assessments for the year for all Lots and Development Parcels is $50,000 or more. The Board must cause detailed and accurate records of the receipts and expenditures of the Association to be kept specifying and itemizing the maintenance, operating, and any other expense incurred. Such records, copies of this Declaration, the Articles and the Bylaws, and any resolutions authorizing expenditures of Association funds must be available for examination by any Owner at convenient weekday hours upon reasonable advance notice determined by the Board.

4.10 **Certificate of Assessment**. A certificate executed and acknowledged by the treasurer or the president of the Association (or an authorized agent of either officer, if neither the president nor treasurer is available) stating the indebtedness for Assessments and charges, or lack thereof, upon any Lot or Development Parcel will be conclusive upon the Association as to the amount of such indebtedness on the date of the certificate, in favor of all persons who rely thereon in good faith. Such a certificate must be furnished to any Sub Association, Owner or any Mortgagee of a Lot or Development Parcel within a reasonable time after request, in recordable form, at a reasonable fee. Unless otherwise prohibited by law, any Mortgagee holding a lien on a Lot or Development Parcel may pay any unpaid Assessments or charges with respect to such Lot or Development Parcel, and, upon such payment, will have a lien on such Lot or Development Parcel for the amounts paid.

4.11 **Contribution to Working Capital Fund**. In connection with the Close of Escrow for the closing of the sale of each Lot to an Owner other than Declarant, the initial Owner of such Lot (including a builder who acquires a Lot or Lots from Declarant) must make a nonrefundable working capital contribution payment to the Association for an initial working capital fund (Working Capital Fund), which contribution must be in an amount equal to $350.00 per Lot (Initial Working Capital Contribution) or such other amount as the Board determines from time to time is appropriate. The Initial Working Capital Contribution may not be considered as an advance payment of any Assessments. The Working Capital Fund may be used as determined by the Board.

ARTICLE 5. NONPAYMENT OF ASSESSMENTS

5.1 **Delinquency**. Any installment of any Assessment provided for in this Declaration will be delinquent, if it is not paid on the due date as established by the Board. With respect to each installment of an Assessment not paid within 10 days after its due date, the Board may, at its election, require the Owner or the Sub Association responsible for the delinquent Owner to pay a late charge in the amount set forth in a previously approved schedule thereof which has been delivered to the Owners and the Sub Association, together with interest on such delinquent sum at a rate to be determined by the Board, but not to exceed the maximum rate permitted by law, calculated from the date of delinquency to and including the date full payment is received by the Association. If any installment of an Assessment is not paid within 30 days after its due date, the Board must mail a notice to the Sub Association, the delinquent Owner, and to any Mortgagee of the delinquent Owner. The notice must specify (1) the fact that the installment

is delinquent; (2) the amount of the Assessment and any late fees and interest accrued thereon; and (3) that (a) failure to cure the default on or before the date specified in the notice may result in acceleration of the balance of the installments of the Assessments for the then current fiscal year and (b) the Association has the right to record a lien (Association Lien) against each individual Owner's Lot or Development Parcel for the Pro-rata amount of the Assessment and related charges. The Association has the right to accelerate all of the unpaid balance of all Assessments for the then current fiscal year, attributable to any Owner and their Lot, Development Parcel or interest therein, after written notice as specified above. Such accelerated Assessments will be immediately due and payable without further demand. The Association may record the Association Lien against the individual Owner's Lot or Development Parcel and enforce the collection of the Assessments and all charges thereon in any manner authorized by law or by this Declaration, but a lien is not required to be recorded to be valid. All late fees, legal fees, interest or any other charges levied by the Association will be assessed against the Owner and billed through the applicable Sub Association.

5.2 **Lien and Notice of Lien**. Each Owner vests in the Association, or its assigns, the right and power to bring all actions at law or to foreclose an Association Lien provided for in Section 5.1 against an Owner and such Owner's Lot or Development Parcel for the collection of delinquent Assessments. No action may be brought to foreclose said delinquent Association Lien or to proceed under the power of sale herein provided sooner than 30 days after the date a notice of claim of lien is recorded by the Association in the Office of the Cowlitz County Auditor and a copy thereof is deposited in the United States mail, certified or registered, postage prepaid, to the Owner of said Lot or Development Parcel at said Owner's last known address. The notice of claim of lien must contain a sufficient legal description of the Lot or Development Parcel, the record Owner or reputed Owner thereof, and the amount claimed, including, at the Association's option, the cost of preparing and recording the notice of claim of lien, interest on the unpaid Assessments and costs of collections, including attorney's fees. Each Owner, by acceptance of the deed for a Lot or Development Parcel subject to this Declaration, acknowledges that all liens authorized hereunder are consensual and arise at the time the Assessments are levied.

5.3 **Foreclosure and Sale**. Any such foreclosure and sale provided for in Section 5.2 must be conducted in accordance with the laws of the State of Washington applicable to the exercise of powers of judicial and non-judicial foreclosures and sale of mortgages. The Association, through its duly authorized agents, has the power to bid on the Lot or Development Parcel at the foreclosure sale and to acquire and hold, lease, mortgage and convey the same.

5.4 **Curing the Default**. Upon the timely curing of any default for which an Association Lien was recorded by the Association, the Board, or an authorized representative thereof, must record an appropriate release of such notice upon payment by the applicable Owner of a fee to be determined by the Board to cover the cost of preparing and recording such release, together with the payment of such other costs, interests and fees as will have been incurred by the Association by reason of such default. Any purchaser or encumbrancer, who has acted in good faith and extended value, may rely upon such release as conclusive evidence of the full satisfaction of the sums stated in the release.

5.5 **Cumulative Remedies**. The Association Lien and right of foreclosure and sale are in addition to, and not in substitution for, all other rights and remedies which the Association, and/or its assigns, may have hereunder, in equity and at law, including, but not limited to, a suit to recover a money judgment for unpaid Assessments, or the suspension of an owner's right to vote until any Assessments unpaid for a period in excess of 30 days are paid. Any institution of a suit to recover a money judgment will not constitute an affirmation of the adequacy of money damages.

5.6 **Subordination of Association Liens**. All sums assessed in accordance with the provisions of this Declaration will constitute a lien on the respective Lot or Development Parcel prior and superior to all other liens, except (1) all taxes, bonds, assessments and other levies or liens which, by law, would be superior thereto, and (2) the lien or charge of any Mortgage of Record made in good faith and for value and recorded prior to the date the Board levies the Assessment through Board action. Upon the foreclosure of, or acceptance of a deed in lieu of foreclosure of, such a prior Mortgage that has priority over an Assessment lien, the foreclosure purchaser or deed-in-lieu grantee will take title free of the lien for unpaid, non-priority Assessments, but subject to the lien hereof for all said charges that accrue subsequent to the foreclosure or deed given in lieu of foreclosure.

5.7 **Exempt Property**. The following property is exempt from the Assessments created herein and will not be subject to liens for unpaid Assessments: (a) all properties dedicated to and accepted by a public authority; (b) all Common Areas; and (c) all vacant Lots, Development Parcels or other portions of the Property the fee title to which is retained by Declarant

5.8 **Rights of Board – Waiver of Owners**. Each Owner hereby vests in and delegates to the Board, the right and power to bring all actions at law, including lien foreclosures, whether judicially or by power of sale or otherwise, against any Owner for collection of the delinquent assessments in accordance herewith. Each Owner hereby expressly waives any objection to the enforcement in accordance with this Declaration, of the obligation to pay Assessments as set forth herein.

ARTICLE 6. EASEMENTS, DEDICATIONS, AND RIGHTS OF ENTRY

6.1 **Easements**.

(a) Access. Declarant expressly reserves for the benefit of the Association and for the Owners of the Property reciprocal, non-exclusive easements over all of the Common Areas for access to the Lots, Development Parcels and other Common Areas. Subject to the provisions of this Declaration and the applicable Plat or survey governing use and enjoyment thereof, such easements may be used by Declarant, its successors, the Owners, and any guests, tenants, and invitees residing upon or temporarily visiting the Property, for areas designated as walkways, vehicular access, parking, drainage and such other purposes reasonably

necessary for use and enjoyment of any Lot or Development Parcel in the Property. In addition to the foregoing, each Lot and Development Parcel is subject to an easement for encroachments created by construction, settlement, and overhangs as designed or constructed by the Declarant.

(b) Maintenance and Repair. Declarant expressly reserves for the benefit of the Association and all agents, officers and employees of the Association non-exclusive easements over the Common Areas, Lots and Development Parcels necessary to maintain and repair the Common Areas and to perform all other tasks in accordance with the provisions of this Declaration. There are specifically reserved for the benefit of the Owners easements for the utility services and the repair, replacement and maintenance of the same over all of the Common Areas. Such easements must be established and used so as not to unreasonably interfere with the use and enjoyment by the Owners of their Lots, Development Parcels and the Common Areas. All such easements will be appurtenant to and will pass with the title to every Lot and Development Parcel conveyed.

(c) Utility Easements. Various easements are reserved on the Property, as provided by individual Plats, other recorded instruments, applicable laws, ordinances and other governmental rules and regulations for utility installation and maintenance, including but not limited to, underground electric power, telephone, cable television, digital information, water, sewer, gas and drainage and accessory equipment, together with the right to enter upon any Lot or Development Parcel at all times for said purposes. Within these easements, no structure, planting, or other material may be placed or permitted to remain, that may damage, interfere with the installation and maintenance of utilities, which may change the direction of flow of drainage channels in the easements, or that may obstruct the flow of water through drainage channels in the easements. Each Owner hereby agrees not to place locks on structures enclosing utility meters or interfere with the access of utility representatives to said meters or easements. The easement areas on each Lot and Development Parcel, and all improvements thereon, must be maintained continuously by the Owner of each Lot and Development Parcel, except for those improvements for which a public authority, utility company or the Association is responsible within the easement areas. The Owner must maintain the portion of any utility on the Owner's Lot or Development Parcel, or within a private easement for the Owner's Lot or Development Parcel that serves only the Owner's Lot or Development Parcel to the point of connection to the portion of the system that serves more than one Lot or Development Parcel. The Association has an easement for the maintenance, repair, replacement, and restoration of the portions of the easements that serve more than one Lot or Development Parcel up to the point of connection to the public system.

(d) Walkways and Driveways. There may be no obstruction, including, but not limited to obstruction by basketball hoops or other similar sporting equipment, of any Streets, walkways, or driveways on or located within the Property which would interfere with the free circulation of foot, bicycle or automotive traffic, except such obstruction as may be reasonably required in connection with repairs of such Streets, walkways, and driveways. Use of all Streets, walkways, and driveways within the Property will be subject to the reasonable rules and regulations adopted by the Association. The Association may, but is not obligated to, take

such action as may be necessary to abate or enjoin any interference with or obstruction of Streets, walkways, and driveways, and will have the right of entry to Lots or Development Parcels for purposes of removing said interference or obstruction including towing of vehicles that are parked on Streets, driveways or walkways for extended periods or in violation of rules and regulations adopted by the Association or set forth in this Declaration. Any costs incurred by the Association in connection with such abatement, injunction, or corrective work will be deemed to be a Special Assessment of the Owner or Sub Association responsible for the interference or obstruction. Free use of the Streets, walkways, and driveways and free circulation of foot, bicycle and vehicular traffic are essential elements of Declarant's plan for development of the Property.

(e) Landscaping Maintenance Easement. Declarant expressly reserves for the benefit of the Association and all agents, officers and employees of the Association non-exclusive easements over the Common Areas, Lots and Development Parcels to perform maintenance of landscaping, including the trimming, watering and fertilization of all grass, ground cover, shrubs or trees, removal of dead or waste materials, or replacement of any dead or diseased grass, ground cover, shrubs or trees, and also including any yard maintenance. Notwithstanding the foregoing, each Owner will be primarily responsible for maintaining the landscaping and yard areas on their respective Lot and Development Parcel, as provided in this Declaration, and as determined by a Sub Association's Governing Documents.

ARTICLE 7. REPAIR AND MAINTENANCE

7.1 **Repair and Maintenance Duties of the Association**. Following their initial installation, the Association must maintain, repair, replace, resurface and make necessary improvements to the Common Areas, or may contract for such maintenance, repair, replacement, resurfacing, and improvements, to keep the Common Areas, including without limitation all Improvements thereon, in a good, sanitary, and attractive condition. Such maintenance, repairs, replacement, resurfacing, and improvements include, without limitation, maintenance and replacement of lighting, shrubs, trees, vegetation, irrigation systems (if any), Signs, play structures, benches, picnic facilities, playfields and appurtenances and any other improvements located on the Common Areas, repair of and payment for all centrally metered utilities, mechanical and electrical equipment in the Common Areas, to include care and upkeep of any median within the public street rights-of way, repair and maintenance of storm water facilities and equipment (to the extent such maintenance is not performed by the municipality or any utility service provider), and repair and maintenance of all parking areas, walks, and other means of ingress and egress within the Common Areas. All such maintenance, repairs and improvements to the Common Areas must be paid for as a Common Expense**.** The Association must pay all real and personal property taxes and Assessments which will constitute a lien upon any portion of the Common Areas.

DRAFT

ARTICLE 8. COMMON AREA PROTECTION

8.1 **Association Control**. The Association owns fee title to the Common Areas, except as expressly stated in this Declaration or other Recorded document. The Association's appurtenant rights and duties with respect to the Common Areas include, without limitation, the following:

(a) Limits. The right of the Association to reasonably limit the number of guests, patrons and invitees of Owners using the Common Areas.

(b) Rules. The right of the Association to establish uniform rules and regulations pertaining to the use of the Common Areas.

(c) Borrowings. The right of the Association in accordance with the Articles, Bylaws and this Declaration, with a Majority Vote of the Owners, to borrow money for the purpose of maintaining and preserving the Common Areas, and in aid thereof to mortgage any or all of its real or personal property as security for money borrowed or debts incurred, provided that the right of any such Mortgagee of the Association will be subordinated to the rights of the Owners.

(d) Voting Rights. The right of the Association to suspend the voting rights and right to use the Common Areas by an Owner for any period during which any Assessment against the Owner's Lot or Development Parcel remains unpaid and delinquent for a period not to exceed 30 days for any single infraction of the published rules and regulations of the Association, provided that any suspension of such voting rights or rights to use the Common Areas may be made only by the Board, after notice and an opportunity for a hearing, if any, as provided in the Bylaws.

8.2 **Reserved Rights**. Declarant has a Development Right for the nonexclusive use of the Common Areas without charge, for sales and marketing purposes, display, advertising, access, ingress, egress, and exhibit purposes, which right Declarant hereby expressly reserves for itself and its sales agents and representatives.

8.3 **Easements for City and County Use**. Declarant hereby reserves and covenants for itself and all future Owners within the Property, the right to grant easements for public services and utilities, including without limitation, the right of the governmental and municipal entities or utility purveyors to install, maintain and repair public Streets, Street lights, curbs, gutters and sidewalks, sanitary sewer, storm water facilities and water systems, and allow the police and other emergency and public safety personnel to enter upon any part of the Common Areas for the purpose of enforcing the law.

8.4 **Waiver of Use**. No Owner or Sub Association may exempt themselves from personal liability for Assessments duly levied by the Association, nor release the Lot, Development Parcel or other property owned by them from the liens and charges hereof, by

waiver of the use and enjoyment of the Common Areas or by abandonment of a Lot, Development Parcel or any other property in the Property.

8.5 **Trash and Other Debris**. No trash, debris, waste, grass clippings, or hazardous waste may be dumped, deposited, or placed in any Common Areas by any Sub Association, Owner or Occupant.

8.6 **Taxes**. Each Owner must execute such instruments and take such action as may reasonably be specified by the Association to obtain a separate real estate tax assessment of each Lot or Development Parcel. If any such taxes or assessments may, in the opinion of the Association, nevertheless be a lien on the Common Areas, or any part thereof, they must be paid by the Association and each Owner will be obligated to pay or to reimburse the Association for, as the case may be, the taxes and assessments assessed by the County Assessor or other taxing authority against the Common Areas and attributable to such Owner's Lot or Development Parcel and interest in the Common Areas.

8.7 **Permissive Use**. Any Owner may permit an Occupant to use the Common Areas in the same manner as an Owner. All Owners are responsible for informing any Occupants of the contents of this Declaration and the rules regarding the Common Areas, and will be responsible for requiring its Occupants to comply with this ARTICLE 8. No Owner, guest, Occupant, invitee, or licensee may conduct or allow others to conduct any offensive or obnoxious activities within the Common Areas.

8.8 **Wetland and Habitat Conservation Covenants**. The Association and all Owners are subject to all provisions, restrictions, and conditions contained in any permit, approved mitigation plan, or separately recorded conservation covenant applicable to any wetland and habitat conservation areas on the Property as shown on the Master Plan or any Plat of the Property.

ARTICLE 9. ARCHITECTURAL CONTROL COMMITTEE

9.1 **Committee**. Each Sub Association may establish an Architectural Review Committee in its Governing Documents.

ARTICLE 10. SUB ASSOCIATIONS

10.1 **Sub Association Requirements**. The Declarant has the Development Right to create Sub Associations and approve and execute Sub Association's Governing Documents in its sole discretion during the Development Period.

ARTICLE 11. DAMAGE OR LOSS TO IMPROVEMENTS

11.1 **Restoration of Common Areas**. Except as otherwise provided in this Declaration, in the event of any destruction of any portion of the Common Areas or any other Improvements insured by the Association, the Association must restore and repair the same to

DRAFT

its former condition, as promptly as practical. The proceeds of any insurance must be used for such purpose. The Board is authorized to have the necessary documents prepared and executed, and to take such other action so as to effect such reconstruction as promptly as practical. The Common Areas and all other Improvements must be constructed or rebuilt substantially in accordance with the original construction plans available, if deemed practicable by the Board. In the event that the amount available from the proceeds of such insurance policies for such restoration and repair is less than the estimated cost of restoration and repair, a Reconstruction Assessment may be levied by the Board upon the Owners and their Lots and Development Parcels in order to provide the necessary funds for such reconstruction over and above the amount of any insurance proceeds available for such purpose. Reconstruction Assessments will be borne by the Owners in the same proportions as their Prorata Share of General Assessments. If, prior to the end of the Development Period, the Common Areas or Improvements thereon are destroyed and the insurance proceeds are less than the estimated cost of repair or reconstruction, the Declarant may elect not to restore or rebuild some or all of the Improvements or Common Areas or may elect to restore or rebuild only those for which the Declarant has received insurance proceeds sufficient to pay all costs associated therewith. Reconstruction Assessments must be approved and levied in the same manner as Capital Improvement Assessments as set forth in Section 4.5.

11.2 **Restoration Obligations of Owners**. In the event of the damage or destruction of any portion of a Lot or Development Parcel or the Improvements thereon, it is the duty of the Owner of such Lot or Development Parcel, as soon as may be practical, to repair or replace the damage or destruction or such portion thereof as will render such damage or destruction indiscernible from the exterior of the Lot or Development Parcel. Any reconstruction, replacement or repair required by this section must be in accordance with the original plans and specifications of the Lot or Development Parcel or plans and specifications approved by both any architectural control committee and the holders of Mortgage(s) of Record which encumber(s) the Lot or Development Parcel.

11.3 **Condemnation**. In the event that all or any portion of the Common Areas are taken or condemned by any authority exercising the power of eminent domain, the condemnation award must be used to restore the remaining Common Areas, and any balance must be turned over to the Association. The Board has the exclusive right to prosecute any such proceedings; provided, however, that nothing contained herein to the contrary may prevent an Owner from joining in the proceeding for purposes of claiming that the condemnation action has materially affected said Owner's property. The entire award must be paid to the Association in trust for the benefit of the Owners. The Board must distribute the portion of the award not used to restore the Common Areas to the Owners in proportion to their Prorata Share of General Assessments; provided, however, that if a Lot or Development Parcel is encumbered by a Mortgage or Mortgages which has or have a provision relating to condemnation, then in-lieu-of distributing the award to the Owner of said Lot or Development Parcel, the Board must distribute the award directly to the Mortgagee of the Mortgage with the highest priority and seniority for distribution or payment in accordance with the terms and conditions of said Mortgagee's Mortgage.

ARTICLE 12. PROTECTION OF MORTGAGEES

12.1 **Mortgagee Provisions**. A breach of any of the provisions, covenants, restrictions or limitations hereof or the Recordation of any Association Lien or the pursuit of any remedy hereunder will not defeat or render invalid the lien of any Mortgage of Record. The Owners and their Mortgagees may examine the books and records of the Association during all normal business hours, upon serving written notice of such examination on the Board. All of the provisions herein will be binding upon and effective against any Owner whose title to said Lot or Development Parcel is hereafter acquired through foreclosure or trustee's sale. The Mortgagee of any Mortgage of Record on any Lot or Development Parcel may file with the Board a written request for written notification from the Association of any default by the Mortgagor of such Lot or Development Parcel in the performance of such Mortgagor's obligations under this Declaration which is not cured within 30 days, and the Board must give notice thereof to each such Mortgagee. Each Institutional Lender which holds a Mortgage encumbering any Lot or Development Parcel in the Property which obtains title to such Lot or Development Parcel pursuant to the remedies provided in such Mortgage, by judicial or non-judicial foreclosure or by deed in lieu of foreclosure, will take title to such Lot or Development Parcel free and clear of any claims for unpaid Assessments or charges against such Lot or Development Parcel unless the Assessments have priority under this Declaration.

ARTICLE 13. DURATION AND AMENDMENT

13.1 **Duration**. This Declaration will continue in full force until 50 years from the date hereof unless a Declaration of Termination or Declaration of Renewal is Recorded meeting the requirements of an amendment to this Declaration as set forth in Section 13.2. There will be no severance by sale, conveyance, encumbrance or hypothecation of an interest in any Lot or Development Parcel from the appurtenant Membership as long as this Declaration continues in full force and effect.

13.2 **Amendment**. Notice of the subject matter of a proposed amendment to this Declaration in reasonably detailed form must be included in the notice of any meeting of the Association at which a proposed amendment is to be considered. The amendment will be adopted if approved by the vote, in person or by proxy, or written consent, of 67% or more of the Total Voting Power of the Association; provided, however, that until the Turnover Date no termination or other amendment will be effective without the written approval of Declarant, in Declarant's sole discretion; and provided further, that no amendment to Section 16.2 below may be made at any time without the written approval of Declarant, in Declarant's sole discretion while Declarant owns any Lot or Development Parcel. A copy of each amendment which has been properly adopted must be certified by at least 2 officers of the Association and the amendment will be effective when the Certificate of Amendment is Recorded. Notwithstanding the foregoing, any of the following amendments, to be effective, must be approved in writing by the record holders of 100% of the aggregate value of Mortgages encumbering the Property at the time of such amendment (provided that any Mortgage holder that fails to submit written notice of

approval or disapproval of any such amendment within 30 days of notice from the Association regarding such amendment will be deemed to have consented to such amendment):

(a) Lien Rights. Any amendment which affects or purports to affect the validity or priority of encumbrances or the rights or protections granted to Mortgagees as provided in ARTICLE 12 or which seeks to modify Section 13.2 hereof.

(b) Assessments. Any amendment which would necessitate a Mortgagee after it has acquired a Lot or Development Parcel through foreclosure to pay more than its Prorata Share of any Assessments accruing after such foreclosure.

(c) Cancellation. Any amendment which would or could result in a Mortgage being cancelled by forfeiture.

(d) Mortgagees. Any amendment which would have a material, adverse effect on any Mortgagee.

13.3 **Amendments and Modifications by Declarant**. For so long as Declarant owns a Lot, Declarant acting alone will have the right to modify or amend this Declaration unilaterally without any other Owner approval. Within 30 days after any such modification or amendment by Declarant, Declarant must deliver a written notice of such modification or amendment to each Owner, which notice must include a copy of the executed, acknowledged and recorded modification or amendment.

ARTICLE 14. LIMITATION OF LIABILITY

14.1 **Limitation of Liability**. So long as a member of the Board, or any of the Board's committees, Declarant or any agent of the foregoing has acted in good faith, without willful or intentional misconduct, upon the basis of information possessed by such person, then that person will not be personally liable to any Owner, the Association, or to any other person for any damage, loss, or claim on account of any, omission, error, or negligence of such person, except this article will not apply to the extent such acts, omissions or errors are covered by the Association's insurance. In connection with all reviews, acceptances, inspections, permissions, consents or approvals required or permitted by or from either the Declarant, the Association or a committee under this Declaration, neither Declarant, the Association, nor a committee will be liable to any Owner or to any other person on account of any claim, liability, damage or expense suffered or incurred by or threatened against any Owner or such other person and arising out of or in any way relating to the subject matter of any such review, acceptance, inspection, permission, consent or approval, whether given, granted, withheld or denied.

ARTICLE 15. INSURANCE; LOSSES.

15.1 **Insurance**. The Board must procure for the Association, and continuously maintain, as a Common Expense, one or more policies of insurance as follows: (a) insurance against property loss or damage by fire or other hazards covered by the standard extended

coverage endorsement in an amount as near as practicable to the full insurable replacement value (without deduction for depreciation) of the Common Areas, or such other fire and casualty insurance as the Board determines will give substantially equal or greater protection, (b) commercial general liability insurance for the use and ownership of the Common Areas, (c) worker's compensation insurance to the extent required by applicable law, (d) insurance against loss of personal property of the Association by fire, theft, and other losses with deductible provisions as the Association deems advisable, and (e) any other insurance the Board deems advisable. Such insurance policies must meet the insurance and fidelity bond requirements for similar projects established by Federal National Mortgage Association, Government National Mortgage Association, Federal Home Loan Mortgage Corporation, Federal Housing Authority, and Veterans Administration, so long as any of them is a Mortgagee or Owner, except to the extent such coverage is not available or has been waived by any of the foregoing. All policies must include an endorsement providing coverage for Directors and Officers of the Association. Any deductible will be a Common Expense of the Association.

15.2 **Casualty Losses**. In the event of substantial damage or destruction of any Common Area, all applicable insurance proceeds for such damage or destruction must be paid to the Association for repair, replacement, or other disbursement as determined by the Board.

ARTICLE 16. GENERAL PROVISIONS

16.1 **Legal Proceedings**. Failure to comply with any of the terms of this Declaration, the Articles, the Bylaws, or any regulations by an Owner or Occupant, their guests, employees, invitees or tenants, will be grounds for relief which may include, without limitation, an action to recover sums due for damages, injunctive relief, foreclosure of lien, lien, or any combination thereof, which relief may be sought by Declarant, the Association, the Board, or, if appropriate, by an aggrieved Owner. Failure to enforce any provision thereof will not constitute a waiver of the right to enforce said provision, or any other provision thereof. The Association, the Board, any Owner (so long as such Owner is not at that time in default hereunder), or Declarant will be entitled to bring an action for damages against any defaulting Owner, and in addition may enjoin any violation of this Declaration by any Owner. Any judgment rendered in any action or proceeding pursuant thereto must include a sum for attorneys' fees, including attorneys' fees incurred on appeal, in such amount as the Court may deem reasonable in favor of the prevailing party, as well as the amount of any delinquent payment, together with interest thereon at the rate established by the Board therefore from time to time, costs of collection and court costs. Each remedy provided for in this Declaration will be cumulative and not exclusive or exhaustive.

16.2 **Special Declarant Provisions**. In addition to the right reserved to Declarant in this Declaration, no amendment to this Declaration will be effective without the Declarant's prior written consent if the effect of the amendment would be to increase any obligation or liability of Declarant to the Owners, Occupants, Members, the Association, or the Board; or to lessen or decrease the Development Rights or any other rights of the Declarant under this

Declaration; or revoke, reduce, amend or modify any waivers or releases given in favor of the Declarant under this Declaration.

16.3 **Severability**. The provisions hereof must be deemed independent or severable, and a determination of invalidity or partial invalidity or enforceability of any one provision or portion hereof by a court of competent jurisdiction will not affect the validity or enforceability of any other provision hereof.

16.4 **Interpretation**. The provisions of this Declaration must be liberally construed to effectuate its purpose of creating a uniform plan for the creation and operation of the Master Community and for the maintenance of the Common Areas, and any violation of this Declaration will be deemed to be a nuisance. The article and section headings, titles and captions have been inserted for convenience only and may not be considered or referred to in resolving questions of interpretation or construction. Unless the context otherwise requires, as used herein, the singular and the plural each include the other and the masculine, feminine or neuter each include the masculine, feminine and neuter. All pronouns and any variations thereof must be deemed to refer to the masculine, feminine, neuter, singular or plural as the identity of the Person or Persons may require.

16.5 **Construction and Sales by Declarant**. Nothing in this Declaration may limit, and no Owner may do anything which will interfere with, the right of Declarant to reasonably subdivide or re-subdivide any portion of the Property owned by Declarant, or to complete any construction of Improvements on the Lots and Development Parcels owned by Declarant and the Common Areas, or to alter the foregoing and its construction plans and designs, or to construct such additional Improvements on such Lots, Development Parcels and Common Areas as Declarant deems advisable prior to completion and sale of the last Lot and Development Parcel owned by Declarant. Each Owner, by accepting a deed of a Lot or Development Parcel from Declarant, hereby acknowledges that the activities of Declarant may constitute a temporary inconvenience or nuisance to the Owners but nonetheless are permitted. Such rights include, but are not limited to, erecting, constructing and maintaining on the Property such structures and displays as may be reasonably necessary for the conduct of Declarant's business or completing the work of disposing of the Lots and Development Parcels by sale, lease or otherwise. Declarant may at any time use any Lots and Development Parcels owned by Declarant as models or real estate sales or leasing and renting offices. This Declaration does not limit the right of Declarant at any time prior to conveyance of title by deed to the last Lot and Development Parcel owned by Declarant to establish on the Lots and Development Parcels owned by Declarant and the Common Areas additional easements, reservations and rights-of-way to itself, to utility companies, or to other Persons as may from time to time be reasonably necessary to the property development and disposal of the Lots and Development Parcels owned by Declarant. Such easements may be created for the construction, installation, maintenance, removal, replacement, operation and use of utilities, including without limitation sewers, water and gas pipes and systems, drainage lines and systems, electric power and conduit lines and wiring, television, internet, telecommunication, and telephone conduits, lines and wires, and other utilities, public or private, beneath the ground surface (except vaults, vents, access structures

and other facilities required to be above ground surface by good engineering practice), including the right to dedicate, grant or otherwise convey easements for rights-of-way to any public utility or governmental entity for such purposes. In the performance of any work in connection with such utilities, Declarant may not unreasonably interfere with or disrupt the use of the Common Areas or the facilities located thereon and must replace and restore the areas and facilities as nearly as possible to the condition in which they were prior to the performance of such work. All or any portion of the rights of Declarant hereunder, including but not limited to the Development Rights, may be assigned to any successor or successors to all or part of Declarant's respective interest in the Property, by an express written Recorded assignment or deed.

16.6 **Owner Liability and Duty**. Each Owner must indemnify and hold harmless the Association for any injury to any person or damage to the Common Areas or any equipment thereon which may be sustained by reason of the negligence of said Owner or of his guests, employees, invitees or tenants. The damage and costs incurred by the Association as a result thereof will become a Special Assessment against such Owner and their Lot or Development Parcel, and will be subject to levy, enforcement and collection in accordance with the Association Lien procedure provided for in this Declaration. The Association reserves the right to charge a Special Assessment to such Owner equal to the increase, if any, in the insurance premium directly attributable to the damage or injury caused by such Owner or by the use of the Lot or Development Parcel of such Owner. The Association will hold each Owner harmless from liability for loss or injuries that are covered by insurance then maintained by the Association.

16.7 **Association Waiver**. Notwithstanding anything herein to the contrary, to the extent that any Owner waives any claims against Declarant, or releases the Declarant from any claim with respect to a Lot, Development Parcel, the Common Areas, the Improvements, and/or the Community, then the Association must be deemed to have likewise released Declarant (and its officers, directors, shareholders, members, partners, employees, agents and representatives) from any claim with respect to such Lot or Development Parcel, the Common Areas, the Improvements, and/or the Master Community on a Prorata basis applicable to each such Lot and Development Parcel.

16.8 **No Public Right or Dedication**. Nothing contained in this Declaration may be deemed to be a gift or dedication of all or any part of the Property to the public, or for any public use.

16.9 **Indemnification**. Each officer of the Association, and each member of the Board or a committee, and any agents thereof, must be indemnified by the Association against all expenses and liabilities (including attorneys' fees and costs) reasonably incurred by or imposed in connection with any litigation or other proceeding by reason of such individual holding a position or office, whether or not such person holds that position at the time the expense or liability is incurred, except to the extent such expenses or liabilities are covered by insurance and except as specified in the Articles of Incorporation. However, in the event of a settlement, the indemnification will apply only when the Board approves such settlement and reimbursement as being in the best interests of the Association.

16.10 **Access to Lots and Development Parcels**. The Declarant, the Board, and the Association (and, as applicable, any of their officers, directors, shareholders, members, partners, employees, agents and representatives) may enter upon any Lot or Development Parcel, which entry will not be deemed a trespass, and take whatever steps are necessary to correct a violation of the provisions of this Declaration.

16.11 **No Third-Party Rights**. This Declaration is made for the exclusive benefit of the Association, the Board, the Owners, the Members, any Sub Associations, the Declarant and their successors. This Declaration is not intended for the benefit of any other Person besides the Association, the Board, the Owners, the Members, any Sub Associations, the Declarant and their successors. No third party has any rights under this Declaration against any of the Association, the Board, the Owners, the Members, any Sub Associations, the Declarant and their successors.

16.12 **Notices**. Except as otherwise provided in this Declaration, in each instance in which notice is to be given to an Owner, the same must be in writing and may be delivered personally to the Owner, in which case personal delivery of such notice to one or more Co-Owners of a Lot or Development Parcel or to any general partner of a partnership owning a Lot or Development Parcel will be deemed delivery to all Co-Owners or to the partnership, as the case may be. Personal delivery of such notice to any officer or agent for the service of process on a corporation will be deemed delivery to the corporation. In lieu of the foregoing, such notice may be delivered by regular United States mail, postage prepaid, addressed to the Owner at the most recent address furnished by such Owner to the Association or, if no such address will have been furnished, to the street address of such Lot or Development Parcel. Such notice will be deemed delivered 48 hours after the time of such mailing, except for notice of a meeting of Members or of the Board in which case the notice provisions of the Bylaws will control. Any notice to be given to the Association may be delivered personally to any member of the Board, or sent by United States mail, postage prepaid, addressed to the Association at such address as may be fixed from time to time and circulated to all Owners. Any notice to be given to the Declarant may be delivered personally to Declarant, or sent by United States mail, postage prepaid, addressed to the Declarant at such address as may be fixed from time to time and circulated to all Owners.

Signature block on following page

DRAFT

CT6, LLC

_____
By: _____
Date: _____

State of Washington)
) ss.
County of Clark)

I certify that I know or have satisfactory evidence that _____ is the person who appeared before me, and said person acknowledged that he signed this instrument, on oath stated that he was authorized to execute the instrument and acknowledged it as the Manager of CT6, LLC to be the free and voluntary act of such party for the uses and purposes mentioned in the instrument.

Dated: _____, 2025.

Notary Seal

_____
Notary Public for Washington

_____
Name of Notary

My appointment expires: _____

DRAFT

EXHIBIT A
LEGAL DESCRIPTION

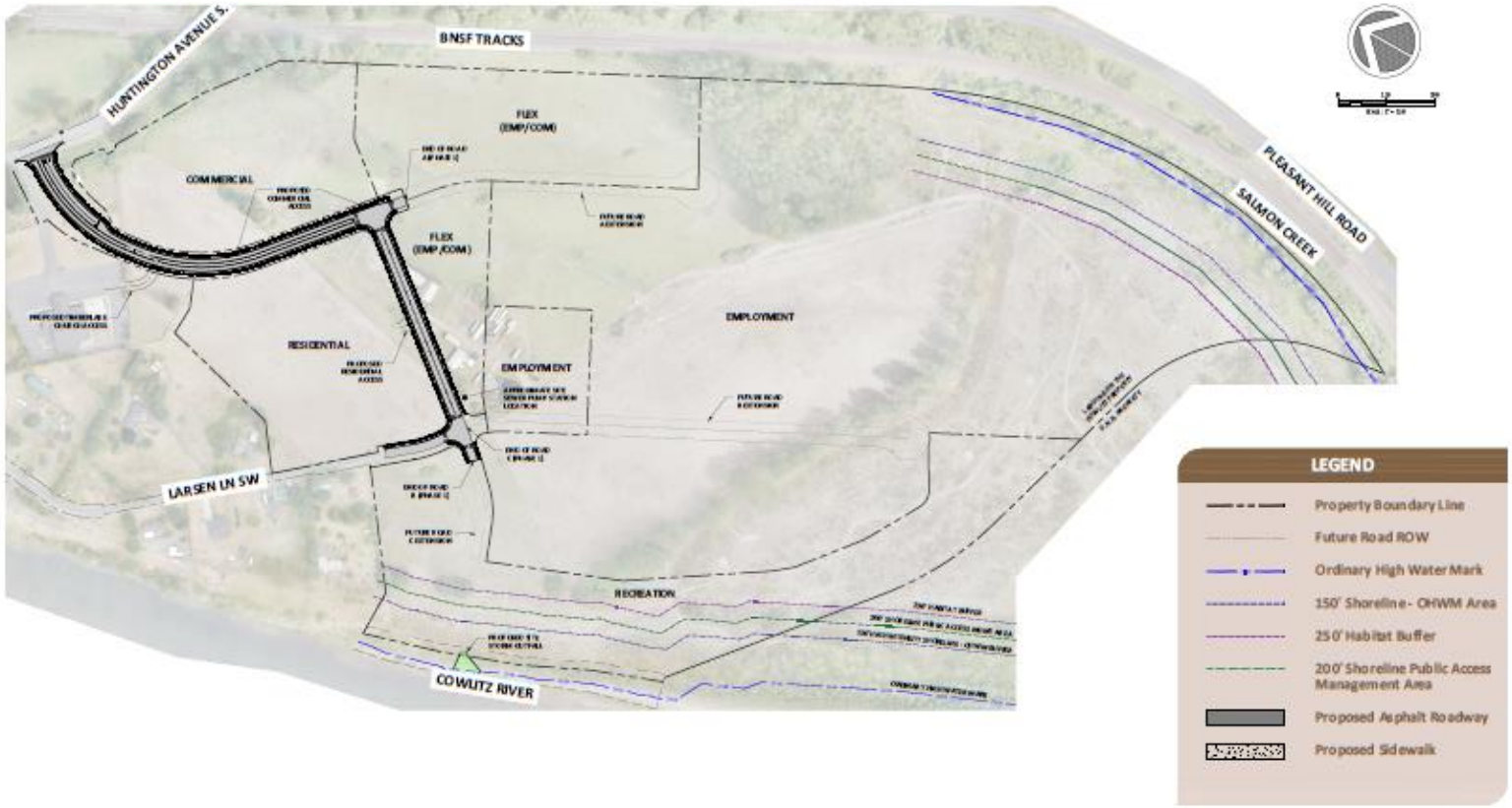
DRAFT

EXHIBIT A-1

MASTER PLAN

See following page

DRAFT



LANDING ON THE COWLITZ

MacKay Sposito

EXHIBIT B

COMMON AREAS AND FACILITIES

DRAFT

SUBDIVISION

Issued By:

CHICAGO TITLE INSURANCE COMPANY

Guarantee/Certificate Number:

622-173054

CHICAGO TITLE INSURANCE COMPANY

a corporation, herein called the Company

GUARANTEES

Castle Rock

herein called the Assured, against actual loss not exceeding the liability amount stated in Schedule A which the Assured shall sustain by reason of any incorrectness in the assurances set forth in Schedule A.

LIABILITY EXCLUSIONS AND LIMITATIONS

1. No guarantee is given nor liability assumed with respect to the identity of any party named or referred to in Schedule A or with respect to the validity, legal effect or priority of any matter shown therein.
2. The Company's liability hereunder shall be limited to the amount of actual loss sustained by the Assured because of reliance upon the assurance herein set forth, but in no event shall the Company's liability exceed the liability amount set forth in Schedule A.

Please note carefully the liability exclusions and limitations and the specific assurances afforded by this guarantee. If you wish additional liability, or assurances other than as contained herein, please contact the Company for further information as to the availability and cost.

Chicago Title Insurance Company

By:

Michael J. Nolan, President

Attest:

Marjorie Nemzura, Secretary

Chicago Title Company of Washington
655 W. Columbia Way, Suite 200
Vancouver, WA 98660

Countersigned By:

Phil Archer
Authorized Officer or Agent

ISSUING OFFICE:

Title Officer: James R. Copeland
Chicago Title Company of Washington
655 W. Columbia Way, Suite 200
Vancouver, WA 98660
Phone: 360-601-4370 Fax: 877-334-2993
Main Phone: (360)696-0551
Email: James.Copeland@ctt.com

SCHEDULE A

Liability	Premium	Tax
$1,000.00	$350.00	$30.10

Effective Date: January 22, 2025 at 08:00 AM

The assurances referred to on the face page are:

That, according to those public records which, under the recording laws, impart constructive notice of matter relative to the following described property:

For APN/Parcel ID(s): 308120300

A PARCEL OF PROPERTY LOCATED IN A PORTION OF THE BENJAMIN HUNTINGTON D.L.C. AND THE SOUTH HALF OF SECTION 14, AND THE NORTH HALF OF SECTION 23, TOWNSHIP 9 NORTH, RANGE 2 WEST OF THE WILLAMETTE MERIDIAN IN THE CITY OF CASTLE ROCK, COWLITZ COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

COMMENCING AT THE CORNER COMMON TO SECTION 13, 14, 23 AND 24, TOWNSHIP 9 NORTH, RANGE 2 WEST, AS SHOWN ON RECORD-OF-SURVEY RECORDED IN VOLUME 43, PAGES 120-121 OF THE WILLAMETTE MERIDIAN, COWLITZ COUNTY, WASHINGTON;

THENCE NORTH 01°42'22" EAST, ALONG THE EAST LINE OF THE SOUTHEAST QUARTER OF SAID SECTION 14, A DISTANCE OF 742.50 FEET TO THE NORTH LINE OF THE SOUTH HALF OF THE BENJAMIN HUNTINGTON DONATION LAND CLAIM;

THENCE NORTH 88°18'14" WEST, ALONG SAID NORTH LINE, 1915.35 FEET;

THENCE SOUTH 01°33'06" WEST 26.70 FEET TO THE NORTHWEST CORNER OF "PARCEL I" AS CONVEYED TO CT6, LLC BY DEED RECORDED UNDER AUDITOR'S FILE NUMBER 3682681, COWLITZ COUNTY RECORDS AND THE TRUE POINT OF BEGINNING;

THENCE SOUTH 88°09'15" EAST ALONG THE NORTH LINE OF SAID PARCEL I, A DISTANCE OF 88.61 FEET;

THENCE NORTH 68°26'31" EAST ALONG THE NORTH LINE OF SAID PARCEL I, A DISTANCE OF 93.90 FEET TO A NON-TANGENT 530.00 FOOT RADIUS CURVE TO THE LEFT, FROM WHICH THE RADIUS POINT BEARS NORTH 67°48'33" EAST;

THENCE ALONG SAID 530.00 FOOT NON-TANGENT CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 22°53'04" (LONG CHORD BEARS SOUTH 38°40'15" WEST 210.28 FEET) AN ARC DISTANCE OF 211.69 FEET;

THENCE SOUTH 50°06'47" EAST 328.61 FEET TO A 35.00 FOOT RADIUS CURVE TO THE RIGHT;

THENCE ALONG SAID 35.00 FOOT RADIUS CURVE TO THE RIGHT, THROUGH A CENTRAL ANGLE OF 88°23'02" AN ARC DISTANCE OF 53.99 FEET;

SCHEDULE A
(continued)

THENCE SOUTH 38°16'16" WEST 604.48 FEET TO A 30.00 FOOT RADIUS CURVE TO THE RIGHT;

THENCE ALONG SAID 30.00 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 82°46'20" AN ARC DISTANCE OF 43.34 FEET TO A POINT 30.00 FEET NORTHERLY OF, WHEN MEASURED RADIALLY TO, THE CENTERLINE OF LARSEN LANE AS SHOWN ON SAID RECORD OF SURVEY, VOLUME 43, PAGES 120-121 AND A 313.53 FOOT RADIUS COMPOUND CURVE TO THE RIGHT;

THENCE PARALLEL WITH SAID LARSEN LANE CENTERLINE AND ALONG SAID 313.53 FOOT RADIUS CURVE TO THE RIGHT, THROUGH A CENTRAL ANGLE OF 19°31'25", AN ARC DISTANCE OF 106.94 FEET:

THENCE NORTH 39°25'59" WEST, PARALLEL WITH SAID CENTERLINE 82.70 FEET;
THENCE NORTH 41°01'19" WEST, PARALLEL WITH SAID CENTERLINE 22.20 FEET;
THENCE SOUTH 48°56'17" WEST 17.50 FEET TO THE NORTH RIGHT-OF-WAY LINE OF SAID LARSEN LANE, SAID NORTH RIGHT OF WAY LINE BEING 12.50 FEET NORTHERLY OF, WHEN MEASURED PERPENDICULAR TO, SAID CENTERLINE;

THENCE NORTH 41°01'19" WEST, ALONG SAID NORTHERLY RIGHT-OF-WAY LINE 337.54 FEET TO THE WEST LINE OF "PARCEL I" AS CONVEYED TO CT6, LLC BY DEED RECORDED UNDER AUDITOR'S FILE NUMBER 3682681, COWLITZ COUNTY RECORDS;

THENCE NORTH 53°08'46" EAST, LEAVING SAID NORTHERLY RIGHT-OF-WAY LINE AND ALONG THE WEST LINE OF SAID "PARCEL I" A DISTANCE OF 165.33 FEET;

THENCE NORTH 14°33'38" EAST, ALONG SAID WEST LINE 393.71 FEET TO THE TRUE POINT OF BEGINNING.

Title to said real property is vested in:

CT6, LLC, a Washington limited liability company

subject to the matters shown below under Exceptions, which Exceptions are not necessarily shown in the order of their priority.

END OF SCHEDULE A

SCHEDULE B

SCHEDULE B
(continued)

SPECIAL EXCEPTIONS

1. Taxes or assessments which are not shown as existing liens by the records of any taxing authority that levies taxes or assessments on real property or by the public records. Proceedings by a public agency which may result in taxes or assessments, or notices of such proceedings, whether or not shown by the records of such agency or by the public records.

2. (a) Unpatented mining claims; (b) reservations or exceptions in patents or in Acts authorizing the issuance thereof; (c) water rights, claims or title to water, whether or not the matters excepted under (a), (b) or (c) are shown in the public records.

3. Property taxes, which are a lien not yet due and payable, including any assessments collected with taxes to be levied for the year 2025.

   General and special taxes and charges, payable February 15, delinquent if first half unpaid on May 1, second half delinquent if unpaid on November 1 of the tax year:

Year:	2024
Tax Account No.:	30813 (parent parcel)
School District/Levy Code:	600
Assessed Total:	$113,170.00
Millage Rate:	8.145370

   General and Special Taxes:

First Half Billed:	$471.09
Second Half Billed:	$471.01
Unpaid:	$0.00

   Prior to close of escrow, please contact the Tax Collector's Office to confirm all amounts owing, including current fiscal year taxes, supplemental taxes, escaped assessments and any delinquencies.

   General and special taxes and charges, payable February 15, delinquent if first half unpaid on May 1, second half delinquent if unpaid on November 1 of the tax year:

Year:	2024
Tax Account No.:	30812 (parent parcel)
School District/Levy Code:	600
Assessed Total:	$236,140.00
Millage Rate:	8.145370

   General and Special Taxes:

First Half Billed:	$977.14
Second Half Billed:	$977.09
Unpaid:	$0.00

   Prior to close of escrow, please contact the Tax Collector's Office to confirm all amounts owing, including current fiscal year taxes, supplemental taxes, escaped assessments and any delinquencies.

SCHEDULE B
(continued)

4. Assessments, if any, levied by the city of Castle Rock.

5. Boundary Line Agreement, and the terms and conditions thereof:

   Recording Date: July 27, 2018
   Recording No.: 3597924

6. Boundary Adjustment Agreement, and the terms and conditions thereof:

   Recording Date: May 3, 2024
   Recording No.: 3751157

7. Memorandum of Development Agreement, and the terms and conditions thereof:

   Recording Date: May 3, 2024
   Recording No.: 3751162

8. Boundary Line Agreement and Deed, and the terms and conditions thereof:

   Recording Date: December 31, 2024
   Recording No.: 3763318

9. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

   Granted to: Northwestern Long Distance Telephone Co.
   Purpose: telephone and telegraph lines
   Recording Date: September 22, 1908
   Recording No.: Volume 27, Page 489

10. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

    Granted to: Puget Sound Power & Light Co.
    Purpose: Transmission of electric energy
    Recording Date: November 7, 1934
    Recording No.: 126951

11. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

    Granted to: Puget Sound Power & Light Co.
    Purpose: Electric transmission line
    Recording Date: November 7, 1934
    Recording No.: 126952

12. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

    Granted to: State of Washington Department of Game
    Purpose: to permit and allow the free and unrestricted passage over and use of said stream bank property by sport fishermen in order to fish in the Cowlitz River
    Recording Date: December 23, 1958
    Recording No.: 497370

SCHEDULE B
(continued)

13. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	PUBLIC UTILITY DISTRICT NO. 1 OF COWLITZ COUNTY, WASHINGTON
Purpose:	Electric transmission line
Recording Date:	March 30, 1964
Recording No.:	582564

14. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	Cowlitz County
Purpose:	to replace the channel
Recording Date:	June 18, 1980
Recording No.:	800618012

15. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	Cowlitz County
Purpose:	replace the channel
Recording Date:	September 3, 1980
Recording No.:	800903017

16. Easement(s) for the purpose(s) shown below and rights incidental thereto as set forth in a document:

In favor of:	Cowlitz County
Purpose:	school bus turnaround
Recording Date:	December 29, 1965
Recording No.:	620999
Affects:	said premises and other property

17. Easement(s) for the purpose(s) shown below and rights incidental thereto as set forth in a document:

In favor of:	Sprint Communications Company L.P. or Level 3 Communications, LLC
Purpose:	telecommunications easement
Recording Date:	October 24, 2013
Recording No.:	3491199
Affects:	exact location cannot be ascertained of record

18. Reservations contained in the Deed:

Grantor:	Ivy M. Larsen, a single woman
Recording Date:	July 11, 1957
Recording No.:	474558

19. Easements and Encroachments as disclosed on record of survey

Recording Date:	September 5, 1996
Recording No.:	Volume 15, Pages 163 and 164

SCHEDULE B
(continued)

20. Lease Option to Purchase, and the terms and conditions thereof:

Recording Date: May 25, 2021
Recording No.: 3683200

21. Covenants, conditions, restrictions, recitals, reservations, easements, easement provisions, encroachments, dedications, building setback lines, notes, statements, and other matters, if any, but omitting any covenants or restrictions, if any, including but not limited to those based upon race, color, religion, sex, sexual orientation, familial status, marital status, disability, handicap, national origin, ancestry, or source of income, as set forth in applicable state or federal laws, except to the extent that said covenant or restriction is permitted by applicable law, as set forth on Survey:

Recording No: 3732400, Volume 43, Page 120

22. Any rights, interests, or claims which may exist or arise by reason of the following matters disclosed by survey,

Recording Date: October 23, 2023
Recording No.: 3742475
Matters shown: Boundary lines

23. Covenants, conditions, restrictions, recitals, reservations, easements, easement provisions, encroachments, dedications, building setback lines, notes, statements, and other matters, if any, but omitting any covenants or restrictions, if any, including but not limited to those based upon race, color, religion, sex, sexual orientation, familial status, marital status, disability, handicap, national origin, ancestry, or source of income, as set forth in applicable state or federal laws, except to the extent that said covenant or restriction is permitted by applicable law, as set forth on Survey:

Recording No: 3762029, Volume 45, Page 110

24. Any unrecorded leaseholds, right of vendors and holders of security interests on personal property installed upon the Land and rights of tenants to remove trade fixtures at the expiration of the terms.

END OF EXCEPTIONS

NOTES

The following matters will not be listed as Special Exceptions in Schedule B of the policy. There will be no coverage for loss arising by reason of the matters listed below because these matters are either excepted or excluded from coverage or are not matters covered under the insuring provisions of the policy.

Note A: Your application for title insurance was placed by reference to only a street address or tax identification number. Based on our records, we believe that the legal description in this report covers the parcel(s) of Land that you requested. If the legal description is incorrect, the seller/borrower must notify the Company and/or the settlement company in order to prevent errors and to be certain that the correct parcel(s) of Land will appear on any documents to be recorded in connection with this transaction and on the policy of title insurance.

Note B: Note: The Public Records indicate that the address of the improvement located on said Land is as follows:

Vacant land

SCHEDULE B
(continued)

Note C: Notice: Please be advised that our search disclosed that the Land is vacant. The Company reserves the right to require further evidence to establish and verify the identity of the seller. The Company further reserves the right to make additional requirements or add additional items or exceptions upon receipt of the requested evidence.

Note D: Note: FOR INFORMATIONAL PURPOSES ONLY:

The following may be used as an abbreviated legal description on the documents to be recorded, per Amended RCW 65.04.045. Said abbreviated legal description is not a substitute for a complete legal description within the body of the document:

Tract 1 of Boundary Line Adjustment Survey, Book 45, Page 110
Tax Account No.: 308120300

Note E: Note: This map/plat is being furnished as an aid in locating the herein described Land in relation to adjoining streets, natural boundaries and other land. Except to the extent a policy of title insurance is expressly modified by endorsement, if any, the Company does not insure dimensions, distances or acreage shown thereon.

Note F: The recording fee (per document) is currently:

Deed	$303.50 plus $1.00 for each additional page
Deed of Trust	$304.50 plus $1.00 for each additional page

Note: When possible, the company will record electronically, and an additional $15.00 fee will apply.

Note: A multiple transaction document incurs an additional fee for each additional title.

Note: A document which fails to conform to certain formatting and page one requirements incurs an additional $50.00 fee.

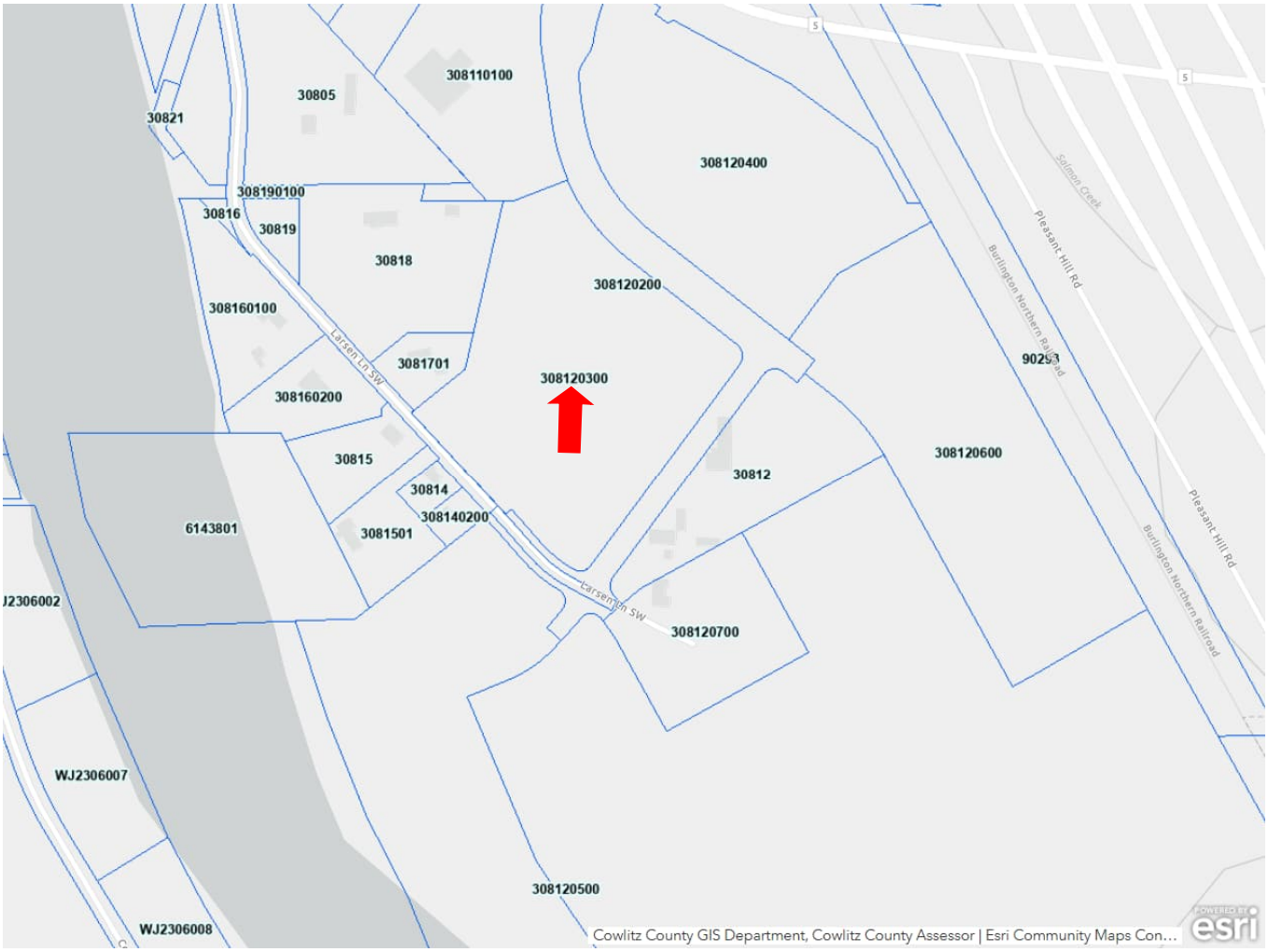
RECORDING FEES ARE SUBJECT TO CHANGE WITHOUT NOTICE.

Please send all recording packages to:
Recording Department
655 W. Columbia Way, Suite 200
Vancouver, WA 98660

Please email all releases to:
ClarkWArecordings@fnf.com

END OF NOTES

END OF SCHEDULE B



This map/plat is being furnished as an aid in locating the herein described Land in relation to adjoining streets, natural boundaries and other land, and is not a survey of the land depicted. Except to the extent a policy of title insurance is expressly modified by endorsement, if any, the Company does not insure dimensions, distances, location of easements, acreage or other matters shown thereon.

CT6, LLC.

AFFIDVAIT OF NEIGHBORHOOD MEEITNG NOTICE MAILING

AFFIDAVIT OF NEIGHBORHOOD MEETING NOTICE MAILING

I, Ingrid Friedberg, on behalf of CT6, LLC, hereby certify that on November 12, 2024, mailed a neighborhood meeting invitation for the River's Edge at the Landing Subdivision project to neighboring property owners within three- (300) hundred feet of the subject site, in accordance with the requirements of the City of Castle Rock Municipal Code Section 16.12.013.A.

Ingrid Friedberg

Ingrid Friedberg

3/13/25

Date

STATE OF WASHINGTON)
)
County of Clark)

ss.

This record was acknowledged before me on March 13, 2025, by Ingrid Friedberg.

NOTARY PUBLIC
Commission Number 22001984
Janette Pipkin
My Appointment Expires 12/9/2025
STATE OF WASHINGTON

NOTARY PUBLIC for the State of Washington

My Commission Expires: 12/09/2025

CT6, LLC.

NEIGHBORHOOD MEETING NOTICE LETTER

TAPANI INC.

November 12, 2024

RE: **Neighborhood Meeting Notice for the Proposed Development in the Approved Landing on the Cowlitz Master Plan**
Located South of Huntington Avenue South in Castle Rock

Dear Larsen Lane LLC:

On behalf of, CT6, LLC, an affiliate of Tapani Inc., you are cordially invited to attend a neighborhood meeting to discuss proposed development within the approved Landing on the Cowlitz (LOTC) Master Plan, from **5:00-6:30 p.m. on Monday, November 25 at the Castle Rock Senior Center, 222 2nd Avenue SW in Castle Rock**.

CT6, LLC is currently considering two (2) separate developments within the approved Landing on the Cowlitz (LOTC) Master Plan. The LOTC Master Plan was approved in 2021 and includes several different land use area types. Please see the attached *Approved Master Plan* for more information. The Master Plan did not include site-specific plan approvals and requires that all future development go through a land use and engineering permitting process.

The purpose of the upcoming neighborhood meeting is to discuss two (2) separate proposed site-specific developments with surrounding property owners and residents involving:

- The River's Edge at the Landing includes a 61-detached single family residential subdivision within about nine (9) acres within the LOTC residential land use area. Please see the attached *Conceptual River's Edge at the Landing Subdivision Layout.* The approved LOTC allows for up to two hundred (200) dwelling units.
- The River's Edge RV Park includes a 173-stall recreational RV park within an approximately fifteen- (15) acre area of the parks and open space land use area of the LOTC. For more information, please see the attached *Conceptual River's Edge RV Layout*. The approved LOTC allows for up to two hundred (200) recreational RV stalls.

CT6, LLC and its engineering consultant are working on preparing necessary applications for review and approval by the City of Castle Rock. Please note that this will be an informational meeting with the developer and is not intended to take the place of a public hearing before the Planning Commission. You will have an opportunity to present testimony to the Planning Commission after applications are submitted to the City for review.

Headquarters
PO Box 1900, 1904 SE 6th Place
Battle Ground, WA 98604
(360) 687-1148

Tri-Cities Office
2213 Henderson Loop
Richland, WA 99354
(509) 590-1184

Tualatin Office
18500 SW Pacific Hwy
Tualatin, OR 97062
(503) 883-3169

Website
tapani.com
Email
info@tapani.com

We look forward to seeing you at the meeting and hearing your thoughts on the proposed subdivision and recreational RV park. Should you have any questions beforehand, please do not hesitate to reach out.

Sincerely,

Ingrid Friedberg

Ingrid Friedberg
Special Projects Manager
ingridf@tapani.com
360.553.9144

Attachments: Approved Landing on the Cowlitz Master Plan
Conceptual River's Edge at the Landing Subdivision Layout
Conceptual River's Edge RV Layout

TAPANI INC.

November 12, 2024

RE: **Neighborhood Meeting Notice for the Proposed Development in the Approved Landing on the Cowlitz Master Plan**
Located South of Huntington Avenue South in Castle Rock

Dear Sherri:

On behalf of, CT6, LLC, an affiliate of Tapani Inc., you are cordially invited to attend a neighborhood meeting to discuss proposed development within the approved Landing on the Cowlitz (LOTC) Master Plan, from **5:00-6:30 p.m. Monday, November 25 at the Castle Rock Senior Center, 222 2nd Avenue SW in Castle Rock**.

CT6, LLC is currently considering two (2) separate developments within the approved Landing on the Cowlitz (LOTC) Master Plan. The LOTC Master Plan was approved in 2021 and includes several different land use area types. Please see the attached *Approved Master Plan* for more information. The Master Plan did not include site-specific plan approvals and requires that all future development go through a land use and engineering approval process.

The purpose of the upcoming neighborhood meeting is to discuss two (2) separate proposed site-specific developments with surrounding property owners and residents involving:

- The River's Edge at the Landing includes a 61-detached single family residential subdivision within about nine (9) acres within the LOTC residential land use area. Please see the attached *Conceptual River's Edge at the Landing Subdivision Layout.* The approved LOTC allows for up to two hundred (200) dwelling units.
- The River's Edge RV Park includes a 173-stall recreational RV park within an approximately fifteen- (15) acre area of the parks and open space land use area of the LOTC. For more information, please see the attached *Conceptual River's Edge RV Layout*. The approved LOTC allows for up to two hundred (200) recreational RV stalls.

CT6, LLC and its engineering consultant are working on preparing a subdivision, site plan and shoreline permit application for review and approval by the City of Castle Rock. Please note that this will be an informational meeting with the developer and is not intended to take the place of a public hearing before the Planning Commission. You will have an opportunity to present testimony to the Planning Commission after applications are submitted to the City for review.

Headquarters
PO Box 1900, 1904 SE 6th Place
Battle Ground, WA 98604
(360) 687-1148

Tri-Cities Office
2213 Henderson Loop
Richland, WA 99354
(509) 590-1184

Tualatin Office
18500 SW Pacific Hwy
Tualatin, OR 97062
(503) 883-3169

Website
tapani.com
Email
info@tapani.com

We look forward to seeing you at the meeting and hearing your thoughts on the proposed subdivision and recreational RV park. Should you have any questions beforehand, please do not hesitate to reach out.

Sincerely,

Ingrid Friedberg

Ingrid Friedberg
Special Projects Manager
ingridf@tapani.com
360.553.9144

Attachments: Approved Landing on the Cowlitz Master Plan
Conceptual River's Edge at the Landing Subdivision Layout
Conceptual River's Edge RV Layout

TAPANI INC.

November 12, 2024

RE: **Neighborhood Meeting Notice for the Proposed Development in the Approved Landing on the Cowlitz Master Plan**
Located South of Huntington Avenue South in Castle Rock

Dear Bounmy:

On behalf of, CT6, LLC, an affiliate of Tapani Inc., you are cordially invited to attend a neighborhood meeting to discuss proposed development within the approved Landing on the Cowlitz (LOTC) Master Plan, from **5:00-6:30 p.m. Monday, November 25 at the Castle Rock Senior Center, 222 2nd Avenue SW in Castle Rock**.

CT6, LLC is currently considering two (2) separate developments within the approved Landing on the Cowlitz (LOTC) Master Plan. The LOTC Master Plan was approved in 2021 and includes several different land use area types. Please see the attached *Approved Master Plan* for more information. The Master Plan did not include site-specific plan approvals and requires that all future development go through a land use and engineering permitting process.

The purpose of the upcoming neighborhood meeting is to discuss two (2) separate proposed site-specific developments with surrounding property owners and residents involving:

- The River's Edge at the Landing includes a 61-detached single family residential subdivision within about nine (9) acres within the LOTC residential land use area. Please see the attached *Conceptual River's Edge at the Landing Subdivision Layout.* The approved LOTC allows for up to two hundred (200) dwelling units.
- The River's Edge RV Park includes a 173-stall recreational RV park within an approximately fifteen- (15) acre area of the parks and open space land use area of the LOTC. For more information, please see the attached *Conceptual River's Edge RV Layout*. The approved LOTC allows for up to two hundred (200) recreational RV stalls.

CT6, LLC and its engineering consultant are working on preparing a subdivision, site plan and shoreline permit application for review and approval by the City of Castle Rock. Please note that this will be an informational meeting with the developer and is not intended to take the place of a public hearing before the Planning Commission. You will have an opportunity to present testimony to the Planning Commission after applications are submitted to the City for review.

Headquarters
PO Box 1900, 1904 SE 6th Place
Battle Ground, WA 98604
(360) 687-1148

Tri-Cities Office
2213 Henderson Loop
Richland, WA 99354
(509) 590-1184

Tualatin Office
18500 SW Pacific Hwy
Tualatin, OR 97062
(503) 883-3169

Website
tapani.com
Email
info@tapani.com

We look forward to seeing you at the meeting and hearing your thoughts on the proposed subdivision and recreational RV park. Should you have any questions beforehand, please do not hesitate to reach out.

Sincerely,

Ingrid Friedberg

Ingrid Friedberg
Special Projects Manager
ingridf@tapani.com
360.553.9144

Attachments: Approved Landing on the Cowlitz Master Plan
Conceptual River's Edge at the Landing Subdivision Layout
Conceptual River's Edge RV Layout

TAPANI INC.

November 12, 2024

RE: **Neighborhood Meeting Notice for the Proposed Development in the Approved Landing on the Cowlitz Master Plan**
Located South of Huntington Avenue South in Castle Rock

Dear Roy:

On behalf of, CT6, LLC, an affiliate of Tapani Inc., you are cordially invited to attend a neighborhood meeting to discuss proposed development within the approved Landing on the Cowlitz (LOTC) Master Plan, from **5:00-6:30 p.m. Monday, November 25 at the Castle Rock Senior Center, 222 2nd Avenue SW in Castle Rock**.

CT6, LLC is currently considering two (2) separate developments within the approved Landing on the Cowlitz (LOTC) Master Plan. The LOTC Master Plan was approved in 2021 and includes several different land use area types. Please see the attached *Approved Master Plan* for more information. The Master Plan did not include site-specific plan approvals and requires that all future development go through a land use and engineering permitting process.

The purpose of the upcoming neighborhood meeting is to discuss two (2) separate proposed site-specific developments with surrounding property owners and residents involving:

- The River's Edge at the Landing includes a 61-detached single family residential subdivision within about nine (9) acres within the LOTC residential land use area. Please see the attached *Conceptual River's Edge at the Landing Subdivision Layout.* The approved LOTC allows for up to two hundred (200) dwelling units.
- The River's Edge RV Park includes a 173-stall recreational RV park within an approximately fifteen- (15) acre area of the parks and open space land use area of the LOTC. For more information, please see the attached *Conceptual River's Edge RV Layout*. The approved LOTC allows for up to two hundred (200) recreational RV stalls.

CT6, LLC and its engineering consultant are working on preparing a subdivision, site plan and shoreline permit application for review and approval by the City of Castle Rock. Please note that this will be an informational meeting with the developer and is not intended to take the place of a public hearing before the Planning Commission. You will have an opportunity to present testimony to the Planning Commission after applications are submitted to the City for review.

Headquarters
PO Box 1900, 1904 SE 6th Place
Battle Ground, WA 98604
(360) 687-1148

Tri-Cities Office
2213 Henderson Loop
Richland, WA 99354
(509) 590-1184

Tualatin Office
18500 SW Pacific Hwy
Tualatin, OR 97062
(503) 883-3169

Website
tapani.com
Email
info@tapani.com

We look forward to seeing you at the meeting and hearing your thoughts on the proposed subdivision and recreational RV park. Should you have any questions beforehand, please do not hesitate to reach out.

Sincerely,

Ingrid Friedberg

Ingrid Friedberg
Special Projects Manager
ingridf@tapani.com
360.553.9144

Attachments: Approved Landing on the Cowlitz Master Plan
Conceptual River's Edge at the Landing Subdivision Layout
Conceptual River's Edge RV Layout

TAPANI INC.

November 12, 2024

RE: **Neighborhood Meeting Notice for the Proposed Development in the Approved Landing on the Cowlitz Master Plan**
Located South of Huntington Avenue South in Castle Rock

Dear Cowlitz County:

On behalf of, CT6, LLC, an affiliate of Tapani Inc., you are cordially invited to attend a neighborhood meeting to discuss proposed development within the approved Landing on the Cowlitz (LOTC) Master Plan, from **5:00-6:30 p.m. Monday, November 25 at the Castle Rock Senior Center, 222 2nd Avenue SW in Castle Rock**.

CT6, LLC is currently considering two (2) separate developments within the approved Landing on the Cowlitz (LOTC) Master Plan. The LOTC Master Plan was approved in 2021 and includes several different land use area types. Please see the attached *Approved Master Plan* for more information. The Master Plan did not include site-specific plan approvals and requires that all future development go through a land use and engineering permitting process.

The purpose of the upcoming neighborhood meeting is to discuss two (2) separate proposed site-specific developments with surrounding property owners and residents involving:

- The River's Edge at the Landing includes a 61-detached single family residential subdivision within about nine (9) acres within the LOTC residential land use area. Please see the attached *Conceptual River's Edge at the Landing Subdivision Layout.* The approved LOTC allows for up to two hundred (200) dwelling units.
- The River's Edge RV Park includes a 173-stall recreational RV park within an approximately fifteen- (15) acre area of the parks and open space land use area of the LOTC. For more information, please see the attached *Conceptual River's Edge RV Layout*. The approved LOTC allows for up to two hundred (200) recreational RV stalls.

CT6, LLC and its engineering consultant are working on preparing a subdivision, site plan and shoreline permit application for review and approval by the City of Castle Rock. Please note that this will be an informational meeting with the developer and is not intended to take the place of a public hearing before the Planning Commission. You will have an opportunity to present testimony to the Planning Commission after applications are submitted to the City for review.

Headquarters
PO Box 1900, 1904 SE 6th Place
Battle Ground, WA 98604
(360) 687-1148

Tri-Cities Office
2213 Henderson Loop
Richland, WA 99354
(509) 590-1184

Tualatin Office
18500 SW Pacific Hwy
Tualatin, OR 97062
(503) 883-3169

Website
tapani.com
Email
info@tapani.com

We look forward to seeing you at the meeting and hearing your thoughts on the proposed subdivision and recreational RV park. Should you have any questions beforehand, please do not hesitate to reach out.

Sincerely,

Ingrid Friedberg

Ingrid Friedberg
Special Projects Manager
ingridf@tapani.com
360.553.9144

Attachments: Approved Landing on the Cowlitz Master Plan
Conceptual River's Edge at the Landing Subdivision Layout
Conceptual River's Edge RV Layout

TAPANI INC.

November 12, 2024

RE: **Neighborhood Meeting Notice for the Proposed Development in the Approved Landing on the Cowlitz Master Plan**
Located South of Huntington Avenue South in Castle Rock

Dear City of Castle Rock:

On behalf of, CT6, LLC, an affiliate of Tapani Inc., you are cordially invited to attend a neighborhood meeting to discuss proposed development within the approved Landing on the Cowlitz (LOTC) Master Plan, from **5:00-6:30 p.m. Monday, November 25 at the Castle Rock Senior Center, 222 2nd Avenue SW in Castle Rock**.

CT6, LLC is currently considering two (2) separate developments within the approved Landing on the Cowlitz (LOTC) Master Plan. The LOTC Master Plan was approved in 2021 and includes several different land use area types. Please see the attached *Approved Master Plan* for more information. The Master Plan did not include site-specific plan approvals and requires that all future development go through a land use and engineering permitting process.

The purpose of the upcoming neighborhood meeting is to discuss two (2) separate proposed site-specific developments with surrounding property owners and residents involving:

- The River's Edge at the Landing includes a 61-detached single family residential subdivision within about nine (9) acres within the LOTC residential land use area. Please see the attached *Conceptual River's Edge at the Landing Subdivision Layout.* The approved LOTC allows for up to two hundred (200) dwelling units.
- The River's Edge RV Park includes a 173-stall recreational RV park within an approximately fifteen- (15) acre area of the parks and open space land use area of the LOTC. For more information, please see the attached *Conceptual River's Edge RV Layout*. The approved LOTC allows for up to two hundred (200) recreational RV stalls.

CT6, LLC and its engineering consultant are working on preparing a subdivision, site plan and shoreline permit application for review and approval by the City of Castle Rock. Please note that this will be an informational meeting with the developer and is not intended to take the place of a public hearing before the Planning Commission. You will have an opportunity to present testimony to the Planning Commission after applications are submitted to the City for review.

Headquarters
PO Box 1900, 1904 SE 6th Place
Battle Ground, WA 98604
(360) 687-1148

Tri-Cities Office
2213 Henderson Loop
Richland, WA 99354
(509) 590-1184

Tualatin Office
18500 SW Pacific Hwy
Tualatin, OR 97062
(503) 883-3169

Website
tapani.com
Email
info@tapani.com

We look forward to seeing you at the meeting and hearing your thoughts on the proposed subdivision and recreational RV park. Should you have any questions beforehand, please do not hesitate to reach out.

Sincerely,

Ingrid Friedberg

Ingrid Friedberg
Special Projects Manager
ingridf@tapani.com
360.553.9144

Attachments: Approved Landing on the Cowlitz Master Plan
Conceptual River's Edge at the Landing Subdivision Layout
Conceptual River's Edge RV Layout

TAPANI INC.

November 12, 2024

RE: **Neighborhood Meeting Notice for the Proposed Development in the Approved Landing on the Cowlitz Master Plan**
Located South of Huntington Avenue South in Castle Rock

Dear Timberlake Christian Fellowship:

On behalf of, CT6, LLC, an affiliate of Tapani Inc., you are cordially invited to attend a neighborhood meeting to discuss proposed development within the approved Landing on the Cowlitz (LOTC) Master Plan, from **5:00-6:30 p.m. Monday, November 25 at the Castle Rock Senior Center, 222 2nd Avenue SW in Castle Rock**.

CT6, LLC is currently considering two (2) separate developments within the approved Landing on the Cowlitz (LOTC) Master Plan. The LOTC Master Plan was approved in 2021 and includes several different land use area types. Please see the attached *Approved Master Plan* for more information. The Master Plan did not include site-specific plan approvals and requires that all future development go through a land use and engineering permitting process.

The purpose of the upcoming neighborhood meeting is to discuss two (2) separate proposed site-specific developments with surrounding property owners and residents involving:

- The River's Edge at the Landing includes a 61-detached single family residential subdivision within about nine (9) acres within the LOTC residential land use area. Please see the attached *Conceptual River's Edge at the Landing Subdivision Layout.* The approved LOTC allows for up to two hundred (200) dwelling units.
- The River's Edge RV Park includes a 173-stall recreational RV park within an approximately fifteen- (15) acre area of the parks and open space land use area of the LOTC. For more information, please see the attached *Conceptual River's Edge RV Layout*. The approved LOTC allows for up to two hundred (200) recreational RV stalls.

CT6, LLC and its engineering consultant are working on preparing a subdivision, site plan and shoreline permit application for review and approval by the City of Castle Rock. Please note that this will be an informational meeting with the developer and is not intended to take the place of a public hearing before the Planning Commission. You will have an opportunity to present testimony to the Planning Commission after applications are submitted to the City for review.

Headquarters
PO Box 1900, 1904 SE 6th Place
Battle Ground, WA 98604
(360) 687-1148

Tri-Cities Office
2213 Henderson Loop
Richland, WA 99354
(509) 590-1184

Tualatin Office
18500 SW Pacific Hwy
Tualatin, OR 97062
(503) 883-3169

Website
tapani.com
Email
info@tapani.com

We look forward to seeing you at the meeting and hearing your thoughts on the proposed subdivision and recreational RV park. Should you have any questions beforehand, please do not hesitate to reach out.

Sincerely,

Ingrid Friedberg

Ingrid Friedberg
Special Projects Manager
ingridf@tapani.com
360.553.9144

Attachments: Approved Landing on the Cowlitz Master Plan
Conceptual River's Edge at the Landing Subdivision Layout
Conceptual River's Edge RV Layout

TAPANI INC.

November 12, 2024

RE: **Neighborhood Meeting Notice for the Proposed Development in the Approved Landing on the Cowlitz Master Plan**
Located South of Huntington Avenue South in Castle Rock

Dear Matthew:

On behalf of, CT6, LLC, an affiliate of Tapani Inc., you are cordially invited to attend a neighborhood meeting to discuss proposed development within the approved Landing on the Cowlitz (LOTC) Master Plan, from **5:00-6:30 p.m. Monday, November 25 at the Castle Rock Senior Center, 222 2nd Avenue SW in Castle Rock**.

CT6, LLC is currently considering two (2) separate developments within the approved Landing on the Cowlitz (LOTC) Master Plan. The LOTC Master Plan was approved in 2021 and includes several different land use area types. Please see the attached *Approved Master Plan* for more information. The Master Plan did not include site-specific plan approvals and requires that all future development go through a land use and engineering permitting process.

The purpose of the upcoming neighborhood meeting is to discuss two (2) separate proposed site-specific developments with surrounding property owners and residents involving:

- The River's Edge at the Landing includes a 61-detached single family residential subdivision within about nine (9) acres within the LOTC residential land use area. Please see the attached *Conceptual River's Edge at the Landing Subdivision Layout.* The approved LOTC allows for up to two hundred (200) dwelling units.
- The River's Edge RV Park includes a 173-stall recreational RV park within an approximately fifteen- (15) acre area of the parks and open space land use area of the LOTC. For more information, please see the attached *Conceptual River's Edge RV Layout*. The approved LOTC allows for up to two hundred (200) recreational RV stalls.

CT6, LLC and its engineering consultant are working on preparing a subdivision, site plan and shoreline permit application for review and approval by the City of Castle Rock. Please note that this will be an informational meeting with the developer and is not intended to take the place of a public hearing before the Planning Commission. You will have an opportunity to present testimony to the Planning Commission after applications are submitted to the City for review.

Headquarters
PO Box 1900, 1904 SE 6th Place
Battle Ground, WA 98604
(360) 687-1148

Tri-Cities Office
2213 Henderson Loop
Richland, WA 99354
(509) 590-1184

Tualatin Office
18500 SW Pacific Hwy
Tualatin, OR 97062
(503) 883-3169

Website
tapani.com
Email
info@tapani.com

We look forward to seeing you at the meeting and hearing your thoughts on the proposed subdivision and recreational RV park. Should you have any questions beforehand, please do not hesitate to reach out.

Sincerely,

Ingrid Friedberg

Ingrid Friedberg
Special Projects Manager
ingridf@tapani.com
360.553.9144

Attachments: Approved Landing on the Cowlitz Master Plan
Conceptual River's Edge at the Landing Subdivision Layout
Conceptual River's Edge RV Layout

TAPANI INC.

November 12, 2024

RE: **Neighborhood Meeting Notice for the Proposed Development in the Approved Landing on the Cowlitz Master Plan**
Located South of Huntington Avenue South in Castle Rock

Dear Terry:

On behalf of, CT6, LLC, an affiliate of Tapani Inc., you are cordially invited to attend a neighborhood meeting to discuss proposed development within the approved Landing on the Cowlitz (LOTC) Master Plan, from **5:00-6:30 p.m. Monday, November 25 at the Castle Rock Senior Center, 222 2nd Avenue SW in Castle Rock**.

CT6, LLC is currently considering two (2) separate developments within the approved Landing on the Cowlitz (LOTC) Master Plan. The LOTC Master Plan was approved in 2021 and includes several different land use area types. Please see the attached *Approved Master Plan* for more information. The Master Plan did not include site-specific plan approvals and requires that all future development go through a land use and engineering permitting process.

The purpose of the upcoming neighborhood meeting is to discuss two (2) separate proposed site-specific developments with surrounding property owners and residents involving:

- The River's Edge at the Landing includes a 61-detached single family residential subdivision within about nine (9) acres within the LOTC residential land use area. Please see the attached *Conceptual River's Edge at the Landing Subdivision Layout.* The approved LOTC allows for up to two hundred (200) dwelling units.
- The River's Edge RV Park includes a 173-stall recreational RV park within an approximately fifteen- (15) acre area of the parks and open space land use area of the LOTC. For more information, please see the attached *Conceptual River's Edge RV Layout*. The approved LOTC allows for up to two hundred (200) recreational RV stalls.

CT6, LLC and its engineering consultant are working on preparing a subdivision, site plan and shoreline permit application for review and approval by the City of Castle Rock. Please note that this will be an informational meeting with the developer and is not intended to take the place of a public hearing before the Planning Commission. You will have an opportunity to present testimony to the Planning Commission after applications are submitted to the City for review.

Headquarters
PO Box 1900, 1904 SE 6th Place
Battle Ground, WA 98604
(360) 687-1148

Tri-Cities Office
2213 Henderson Loop
Richland, WA 99354
(509) 590-1184

Tualatin Office
18500 SW Pacific Hwy
Tualatin, OR 97062
(503) 883-3169

Website
tapani.com
Email
info@tapani.com

We look forward to seeing you at the meeting and hearing your thoughts on the proposed subdivision and recreational RV park. Should you have any questions beforehand, please do not hesitate to reach out.

Sincerely,

Ingrid Friedberg

Ingrid Friedberg
Special Projects Manager
ingridf@tapani.com
360.553.9144

Attachments: Approved Landing on the Cowlitz Master Plan
Conceptual River's Edge at the Landing Subdivision Layout
Conceptual River's Edge RV Layout

TAPANI INC.

November 12, 2024

RE: **Neighborhood Meeting Notice for the Proposed Development in the Approved Landing on the Cowlitz Master Plan**
Located South of Huntington Avenue South in Castle Rock

Dear Andrew:

On behalf of, CT6, LLC, an affiliate of Tapani Inc., you are cordially invited to attend a neighborhood meeting to discuss proposed development within the approved Landing on the Cowlitz (LOTC) Master Plan, from **5:00-6:30 p.m. Monday, November 25 at the Castle Rock Senior Center, 222 2nd Avenue SW in Castle Rock**.

CT6, LLC is currently considering two (2) separate developments within the approved Landing on the Cowlitz (LOTC) Master Plan. The LOTC Master Plan was approved in 2021 and includes several different land use area types. Please see the attached *Approved Master Plan* for more information. The Master Plan did not include site-specific plan approvals and requires that all future development go through a land use and engineering permitting process.

The purpose of the upcoming neighborhood meeting is to discuss two (2) separate proposed site-specific developments with surrounding property owners and residents involving:

- The River's Edge at the Landing includes a 61-detached single family residential subdivision within about nine (9) acres within the LOTC residential land use area. Please see the attached *Conceptual River's Edge at the Landing Subdivision Layout.* The approved LOTC allows for up to two hundred (200) dwelling units.
- The River's Edge RV Park includes a 173-stall recreational RV park within an approximately fifteen- (15) acre area of the parks and open space land use area of the LOTC. For more information, please see the attached *Conceptual River's Edge RV Layout*. The approved LOTC allows for up to two hundred (200) recreational RV stalls.

CT6, LLC and its engineering consultant are working on preparing a subdivision, site plan and shoreline permit application for review and approval by the City of Castle Rock. Please note that this will be an informational meeting with the developer and is not intended to take the place of a public hearing before the Planning Commission. You will have an opportunity to present testimony to the Planning Commission after applications are submitted to the City for review.

Headquarters
PO Box 1900, 1904 SE 6th Place
Battle Ground, WA 98604
(360) 687-1148

Tri-Cities Office
2213 Henderson Loop
Richland, WA 99354
(509) 590-1184

Tualatin Office
18500 SW Pacific Hwy
Tualatin, OR 97062
(503) 883-3169

Website
tapani.com
Email
info@tapani.com

We look forward to seeing you at the meeting and hearing your thoughts on the proposed subdivision and recreational RV park. Should you have any questions beforehand, please do not hesitate to reach out.

Sincerely,

Ingrid Friedberg

Ingrid Friedberg
Special Projects Manager
ingridf@tapani.com
360.553.9144

Attachments: Approved Landing on the Cowlitz Master Plan
Conceptual River's Edge at the Landing Subdivision Layout
Conceptual River's Edge RV Layout

TAPANI INC.

November 12, 2024

RE: **Neighborhood Meeting Notice for the Proposed Development in the Approved Landing on the Cowlitz Master Plan**
Located South of Huntington Avenue South in Castle Rock

Dear Roy:

On behalf of, CT6, LLC, an affiliate of Tapani Inc., you are cordially invited to attend a neighborhood meeting to discuss proposed development within the approved Landing on the Cowlitz (LOTC) Master Plan, from **5:00-6:30 p.m. Monday, November 25 at the Castle Rock Senior Center, 222 2nd Avenue SW in Castle Rock**.

CT6, LLC is currently considering two (2) separate developments within the approved Landing on the Cowlitz (LOTC) Master Plan. The LOTC Master Plan was approved in 2021 and includes several different land use area types. Please see the attached *Approved Master Plan* for more information. The Master Plan did not include site-specific plan approvals and requires that all future development go through a land use and engineering permitting process.

The purpose of the upcoming neighborhood meeting is to discuss two (2) separate proposed site-specific developments with surrounding property owners and residents involving:

- The River's Edge at the Landing includes a 61-detached single family residential subdivision within about nine (9) acres within the LOTC residential land use area. Please see the attached *Conceptual River's Edge at the Landing Subdivision Layout.* The approved LOTC allows for up to two hundred (200) dwelling units.
- The River's Edge RV Park includes a 173-stall recreational RV park within an approximately fifteen- (15) acre area of the parks and open space land use area of the LOTC. For more information, please see the attached *Conceptual River's Edge RV Layout*. The approved LOTC allows for up to two hundred (200) recreational RV stalls.

CT6, LLC and its engineering consultant are working on preparing a subdivision, site plan and shoreline permit application for review and approval by the City of Castle Rock. Please note that this will be an informational meeting with the developer and is not intended to take the place of a public hearing before the Planning Commission. You will have an opportunity to present testimony to the Planning Commission after applications are submitted to the City for review.

Headquarters
PO Box 1900, 1904 SE 6th Place
Battle Ground, WA 98604
(360) 687-1148

Tri-Cities Office
2213 Henderson Loop
Richland, WA 99354
(509) 590-1184

Tualatin Office
18500 SW Pacific Hwy
Tualatin, OR 97062
(503) 883-3169

Website
tapani.com
Email
info@tapani.com

We look forward to seeing you at the meeting and hearing your thoughts on the proposed subdivision and recreational RV park. Should you have any questions beforehand, please do not hesitate to reach out.

Sincerely,

Ingrid Friedberg

Ingrid Friedberg
Special Projects Manager
ingridf@tapani.com
360.553.9144

Attachments: Approved Landing on the Cowlitz Master Plan
Conceptual River's Edge at the Landing Subdivision Layout
Conceptual River's Edge RV Layout

TAPANI INC.

November 12, 2024

RE: **Neighborhood Meeting Notice for the Proposed Development in the Approved Landing on the Cowlitz Master Plan**
Located South of Huntington Avenue South in Castle Rock

Dear Ray:

On behalf of, CT6, LLC, an affiliate of Tapani Inc., you are cordially invited to attend a neighborhood meeting to discuss proposed development within the approved Landing on the Cowlitz (LOTC) Master Plan, from **5:00-6:30 p.m. Monday, November 25 at the Castle Rock Senior Center, 222 2nd Avenue SW in Castle Rock**.

CT6, LLC is currently considering two (2) separate developments within the approved Landing on the Cowlitz (LOTC) Master Plan. The LOTC Master Plan was approved in 2021 and includes several different land use area types. Please see the attached *Approved Master Plan* for more information. The Master Plan did not include site-specific plan approvals and requires that all future development go through a land use and engineering permitting process.

The purpose of the upcoming neighborhood meeting is to discuss two (2) separate proposed site-specific developments with surrounding property owners and residents involving:

- The River's Edge at the Landing includes a 61-detached single family residential subdivision within about nine (9) acres within the LOTC residential land use area. Please see the attached *Conceptual River's Edge at the Landing Subdivision Layout.* The approved LOTC allows for up to two hundred (200) dwelling units.
- The River's Edge RV Park includes a 173-stall recreational RV park within an approximately fifteen- (15) acre area of the parks and open space land use area of the LOTC. For more information, please see the attached *Conceptual River's Edge RV Layout*. The approved LOTC allows for up to two hundred (200) recreational RV stalls.

CT6, LLC and its engineering consultant are working on preparing a subdivision, site plan and shoreline permit application for review and approval by the City of Castle Rock. Please note that this will be an informational meeting with the developer and is not intended to take the place of a public hearing before the Planning Commission. You will have an opportunity to present testimony to the Planning Commission after applications are submitted to the City for review.

Headquarters
PO Box 1900, 1904 SE 6th Place
Battle Ground, WA 98604
(360) 687-1148

Tri-Cities Office
2213 Henderson Loop
Richland, WA 99354
(509) 590-1184

Tualatin Office
18500 SW Pacific Hwy
Tualatin, OR 97062
(503) 883-3169

Website
tapani.com
Email
info@tapani.com

We look forward to seeing you at the meeting and hearing your thoughts on the proposed subdivision and recreational RV park. Should you have any questions beforehand, please do not hesitate to reach out.

Sincerely,

Ingrid Friedberg

Ingrid Friedberg
Special Projects Manager
ingridf@tapani.com
360.553.9144

Attachments: Approved Landing on the Cowlitz Master Plan
Conceptual River's Edge at the Landing Subdivision Layout
Conceptual River's Edge RV Layout

TAPANI INC.

November 12, 2024

RE: **Neighborhood Meeting Notice for the Proposed Development in the Approved Landing on the Cowlitz Master Plan**
Located South of Huntington Avenue South in Castle Rock

Dear Mel:

On behalf of, CT6, LLC, an affiliate of Tapani Inc., you are cordially invited to attend a neighborhood meeting to discuss proposed development within the approved Landing on the Cowlitz (LOTC) Master Plan, from **5:00-6:30 p.m. Monday, November 25 at the Castle Rock Senior Center, 222 2nd Avenue SW in Castle Rock**.

CT6, LLC is currently considering two (2) separate developments within the approved Landing on the Cowlitz (LOTC) Master Plan. The LOTC Master Plan was approved in 2021 and includes several different land use area types. Please see the attached *Approved Master Plan* for more information. The Master Plan did not include site-specific plan approvals and requires that all future development go through a land use and engineering permitting process.

The purpose of the upcoming neighborhood meeting is to discuss two (2) separate proposed site-specific developments with surrounding property owners and residents involving:

- The River's Edge at the Landing includes a 61-detached single family residential subdivision within about nine (9) acres within the LOTC residential land use area. Please see the attached *Conceptual River's Edge at the Landing Subdivision Layout.* The approved LOTC allows for up to two hundred (200) dwelling units.
- The River's Edge RV Park includes a 173-stall recreational RV park within an approximately fifteen- (15) acre area of the parks and open space land use area of the LOTC. For more information, please see the attached *Conceptual River's Edge RV Layout*. The approved LOTC allows for up to two hundred (200) recreational RV stalls.

CT6, LLC and its engineering consultant are working on preparing a subdivision, site plan and shoreline permit application for review and approval by the City of Castle Rock. Please note that this will be an informational meeting with the developer and is not intended to take the place of a public hearing before the Planning Commission. You will have an opportunity to present testimony to the Planning Commission after applications are submitted to the City for review.

Headquarters
PO Box 1900, 1904 SE 6th Place
Battle Ground, WA 98604
(360) 687-1148

Tri-Cities Office
2213 Henderson Loop
Richland, WA 99354
(509) 590-1184

Tualatin Office
18500 SW Pacific Hwy
Tualatin, OR 97062
(503) 883-3169

Website
tapani.com
Email
info@tapani.com

We look forward to seeing you at the meeting and hearing your thoughts on the proposed subdivision and recreational RV park. Should you have any questions beforehand, please do not hesitate to reach out.

Sincerely,

Ingrid Friedberg

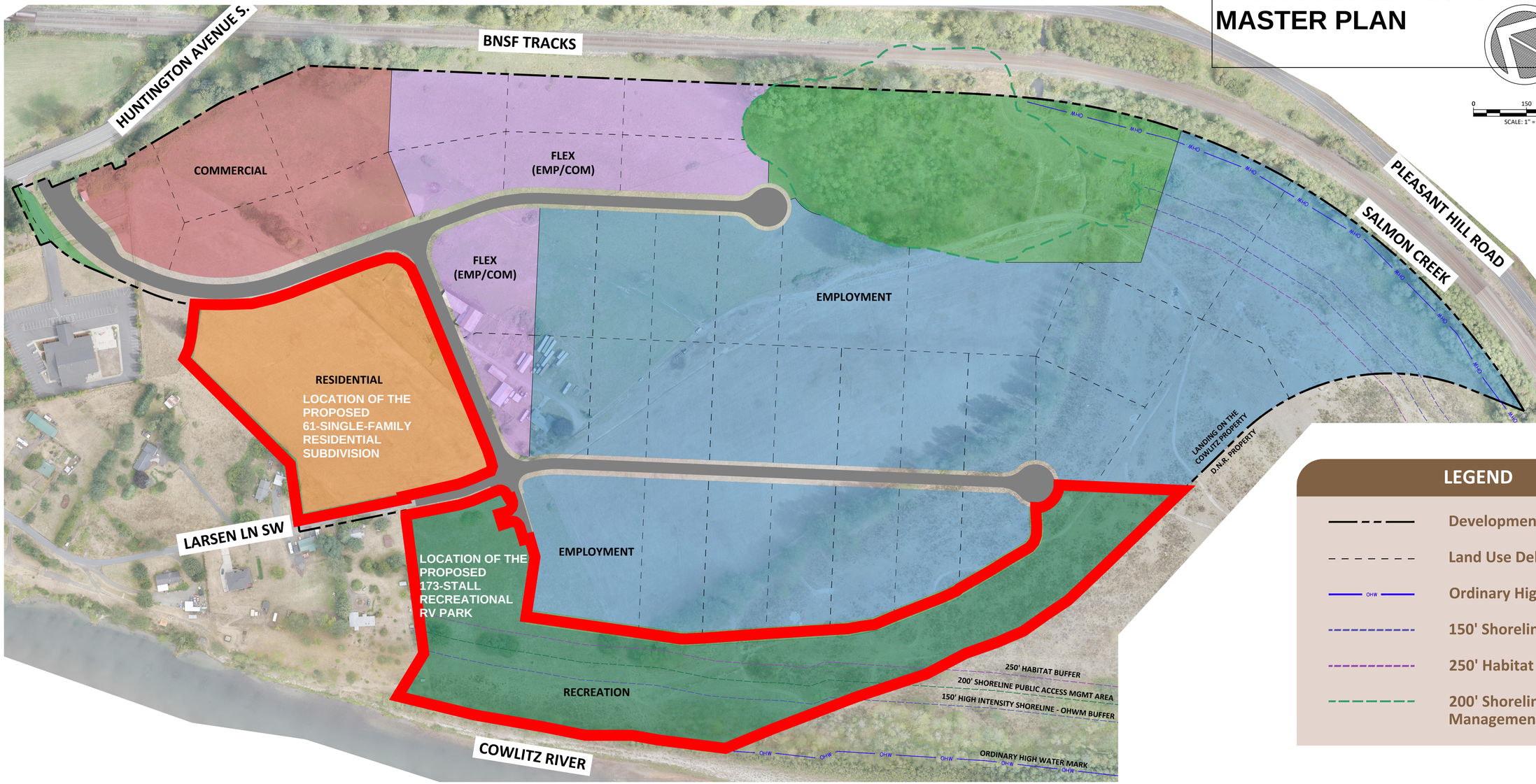
Ingrid Friedberg
Special Projects Manager
ingridf@tapani.com
360.553.9144

Attachments: Approved Landing on the Cowlitz Master Plan
Conceptual River's Edge at the Landing Subdivision Layout
Conceptual River's Edge RV Layout

CT6, LLC.

NEIGHBORHOOD MEETING NOTICE LETTER - ATTACHMENTS

APPROVED LANDING ON THE COWLITZ MASTER PLAN



0 150 300
SCALE: 1" = 150'

LEGEND

- Development Boundary
- Land Use Delineation
- OHW — Ordinary High Water Mark
- 150' Shoreline - OHWM Area
- 250' Habitat Buffer
- 200' Shoreline Public Access Management Area

EMPLOYMENT (50.9 AC)

1. Light Industrial and accessory uses
2. 624,000 square feet of building usage complying with the Industrial (I) zoning district as conditioned in Ord. 2021-10

COMMERCIAL (8.6 AC)

1. Neighborhood retail
2. Commercial and professional services
3. 98,000 square feet of building usage complying with the Highway Business (C-2) zoning district as conditioned in Ord. 2021-10.

FLEX (10.9 AC)

1. Employment or commercial use
2. Allows flexibility and adaptability to future market conditions
3. Development area maximums complying with Ord. 2021-10 for commercial and employment

RECREATIONAL (14.6 AC)

1. Maximum 200 RV spaces
2. Public access to Cowlitz River for fishing, rustic boat launch, and other recreational uses
3. Potential tourist attraction for Castle Rock town center

RESIDENTIAL (9.1 AC)

1. Medium-density residential presence adjacent to commercial and employment uses lends to a live/work environment
2. Maximum of 200 dwelling units

OPEN SPACE (13.3 AC)

1. Landscape buffering
2. Open space
3. Potential critical areas protection (pending final delineation)

Note: Refer to Circulation and Access Plan for cross-circulation requirements and conceptual pedestrian easement locations.

LANDING ON THE COWLITZ

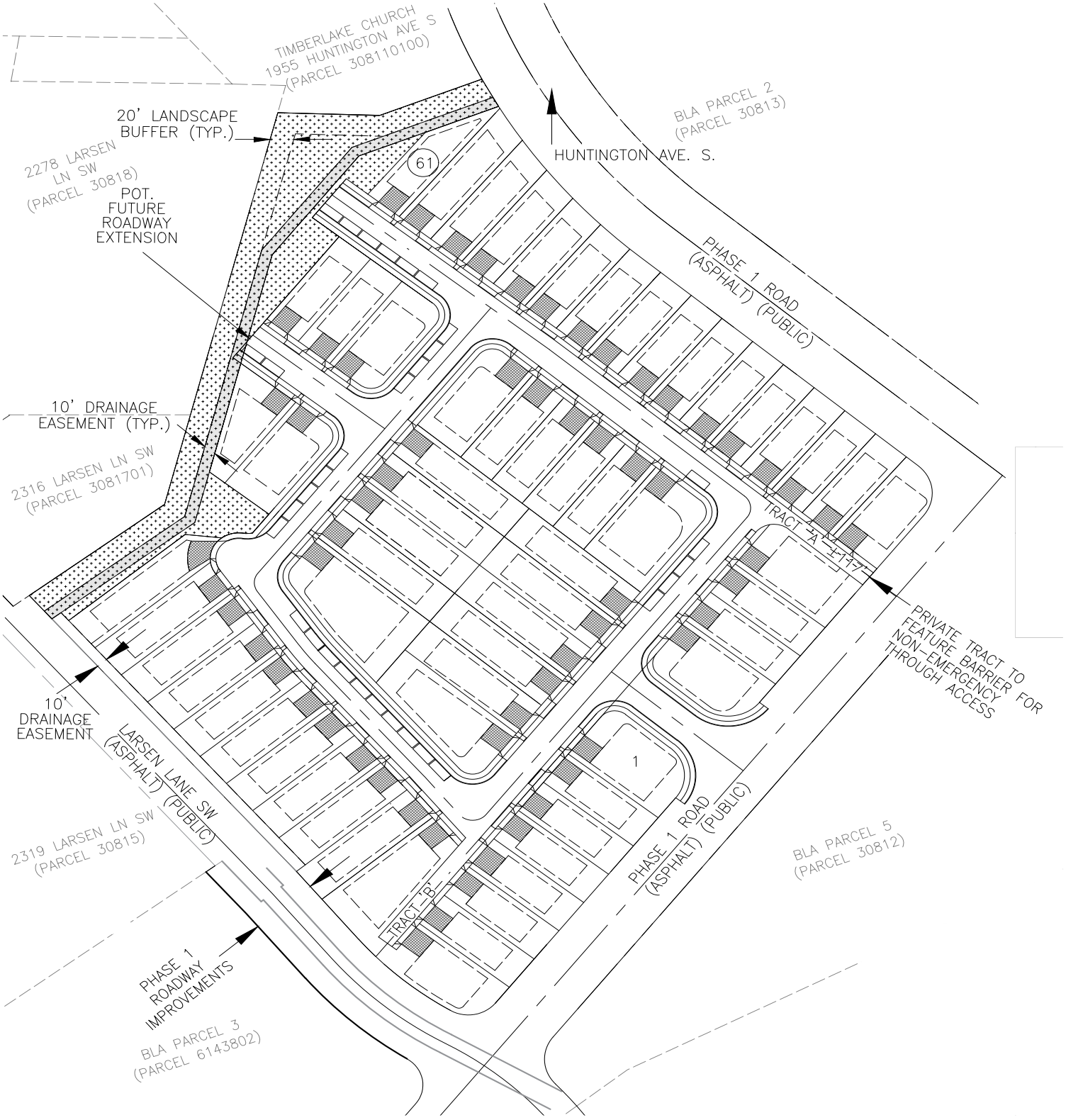
REVISED MASTER PLAN LAYOUT | OCTOBER 2023

MacKay Sposito

ENERGY PUBLIC WORKS LAND DEVELOPMENT

www.mackaysposito.com

TAPANI INC.

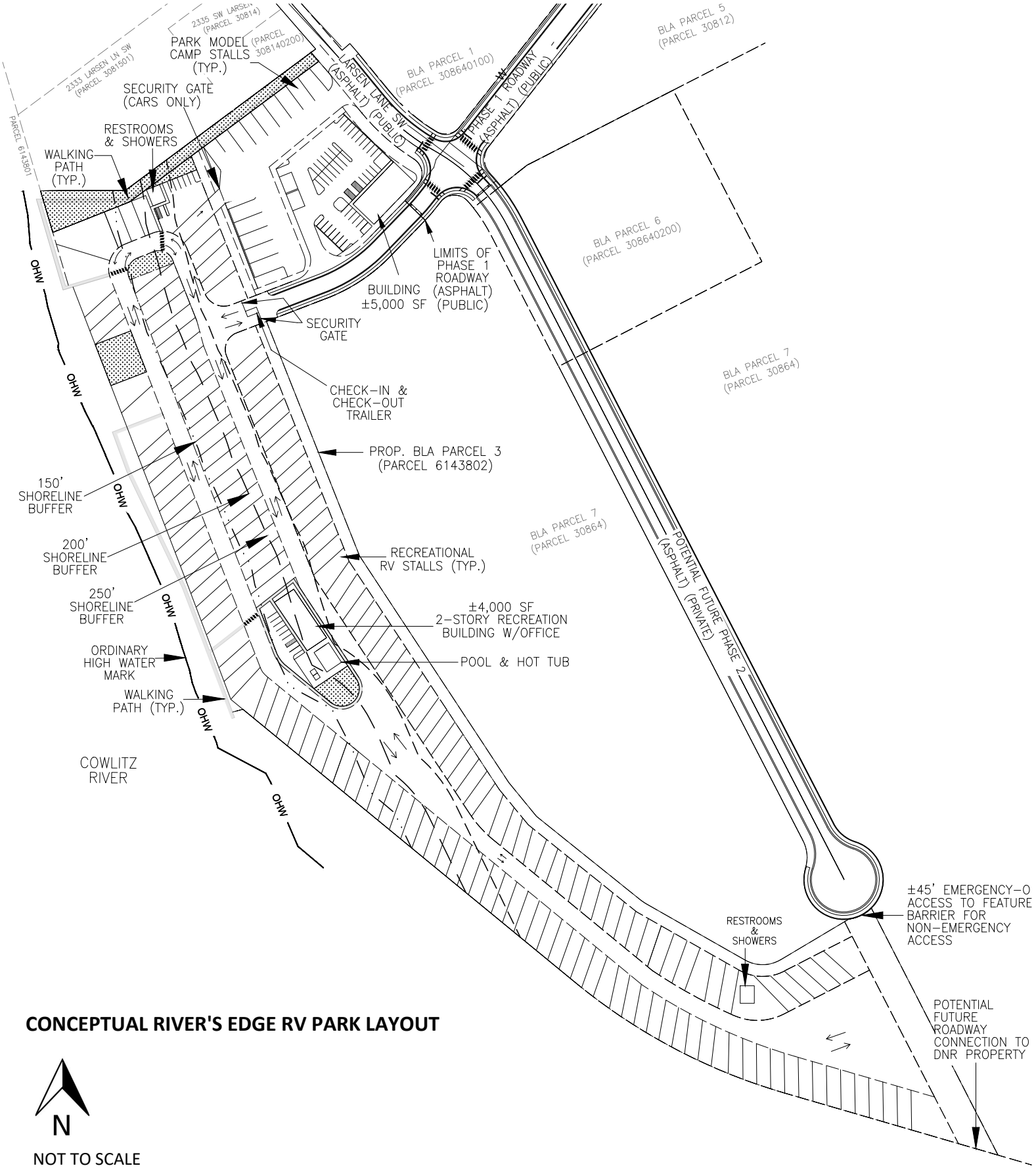


CONCEPTUAL RIVER'S EDGE AT THE LANDING SUBDIVISION LAYOUT

N

NOT TO SCALE

TAPANI INC.



CONCEPTUAL RIVER'S EDGE RV PARK LAYOUT

N

NOT TO SCALE

CT6, LLC.

ADDRESSES FOR PROPERTY OWNERS WITHIN 300-FEET OF THE PROPOSED DEVELOPMENT

Cowlitz CountyTitle

1159 14th Avenue
Longview, WA 98632
360.423.5330
www.cowlitztitle.com

300 Foot Radius Search

Certification

Parcel: 30813

Cowlitz County Title certifies that the property information provided in the attached list is a true and accurate representation of the neighboring properties of the above mentioned parcel as compiled from the records of Cowlitz County via Sentry Dynamics.

Steve Quaife 11-8-2024

Steve Quaife: VP/Manager

State of Washington

County of Cowlitz

I certify that I know or have satisfactory evidence that Steve Quaife is the person who appeared before me and said person acknowledged that he signed this instrument and acknowledged it to be free and voluntary act for the uses and purposes mentioned in the instrument.

AMY J HOYER NOTARY PUBLIC 152561 COMMISSION EXPIRES 2-07-27 STATE OF WASHINGTON

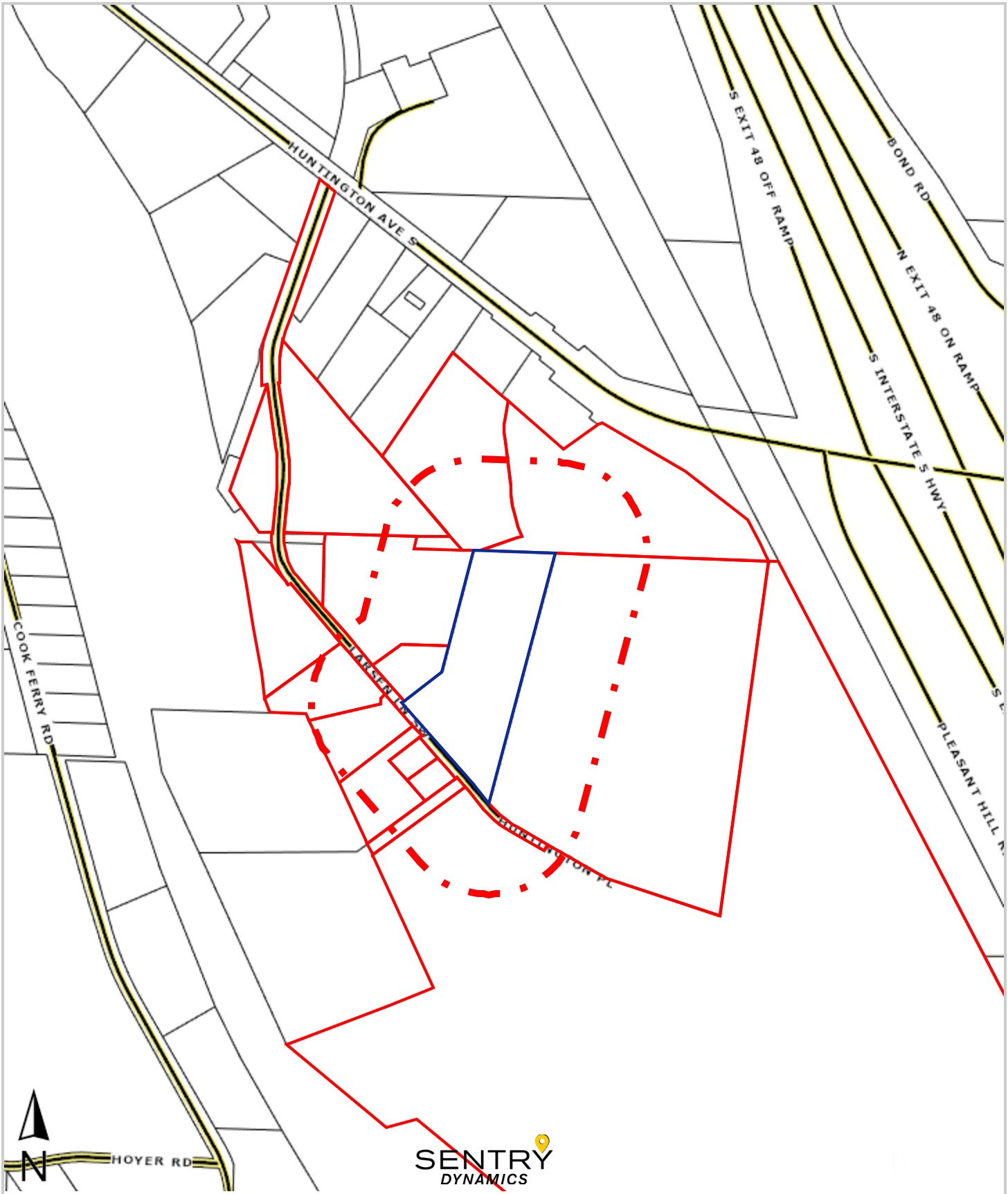
Amy J Hoyer

Notary Public in and for the State of Washington,

Residing in Kelso

Exp. Date 2/7/2027

Today's Date: 11/8/2024



Cowlitz CountyTitle

This map/plat is being furnished as an aid in locating the herein described land in relation to adjoining streets, natural boundaries and other land, and is not a survey of the land depicted. Except to the extent a policy of title insurance is expressly modified by endorsement, if any, the company does not insure dimensions, distances, location of easements, acreage or other matters shown thereon.

Cowlitz County Title

1159 14th Avenue
Longview, WA 98632
360.423.5330
www.cowlitztitle.com

300 Foot Radius Search

Certification

Parcel: 6143802

Cowlitz County Title certifies that the property information provided in the attached list is a true and accurate representation of the neighboring properties of the above mentioned parcel as compiled from the records of Cowlitz County via Sentry Dynamics.

Steve Quaife 11-8-2024

Steve Quaife: VP/Manager

State of Washington

County of Cowlitz

I certify that I know or have satisfactory evidence that Steve Quaife is the person who appeared before me and said person acknowledged that he signed this instrument and acknowledged it to be free and voluntary act for the uses and purposes mentioned in the instrument.

AMY J HOYER NOTARY PUBLIC 152561 COMMISSION EXPIRES 2-07-27 STATE OF WASHINGTON

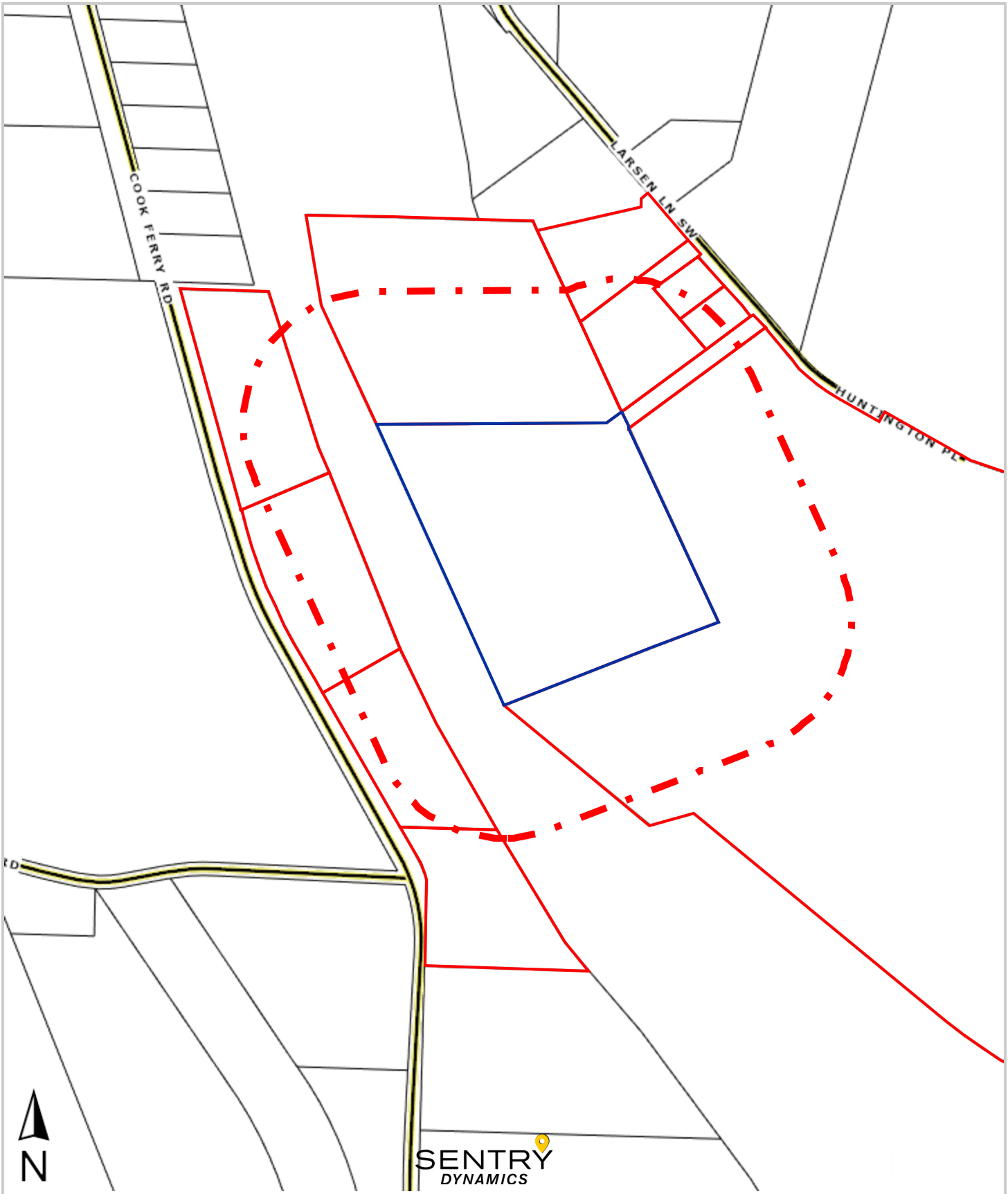
Amy J Hoyer

Notary Public in and for the State of Washington,

Residing in Kelso

Exp. Date 2/7/2027

Today's Date: 11/8/2024



Cowlitz CountyTitle

This map/plat is being furnished as an aid in locating the herein described land in relation to adjoining streets, natural boundaries and other land, and is not a survey of the land depicted. Except to the extent a policy of title insurance is expressly modified by endorsement, if any, the company does not insure dimensions, distances, location of easements, acreage or other matters shown thereon.

Cowlitz CountyTitle

1159 14th Avenue
Longview, WA 98632
360.423.5330
www.cowlitztitle.com

300 Foot Radius Search

Certification

Parcel: 308640100

Cowlitz County Title certifies that the property information provided in the attached list is a true and accurate representation of the neighboring properties of the above mentioned parcel as compiled from the records of Cowlitz County via Sentry Dynamics.

Steve Quaife 11-8-2024

Steve Quaife: VP/Manager

State of Washington

County of Cowlitz

I certify that I know or have satisfactory evidence that Steve Quaife is the person who appeared before me and said person acknowledged that he signed this instrument and acknowledged it to be free and voluntary act for the uses and purposes mentioned in the instrument.

AMY J HOYER NOTARY PUBLIC 152561 COMMISSION EXPIRES 2-07-27 STATE OF WASHINGTON

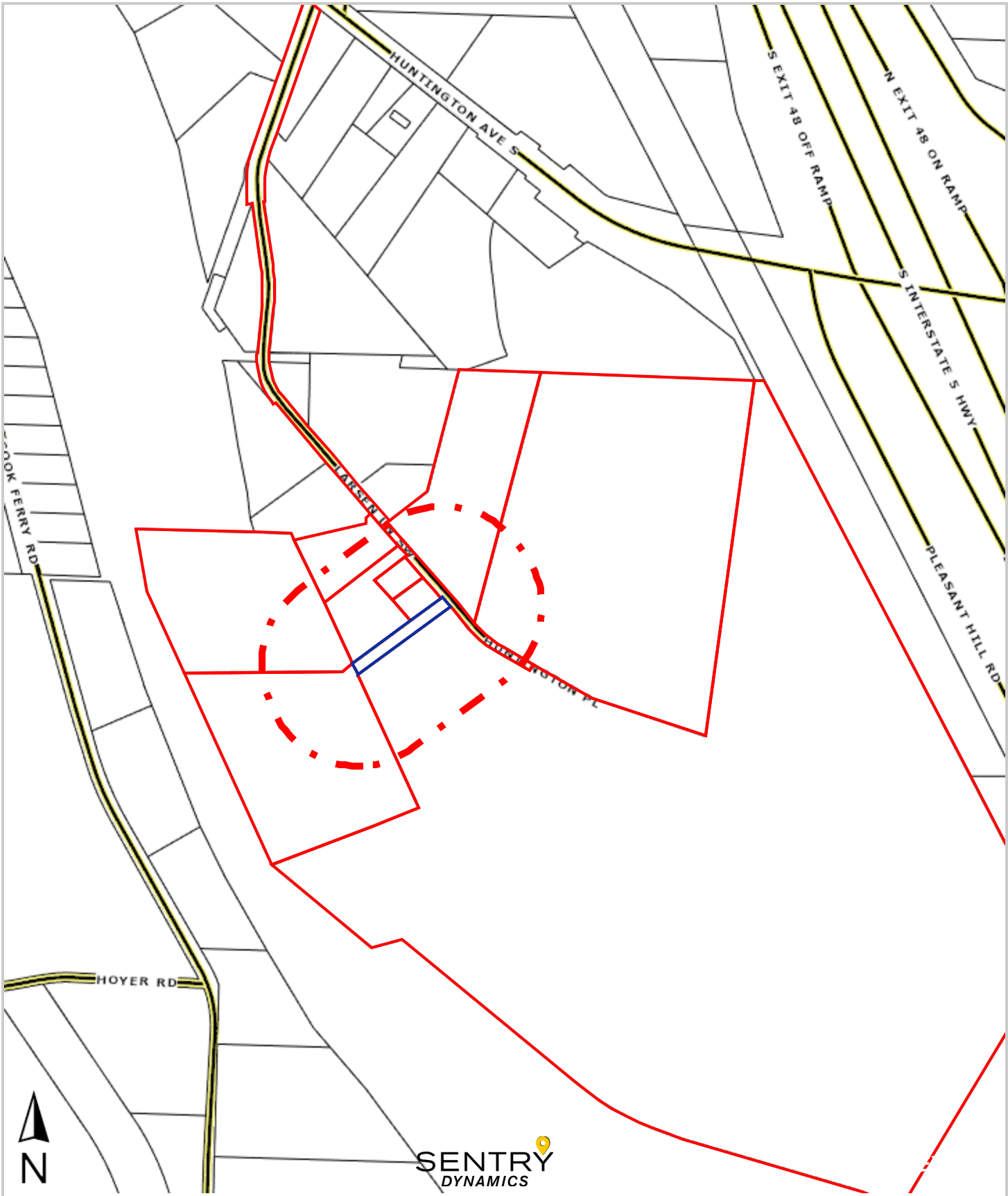
Amy J Hoyer

Notary Public in and for the State of Washington,

Residing in Kelso

Exp. Date 2/7/2027

Today's Date: 11/8/2024



Cowlitz CountyTitle

This map/plat is being furnished as an aid in locating the herein described land in relation to adjoining streets, natural boundaries and other land, and is not a survey of the land depicted. Except to the extent a policy of title insurance is expressly modified by endorsement, if any, the company does not insure dimensions, distances, location of easements, acreage or other matters shown thereon.

City of Castle Rock
PO Box 370
Castle Rock, WA 98611

Melvin Larsen
2112 Larsen Lane SW
Castle Rock, WA 98611

Timberlake Christian Fellowship
4505 236th Avenue NE
Redmond, WA 98053

Matthew Fulton
2217 Larsen Lane SW
Castle Rock, WA 98611

Terry Badley
2275 Larsen Lane SW
Castle Rock, WA 98611

Andrew Simmons Jr.
2316 Larsen Lane SW
Castle Rock, WA 98611

Roy Henson
2278 Larsen Lane SW
Castle Rock, WA
98611

Larsen Lane LLC
2278 Larsen Lane SW
Castle Rock, WA 98611

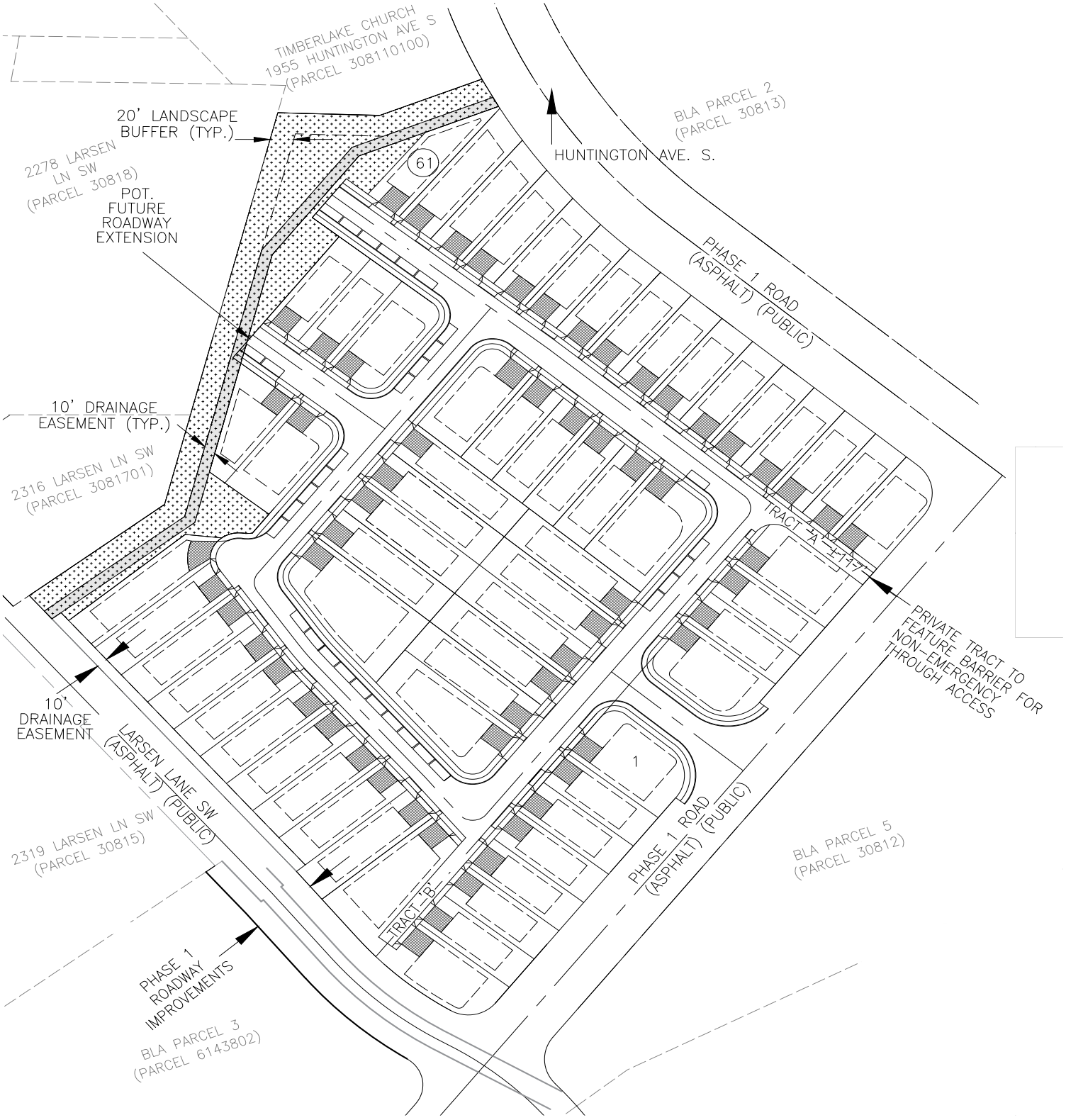
Sherri Luster
2319 Larsen Lane SW
Castle Rock, WA 98611

Bounmy Vongkoth
2333 Larsen Lane SW
Castle Rock, WA 98611

Raymond Pieren
944 NW Hill Avenue
Roseburg, OR 97471

Cowlitz County
207 N 4th Avenue, Room 308
Kelso WA 98626

TAPANI INC.

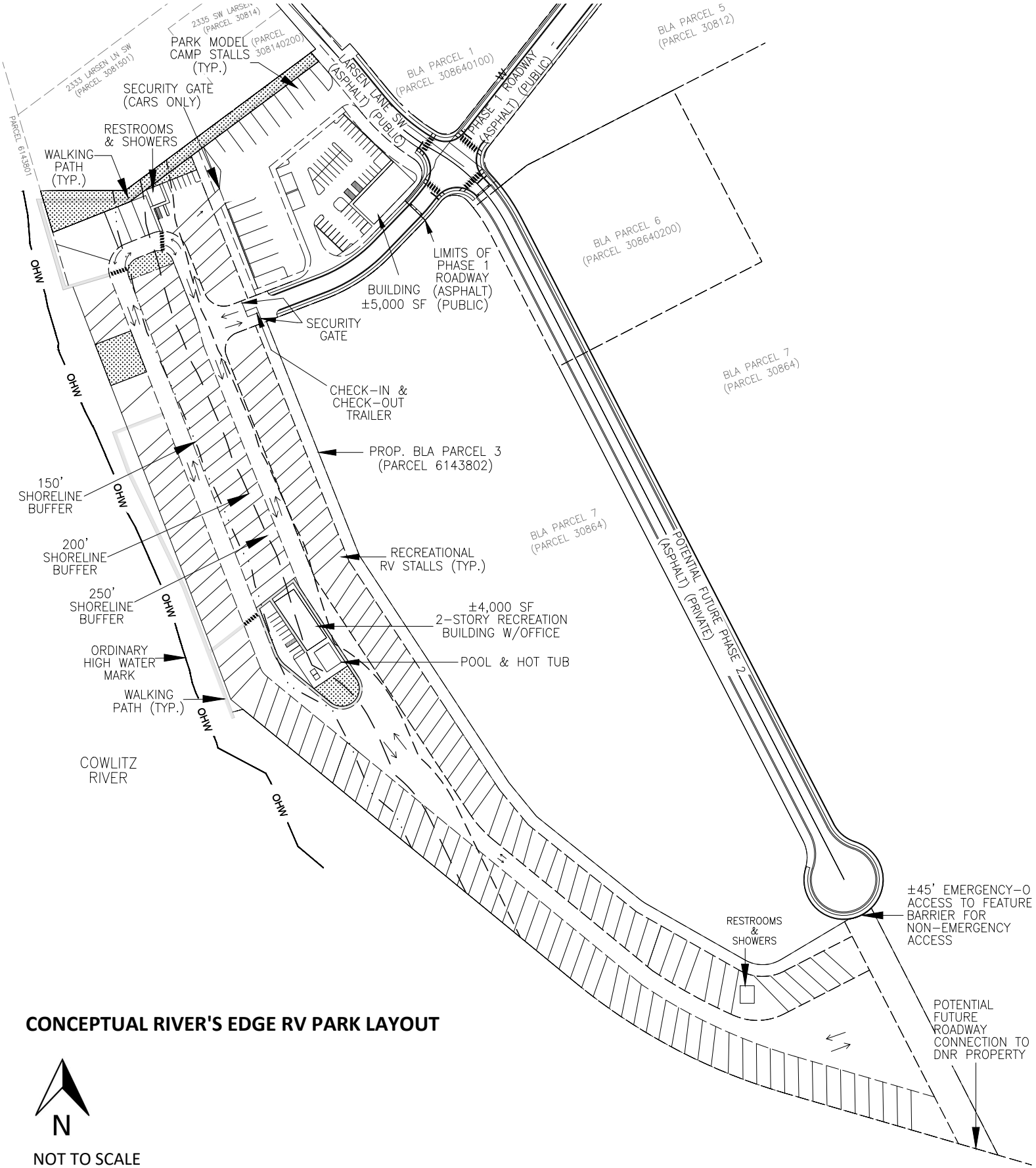


CONCEPTUAL RIVER'S EDGE AT THE LANDING SUBDIVISION LAYOUT

N

NOT TO SCALE

TAPANI INC.



CONCEPTUAL RIVER'S EDGE RV PARK LAYOUT

N

NOT TO SCALE

Cowlitz CountyTitle

1159 14th Avenue
Longview, WA 98632
360.423.5330
www.cowlitztitle.com

300 Foot Radius Search

Certification

Parcel: 30813

Cowlitz County Title certifies that the property information provided in the attached list is a true and accurate representation of the neighboring properties of the above mentioned parcel as compiled from the records of Cowlitz County via Sentry Dynamics.

Steve Quaife 11-8-2024

Steve Quaife: VP/Manager

State of Washington

County of Cowlitz

I certify that I know or have satisfactory evidence that Steve Quaife is the person who appeared before me and said person acknowledged that he signed this instrument and acknowledged it to be free and voluntary act for the uses and purposes mentioned in the instrument.

AMY J HOYER NOTARY PUBLIC 152561 COMMISSION EXPIRES 2-07-27 STATE OF WASHINGTON

Amy J Hoyer

Notary Public in and for the State of Washington,

Residing in Kelso

Exp. Date 2/7/2027

Today's Date: 11/8/2024

Cowlitz CountyTitle

This map/plat is being furnished as an aid in locating the herein described land in relation to adjoining streets, natural boundaries and other land, and is not a survey of the land depicted. Except to the extent a policy of title insurance is expressly modified by endorsement, if any, the company does not insure dimensions, distances, location of easements, acreage or other matters shown thereon.

Cowlitz County Title

1159 14th Avenue
Longview, WA 98632
360.423.5330
www.cowlitztitle.com

300 Foot Radius Search

Certification

Parcel: 6143802

Cowlitz County Title certifies that the property information provided in the attached list is a true and accurate representation of the neighboring properties of the above mentioned parcel as compiled from the records of Cowlitz County via Sentry Dynamics.

Steve Quaife 11-8-2024

Steve Quaife: VP/Manager

State of Washington

County of Cowlitz

I certify that I know or have satisfactory evidence that Steve Quaife is the person who appeared before me and said person acknowledged that he signed this instrument and acknowledged it to be free and voluntary act for the uses and purposes mentioned in the instrument.

AMY J HOYER NOTARY PUBLIC 152561 COMMISSION EXPIRES 2-07-27 STATE OF WASHINGTON

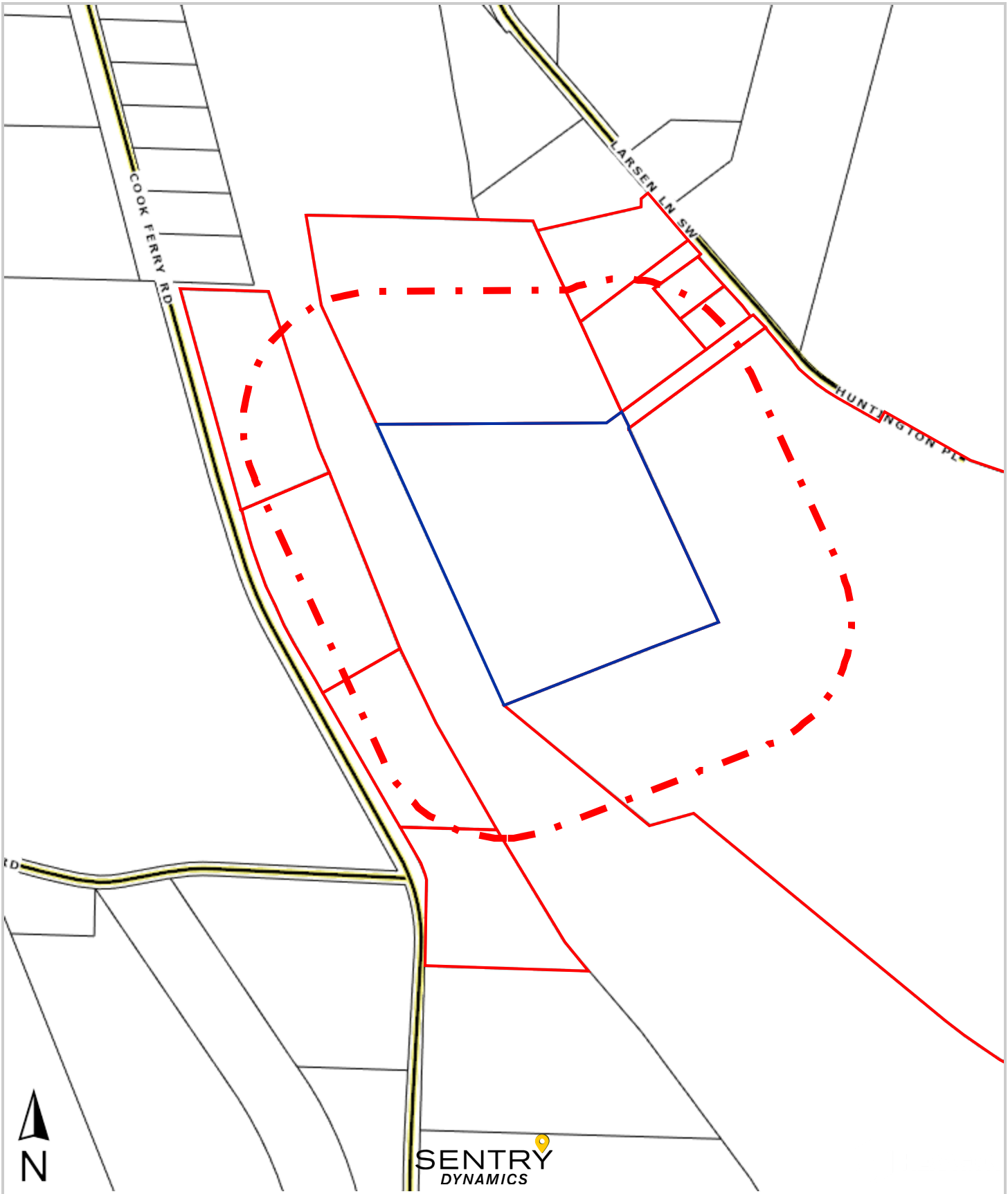
Amy J Hoyer

Notary Public in and for the State of Washington,

Residing in Kelso

Exp. Date 2/7/2027

Today's Date: 11/8/2024



Cowlitz CountyTitle

This map/plat is being furnished as an aid in locating the herein described land in relation to adjoining streets, natural boundaries and other land, and is not a survey of the land depicted. Except to the extent a policy of title insurance is expressly modified by endorsement, if any, the company does not insure dimensions, distances, location of easements, acreage or other matters shown thereon.

Cowlitz CountyTitle

1159 14th Avenue
Longview, WA 98632
360.423.5330
www.cowlitztitle.com

300 Foot Radius Search

Certification

Parcel: 308640100

Cowlitz County Title certifies that the property information provided in the attached list is a true and accurate representation of the neighboring properties of the above mentioned parcel as compiled from the records of Cowlitz County via Sentry Dynamics.

Steve Quaife 11-8-2024

Steve Quaife: VP/Manager

State of Washington

County of Cowlitz

I certify that I know or have satisfactory evidence that Steve Quaife is the person who appeared before me and said person acknowledged that he signed this instrument and acknowledged it to be free and voluntary act for the uses and purposes mentioned in the instrument.

AMY J HOYER NOTARY PUBLIC 152561 COMMISSION EXPIRES 2-07-27 STATE OF WASHINGTON

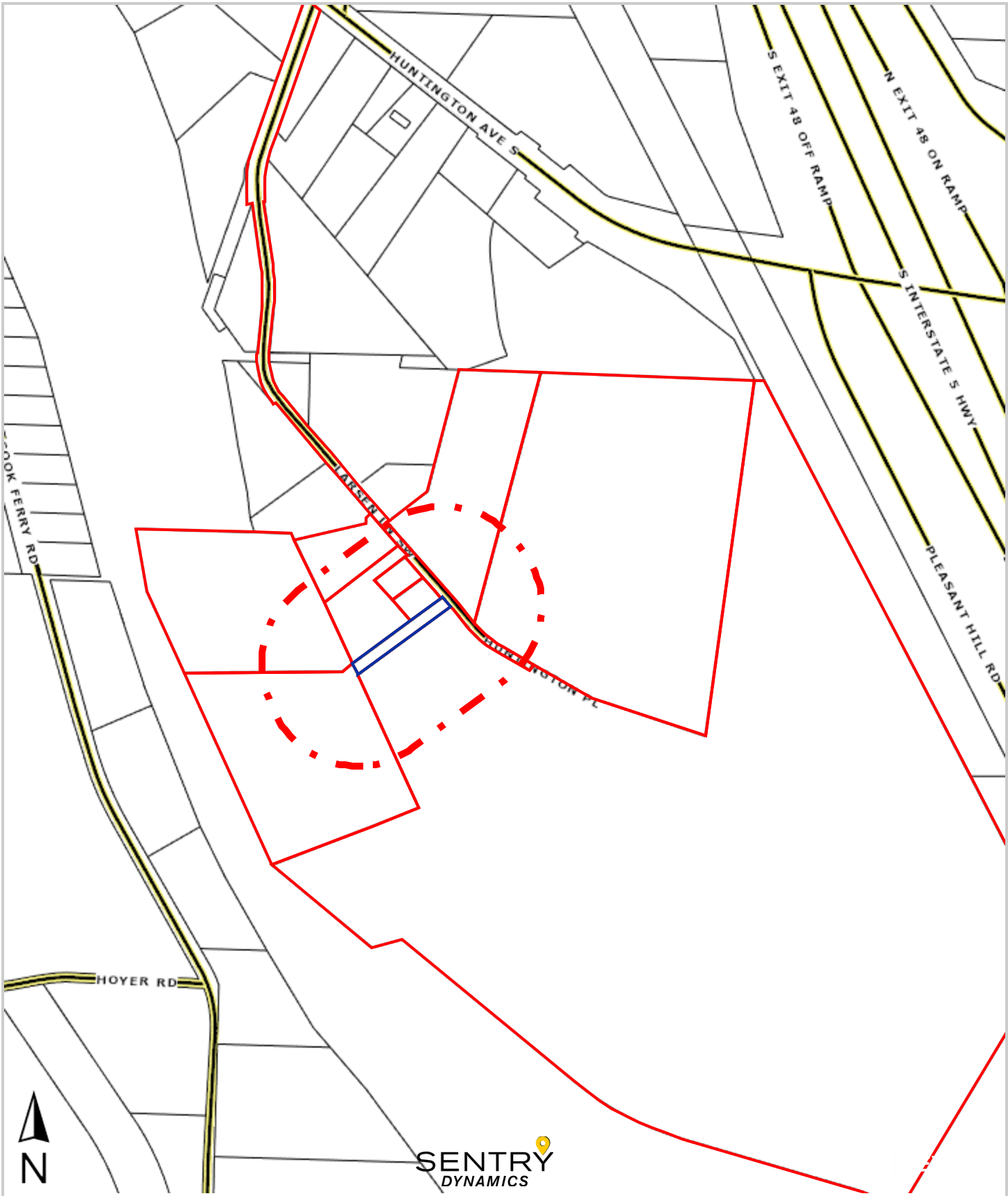
Amy J Hoyer

Notary Public in and for the State of Washington,

Residing in Kelso

Exp. Date 2/7/2027

Today's Date: 11/8/2024



Cowlitz County Title

This map/plat is being furnished as an aid in locating the herein described land in relation to adjoining streets, natural boundaries and other land, and is not a survey of the land depicted. Except to the extent a policy of title insurance is expressly modified by endorsement, if any, the company does not insure dimensions, distances, location of easements, acreage or other matters shown thereon.

City of Castle Rock
PO Box 370
Castle Rock, WA 98611

Melvin Larsen
2112 Larsen Lane SW
Castle Rock, WA 98611

Timberlake Christian Fellowship
4505 236th Avenue NE
Redmond, WA 98053

Matthew Fulton
2217 Larsen Lane SW
Castle Rock, WA 98611

Terry Badley
2275 Larsen Lane SW
Castle Rock, WA 98611

Andrew Simmons Jr.
2316 Larsen Lane SW
Castle Rock, WA 98611

Roy Henson
2278 Larsen Lane SW
Castle Rock, WA
98611

Larsen Lane LLC
2278 Larsen Lane SW
Castle Rock, WA 98611

Sherri Luster
2319 Larsen Lane SW
Castle Rock, WA 98611

Bounmy Vongkoth
2333 Larsen Lane SW
Castle Rock, WA 98611

Raymond Pieren
944 NW Hill Avenue
Roseburg, OR 97471

Cowlitz County
207 N 4th Avenue, Room 308
Kelso WA 98626

CT6, LLC.

NEIGHBORHOOD MEETING SIGN IN SHEET

NEIGHBORHOOD MEETING SIGN-IN SHEET
LANDING ON THE COWLITZ MASTER PLAN
NOVEMBER 25, 2024 | 5PM | CITY OF CASTLE ROCK SENIOR CENTER

First and Last Name	Phone No.	Email Address
Kingston Chirwa		kchirwa@mackaysposito.com
JADA RUPLEY		jadarupley@gmail.com
Renelle Smith	360-465-9545	Renelle.smith@dnr.wa.gov
Mike Canton		Cantonsells@yahoo.com
Roy Hedson		
Elizabeth Vaughn (ELS)	360 5601173	elizabeth@eco-land.com
Chris Fritsch	360.501.2940	cfritsch@crschools.org
Rick Dahl		dahlr@cowlitzwa.gov
Matt Fulton		
Taylor Wilson	360-823-1344	twilson@mackaysposito.com
Abram Jenks	503.729.0566	
Shane Tapani	360-907-8629	Shane@tapani.com

NEIGHBORHOOD MEETING SIGN-IN SHEET		
First and Last Name	**Phone No.**	**Email Address**
PETER TUCK		ptuck@meekaysposito.com
TED SPRAGUE	360.423.9921	sprague cowlitzeda.com
BRENT ARNOLD (COWLITZ PUD)	(360) 501-9502	barnold@cowlitzpud.org
Kharlene Akesson	360.274.8181	kakesson@ci.castle-rock.wa.us
Karen Cain	360-957-0945	evergrn@hotmail.com
Jerome Sarkinen		jeromes@tapani.com
Derrick Smith		dsmith@mackaysposito.com
Ingrid Friedberg		ingridf@tapani.com
Daniel Stumpf		daniel@lancastermobley.com
Ed Orcutt		Ed.Orcutt@leg.wa.gov

City of Castle Rock

PO Box 370
Castle Rock, WA 98611

LOTC Pre-Application Conference Notes
River's Edge at the Landing Subdivision
CR-PA-24-06

CRMC 17.77.040 Development Permit Review Procedures

A. Preapplication. Prior to applying for a development permit, a developer may present to the city clerk-treasurer a preliminary or conceptual floor plan, plot plan, drawing, site plan, or narrative which shall contain (in a rough and approximate manner) as much of the permit application requirements as is known, together with the forms provided by the city. The purpose of the pre-application meeting is to enable the developer presenting the proposal to obtain the assessment of the development review committee as to the proposal's compliance with the adopted plans, policies and ordinances of the city and obtain information of a general nature regarding such issues as city services, access, and other factors as appropriate. This consultation should include obtaining preliminary facts and data pertaining to the proposed site, as well as the types of concerns that might be anticipated for the proposed use at the proposed site. Information obtained from city staff at this stage shall not be considered binding upon the city.

On November 6, 2024, members of the Development Review Committee met with the Landing on the Cowlitz (LOTC) Team to discuss preliminary plans for a sixty-one (61) single-family residential detached lot subdivide subdivision.

Attendees:

- Shane Tapani – Tapani Inc.
- Ingrid Friedberg – Tapani Inc.
- Abram Jenks - Tapani Inc.
- Taylor Wilson – MacKay Sposito
- James Heyen – West Consultants
- Daniel Stumpf – Lancaster Mobley
- Elizabeth Vaughn – Ecological Land Services, Inc. (ELS)
- Lacey Hoffmann – Ecological Land Services, Inc. (ELS)

- Kirsten Peterson – SCJ Alliance, Castle Rock Consulting Planner
- Malissa Paulsen - SCJ Alliance, Castle Rock Consulting Planner
- Cindy Gower - Gibbs & Olson, Castle Rock Consulting Engineer
- Tom Gower – Gibbs & Olson, Castle Rock Consulting Engineer
- Paul Helenberg – Mayor, City of Castle Rock
- Dave Vorse – Public Works Director, City of Castle Rock
- Tyler Stone – Public Works Senior Operator, City of Castle Rock
- Carie Cuttonaro – Clerk-Treasurer, City of Castle Rock
- Karlene Akesson – Deputy Clerk, City of Castle Rock

Building Department Notes/Fire Marshall Notes

1) Building Heights
    - This development exceeds 30 lots therefore, two access points are required per the fire code.
    - One of the access points can be for emergency use only but must be a minimum of 217 feet from the primary access. The code requires that when a second access is required, it must be separated by a distance of not less than ½ the diagonal distance of the proposed area.
    - Planning: If any proposed 3-story residence is below the maximum height allowance of 40 feet or less within the "Residential land use area" (and meets all other bulk standards as required) then it would be permitted.
    - Planning: All bulk and development standards as laid out in all documents related to the development, including the approved Development Agreement, and within the Castle Rock Municipal Code (as applicable) must be adhered to.

Planning Department Notes

1) SEPA Checklist
    - A SEPA Checklist must be completed and submitted with the application for each implementing phase (per the Modified MDNS dated September 8, 2021- Exhibit C. of the DA and Item No. 22 of the Castle Rock Landing on the Cowlitz Conditions of Master Site Plan Approval document dated October 22, 2021 – Exhibit D. of the DA).
    - If the proposed subdivision meets the mitigating measures as outlined in the Modified MDNS dated September 8, 2021, it is requested that the applicant provide a Memorandum that references the Modified MDNS and states that the proposed subdivision meets those requirements and does not increase the environmental impacts.
    - If it is determined by staff or the applicant that there is any increase in environmental impact, then an additional SEPA review including public and agency comment period shall be required.

    - Stormwater Plan – A modified/new Stormwater plan may trigger a new SEPA review. If the proposed subdivision does not meet the modified mitigating measures as

outlined in the Modified MDNS dated September 8, 2021, please outline the proposed changes (such as the Stormwater Plan). Per the Modified MDNS dated September 8, 2021, 1.a. *The City may require additional mitigation and/or conditions for approval based on the analysis of these subsequent environmental documents.*

2) Cultural and Archaeological Consultation
   - Should a cultural or archeological finding occur, the developer is to follow the procedures set forth in the Modified MDNS dated September 8, 2021, Section 13.

3) Approvals pending the FEMA Letter of Map Amendment-Fill (CLOMR-F)
   - ~~Generally, construction~~Development within a floodplain ~~is not~~is required to meet the City Flood Damage Prevention or receive a ~~permitted before receiving~~ a Letter of Map Revision Based on Fill (LOMR-F) approval from FEMA, as it is required to officially remove a property from the floodplain designation and allow construction to proceed. ~~As such, an applicant must first obtain the LOMR-F, as it confirms that the placed fill raised a property above the base flood elevation before starting construction in the area previously considered a floodplain.~~ In some cases, a "Conditional Letter of Map Revision" (CLOMR) may be issued, which means that construction can proceed based on proposed plans, but the final LOMR-F approval is only granted once the project is completed according to the specified design.
     - If the CLOMR~~-F~~ is not already ~~issued~~ reviewed ~~and approved~~ by FEMA by the time the Preliminary Plat Application is submitted, the development will need to be reviewed based on existing conditions, as though it does not have a CLOMR-F and will need to meet the requirements set forth in Castle Rock Municipal Code Chapter (CRMC) Title 15 – Flood Damage Prevention.
   - Per the DA – Section 6.2 – The City will review any preliminary plat consistent with CRMC 16.12.
   - CRMC 16.12.005 C. – General Provisions. 16.12.090 B. – Preliminary plat – Approval criteria for planning commission – provides information regarding the review of a subdivision application in a flood zone.
   - Notwithstanding the aforementioned, ~~I~~if the applicant should choose to submit a preliminary plat subdivision application that has been designed to meet the Flood Damage Prevention requirements of CMCR Title 15, prior to receiving FEMA approval, the City ~~would likely be~~is willing to review the subdivision concurrently with FEMA's review of the LOMR-F.
   - It would be beneficial to submit with the subdivision application materials, a memorandum and a site plan that states/depicts how the subdivision would meet the provision of CRMC Chapter 16.12 Subdivisions and CRMC 15.24 – Flood Damage Prevention, should the LOMR-F be approved.
   - Be very clear with elevations/fill and documentation on elevations/fill and how you will comply with the various floodplain measures.

- When designing the infrastructure improvements, it will be necessary to demonstrate compliance with all measures of the September 8, 2021 Modified MDNS, with special attention paid to Item #5, which states:

  > 5. Prior to the initiation of any clearing and grading activities the Project Sponsor shall submit for City review and approval of a Master Clearing, Fill, and Grading Plan that is integrated with a Master Stormwater Management Plan **that includes an analysis of the impacts of the development to the adjacent properties and measure to ensure that stormwater or flood waters will not adversely affect neighboring properties.**

- While Certificates of Occupancy are not issued until after approval of a Final Subdivision, the structures that are proposed for future constructions will need to comply with Measure #4 of the Modified MDNS:

  > 4. All development activities shall comply with the City Flood Hazard Prevention regulations including the elevation of buildings at least one foot above base flood elevation.

  As such, the placement of fill, the design of infrastructure improvements, and proposed locations of future structures will all need to be taken into consideration when compiling a subdivision application that is intended to be placed on fill on property that is considered floodplain by FEMA.
- Should it be demonstrated by the applicant that the local city flood ordinance requirements have been met, then the City will proceed with review and issuance of building permits in a manner consistent with standard building permit review procedures.
- The city is tasked with ensuring compliance with both local ordinances and federal regulations. Issuing building permits prior to FEMA's approval and/or compliance with CRMC would violate these regulations and could expose the city to liability in the event of a flood. The City's willingness to review the preliminary plat application should not be construed as approval of the LOMR-F or CLOMR-F. or approval of the preliminary plat itself.
- Various conditions of approval for the preliminary plat application may be considered during the review process.
- The City will follow the processes in place within the timelines that are set and outlined by the State, the City, and the Development Agreement. Section 5 of the Development Agreement specifies that the project is vested to the Castle Rock Municipal Code in effect on November 8, 2021, including CRMC 15.24.
- Please refer to previous notes regarding the SEPA checklist. As previously indicated, if a new SEPA checklist is warranted due to substantial changes that could increase the environmental impacts, then it will be necessary to submit a a new checklist and pay the associated fees. If it is determined that only a memo is warranted, then the SEPA checklist application fee will not apply.

4) Critical Areas/Shoreline Jurisdiction

- As described in vesting sections of the Development Agreement, this development will be subject to the existing critical area requirements of the November 8, 2021 CRMC. Exceptions to this requirements would be considered if and when they become applicable. FEMA minimum standards are required to be met at the time of development.- Please also refer to above response regarding flood plain permitting requirements.
- The proposal and all submittal materials must show compliance with the current Shoreline Master Plan Regulations

5) Neighborhood Meeting
   - The layout presented in the neighborhood meeting must be substantially similar but does not have to be exactly what will be included in the submitted subdivision application.

6) Permitted Density/Lot Sizing
   - The LOTC DA (Section 6.1.1) specifies a minimum lot size of 3,500 square feet
   - There are no minimum lot width lot sizes identified in the DA
   - The proposed subdivision layout shows Rear Loaded Lots (Lots 46-61)
     - There was no opposition to the rear loaded lot configuration
     - Driveways should not be served off of the collector road and minor arterial road

7) Setbacks and Landscape Buffers
   - The landscape buffer will not count towards the required park/open space area.
   - If there is a trail or similar use located within the landscape buffer area, it may be indicated on the plan and be identified as being within the landscape buffer.
   - In the instance there is a future phase 2 addition: If a written agreement to modify the twenty (20) foot landscape buffer with abutting property owners not included in the LOTC Master Plan is obtained from private property owners abutting the approved LOTC Maste Plan, the City does not see an immediate issue with an agreed upon modified landscape buffer.
   - Maintenance of the landscape buffer may require more discussion. The Landscape Buffer may be a relevant item to address at the neighborhood meeting.

8) Building Types/Building heights

- As long as the building does not exceed the 40' height limit in the residential district, then the buildings would be permitted as long as all other bulk standards are met.
- Exhibit B of the D.A. includes the Conditions of Master Site Plan approval. Condition 2(c) states the following:
    - Development activities in the Residential Land Use Area shall comply with the provisions of the High Density Residential (R-2) zoning district except as modified by these conditions of approval.
- Condition 4(c) then goes on to outline ten (10) permitted uses in the R-2 zone, which does not include office type uses.
- This does not, however preclude a homeowner form applying for a Home Occupation permit if they want to run a business out of the residence, in accordance with CRMC 17.48.120 through 17.48.150
- If the desire is to allow for other types of uses within the residential designated areas, Development Agreement provides for opportunities to request modifications to the D.A, and conditions of approval.

9) Parking/Driveways
- Public Works commented: 18' is narrow for a two-car driveway, maybe consider the driveway entrance be 18' and widen out to 20' – 24'. The goal is to maintain four (4) off-street parking spaces per residence while maximizing on-street parking for visitors.
- If the applicant is requesting a change to the standard that is not within the range (i.e. smaller than the minimum or larger than the maximum) then a variance would be required unless explicitly stated otherwise in any of the development documents.

10) Master Plan Signage
- Exhibit B, Conditions of Master Site Plan Approval, includes language regarding signage. Conditions #17 states the following:
  17. The project sponsor shall prepare and submit with the first implementing application a Master Signage Plan to guide the design and location of signs throughout the site.
  a. The standards in this plan shall meet or exceed the standards in Castle Rock Municipal Code.
  b. All subsequent implementing applications shall include signs consistent with the approved Master Signage Plan.

Signage is regulated by CMCR 17.82. Signage is required to meet the standards of the zone that it is proposed to be located in. Given that this is a mixed-use development, the City will apply the requirements based on the land use designation assigned in the master plan.

Public Works/Engineering

1) Approvals pending the FEMA Letter of Map Amendment-Fill (CLOMR-F) - See item number 2 of the Planning notes above.

2) Plat Recordation prior to completion of full site improvements
    - The City is willing to work with the developer and have an agreement in place that may "allow the plat recordation prior to completion of full site improvements whereby the Applicant may bond for the outstanding required site improvements provided that substantial completion of the required site development improvements have been demonstrated. This may involve, for example, bonding for sidewalk improvements and the installation of streetlights and street trees after site grading and public utilities have been completed for each lot." (Discussion item IV. Preliminary Plat Review Process 1.) A suggested timeline that came up during the meeting was completion of infrastructure within five (5) years.

3) Parking/Driveways
    - Parking Study Requirement – A parking plot plan along with a narrative. The parking plan shall show parking locations, accessible path of travel to public sidewalk and a parking table summary.
    - The City had agreed to the reduced street width and the required 4 off-street parking. It must be stated on the plat and with each lot that the garage cannot be turned into a living space but must be kept as a garage for vehicles.
    - If the applicant is requesting a change to the standard that is not within the range (i.e. smaller than the minimum or larger than the maximum) then a variance would be required unless explicitly stated otherwise in any of the development documents.
    - 2-car driveway width – The City believes 18' is narrow for a two-car driveway, maybe consider the driveway entrance be 18' and widen out to 20'. The goal is to maintain four (4) off-street parking spaces per residence while maximizing on-street parking for visitors.
    - On-street parking between driveways – The on-street parking should follow the City Standard as much as possible, though it may be acceptable to have a few compact spaces in some areas. The City is willing to work with the Developer to identify where compact parking spaces might work.
        - In the areas where compact parking may be allowed, 17' may be an adequate length if there are no more than 2 sequential stalls (15' in length is not adequate).

- ADA Parking – To meet ADA parking requirements, the developer may utilize the planter strip between the curb and the sidewalk, the planter strip, and possibly press into the sidewalk if necessary.
- The City would like to see where the ADA parking spaces are proposed to be located.

4) Street Lighting
   - The street lighting requirement is a maximum of a 200-foot spacing. For the private driveway access Tracts 'A' and 'B' lighting, the developer may be able to place one light at the Phase 1 standard collector intersection and one off the interior road, possibly negating the need for additional street lighting.

5) Parks, Recreation, and Open Space
   - The first implementing action for the conceptual parks, recreation, and open space would be in relation to the single-family residential subdivision and would not require detailed depiction of the overall 118-acre Master area.
   - The residential park area for the subdivision should be located in a central location within the residential development.
   - With the possibility of a future phase 2 residential development, a current odd-shaped property line, and the possibility of expansion, it may be helpful to have a couple options for the park area so if one does not work, it may be easily relocated to a different lot and the City prefers to have only one park site within the residential area.
   - Reimbursement for the Public Park – Typically there is not a reimbursement for the Public Park however, the City is willing to work with the developer and seek out grants to try to maximize the developer's contribution. The City cannot commit any funds.
   - It may be beneficial to the developer to establish an HOA to help recover costs for the park.

6) Stormwater
   - A revised Stormwater Master Plan and for the entire LOTC site, not just the subdivision, is expected to be submitted prior to the subdivision application. Must show the proposed stormwater system can pass the 100-year storm, hold the 100-year storm when the Cowlitz River is high and provide pumping facility if needed.
   - A preliminary Technical Information Report (TIR) must be prepared and included in the Preliminary Subdivision Plat Application for the River's Edge at the Landing Subdivision.
   - Stormwater Connection Easement - Without seeing the preliminary conceptual design planned for the stormwater easement it is difficult to provide feedback as the stormwater easement is dependent on depth. A ten (10) foot easement likely not adequate to provide access and maintenance for a buried pipe and likely not adequate for ditch maintenance.

7) Connections to City Water and Sewer
    - Please address the comments submitted by Gibbs & Olson regarding the Sanitary Sewer – Basis of Design memo.
    - The residential water service lines will be 1-inch municipex
    - The sewer lateral size – for a single family dwelling in the residential area, is a 4-inch schedule 3034 pvc minimum.
    - PVC meeting the requirements of AWWA C-900 is sufficient for the water mains. Ductile iron may need to be used if there are any concerns with minimum pipe cover, which would be reviewed on a case-by-case basis.
    - Pipe Bedding - Per the City of Castle Rock Development Policies and Public Works Procedures (July 2020 Edition) pipe bedding shall be crushed surfacing top coarse per WSDOT Standard Specification Section 9-03.9(3).
    - Trench Backfill - Per the City of Castle Rock Development Policies and Public Works Procedures (July 2020 Edition) *All granular backfill material will conform to Section 9-03.9 of the WSDOT/APWA Standard Specifications:* Bank Run Gravel for Trench Backfill: *(Trench backfill material shall consist of aggregate for gravel base, as specified in Section 9-03.10, excepting however, that 100 percent of the material shall pass a 2-½-inch screen.)* If the onsite sand material meets this specification, it could be used as trench backfill. Compaction requirements must be met which can be difficult to obtain with this material.

8) Roadway design, Access, and Connectivity
    - Intersection Spacing – Other than for Tracts A & B which will be covered in the Building Official/Fire Marshall Notes section, the proposed intersection spacing presented does appear to meet the City of Castle Rock Public Works Engineering Standards.
    - PUD easement in the Public Right-of-Way – Per the modified Residential Local Access roadway standard. The PUD easement needs to be located on the opposite side of the water main, in the grass strip or underneath the sidewalk. The watermain is to be constructed under the sidewalk on the opposite side.
    - Site distance triangle – City of Castle Rock Engineering Street Standards Section 4.03 – Sight Obstruction Detail Drawing No. CR011ST – The purpose of the drawing is to demonstrate the geometry of the standard, the distances shown in the images are examples only, they do not indicate the actual distance. Please reference the City of Castle Rock Public Works Engineering Standards - Section 4 - Street and Asphalt Concrete Paths and/or Bikeways Standards – it references the AASHTO "Green Book" tables 9.3 and 9.6. The AASHTO "Green Book" controls sight distance.

9) Larsen Lane SW
   - Per the Castle Rock Landing on the Cowlitz Conditions of Master Site Plan Approval, Item #13: *The City may install reasonable measures to prevent the use of Larsen Lane SW in its existing condition to access the Master Planer Development. This may include, but is not limited to, signage, a gate or bollards with a lockbox, and a cul–de-sac or turnaround for vehicles attempting to enter the Master Planned Development.* Once the design layout of the proposed development is known, the City will have a better idea of what will need to be implemented.

   - It is difficult for the City to determine what frontage improvements to Larsen Lane SW would be required without seeing a layout of what a future proposed second phase of development with a connection to Larsen Lane SW looks like.
   - Larsen Lane SW is within an existing public right of way and the City does not intend or have a desire to designate Larsen Lane SW as a private road.

10) Traffic Analysis
   - Lancaster Mobley, Gibbs & Olson and SCJ will coordinate to provide guidance regarding the scope of work for the required Traffic Study.

General Notes

Large Lot Subdivisions – The City is currently working toward getting the draft ordinance regarding Large Lot Non-Residential Subdivision Exemptions to the Planning Commission, Public Hearing, and then to City Council.

Summary of Anticipated Permits/Applications Required and Other General Requirements Per the Developer Agreement (DA), CRMC 16.12, and CRMC 17.77

Technical Studies and reports that will be required as part of the preliminary subdivision application submittal

1) Technical Information Report (TIR) for stormwater analysis and design.
2) Traffic Study
3) Construction Stormwater General Permit (CSWGP)

Permits/Applications Required/General Requirements Per the Developer Agreement (DA), CRMC 16.12, and CRMC 17.77

1) Pre-application Meeting (held on 11/06/2024)
2) Neighborhood Meeting (Tentatively set for November 25, 2024
   - The proponent shall make available a sign-in sheet at the meeting
     - The following items must be submitted to the City with the subdivision application:
       1. A copy of the invitation
       2. A copy of the mailing labels
       3. A notarized affidavit declaring that the invitations were mailed

3) Master Application
4) Request for Variance (when/if applicable)
5) Floodplain Permit (when/if applicable)
6) Shoreline Permit (when/if applicable)
7) General Land Use Application
8) Preliminary Plat Map
9) Vicinity sketch
10) Title Report
11) Per Item 22 of the Castle Rock Landing on the Cowlitz Conditions of Approval dated October 22, 2021:
    - An updated SEPA Environmental Checklist (or a memo describing that there are no substantial changes with the subdivision application).
    - An updated traffic report that identifies the number of trips to be generated, assesses existing conditions, identifies proposed mitigation measures to meet City standards, and that identifies when the mitigation is required. Lancaster Mobley, Gibbs & Olson and SCJ will coordinate to provide guidance regarding the scope of work for the required Traffic Study.
    - Other technical studies and reports that may be required by the City to fully evaluate and mitigate potential adverse impacts.
    - A Landscaping Plan prepared in accordance with the provisions of the Castle Rock Municipal Code and as modified by these by these Conditions of Approval.
    - A Parking Plan prepared in accordance with the provisions of Castle Rock Municipal Code and modified by these Conditions of Approval.
    - An updated Parks, Recreation, and Open Space Master Plan.
    - The applications shall also address the status of applicable conditions of approval of previous phases.
    - An updated Phasing Plan.
12) Any other permits as deemed necessary.
13) All Applicable Fees associated with permit application submittal, pursuant to the adopted fee schedules.

This information is meant to be helpful but not all inclusive. Other approval, codes, permits, and fees may apply. If you have any questions or concerns, please feel free to contact Karlene Akesson - Building & Planning Clerk at 360-274-8181 ext. 302 or by email at kakesson@ci.castle-rockwa.us

November 14, 2024

Daniel Stumpf, PE
Lancaster Mobley
300 W 15th Street, Suite 206
Vancouver, WA 98660

Re: Landing on the Cowlitz Master Plan Developer Agreement Traffic Analysis Clarification

A developer agreement was reached in 2024 for the Landing on the Cowlitz development. Included in this DA was the process for tracking vehicle trips as development occurred and the various off-site mitigation measures that would be required over time. The River's Edge at the Landing Subdivision project held a pre-app with the city on November 6, 2024, to discuss how the DA would be applied to the project. This project is adjacent to the Landing on the Cowlitz study area and was not explicitly included. However, the city has agreed that this area can be incorporated into the DA. Given the circumstances, the question was raised regarding how traffic for The River's Edge at the Landing Subdivision would be handled.

The River's Edge at the Landing Subdivision project was not included in the analysis that supported the Landing on the Cowlitz Master Plan, which could result in the eventual off-site mitigation needs changing. Based on the analysis provided for the Landing on the Cowlitz Master Plan, no off-site mitigation is expected to be needed in the short term. As such, it is not anticipated that the River's Edge at the Landing Subdivision project will require any specific off-stie mitigation to accommodate its vehicle traffic.

Additionally, the DA includes periodic analysis updates as development occurs. This recurring analysis refresh would be an appropriate time to reevaluate the full build out of the Landing on the Cowlitz, with the addition of traffic associated with the River's Edge at the Landing Subdivision.

Given the conditions in the DA related to traffic, the River's Edge at the Landing Subdivision can proceed with only providing a trip accounting analysis. This presumes that the trips will count toward all identified thresholds described in the Landing on the Cowlitz Master Plan DA and that when the first periodic analysis update of traffic is triggered, that the full build out of the Landing on the Cowlitz will be re-evaluated to include the River's Edge at the Landing Subdivision.

If you have any questions, please contact me at (360) 352-1465

Sincerely,

Ryan Shea, PTP, Senior Transportation Planner

Exhibit B: Noticing Materials

THE DAILY NEWS

AFFIDAVIT OF PUBLICATION

Longview Daily News
770 11th Ave
(360) 577-2525

State of Florida, County of Broward, ss:

Edmar Corachia, being first duly sworn, deposes and says: That (s)he is a duly authorized signatory of Column Software, PBC, duly authorized agent of Longview Daily News, published in Cowlitz county, has been approved as a Legal newspaper by order of the Superior court of the State of Washington of Cowlitz County, and that the Annexed printed copy is a true copy of the notice in the above entitled matter as it was printed in the regular entire issue of said paper and online at www.tdn.com , for publication dates as listed below, and that said newspaper was regularly distributed to its subscribers during all of said period, and that said notice was published in said paper and not in a supplement form. That the full amount of the fee charged for said forgoing publication is as listed below, and is $3.50 per line for the first insertion and $3.00 per line for each subsequent insertion. There is also an additional charge of $10.00 for every additional affidavit copy over two copies.

PUBLICATION DATES: June. 3 2025

NOTICE ID: fL6wpY7ZzbN9dnwMN27F
PUBLISHER ID: COL-WA-100953
NOTICE NAME: Notices & MDNS for River's Edge Subdivision
Publication Fee: $375.18

Edmar Corachia

(Signed)_____

SHERI SMITH
Notary Public - State of Florida
Commission # HH269383
Expires on May 31, 2026

VERIFICATION

State of Florida
County of Broward

Subscribed in my presence and sworn to before me on this: 06/05/2025

S Smith

Notary Public
Notarized remotely online using communication technology via Proof.

PUBLIC NOTICE
Notice of Preliminary Plat, SEPA MDNS and Public Hearing
River's Edge at the Landing Subdivision

Lead Agency: City of Castle Rock, WA
Proponent: CT6, LLC
Project Name: River's Edge at the Landing
Location: 0 Larsen Lane SW (Parcel 308120300) adjusted per Boundary Line Adjustment (CR-BLA-24-01 – AFN#3762029), focused on approximately 8.93 acres of the residential designated portion of the approved Landing on the Cowlitz Master Plan.

Description of proposal: The applicant has submitted a Preliminary Plat for a 45 single family residential unit subdivision located in the 8.93 acres residential designated portion of the Landing on the Cowlitz (LOTC) Master Plan. The development will be accessed by a single residential local access roadway connecting to the Standard Collector Road, potential for a future connection to Larsen Lane SW may be obtained depending on agreements with neighboring property owners and feasibility but also could not be extended.

Mitigated Determination of Non-Significance (MDNS): The City of Castle Rock has determined that this proposal will not have a probable significant adverse impact on the environment. Pursuant to WAC 197-11-350(3), the proposal has been clarified, changed, and conditioned to include necessary mitigation measures to avoid, minimize or compensate for probable significant impacts. Materials are available at the City's website www.ci.castle-rock.wa.us or available to the public on request at: 141 "A" Street SW, Castle Rock, WA 98611.

Notice of Public Hearing of the Planning Commission:
Date: June 17, 2025
Time : 6:00 pm
Location : Castle Rock Senior Center 222 2nd Ave SW, Castle Rock, WA 98611
Purpose: To review the proposed preliminary plat and SEPA MDNS.

This MDNS is issued under WAC 197-11-350 and the comment period will end on June 17, 2025. Agency Contact: City Contract Planner Rachel Granrath, Submit written comments to: Karlene Akesson, Deputy Clerk, City of Castle Rock, PO Box 370, Castle Rock, WA 98611 or to kakesson@ci.castle-rock.wa.us

Signature: Rachel Granrath, May 27, 2025
Appeal: Castle Rock Municipal Code (CRMC) 18.04.210 and 18.04.220 (E)
6/3 COL-WA-100953

Notice of Preliminary Plat, SEPA MDNS and Public Hearing

1 message

Karlene Akesson <kakesson@ci.castle-rock.wa.us> Tue, Jun 3, 2025 at 3:16 PM
To: Carie Cuttonaro <ccuttonaro@ci.castle-rock.wa.us>, Jason Lugo <jason.lugo@wsdot.wa.gov>, "Mendoza,Jennifer" <mendozaj@cowlitzwa.gov>, sepaunit@ecy.wa.gov, Chris Fritsch <cfritsch@crschools.org>, Taylor Aalvik <taylor.a@cowlitz.org>, sepa@dahp.wa.gov, Mike Moss <mossm@co.cowlitz.wa.us>, Kessina Lee <TeamRidgefield@dfw.wa.gov>, David Vorse <crpwd@ci.castle-rock.wa.us>, TDN Front Door <frontdoor@tdn.com>, Bill Fashing <bfashing@cwcog.org>, Laurie Lebowsky <laurie.lebowsky@wsdot.wa.gov>, pacific-cascade.region@dnr.wa.gov, Andrea Yoho <yohoa@cowlitzwa.gov>, NRD-Cowlitz Indian Tribe <NRDpermit@cowlitz.org>, Christina Hallock <Tina@swcleanair.org>, sepacenter@dnr.wa.gov, Christian Cordova <Christian.Cordova@wsdot.wa.gov>, Bill LeMonds <chief@cowlitz6fire.org>, Rudy Salakory <Rsalakory@cowlitz.org>, Lorie Clark <lclark@lcfrb.gen.wa.us>, Rachel Granrath <Rachel.Granrath@kimley-horn.com>, Charles Worley <cworley@crpolice.org>, Department of Fish and Wildlife Southwest - Region 5 <R5.planning@dfw.wa.gov>, Duane Johnson <Duane@swcleanair.org>, Jeff Barsness <jeff.barsness@wsdot.wa.gov>, newservice <newservice@cowlitzpud.org>, ECY RE SEPA REGISTER <separegister@ecy.wa.gov>
Cc: Karlene Akesson <kakesson@ci.castle-rock.wa.us>

Good afternoon,

Please see the attached Notice of Preliminary Plat, SEPA MDNS and Public Hearing for the proposed River's Edge at the Landing Subdivision located on approximately 8.93 acres of the residential designated portion of the approved Landing on the Cowlitz (LOTC) Master Plan. (SEPA Record No. 202502295)

Materials will be available for viewing online at:
https://ci.castle-rock.wa.us/notices.htm

--
Karlene Akesson
Deputy Clerk
City of Castle Rock
PO Box 370
Castle Rock, WA 98611
Phone: 360-274-8181

City Hall Hours Effective January 2, 2024:

Monday through Thursday, 7:30 AM – 5:00 PM

CLOSED Friday and legal holidays

01. Public Notice_Rivers Edge Subdivision with Map.pdf
260K

City of Castle Rock
PO Box 370
Castle Rock, WA 98611
(360) 274-7478

Gateway to Mt. St. Helens

PUBLIC NOTICE

Notice of Preliminary Plat, SEPA MDNS and Public Hearing

River's Edge at the Landing Subdivision

Lead Agency: City of Castle Rock, WA
Proponent: CT6, LLC
Project Name: River's Edge at the Landing
Location: 0 Larsen Lane SW (Parcel 308120300) adjusted per Boundary Line Adjustment (CR-BLA-24-01 – AFN#3762029), focused on approximately 8.93 acres of the residential designated portion of the approved Landing on the Cowlitz Master Plan.

Description of proposal: The applicant has submitted a Preliminary Plat for a 45 single family residential unit subdivision located in the 8.93 acres residential designated portion of the Landing on the Cowlitz (LOTC) Master Plan. The development will be accessed by a single residential local access roadway connecting to the Standard Collector Road, potential for a future connection to Larsen Lane SW may be obtained depending on agreements with neighboring property owners and feasibility but also could not be extended.

Mitigated Determination of Non-Significance (MDNS): The City of Castle Rock has determined that this proposal will not have a probable significant adverse impact on the environment. Pursuant to WAC 197-11-350(3), the proposal has been clarified, changed, and conditioned to include necessary mitigation measures to avoid, minimize or compensate for probable significant impacts. Materials are available at the City's website www.ci.castle-rock.wa.us or available to the public on request at: 141 "A" Street SW, Castle Rock, WA 98611.

Notice of Public Hearing of the Planning Commission:

Date: June 17, 2025
Time: 6:00 pm
Location: Castle Rock Senior Center 222 2nd Ave SW, Castle Rock, WA 98611
Purpose: To review the proposed preliminary plat and SEPA MDNS.

This MDNS is issued under WAC 197-11-350 and the comment period will end on June 17, 2025.

Agency Contact: City Contract Planner Rachel Granrath,
Submit written comments to: Karlene Akesson, Deputy Clerk, City of Castle Rock, PO Box 370, Castle Rock, WA 98611 or to kakesson@ci.castle-rock.wa.us

Signature: Rachel Granrath, May 27, 2025
Appeal: Castle Rock Municipal Code (CRMC) 18.04.210 and 18.04.220 (E)

River's Edge at the Landing

VICINITY MAP

N T S

Parcel #308120300

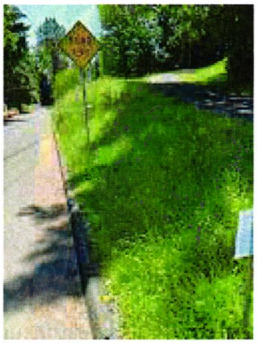
Posted at: City Hall, CR Post Office, CR Library on 06/03/2025
Mailed on: 05/29/2025
Notice + Materials Posted on Website: 06/03/2025

(no subject)

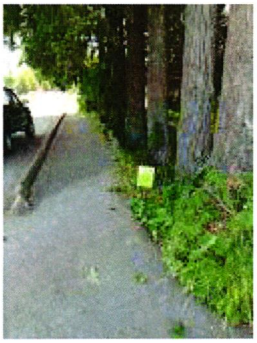
2 messages

Mike Smith <msmith@ci.castle-rock.wa.us> Tue, Jun 3, 2025 at 2:15 PM
To: Karlene Akesson <kakesson@ci.castle-rock.wa.us>

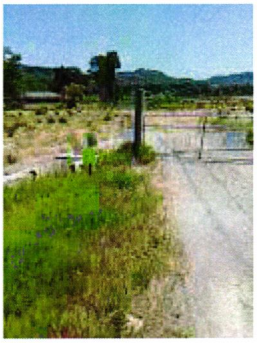
3 attachments



20250603_140435.jpg
6561K



20250603_141109.jpg
5826K



20250603_140706.jpg
7890K

Karlene Akesson <kakesson@ci.castle-rock.wa.us> Tue, Jun 3, 2025 at 3:09 PM
To: Mike Smith <msmith@ci.castle-rock.wa.us>

Is there 1 more?

On Tue, Jun 3, 2025 at 2:15 PM Mike Smith <msmith@ci.castle-rock.wa.us> wrote:

--
Karlene Akesson
Deputy Clerk
City of Castle Rock

PO Box 370
Castle Rock, WA 98611
Phone: 360-274-8181

City Hall Hours Effective January 2, 2024:

Monday through Thursday, 7:30 AM – 5:00 PM

CLOSED Friday and legal holidays

Gmail

Public Notice Sign

1 message

Lucas Richardson <lrichardson@ci.castle-rock.wa.us>
To: Karlene Akesson <kakesson@ci.castle-rock.wa.us>

Tue, Jun 3, 2025 at 4:10 PM

Here is the 4th sign as you leave Timberlee's driveway.

Exhibit C: SEPA MDNS

City of Castle Rock
PO Box 370
Castle Rock, WA 98611
(360) 274-7478

STATE ENVIRONMENTAL POLICY ACT
Mitigated Determination of NonSignificance
River's Edge at the Landing - Preliminary Plat

June 3, 2025

Lead Agency: City of Castle Rock, Washington
Agency Contact: City Contract Planner Rachel Granrath,
Comments submitted to Karlene Akesson, Deputy Clerk, City of Castle Rock, PO Box 370, Castle Rock, WA 98611 or to kakesson@ci.castle-rock.wa.us

Project Description: The applicant has submitted a Preliminary Plat for 45 single family residential unit subdivision (River's Edge at the Landing) located in the 8.93 acres residential designated portion of the Landing on the Cowlitz (LOTC) Master Plan. The development will be accessed by a single residential local access roadway connecting to the Standard Collector Road, potential for a future connection to Larsen Lane SW may be obtained depending on agreements with neighboring property owners and feasibility but also could not be extended.

Project Location: 0 Larsen Lane SW - Parcel 308120300 adjusted per Boundary Line Adjustment (CR-BLA-24-01 – AFN#3762029), focused on approximately 8.93 acres of the residential designated portion of the approved Landing on the Cowlitz Master Plan.

Proponent: CT6, LLC
Project Representative: Ingrid Friedberg, Special Projects Manager
Mailing Address: PO Box 1419, Battle Ground, WA 98604
Telephone: (360) 553-9144
Email: ingridf@tapani.com

The City of Castle Rock has determined that this proposal will not have a probable significant adverse impact on the environment. Pursuant to WAC 197-11-350(3), the proposal has been clarified, changed, and conditioned to include necessary mitigation measures to avoid, minimize or compensate for probable significant impacts. An environmental impact statement (EIS) is not required under RCW 43.21C.030. The necessary mitigation measures are listed below, the Environmental Checklist is attached and associated materials are available at the City's website www.ci.castle-rock.wa.us

This determination is based on the following mitigation measures, findings and conclusions:

- **SR-411 Intersection Mitigation:** At 70% build-out of the Landing Master Plan Development, the intersection of SR-411 and Larson Lane is projected to fall below the designated Level of Service (LOS) "C". To address the impacts of this and other incremental development on the site, the applicant shall be responsible for funding and implementing mitigation improvements—either at 70% build-out or when LOS falls below "C," whichever occurs first. All mitigation measures must be approved by the City of Castle Rock and WSDOT.
- **Dedication of Improvements**: Public improvements associated with right of way and site improvements outside of Homeowner Association (HOA) and Covenants, Conditions, Restrictions and Easements (CC&Rs) owned and maintained areas shall be dedicated to the City. All HOA common areas and facilities shall be maintained in perpetuity.
- **Connection to Larsen Lane:** Road stub connecting to Larsen Lane shall not be extended or connected unless agreements are formally made with neighboring property owners on Larsen Lane.
- In the event of inadvertent discovery of archaeological resources during site disturbance, all work shall cease in the vicinity of the find and the City shall be notified immediately for further direction.
- The applicant will remain compliant with the Master Planned Development Agreement and conditions associated.

This MDNS is issued under WAC 197-11-350 and the comment period will end on June 17, 2025.

Responsible Official:

Agency Contact: City Contract Planner Rachel Granrath,
Submit written comments to: Karlene Akesson, Deputy Clerk, City of Castle Rock, PO Box 370, Castle Rock, WA 98611 or to kakesson@ci.castle-rock.wa.us
Telephone: (360) 274-7478.

Signature

June 3, 2025

Appeal process: Castle Rock Municipal Code (CRMC) 18.04.210 and 18.04.220 (E)

Exhibit D: Comments Received

Gmail

COPY

Karlene Akesson <kakesson@ci.castle-rock.wa.us>

Larsen lane -CT6, LLC Tapani, 6 brothers!, hidden 6.

2 messages

sheryl adams <sheryladams2012@yahoo.com> Sun, Jun 1, 2025 at 9:02 PM
To: kakesson@ci.castle-rock.wa.us

Well , sounds like I was right about Larsen lane 3 years ago ! No one wants to be sold out to tapani and there lies about our road. We were promised no outlet or public access to river , we were promised from the city of castle rock, not to be used!!! City said and tapani said Larsen lane we not be allowed for traffic and be opened for access to development! Also we want our eagles to nest and our beavers not to be bothered also we have geese out with there babies. The wildlife will be impacted on this despicable act done by you the city of castle rock! I was told that our road wasn't going to be touched! See if you keep your word or you sold us out for a pile of cement. And the tax payers are paying for the new water project! . Has the city checked the levels of lead in town at school's pipes! I think that's more important than a development . Don't sell Larsen lane out for tapani and there pile of concrete! It's not right!!! Also the road sign says comments by 10 of June ! Letters are different than what you send . You need to post all letters on road!!!

---

sheryl adams <sheryladams2012@yahoo.com> Sun, Jun 1, 2025 at 9:24 PM
To: kakesson@ci.castle-rock.wa.us

Sent from my

> On Jun 1, 2025, at 9:02 PM, sheryl adams <sheryladams2012@yahoo.com> wrote:
>
> Well , sounds like I was right about Larsen lane 3 years ago ! No one wants to be sold out to tapani and there lies about our road. We were promised no outlet or public access to river , we were promised from the city of castle rock, not to be used!!! City said and tapani said Larsen lane we not be allowed for traffic and be opened for access to development! Also we want our eagles to nest and our beavers not to be bothered also we have geese out with there babies. The wildlife will be impacted on this despicable act done by you the city of castle rock! I was told that our road wasn't going to be touched! See if you keep your word or you sold us out for a pile of cement. And the tax payers are paying for the new water project! . Has the city checked the levels of lead in town at school's pipes! I think that's more important than a development . Don't sell Larsen lane out for tapani and there pile of concrete! It's not right!!! Also the road sign says comments by 10 of June ! Letters are different than what you send . You need to post all letters on road!!!
>
>

5 attachments

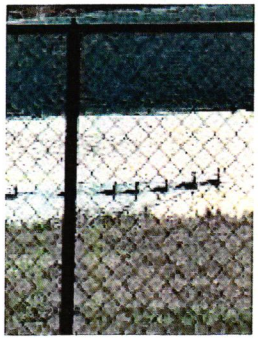


image0.jpeg
2925K

SEPA Record# 202502192 / 202502295
CR-24-051 - CRP-25-007/008 CRP-25-009

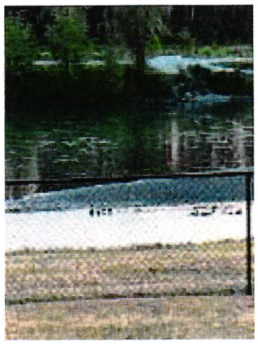


image1.jpeg
3748K

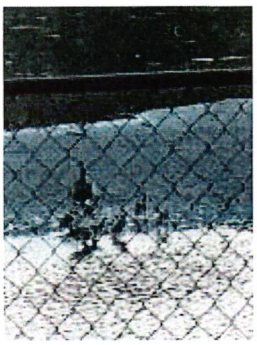


image2.jpeg
2512K

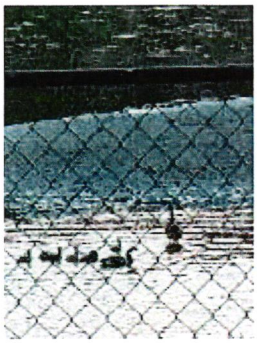


image3.jpeg
2567K

image4.jpeg
3047K

Gmail

Karlene Akesson <kakesson@ci.castle-rock.wa.us>

Castle rock , tapani construction are back yard to Cowlitz. Babies geese

1 message

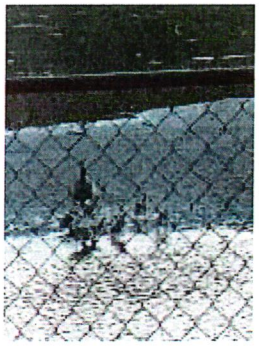
sheryl adams <sheryladams2012@yahoo.com>
To: kakesson@ci.castle-rock.wa.us

Mon, Jun 2, 2025 at 7:04 PM

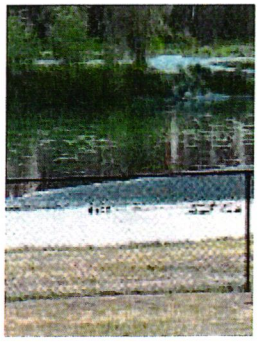
COPY

Sent from my iPhone

5 attachments



IMG_0534.jpg
2512K



IMG_0533.jpg
3748K

SEPA Record # 20250292
OR-24-051-CRP-25-007/008 / 20250295
CRP-25-009

IMG_0530.jpg
2925K

IMG_0529.jpg
2458K

IMG_0527.jpg
2992K

COPY

COPY

This proposed outflow is the harbinger of issues to come and so must bear this present scrutiny not only in design but in its overall purpose. The construction of this outfall raises questions that must begin to be answered at this point in development since an outfall is pointless unless it is attached to some body of water.

1)WOTUS and Setbacks
There is a lack of consensus among the courts as to whether drainage ditches can be considered WOTUS. Please see included documentation from Somach Simmons & Dunn, attorneys at law.

Courts Apply New WOTUS Rule to Ditches and Canal

In the face of this uncertainty it is incumbent upon the applicant to provide for any neighboring property the maximum EPA/governmental agencies setbacks required now or in a future caused by this development. The applicant has created "new drainage features" with the creation of their drainage ditch and should be required to insure that said ditch will NEVER encroach on neighboring property's ability to build or develop, ie setbacks from waterways or other environmental requirements. To fail to do so would constitute the unlawful use of eminent domain by a corporation.

2) Using the "new drainage ditch" to drain stormwater from Timberlake Church and the properties surrounding them, opens the issue of a previously closed infiltration system (that was totally contained on those properties and did not overflow onto the Hornstra, now Tappani property) to the uncertainties of a WOTUS declaration by the EPA or other agencies and potential loss of development use to the properties it drains. (Please see historical data and brief explanation included.)
It is incumbent upon the developers to a) create a closed infiltration system for these properties similar to the closed system in use before the applicant's destruction of that system so they could hookup to their "new ditch" or b) insure in perpetuity that their mitigations include all properties that drain stormwater into the "new drainage ditch" and are free from future stormwater related encumbrances to development.

The above stated concerns are relevant at this stage of planning because the applicant is proposing an outflow that directly discharges in a WOTUS River, the Cowlitz, thus forcing a discussion and decision by EPA and other agencies as to whether "the new ditch" including all waters discharged by this outfall and the ditch supplying the outfall will be declared WOTUS and subject to setback and environmental requirements of WOTUS.

Additionally: at present there are no apparent wetlands or environmentally sensitive areas that "the new ditch" drains, but as the ditch ages, wetlands grasses ie wire grass, cattails, and other determinate plants will grow as well as it providing homes for wetland birds and animals. This will create the potential for future EPA and other agencies designation of "the new ditch" (which is drained by this proposed outflow) as an environmentally sensitive area, requiring setbacks and mitigation to development on adjacent properties.

RECEIVED 6/2/2025

SEPA Record No. 20250229S
CRP-25-009

CR-24-051 - CRP-25-007/008
CRP-25-009

COPY

Finally, I am adamantly opposed to transferring responsibility for maintenance of the infiltration/ overflow system to the church. It must remain Tappani's or the city's responsibility to avoid the same scenario as is presently the case where the city approved, privately engineered design, fails to eliminate the stormwater successfully and leaves the landowners holding the bag for remediation. At minimum a 20 year performance bond must guarantee the proper functioning of this system.

This outflow consequently becomes the harbinger of issues to come and so must bear this present scrutiny as part of this decision making process.

Roy Henson
2278 LARSEN LN SW
1933 HUNTINGTON AVE S
2335 LARSEN LN SW

RECEIVED
6/2/2025

COPY

SOMACH SIMMONS & DUNN
ATTORNEYS AT LAW

Subscribe to our eAlerts

October 15, 2024 | Written by Ellen M. Moskal

Lack of Consensus Emerges as Courts Apply New WOTUS Rule to Ditches and Canals

The limits to federal jurisdiction over "waters of the United States" (WOTUS) have continued to develop following the Supreme Court's landmark decision in *Sackett v. Environmental Protection Agency*, as federal district courts begin to vary in determining federal Clean Water Act jurisdiction over manmade ditches and canals.

A critical question, subject to extensive rulemaking and litigation over past decades, involves the extent to which manmade ditches and canals qualify as waters of the United States subject to federal regulation. In 2001, in *Headwaters Inc. v. Talent Irrigation District*, the Ninth Circuit Court of Appeal recognized manmade irrigation canals as WOTUS if water flowed, at least occasionally, through such features into natural streams. The United States Environmental Protection Agency (EPA) took a consistent view, defining WOTUS to include drainage ditches, even with only intermittent flow, provided that they were tributary to a water of the United States and had perceptible ordinary high water marks.

RECEIVED
6/2/2025

The landscape changed with the Supreme Court's 2006 decision in *Rapanos v. United States* and *Carabell v. United States* (collectively referred to as *Rapanos*), in which the plurality opinion instituted the "relatively permanent" test ("relatively permanent, standing or continuously flowing bodies of water" that are connected to traditional navigable waters, plus wetlands with a "continuous surface connection" to such relatively permanent water bodies, are WOTUS) while a concurrence relied on the "significant nexus" test (WOTUS include wetlands that possess a "significant nexus" to waters that are or were navigable in fact or that could reasonably be so made). The EPA and Army Corps of Engineers issued guidance in 2008, advising that waters that satisfied either test qualified as WOTUS. The Trump and Biden Administrations subsequently adopted competing definitions of WOTUS within the confines of the *Rapanos* decision.

Then, in May 2023, the Supreme Court decided *Sackett*. The court upheld the "relatively permanent" test to the exclusion of the "significant nexus" test, finding that WOTUS include "only those relatively permanent, standing or continuously flowing bodies of water 'forming geographic[al] features' that are described in ordinary parlance as 'streams, oceans, rivers, and lakes.' " Some interpreted this holding as supporting the position that canals and ditches would not qualify as WOTUS because they are not ordinarily described as streams, oceans, rivers, or lakes. The EPA subsequently adopted a revised definition of WOTUS to comport with the *Sackett* decision, expressly excluding, in relevant part, "Ditches (including roadside ditches) excavated wholly in and draining only dry land and that do not carry a relatively permanent flow of water." The revised definition became effective in September 2023. Notably, this definition does not clearly align with *Sackett*, as it does not address the Supreme Court's expression of the limitation to relatively permanent bodies of water that are ordinarily described as streams, oceans, rivers, and lakes.

Over the last year, United States district courts have begun to apply *Sackett* to determine whether canals and ditches qualify as WOTUS. While a consensus has begun to emerge, it has not been consistently interpreted. In the first case decided after *Sackett, San Francisco Baykeeper v. City of Sunnyvale* (*Baykeeper*), the District Court for the Northern District of California reconsidered and upheld its pre-*Sackett* holding that a manmade channel qualified as WOTUS. The channel at issue conveys stormwater, irrigation water runoff, and groundwater to traditional WOTUS. The court held that it qualified under *Sackett* because, though it flowed seasonally, "it flows continuously during certain times of the year" and "more than in direct response to precipitation." The court also rejected the "argument that *Sackett* calls into question whether manmade channels with continuous seasonal flows such as this can be [WOTUS] merely because they are manmade." It did not, however, explain why its holding is consistent with *Sackett's* language limiting WOTUS to those "described in ordinary parlance as 'streams, oceans, rivers, and lakes.' " Similarly, the District Court for the Western District of Washington indicated, in *Waste Action Project v. Girard Res. and Recycling, LLC*, that a ditch flowing into a creek could be grounds for qualification as WOTUS, but did not decide the issue.

RECEIVED 6/2/2025
COPY

In contrast, other district courts have recognized or applied stricter limitations on manmade ditches. Following *Sackett*, the plaintiff in *Ragsdale v. JLM Construction Services, Inc.* (*Ragsdale*), which was decided in the District Court for the Western District of Texas, abandoned his claims that the defendant violated the Clean Water Act by discharging into manmade features, conceding "that the stock pond, drainage ditches, culverts, and trenches are not covered under the [Clean Water Act]." Similarly, in *United States v. Sharfi* (*Sharfi*), the District Court for the Southern District of Florida in 2024 held that seasonal drainage ditches with varying flow throughout the year were not WOTUS under *Sackett*, focusing on the fact that ditches are not ordinarily described as streams, oceans, rivers, or lakes, and that flow was intermittent. Notably, the *Ragsdale* and *Sharfi* courts both cited *Baykeeper* for the general history of the WOTUS rule leading up to *Sackett*, but did not explain or otherwise acknowledge the inconsistencies between their respective analyses.

The developing split among district courts warrants caution in determining whether manmade canals and ditches qualify as WOTUS under the current regulatory regime, particularly within the Northern District of California, which covers Alameda, Contra Costa, Del Norte, Humboldt, Lake, Marin, Mendocino, Monterey, Napa and San Benito, San Francisco, San Mateo, Sunnyvale, and Santa Cruz counties. Moreover, there is a potential for litigation challenging the regulatory exemption for ditches given its inconsistency with the *Sackett* decision. Pursuant to the Supreme Court's recent decision in *Loper Bright Enterprises, et al. v. Raimondo, Secretary of Commerce, et al.*, courts must review the definition of WOTUS using their independent judgment, rather than deferring to the EPA's interpretation of its statutory authority, increasing the chances for successful challenges to the regulation in light of *Sackett's* definition of WOTUS.

For inquiries or additional information, please contact:

- Ellen M. Moskal, emoskal@somachlaw.com
- Kelley M. Taber, ktaber@somachlaw.com

Somach Simmons & Dunn provides the information in its Environmental Law & Policy Alerts and on its website for informational purposes only. This general information is not a substitute for legal advice, and users should consult with legal counsel for specific advice. In addition, using this information or sending electronic mail to Somach Simmons & Dunn or its attorneys does not create an attorney-client relationship with Somach Simmons & Dunn.

Read more news and alerts »

Meet Our Team »

COPY

RECEIVED 6/12/2025

Historical Recap:

The permit for me to short plat and sell the property in 1995 to Cowlitz Valley Christian Center now Timberlake Church, was conditioned by city attorney, city engineer, and city council on the fact that no water would flow across the property line of the Sam Hornstra property per a letter from Odine Husemoen, Sam's attorney. The as built stormwater retention system used 3 French drain/ drywells on my property (1933 and 1955 Huntington, 1955 was subsequently sold for this development) The drywell system functioned successfully as designed. With the construction of the church, the city approved a new stormwater system that included the 3 drywells, berm, and the current bioswale system on the former Timberlake property, now belonging to Tappani. ALL water was contained and perked on site and no stormwater crossed into the Hornstra, now Tappani property. It was a closed system with NO WOTUS potential. Although the berm prevented water from flowing onto the Hornstra property, the churches newly engineered bioswale system backed water onto my property because of what I believe was insufficient sizing for the church runoff.

Currently Tappani destroyed and filled in the third drywell and French drain on my former property and connected the stormwater from Lowe's, now Partridge property, and other northern properties that flows across my property (1933 Huntington) to their drainage system that crosses over the old Hornstra property line. This direct connection of stormwater to their ditch creates a potential WOTUS situation and requires an answer to the original WOTUS question.

COPY

RECEIVED
6/2/2025

CR-24-051 -CRP-25-007/008
CRP-25-009

Walstead, Mertsching Husemoen, Donaldson & Barlow P.S. **Attorneys at Law**

FOUNDING PARTNERS
Howard J. Atwell 1880-1962
Ronald Moore 1897-1968
Jerome Walstead 1913-1981

Michael J. Baldwin
John A. Barlow
Mark S. Brumbaugh
Barry J. Dahl
Norman C. Dick
D.L. Donaldson
Timothy J. Hayes
Odine H. Husemoen
Scott M. Kilpatrick
Charles T. Mertsching
Stephen L. Wanderer
Craig W. Weston

COPY

January 13, 1995

City Engineer
City of Castle Rock
141 A Street, SW
Castle Rock, WA 98611

RE: South Castle Rock Drainage

Dear Sir or Madam:

Some time ago I wrote you on behalf of Sam Hornstra and his wife about a concern he had over potential drainage problems near his property in south Castle Rock. The purpose of this letter is again to alert you to that concern.

Mr. and Mrs. Hornstra want you to be assured that they have no particular problem with any development or growth in Castle Rock. Their concern centers around a potential problem which seems obvious to him. The area around his home has surface water drainage problems now, and any new construction will add to that particular problem. Therefore, it is suggested that your attention to be addressed to storm and surface water drainage.

If there is to be construction in the area of the Hornstra property, we believe that all those problems could be resolved if sufficient drainage is installed at the time of any new construction. If you are already alerted to this problem, then you may disregard this letter, but if not, please take into consideration this problem as any development could have an adverse affect on the Hornstra property.

Thank you in advance for your courtesy and attention to this letter.

Very truly yours,

Odine H. Husemoen

Odine H. Husemoen

OHH:clm
cc: Mr. and Mrs. Hornstra

1000 Twelfth Avenue, Suite 2 • P.O. Box 1549 • Longview, Washington 98632-7934
Longview (206) 423-5220 • Woodland (206) 225-6339 • Vancouver (206) 694-0606 • Fax No. (206) 423-1478

RECEIVED 6/2/2025

COPY

June 9, 1995

Mayor Gene Frymire
City of Castle Rock
P.O. Box 370
Castle Rock, WA 98611

Dear Mayor Frymire:

I wish to inform you that Mr. Roy Henson has agreed to put a berm around his improved property, adequate enough to retain any water runoff from coming onto my property. This is in addition to the drainage system he has already proposed to the council.

If these two measures are done, and the systems are maintained in working order, my concerns regarding the runoff problem from this property will be satisfied.

It is my hope that any further development in the Larsen lane area will be approved with similar conditions to keep any water runoff from draining onto my property.

Sincerely,

Sam Hornstra

Sam Hornstra, Owner
Larsen Lane SW

RECEIVED
6/2/2025

1995

COPY

Description of Project: A portion of the subject property is an old river channel of centuries past. During the eruption of Mt. St. Helens in 1980, this channel was filled by the mud flow. This mud flow hardened forming a less permeable surface which now stands water until it slowly percolates and evaporates. (See cross section)

Scope of Project: The plan is two fold. (1) Drain the existing standing water estimated at 4000 cubic feet. (2) Provide a permanent solution in the form of access from the mud flow to the original sandy loam soil. This is accomplished by a series of trenches and dry-wells. (See plan) Since all property in this area drains in a Southerly direction, this property owner was required to provide drainage for all neighboring property lying to the North of the subject property. This is the purpose of dry-well #1. Dry-wells #2 and #3 provide drainage for the subject property.

Details and Specifications: Dry-wells; 3 @ 800 cubic feet each
capable of draining 50 cu.ft\ hr each
total capability is 1200 cu.ft\ day

Trenches; 2 ft. width, tapered depth to 2ft.

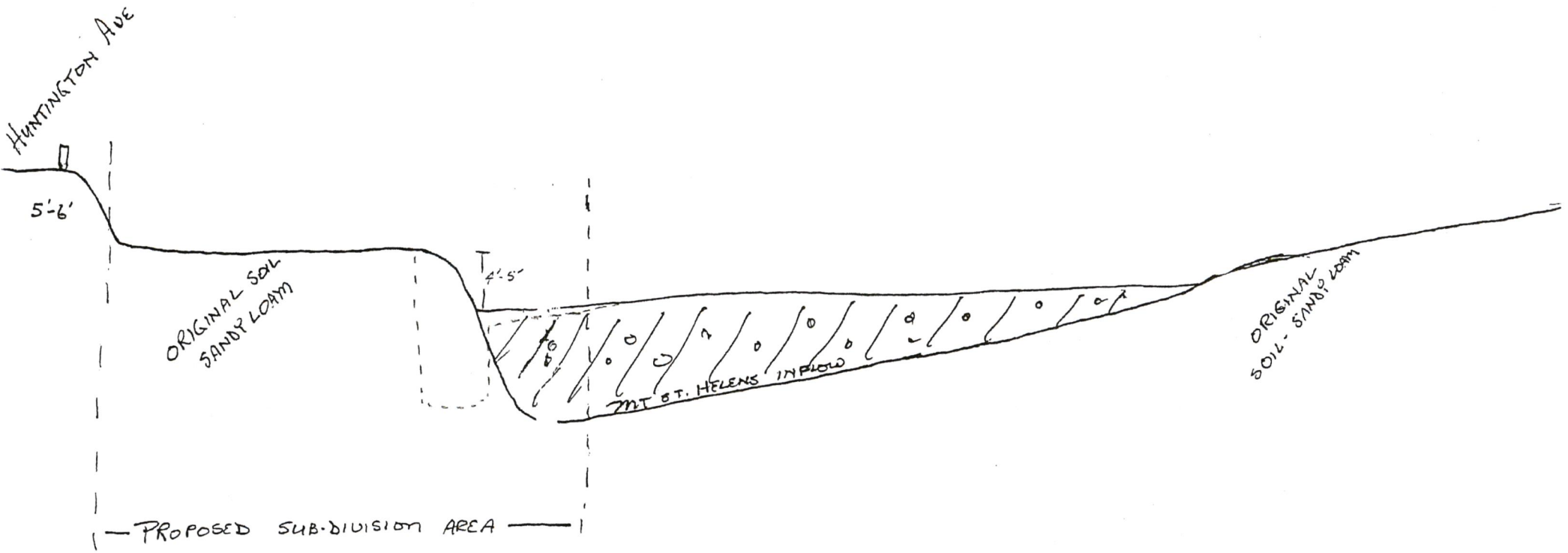
Natural Vegetation; trees planted every 4 ft. along perimeter of property. Young trees will respire 12 gal. water per day. Mature trees 100 gals \day

Rainfall; 1 inch of rain on subject area equals 200 cu.ft

Conclusion: Even in the severest of weather the system has worked. No surface water is flowing onto neighboring properties. Water no longer stands on mud flow area. It is immediately drained away to appropriate dry-well . Video tape of before and after is available as evidence.

RECEIVED
6/2/2025

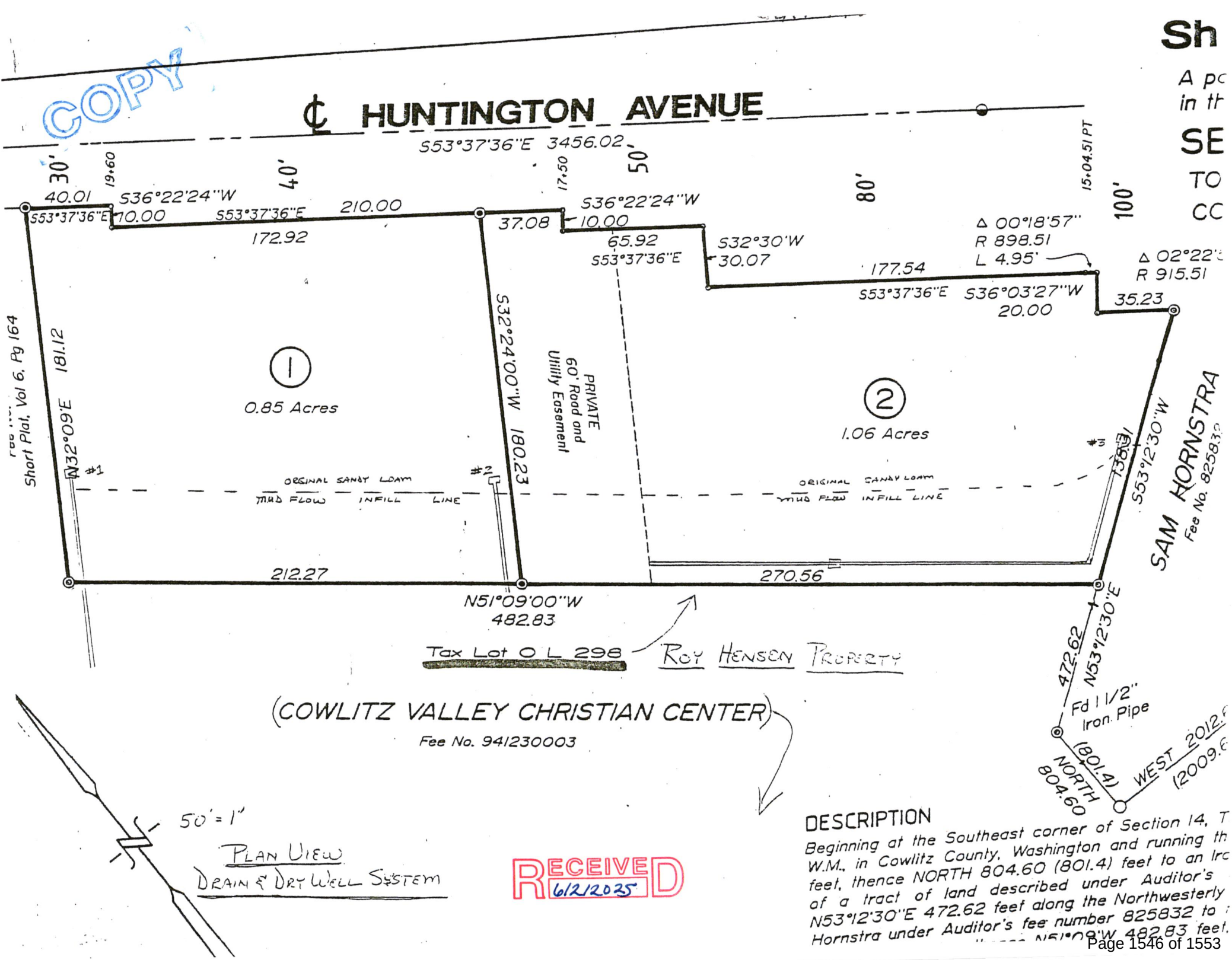
COPY



CROSS SECTION LOOKING SOUTH

NOT TO SCALE

RECEIVED 6/2/2025



DESCRIPTION

Beginning at the Southeast corner of Section 14, T
W.M., in Cowlitz County, Washington and running th
feet, thence NORTH 804.60 (801.4) feet to an Irc
of a tract of land described under Auditor's
N53°12'30"E 472.62 feet along the Northwesterly
Hornstra under Auditor's fee number 825832 to
N51°09'W 482.83 feet.

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Southwest Region Office
PO Box 47775, Olympia, WA 98504-7775 • 360-407-6300

June 16, 2025

Karlene Akesson, Deputy Clerk
City of Castle Rock
PO BOX 370
Castle Rock, WA 98611

Dear Karlene Akesson:

Thank you for the opportunity to comment on the mitigated determination of non-significance for the River's Edge at the Landing Subdivision Project as proposed by CT6, LLC. The Department of Ecology (Ecology) reviewed the environmental checklist and has the following comment(s):

HAZARDOUS WASTE & TOXICS REDUCTION: Garret Peck (564) 669-0836

The applicant proposes to demolish an existing structure(s). In addition to any required asbestos abatement procedures, the applicant should ensure that any other potentially dangerous or hazardous materials present, such as PCB-containing lamp ballasts, fluorescent lamps, and wall thermostats containing mercury, are removed prior to demolition. It is important that these materials and wastes are removed and appropriately managed prior to demolition. It is equally important that demolition debris is also safely managed, especially if it contains painted wood or concrete, treated wood, or other possibly dangerous materials.

Please review the "Dangerous Waste Rules for Demolition, Construction, and Renovation Wastes," posted at Ecology's website, https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Dangerous-waste-guidance/Common-dangerous-waste/Construction-and-demolition. The applicant may also contact Katy Harvey of Ecology's Hazardous Waste and Toxics Reduction Program at katy.harvey@ecy.wa.gov for more information about safely handling dangerous wastes and demolition debris.

SHORELANDS & ENVIRONMENTAL ASSISTANCE: Matt Gerlach, (360) 584-2804

Thank you for the opportunity to review this proposal. Ecology notes that filling a parcel so that the new grade is at or above the base flood elevation doesn't remove the parcel from the special flood hazard area. The only way to remove a parcel from the special flood hazard area is to go through the Letter of Map Change process with FEMA. Any future development will require a floodplain development permit and be subject to applicable conditions (including elevating and/or floodproofing any structures) following the flood damage prevention regulations found in Ch. 15.24 Castle Rock Municipal Code.

SOLID WASTE MANAGEMENT: Derek Rockett (360) 995-3176

All grading and filling of land must utilize only clean fill. All other materials may be considered solid waste and permit approval may be required from your local jurisdictional health department prior to filling. All removed debris resulting from this project must be disposed of at an approved site. Contact the local jurisdictional health department or Department of Ecology for proper management of these materials.

Ecology's comments are based upon information provided by the lead agency. As such, they may not constitute an exhaustive list of the various authorizations that must be obtained or legal requirements that must be fulfilled in order to carry out the proposed action.

If you have any questions or would like to respond to these comments, please contact the appropriate reviewing staff listed above.

Department of Ecology
Southwest Regional Office

(JKT:202502295)

cc: Garret Peck, HWTR
Matt Gerlach, SEA
Derek Rockett, SWM

RE: Notice of Preliminary Plat, SEPA MDNS and Public Hearing (DAHP 2025-06-03886)

Stone, Jessica (DAHP) <jessica.stone@dahp.wa.gov> Mon, Jun 16, 2025 at 9:35 AM
To: Karlene Akesson <kakesson@ci.castle-rock.wa.us>
Cc: "permitreview@cowlitz.org" <permitreview@cowlitz.org>, James Gordon <jgordon@cowlitz.org>, Shana Lombard <slombard@cowlitz.org>, "sdinubilo@squaxin.us" <sdinubilo@squaxin.us>, "106review@ctwsbnr.org" <106review@ctwsbnr.org>, "THPO@grandronde. org (THPO@grandronde.org)" <thpo@grandronde.org>, Casey Barney <casey_barney@yakama.com>, "Jerry Meninick (Yakama)" <jerry_meninick@yakama.com>

Dear Karlene,

Thank you for contacting the DAHP regarding the above-referenced project. Although a negative cultural resources survey was completed in the project location, it is still within an area marked “Very High Risk” for encountering archaeology by our Archaeological Risk Assessment Model. Therefore, we recommend that an Inadvertent Discovery Plan (IDP) be created and kept on site.

Please also note that I have assigned DAHP Project Tracking Number 2025-06-03886 to this project. Please include this number with any future related correspondence.

Thanks, and please let me know if you have any questions,

Jessica

Jessica Stone, Ph.D (she/her)

Assistant State Archaeologist

Email: jessica.stone@dahp.wa.gov | www.dahp.wa.gov

Cell: (360) 890-2633 | Main Office: (360) 586-3065

Hours: 7:30–4:00 PST Monday–Friday

Physical Address: 1110 S. Capitol Way, Suite 30, Olympia, WA 98501

Mailing Address: PO Box 48343, Olympia, WA 98504-8343

CASTLE ROCK Planning Commission **Planning Commission Regular Meeting**
May 20, 2025

1. CALL TO ORDER

Chairperson Rick Sullivan called the regular meeting to order at 6:00 PM.

a. Roll Call

Members present: Chairperson Rick Sullivan, Commissioners Richard Skreen, Ryane Olin, and David VanCamp; Commissioner Rasmussen arrived during roll call. Memebers absent: Robert Frazier
Staff present: Contracted Planner Rachel Granrath, Secretary Karlene Akesson. Mayor Paul Helenberg arrived at approximately 7:00 pm.

2. CITIZEN COMMENTS

3. CONSENT AGENDA

a. Approval of Minutes - February 18, 2025 Planning Commission Regular Meeting Minutes

Commissioner Matt Rasmussen motioned, seconded by Commissioner Ryane Olin, to approve the February 18, 2025 Planning Commission Regular Meeting minutes as presented. Motion carried by roll call vote. Commissioners Rick Sullivan, Matt Rasmussen, Richard Skreen, Ryane Olin, and David VanCamp voted 'Aye'.

b. Request for Special Meeting - July Planning Commission

Commissioner Rick Sullivan provided comment. Secretary Karlene Akesson provided comment, clarified that the July 29, 2025 Special Planning Commission Meeting would be held in place of the canceled July 15, 2025 Regular Planning Commission Meeting.
Commissioner Matt Rasmussen motioned, seconded by Commissioner Ryane Olin, to approve the request for the July 15, 2025 Regular Planning Commission Meeting to be canceled, and a Special Meeting to be held on July 29, 2025. Motion carried by roll call vote. Commissioners Rick Sullivan, Matt Rasmussen, Richard Skreen, Ryane Olin, and David VanCamp voted 'Aye'.

4. REPORTS

Contracted City Planner -
Planner Rachel Granrath gave a verbal report. Commissioner Matt Rasmussen and Planner Rachel Granrath provided additional comment. Commissioner Rick Sullivan and Planner Rachel Granrath provided comment.

5. OLD BUSINESS

a. Periodic Update Grant (PUG) Update

- Draft Critical Areas Checklist
- Draft Development Regulations Checklist
- Draft Public Participation Plan

Planner Rachel Granrath presented the Draft Critical Areas Checklist. Commissioners Richard Skreen, Rick Sullivan, and Ryane Olin provided comment. Planner Rachel Granrath provided additional comment.
Planner Rachel Granrath presented the Draft Development Regulations Checklist.

Planner Rachel Granrath presented the Draft Public Participation Plan. Commissioner Richard Skreen suggested communicating with the Castle Rock Community Development Alliance, a non-profit organization, would be good. Commissioner Matt Rasmussen provided comment. Planner Rachel Granrath provided comment. Commissioner Rick Sullivan and Planner Rachel Granrath provided comment.

b. Food Truck Ordinance

Planner Rachel Granrath presented. Commissioners Richard Skreen, Rick Sulivan, and Matt Rasmussen provided comment. Planner Rachel Granrath provided comment. Commissioners Richard Skreen, Rick Sullivan, and Planner Granrath provided comment. Commissioner Matt Rasmussen and Planner Rachel Granarath provided comment.

Commissioners Matt Rasmussen and Rick Sullivan conveyed the signage regulations (in the draft Mobile Food Vendors code) seem too restrictive, though sandwich board/exterior of the unit type of signs should be addressed. Planner Rachel Granrath stated that she could amend this section to say "exterior of the unit, not the vehicle specifically". The Commissioners were in favor of this proposal.

Planner Rachel Granrath went over parking considerations. Commissioners Matt Rasmussen and Rick Sullivan conveyed the intent of section E. 1. e. of the draft Mobile Food Vendors code was to ensure that mobile food vendors could not pull into any parking lot and open their trucks. In addition, if a parking lot is to be occupied by a mobile food vendor, they prefer there to be adequate parking for both cars and food trucks, as it is preferred that the mobile food vendor be located in the parking lot, not on the street. Commissioner Richard Skreen referenced the Langley Municipal Code and read the following excerpt: "food trucks on city property or right-of-way may only operate in designated food truck zones and in spaces assigned by the city to the operator". Commissioner Richard Skreen asked if a reference similar to this might cover where they are allowed to locate/park. Commissioner Matt Rasmussen, Planner Rachel Granrath, and Commissioner Rick Sullivan provided comment. There was discussion regarding the possibility of mobile food vendors parking on the street and what that would look like. It was conveyed that it would not be unusual for mobile food vendors to park on the street during a special event, where the streets are blocked off, but that it would be unusual for them to park on a street that was not closed to traffic. There was also discussion regarding limiting the number of mobile food trucks allowed to be licensed within the city. It was the consensus of the Planning Commissioners that designated mobile food vendor areas should be established (not including special events) and not to limit the total number of mobile food vendor permits allowed. Planner Rachel Granrath and Commissioner Matt Rasmussen provided comment.

Planner Rachel Granrath went over collecting fees for mobile food vendors. Commissioners Matt Rasmussen, Richard Skreen, Secretary Karlene Akesson, and Commissioner Rick Sullivan provided comment. There was a discussion about how fees are currently assessed and how they should be assessed within the new mobile food vendor ordinance. Secretary Karlene Akesson relayed that the city of Castle Rock has a master fee schedule and that the draft code could reference the master fee schedule. Commissioners Rick Sullivan, Ryane Olin, Matt Rasmussen and Secretary Karlene Akesson provided comment. The commissioners were in favor of this proposal. There was discussion regarding how often the fees would apply. The conversation focused on how often the applicants would have to apply. It was asked if they would be required to apply for each event separately or apply for one permit annually. It was the consensus of the Planning Commission that fees should be assessed and the frequency for which they are required to apply should not be burdensome to the applicants or city staff.

Planner Rachel Granrath went over the frequency portion of the draft code (section F. of the draft

code). Commissioner Rick Sullivan stated he recalled the Commissioners had intended this section to mean mobile food vendors could operate no more than 15 days total per calendar year and no more than 3 consecutive days. Commissioner Richard Skreen asked if the frequency could be regulated by something like a short-term permit that states the timeframe. Commissioners Matt Rasmussen and Rick Sullivan provided comment. Commissioner Matt Rasmussen asked for clarification on how often a permit would need to be applied for. The examples given were: would a permit cover an event for three days, or would it cover an annual permit for anywhere? Secretary Karlene Akesson conveyed that business licensing is currently done on an annual basis, and that the permit to operate a mobile food vending unit within city limits would likely be assessed through the business licensing procedures, with additional application forms that would be sent to food vendor business license applicants. Commissioners Matt Rasmussen, Richard Skreen, and Rick Sullivan provided comments. Secretary Karlene Akesson suggested possibly wording section F. of the draft ordinance to state "Mobile food vendors operating trailers and/or stands outside Special Events approved by the City, can occur up to three days per calendar year". Commissioner Matt Rasmussen suggested stating it as three consecutive days and possibly capping the number of days allowed. Commissioner Rick Sullivan provided comment. Commissioner Ryane Olin conveyed there may be instances where an event might last more than three days. Commissioner Richard Skreen agreed and asked what the mechanism would be for establishing the duration of a short-term permit. Commissioner Matt Rasmussen provided comment. Planner Rachel Granrath conveyed that she could look into what mechanism could be used for establishing the duration of short-term permits. Commissioner Richard Skreen asked if it could be an administrative decision. Planner Rachel Granrath provided additional comment and stated it could probably be an administrative decision. Commissioner Matt Rasmussen conveyed that they were trying to avoid letting someone file for a bunch of permits, which could block others from obtaining permits. Commissioner Ryane Olin suggested looking at Kelso's codes regarding food trucks. Commissioner Rick Sullivan provided comment. Planner Rachel Granrath and Commissioner Ryane Olin provided comment.

Planner Rachel Granrath asked if there were any other sections to comment on. Secretary Karlene Akesson stated section C.7. and provided additional comment. Commissioner Matt Rasmussen suggested combining number 8 of section C with number 7. Secretary Karlene Akesson suggested taking out number 8 and rewording number 7 to say: "Provide proof of license/permit approval from the following agencies: Cowlitz County Health and Human Services Department, Washington State Department of Labor and Industries, and other applicable license/permit approvals associated with the proposed business operations." Planner Rachel Granrath, Commissioners Richard Skreen and Ryane Olin provided comment in favor of the proposal. Commissioner Matt Rasmussen addressed section C number 8 in the draft ordinance that states that the licensing requirements listed "shall be met within 30 days of approval" and asked if the City would issue the permit without having those approvals and if the City could take back the permit if they didn't get the approvals. Secretary Karlene Akesson conveyed the business license could be revoked if the proper licensing was not obtained within thirty days. Commissioner Matt Rasmussen and Secretary Karlene Akesson provided comment. Commissioner Ryane Olin conveyed that food vendors may be licensed in more than one county, and they may need time to schedule inspections with Cowlitz County. Commissioner Matt Rasmussen agreed and there was no opposition to retaining the "shall be met within 30 days of approval" statement. Commissioner Rick Sullivan addressed section D. where there is no mention of a previously discussed item: not having open flames (such as barbecue grills) under canopies. Commissioner Richard Skreen cited that the draft regulations (section C.5.) states: "awnings shall be no less than eight feet above ground level". Commissioners Matt Rasmussen, Richard Skreen, Rick Sullivan, Ryane Olin, and Matt Rasmussen provided comment. It was the consensus of the

commission to not include language regarding open flame in section D. of the draft ordinance. Commissioner Ryane Olin addressed the insurance requirement (section C.9. of the draft ordinance). Secretary Karlene Akesson, Mayor Paul Helenberg and Commissioner Matt Rasmussen provided comment. Secretary Karlene Akesson asked the Commission if the section on insurance should reference the Master Fee Schedule for insurance requirements instead of stating the insurance requirements within this section of the code. Commissioner Matt Rasmussen and Planner Rachel Granrath suggested wording the ordinance to say: "Insurance is required as outlined in the most recently adopted fee schedule". There was no opposition to this proposal.

Planner Rachel Granrath went over the language on page 34 item 3. (Section E.3. of the draft ordinance). Planner Rachel Granrath wanted to make it clear that the allowed locations were listed above (items 1 and 2 of Section E.) and prohibited locations were listed in items 3.a. through 3.e. Planner Rachel Granrath stated they could add language to item number 3.a. that says there may be some approved locations, which would probably likely not be right-of-ways like through ways of streets, but probably a parking stall or something like that. Commissioner Richard Skreen provided comment.

Commissioner Ryane Olin addressed section D.2.a. of the draft ordinance, asking if the vendors are attending an event for multiple days, would they have to clean and vacate each night. Planner Rachel Granrath conveyed this section could be amended to clarify the intent. The Commissioners did not oppose amending this section to clarify its intent.

Commissioners Ryane Olin and Rick Sullivan provided comments regarding hours of operation (section C.6. of the draft ordinance). Commissioner Ryan Olin inquired about how this requirement may affect vendor operations during special events. Secretary Karlene Akesson provided comment. Commissioners Ryane Olin and Matt Rasmussen provided additional comment.

6. NEW BUSINESS

7. ADJOURNMENT

Commissioner Matt Rasmussen motioned, seconded by Commissioner Ryane Olin, to adjourn the regular meeting. All were in favor.

At 7:09 PM, Chairperson Rick Sullivan adjourned the regular meeting.

Karlene Akesson, Secretary