

PRELIMINARY  
**Storm Drainage Report**

FOR  
Trombley Hill Subdivision  
13224 191<sup>st</sup> Ave SE  
Monroe, WA (98272)  
Tax # 28063600101200

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Date: Sept 16, 2025  
Revised:  
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# 1. Project Overview

## 1.1. Executive Summary

The purpose of this report is to address the compliance of stormwater management for a proposed project located at 13224 191<sup>st</sup> Ave SE, Monroe, WA 98272 with tax parcel number 28063600101200. See Figure 1.1 at the end of this Section for a vicinity map. This project proposes the construction of a proposed 48 residential lots, consisting of 39 single-family units and 9 townhome units. This project will be utilizing the City of Monroes standards for R-7 zoning along with Utilities and access roads. The development will be completed in accordance with Monroe City Code and the 2019 Department of Ecology Drainage Manual (2019 DOE manual) as adopted by the City of Monroe as the city’s minimum stormwater regulations.

## 1.2. Existing Conditions Summary

The Site slopes at 5-8% from northeast property corner of the site at 191<sup>st</sup> Ave SE to the southwest property corner along 134<sup>th</sup> Street SE, where stormwater runoff enters an existing 12” culvert. No surface erosion or disturbances were observed within the project site and the upslope vicinity.

Vegetation on the site is largely pasture. The site has been modeled as “C” forested Moderate slopes. The existing site consists of 8.02 ac of pasture, 6.38 ac of forest, 0.11 ac of rooftops and 0.35 ac of driveway area. An existing vegetated swale directs runoff west along 134<sup>th</sup> Street SE. See Section 3.3 for downstream drainage description.

The Natural Resource Conservation Service (NRCS) maps on-site soils as Tokul Gravelly Medial Loam, 0 to 8 Percent Slopes (100%). This soil is characterized as a type C soil. The NRCS Report is presented in Appendix A.

## 1.3. Drainage Information Summary

This report is intended to satisfy Minimum Requirements 1-9 for the 2019 DOE manual. The site will convert 7.85 ac of pasture and several structures to 48 residential lots. This site will add 228,254 sf (5.24 ac) of new impervious area and 112,820 sf (2.59 ac) of pervious area within the 7.85 ac site. The drainage design utilizes a Detention vault with multi-orifice riser (with notch) to attenuate developed runoff to the predeveloped forested condition and to provide Water Quality Treatment. See Section 4 of this report for Flow Control and Water Quality analysis and design. No impact to the downstream drainage system is anticipated from this project.

There is some bypass expected on the southwest portion of the site at a lower elevation than the vault outlet. This will be compensated for by intaking an equivalent amount of area from the property to the east of the site, and 134<sup>th</sup> Street southeast. See basin map in Appendix A.

The 13 elements of the Stormwater Pollution Prevention Plan (SWPPP) will be included with final submittal.



## 2. Conditions and Requirement Summary

This project shall comply with Minimum Requirements #1 through #9, as the development will:

- Result in or add 5,000 square feet or more of new plus replaced hard surface area;
- Convert 2.5 acres or more of native vegetation to pasture

See Figure 2.1 Minimum Requirement flowchart at the end of this Section.

### 2.1. Minimum Requirements

Below is a discussion of each Minimum Requirement as they are applicable to the proposed project.

#### **Minimum Requirement 1: Preparation of Stormwater Site Plans**

This report and the accompanying project documents satisfy this requirement.

#### **Minimum Requirement 2: Stormwater Pollution Prevention Plans (SWPPPs)**

A SWPPP report will be prepared for this project and submitted on final submittal under separate cover.

#### **Minimum Requirement 3: Source Control of Pollution**

All known, available and reasonable source control BMPs will be applied to the project. Applicable operational and structural source control BMPs will be implemented. Operational and structural controls include, but are not limited to:

- Prevention of Prohibited Discharges and Connections
- Spill Containment and Cleanup
- Spill Reporting
- Materials Storage
- Materials Containment
- Area Cleanup

#### **Minimum Requirement 4: Preservation of Natural Drainage Systems and Outfalls**

The natural drainage path sheet flows stormwater runoff across the site into the existing 12-inch culvert at the southwestern corner of the property. Natural drainage patterns shall remain intact to the maximum extent practicable.

#### **Minimum Requirement 5: On-site Stormwater Management**

This project, since it is located inside the UGA on a parcel greater than 5 acres, per 2019 DOE manual Table I-3.1 must: Use the LID BMPs from List #2 for all surfaces within each type of surface in List #2 or Use any Flow Control BMPs desired to achieve the LID Performance Standard and apply BMP T5.13 Post-Construction Soil Quality and Depth. This project elects to Use the LID BMPs from List #2.

#### **Minimum Requirement 6: Run-off Treatment**

The gravel access area onsite creates 38,986 square feet (0.896 acres) of PGHS. This exceeds the 5,000 square foot threshold provided in Figure 1-3.1 of the 2019 DOE manual, therefore, a water quality facility is required.

Calculations, presented in Appendix B, indicate that 0.2659 ac-ft (11,583 cf) of dead storage is required. See Section 4 of this report.

#### **Minimum Requirement 7: Flow Control**

Flow Control for this project is required as:

- The total of effective impervious surfaces is greater than 10,000 square feet.
- More than 2.5 acres or more of native vegetation are converted to pasture.
- A combination of (1) converted vegetation areas and (2) hard surfaces that function as effective impervious surfaces, cause greater than a 0.15 cubic feet per second (cfs) or greater increase in the 100-year flow frequency.

The Flow Control standard is as follows:

- If infiltration is infeasible, stormwater flow control facilities shall be designed and constructed so that stormwater discharges match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 50% of the two-year peak flow up to the full 50-year peak flow. The pre-developed condition shall be matched to the fully forested condition.

See flow control analysis in Section 4 of this report.

#### **Minimum Requirement 8: Wetlands Protection**

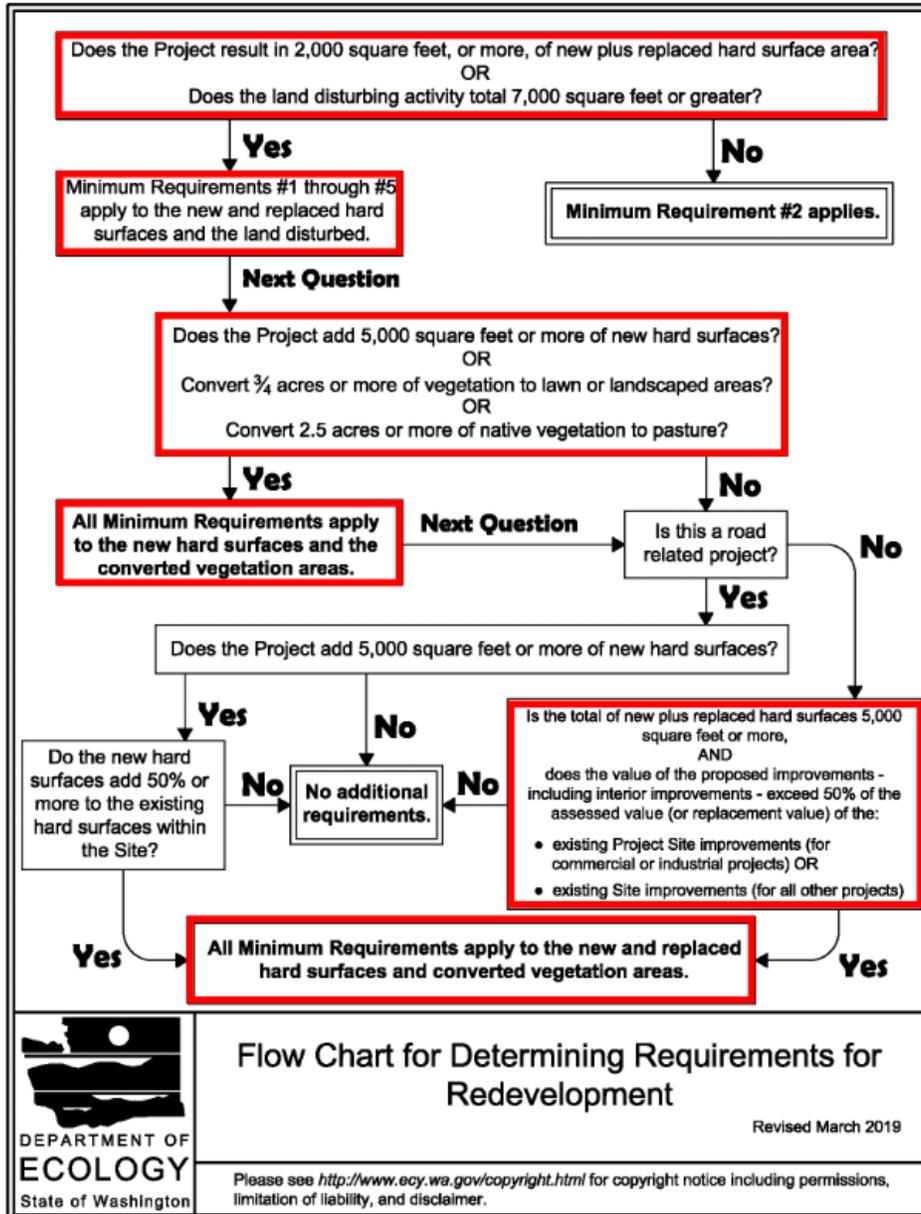
Per section I-3.4.8 of the 2019 DOE, Minimum Requirement #8 applies only to threshold discharge areas whose stormwater discharges into a wetland through a conveyance system. There is no wetland that this project discharges to, therefore Minimum Requirement #8 does not apply to the project site.

#### **Minimum Requirement 9: Operations and Maintenance**

Operations and maintenance will be submitted with final report.

Figure 2.1 Minimum Requirement Flow Chart

Figure I-3.2: Flow Chart for Determining Requirements for Redevelopment



### 3. Off-Site Analysis

#### 3.1. Resource Review

##### Critical Areas

Snohomish County GIS was reviewed for sensitive areas. There are no critical areas or wetlands found onsite.

##### Downstream Drainage Complaints

Below is a summary of all downstream parcels within the ¼-mile study area, and any active or historical drainage complaints:

Parcel	Active Drainage Complaints
28063600101200	None

##### FEMA Maps

FEMA FIRMette 53061C1100F, effective 6/19/2020, shows the site in the unshaded area of Zone X, “Areas of Minimal Flood Hazard”. See Appendix C for the FIRMette.

##### Soils Report

The Natural Resource Conservation Service (NRCS) maps the on-site soils as Tokul Gravelly Medial Loam 0-8% slopes. These soils are made up of type C soils, with a thin duff layer (0-2in) followed by gravelly medial loam (2-33in). Cemented material begins roughly (33-62in). This information is estimated from NRCS Custom soil report.

## 3.2. Upstream

There is no significant upstream area for this project. The parcels directly to the north drain to the west of the project.

## 3.3. Downstream Drainage

Site topography consists of gentle and consistent slopes or roughly 5-8% sloping from the northeast of the project to the southwest. Most of this area is pasture, with several structures and a single-family residence on the northeast of the property. The stormwater from the site and impervious structures sheetflow to the southwest of the property (See Figure 1 Table 3.3). The flow enters a vegetated conveyance ditch on the south end of the property bordering 134<sup>th</sup> Street SE. The flow continues to the west roughly 30 LF offsite to the west, entering a 12" pipe and flowing to a Type 1 Catchbasin (See Figure 2 Table 3.3). The flow moves west roughly 140LF to a Type 1 Catchbasin. The flow exits southwest in a 24" pipe roughly 40LF before entering a Type 1 Catchbasin. The flow exits this Catchbasin flowing northwest in a 24" pipe, flowing roughly 70LF to a Catchbasin. The stormwater continues west roughly 170 LF in a 24" pipe along 134<sup>th</sup> Street SE to the next Catchbasin. The flow exits the catch basin to the west in a 24" pipe traveling roughly 60LF before entering a catch basin. The flow then continues west roughly 60LF to a type 2 catch basin with a solid lid. The pipe exits to the west in an 18" pipe, running roughly 200Lf west before reaching a Type 1 Catchbasin. Exiting the Catchbasin to the west, an 18" pipe runs roughly 60 LF west to a Type 1 Catchbasin. The pipe then runs roughly 120LF west to a Type 2 Catchbasin (See Figure 3, Table 3.3). The Pipe exits the Catchbasin to the northwest in an 18" pipe and runs roughly 100LF to a stormwater detention vault. This marks 1/4Mi from the project. The stormwater path continues south from the vault, running south in an infiltration pipe roughly 700LF before intersecting with Rainier View Road Southeast. The stormwater continues to the southeast along this road, running from a type 2 Catchbasin at the end of the infiltration pipe, south roughly 100LF in an 18" pipe. This connects to a Type 2 Catchbasin south of Rainier View Road Southeast. An 18" pipe runs south roughly 55LF to a Type 2 Catchbasin. A 24" pipe runs southeast underneath a walking trail to the south of the residential properties roughly 400LF. This pipe connects to a Type 2 catchbasin which outlets in a 24" pipe to the southeast roughly 400LF. The pipe connects to a type 2 catchbasin, which outlets to the south in a 36" pipe that travels south under the walking path roughly 36". This outlets to a vegetated area to the south (See figure 4 in Table 3.3), as part of the French Creek Drainage Basin. This marks roughly 1/2Mi and the end of analysis.

Table 3.3 Downstream Drainage Pictures.



Figure 1: South border of site and conveyance ditch to west



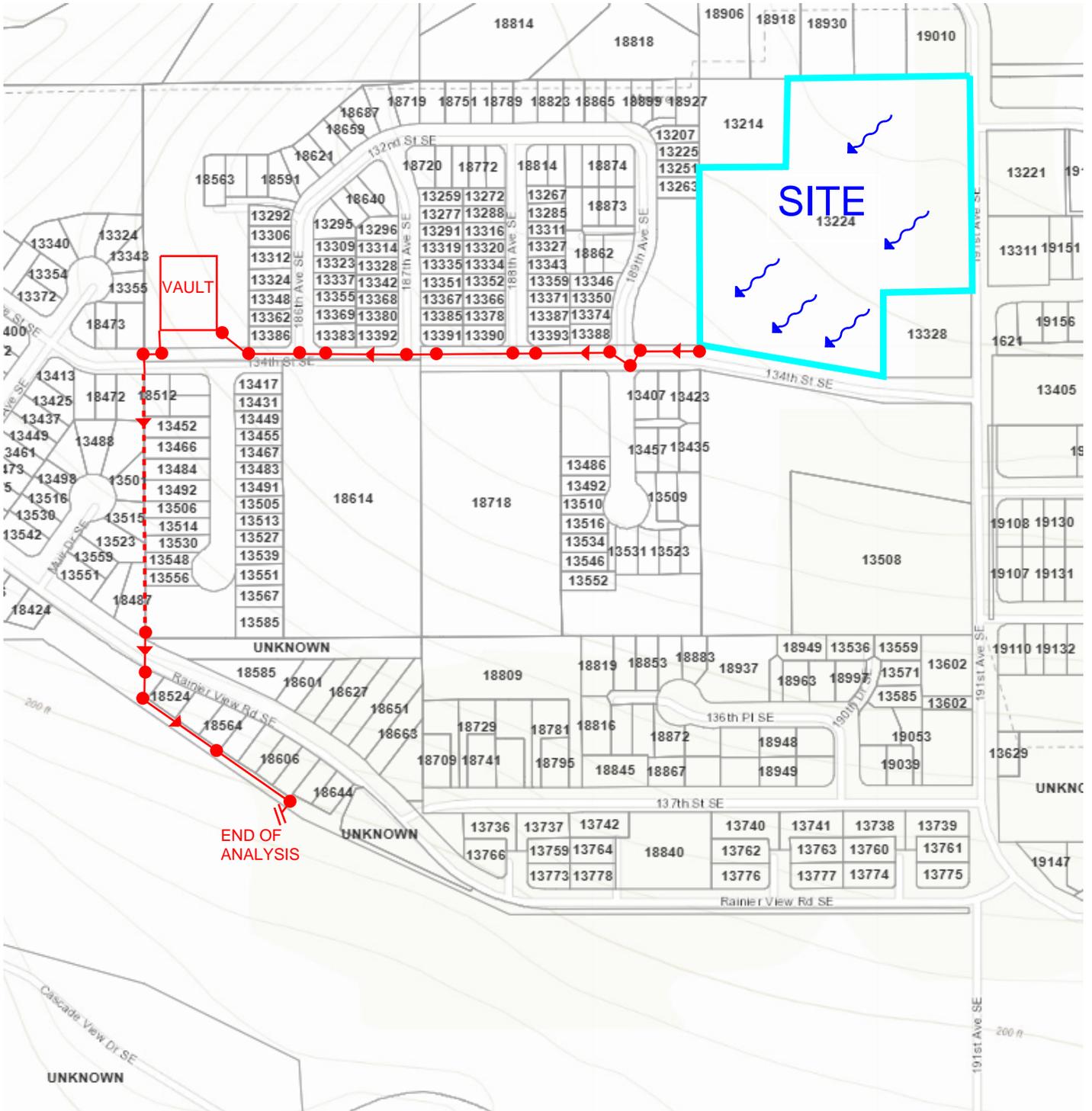
Figure 2: Type 1 catch basin west of south on 134<sup>th</sup> SE



Figure 3: Type 2 catch basin in 134<sup>th</sup> SE



Figure 4: Outfall area south of Rainier View Road SE



## 4. Flow Control and Water Quality Facility Analysis and Design

Runoff from the site will be conveyed by storm drainage pipes and catchbasins to the proposed detention facility. Stormwater from the vault will be conveyed to the natural discharge point of the site, to the southwest of the site and connect to the existing stormwater system in 134<sup>th</sup> Street SE. The runoff will be modulated by a control structure in order to meet the standards of Minimum Requirement 7, which specifies that stormwater discharge shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 50% of the two-year peak flow, up to the full 50-year peak flow. The pre-developed condition shall be matched to the fully-forested condition. This project shall utilize List #2 (2019 DOE manual Table I-3.2) to evaluate site BMP's.

See preliminary WWHM analysis indicating compliance in Appendix B.

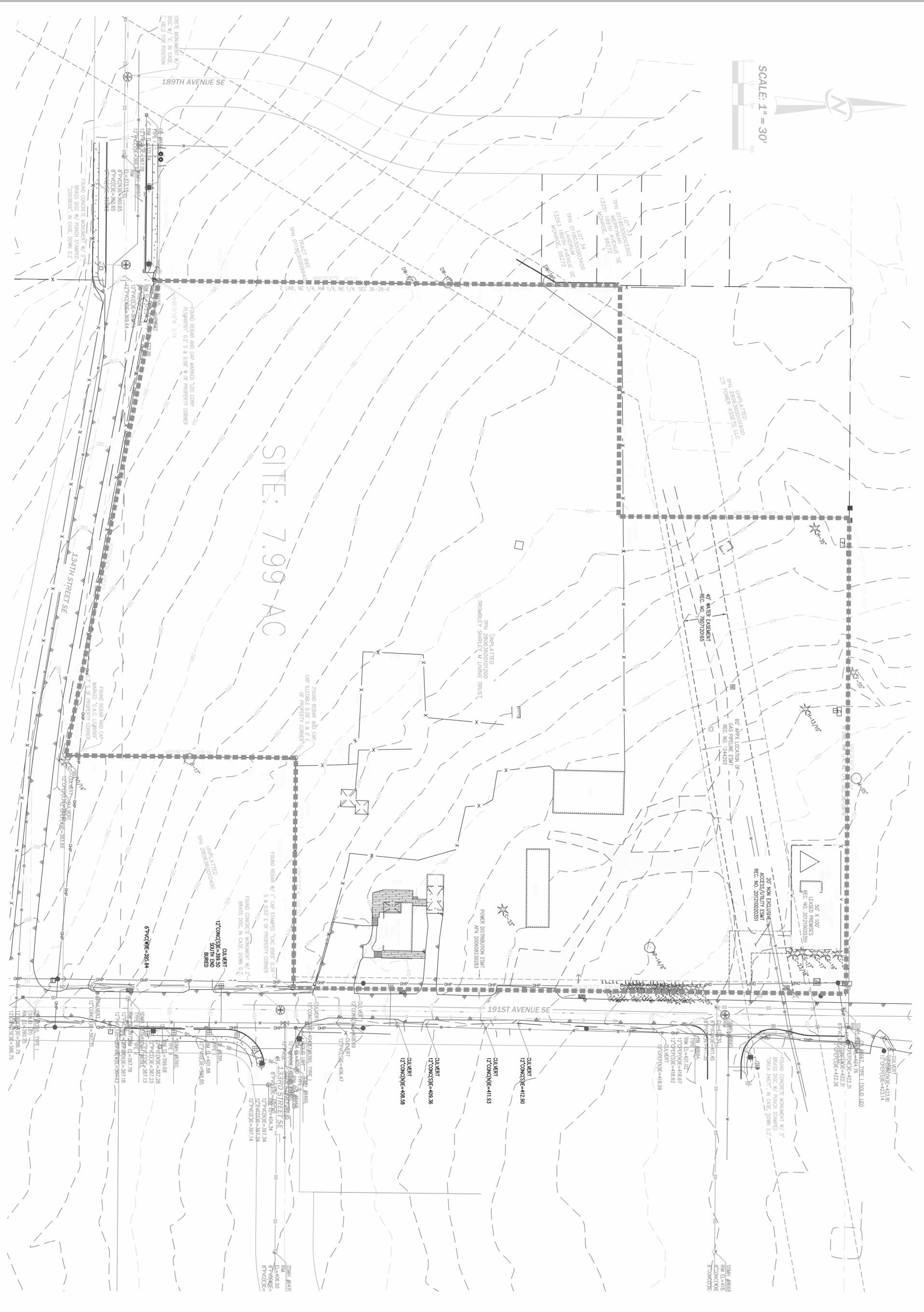
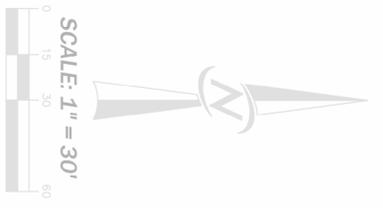
### 4.1. Existing Conditions

The existing site consists of pasture area, a single-family home, a driveway, and pasture/lawn areas. Table 4.1 presents the Pre-Developed Areas.

<b>Table 4.1: Pre-Developed Areas</b>	
<b>Land Cover Type</b>	<b>AREA (Ac.)</b>
<b>Main Basin</b>	
Forest/lawn	7.53
Driveways, Flat	0.35
Rooftops, Flat	0.11
<b>Total:</b>	<b>7.99</b>
<b>Offsite Frontage</b>	
C, Forest, Mod	<b>0.324</b>

Minimum Requirement #7 requires that Pre-Developed Areas be modeled as Historic (Forested). Table 4.2 presents the Pre-Developed Areas as modeled. See Figure 4.1 for the Pre-Developed Basin Map.

<b>Table 4.2: Pre-Developed Areas (Modeled)</b>	
<b>Land Cover Type</b>	<b>AREA (Ac.)</b>
<b>Main Basin</b>	
C, Forest, Mod	7.99
<b>Total:</b>	<b>7.99</b>
<b>Offsite Frontage</b>	
C, Forest, Mod	<b>0.324</b>



PROJECT NUMBER	24299
SHEET	3
DATE	FEBRUARY 23, 2023
DESIGNED	JEREMY REED
DRAWN	JEREMY REED
APPROVED	ROBERT WEST, PLS
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NO.	REVISIONS	DATE

## List #2

### Lawn and Landscaped Areas:

- Post-Construction Soil Quality and Depth in accordance with BMP &5.13: Post Construction Soil Quality and Depth

**Response:** *This BMP will be implemented for all lawn and landscaped areas that are affected by construction and grading activities.*

### Roofs:

1. Full Dispersion in accordance with BMP T5.30: Full Dispersion or Downspout Full Infiltration Systems in accordance with BMP T5.10A: Downspout Full Infiltration.

**Response:** *Downspout infiltration is infeasible due to space limitations and required setbacks.*

2. Bioretention (See BMP T7.30: Bioretention Cells, Swales, and Planter Boxes) facilities that have a minimum horizontally projected surface area below the overflow which is at least 5% of the total surface area draining to it.

**Response:** *Bioretention is infeasible due to a confining glacial till layer present onsite.*

3. Downspout Dispersion Systems in accordance with BMP T5.10B: Downspout Dispersion Systems

**Response:** *Downspout dispersion systems are infeasible for this project due to site limitations constraining the flow path for downspout dispersion.*

4. Perforated Stub-out Connection in accordance with BMP T5.10C: Perforated Stub-out Connections

**Response:** *Perforated stub-out connections will be implemented for this project per BMP T5.10C.*

### Other Hard Surfaces:

1. Full Dispersion in accordance with BMP T5.30: Full Dispersion

**Response:** *Full dispersion is infeasible for this project due to limited space for full dispersion.*

2. Permeable Pavement in accordance with BMP T5.15: Permeable Pavements

**Response:** *The site is underlain by till and possesses negligible infiltration potential. Permeable pavement is infeasible on this site.*

3. Bioretention BMP's (See BMP T7.30: Bioretention Cells, Swales, and Planter Boxes) that have a minimum horizontally projected surface area below the overflow which is at least 5% of the total surface area draining to it.

**Response:** *The site is underlain by till and possesses negligible infiltration potential. Permeable pavement is infeasible on this site.*

4. Sheet Flow Dispersion in accordance with BMP T5.12: Sheet Flow Dispersion or Concentrated Flow Dispersion in accordance with BMP T5.11: Concentrated Flow Dispersion

**Response:** *Dispersion BMPs are infeasible for this project due to limited site space for sheet flow dispersion.*

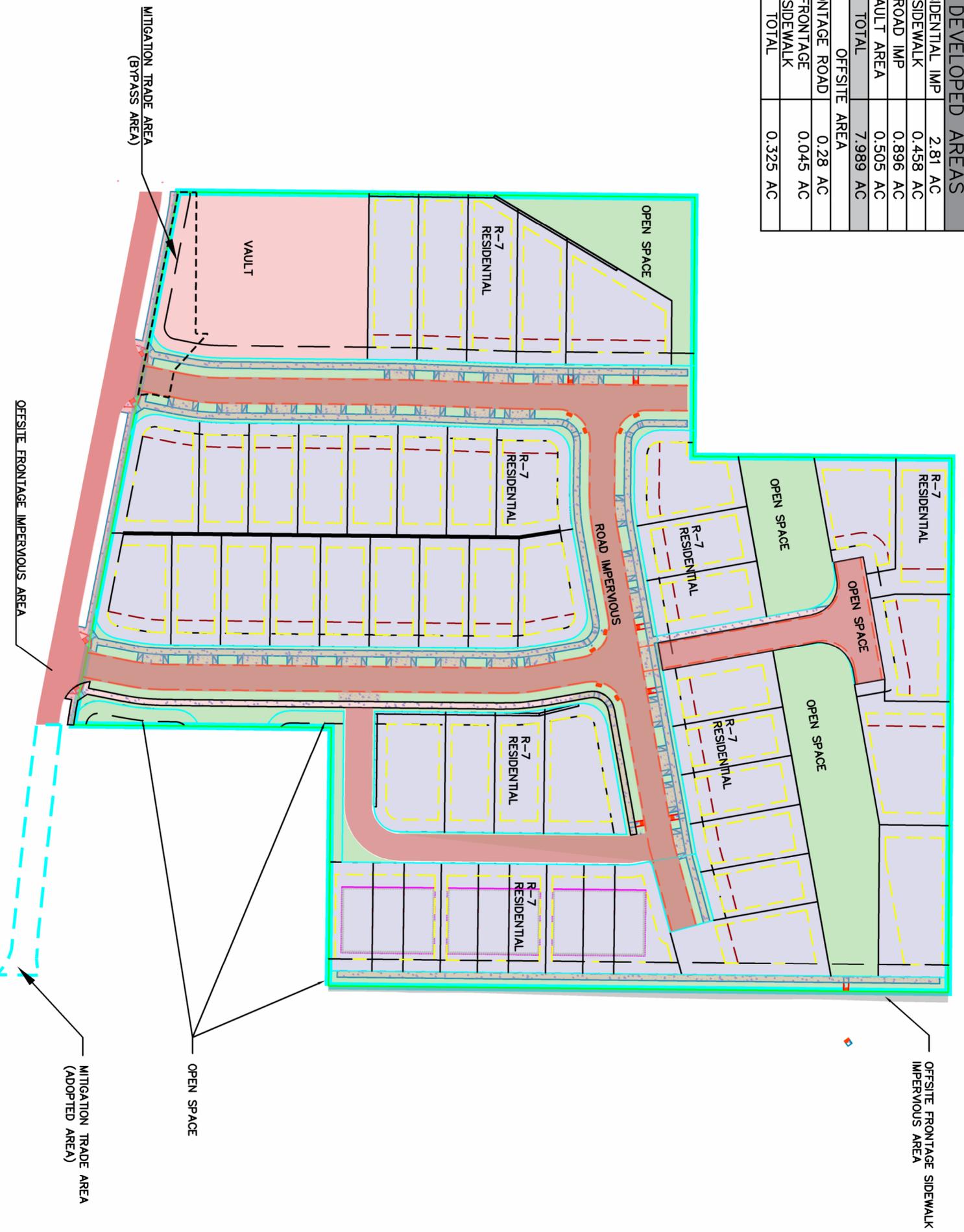
## 4.2. Developed Conditions

The developed site proposes to clear the site and construct 49 townhomes and associated roads and utilities. This includes frontage road area. There is an existing gas pipe easement and a cell phone tower easement. There is a stormwater vault in the southwest of the site that will be counted as hard surface. Table 4.3 presents the developed condition land uses and areas. See figure 4.2 for the Developed Basin Map.

The developed site proposes to let the existing path in the Right of way tract remain.

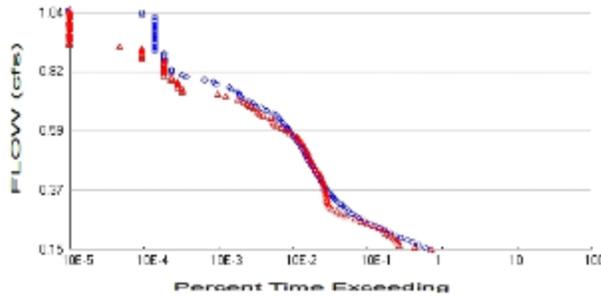
<b>Table 4.3: Developed Areas</b>	
<b>Land Cover Type</b>	<b>AREA (Ac.)</b>
C, Pasture, mod	3.32
Residential roof areas	2.81
Sidewalk	0.458
Impervious roads	0.896
Vault area	0.505
<b>Total:</b>	<b>7.989</b>
<b>Offsite area</b>	
Frontage road	0.28
Frontage sidewalk	0.045
<b>TOTAL:</b>	<b>0.325</b>

DEVELOPED AREAS	
RESIDENTIAL IMP	2.81 AC
SIDEWALK	0.458 AC
ROAD IMP	0.896 AC
VAULT AREA	0.505 AC
TOTAL	7.989 AC
OFFSITE AREA	
FRONTAGE ROAD	0.28 AC
FRONTAGE SIDEWALK	0.045 AC
TOTAL	0.325 AC



### 4.3. Flow Control

The detention vault for the project has been sized using WWHM to meet minimum requirement 7 flow control. See Appendix B for WWHM generated reports. The detention vault has been modeled using the areas provided in Tables 4.1 through 4.3 for site modeled areas. Table 4.4 presents the Pre- and Post-Developed peak flows for the 2-, 10-, 25-, 50- and 100-Year Storm Recurrence Events.



The vault geometry is 100 foot width and 120 foot Length. A 9.2 foot riser height with a three-orifice riser with an 18” overflow.

The stormwater vault positioning and grading for this project are preliminary, but it is currently likely that the vault will be unable to capture all of the developed basin’s stormwater flow for a small area on the southwest of the project. It is proposed that this project will intake an equivalent amount of area from 134<sup>th</sup> Street SE that runs from the south east of the project and flows through the frontage. This will be calculated in the final submittal to be equivalent to the amount of stormwater lost to the uncapturable stormwater to the southwest of the vault on site.

### 4.4. Water Quality

The project adds or replaces greater than 5,000 SF of PGIS, therefore water quality treatment is required per 2019 DOE manual.

The detention vault utilizes a 4-foot wetpond in the combined detention and wetpool facility. WWHM software was used to determine water quality facility volume requirements. The snip below from WWHM shows that the on-line facility requires a minimum volume of 11,766 CF (0.2701 ac-ft) to achieve basic water quality treatment. The vault provides a volume of 12,000 CF (0.275 ac-ft).

#### Water Quality

##### Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.2701 acre-feet
On-line facility target flow:	0.1374 cfs.
Adjusted for 15 min:	0.1374 cfs.
Off-line facility target flow:	0.0896 cfs.
Adjusted for 15 min:	0.0896 cfs.

The area just to the south of the vault contains area that is not able to be contained by the conveyance system. This area contains 573 square feet of pollution generating impervious area. This will be compensated for by capturing an equivalent amount of area from upstream area on 134<sup>th</sup> Street SE.

## 4.5. BMP Design

### **BMP T5.13 Post Construction Soil Quality and Depth**

Amended soils shall be utilized in all disturbed areas that will not be receiving hard surfaces in the developed condition.

## 5. Conveyance System Analysis and Design

Final conveyance design and backwater calculations will be provided with final design.

## 6. Special Reports and Studies

- N/A

## 7. Other Permits

Any necessary permits will be provided with final design.

## 8. Erosion and Sedimentation Control Analysis and Design

Project SWPPP Documents and Plans will be provided with final design.

## 9. Operations and Maintenance Manual

Operations and maintenance manual will be provided with final design.

# Appendix A

NRCS Soil Report

Geotechnical Report



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**GEOTECHNICAL ENGINEERING STUDY  
TROMBLEY SHORT PLAT  
13224 – 191<sup>ST</sup> AVENUE SOUTHEAST  
MONROE, WASHINGTON**

**ES-10296**



Geotechnical Engineering



Environmental Services



Earthwork Observation & Testing

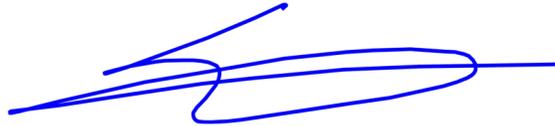


CESCL & Stormwater Services

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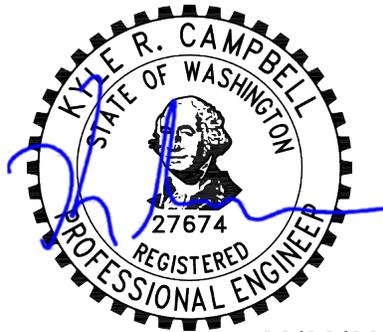
**PREPARED FOR**  
**REID DEVELOPMENT GROUP, LLC**

**June 30, 2025**



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06/30/2025

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**Senior Principal Engineer**

**GEOTECHNICAL ENGINEERING STUDY**  
**TROMBLEY SHORT PLAT**  
**13224 – 191<sup>ST</sup> AVENUE SOUTHEAST**  
**MONROE, WASHINGTON**

**ES-10296**

# Important Information about This

# Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

**The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.**

## Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

## Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer

will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

## Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

## You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

### Most of the “Findings” Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site’s subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

### This Report’s Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

### This Report Could Be Misinterpreted

Other design professionals’ misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals’ plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

### Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note*

*conspicuously that you’ve included the material for information purposes only.* To avoid misunderstanding, you may also want to note that “informational purposes” means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

### Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled “limitations,” many of these provisions indicate where geotechnical engineers’ responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

### Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a “phase-one” or “phase-two” environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

### Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer’s services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, *proper implementation of the geotechnical engineer’s recommendations will not of itself be sufficient to prevent moisture infiltration.* **Confront the risk of moisture infiltration** by including building-envelope or mold specialists on the design team. **Geotechnical engineers are not building-envelope or mold specialists.**



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June 30, 2025  
ES-10296

Reid Development Group, LLC  
PO Box 1930  
Woodinville, Washington 98072

Attention: Michael Reid

Greetings:

Earth Solutions NW, LLC (ESNW) is pleased to present this geotechnical engineering study per our scope of services outlined in the proposal dated December 6, 2024. This study is meant to support the proposed residential construction at the subject address. Based on the results of our investigation, the proposed project is feasible from a geotechnical standpoint. The site is underlain by glacial till deposits based on our subsurface exploration (May 21, 2025).

The site will be graded to create building pads following demolition of the existing structures on the site. After completing earthwork activities in accordance with recommendations in this report, the proposed structures can be supported on conventional spread and continuous foundations bearing on undisturbed, competent native soil, re-compacted existing fill, or new structural fill. If structural building pads are disturbed during wet weather, remediation measures such as cement treatment or overexcavation and replacement with rock may be necessary in some areas.

From a geotechnical standpoint, infiltration on the subject site should be considered infeasible based on the in-situ infiltration testing ESNW performed during the site exploration. The cemented nature of glacial till precludes full-infiltration.

Pertinent geotechnical recommendations are provided in this study. We appreciate the opportunity to be of service to you on this project. If you have any questions regarding the content of this geotechnical engineering study, please call.

Sincerely,

**EARTH SOLUTIONS NW, LLC**



Stephen H. Avril  
Project Manager

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### **APPENDICES**

<b>Appendix A</b>	<b>Subsurface Exploration Logs</b>
<b>Appendix B</b>	<b>Laboratory Test Results</b>

**GEOTECHNICAL ENGINEERING STUDY  
TROMBLEY SHORT PLAT  
13224 – 191<sup>ST</sup> AVENUE SOUTHEAST  
MONROE, WASHINGTON**

**ES-10296**

**INTRODUCTION**

**General**

This geotechnical engineering study (study) was prepared for the proposed residential development on the west side of 191<sup>st</sup> Avenue Southeast, north of the intersection with 134<sup>th</sup> Street Southeast in Monroe, Washington. The site is comprised of a single tax parcel (parcel number 28063600101200). The purpose of this study was to develop geotechnical recommendations for the project. The following tasks were completed as part of our scope of services for this project:

- Logging, and sampling of a series of test pits to characterize soil and groundwater conditions.
- In-situ infiltration testing.
- Laboratory testing of soil samples collected at the test locations.
- Engineering analyses and recommendations for the proposed development.
- Preparation of this report.

**Project Description**

The proposed project consists of re-development of the existing parcel (parcel number 28063600101200) with construction of a series of single-family residences following the demolition of the existing structures on the subject site who's location is not demonstrated on the subsurface location plan ESNW is providing due to the site survey which ESNW was provided by the client, where no structures were shown. Infiltration is being investigated to aid in stormwater management, and ESNW has provided a preliminary infiltration opinion based on observation of a small-scale Pilot Infiltration Test (PIT) on the subject site.

Based on our experience with similar projects and site grades we anticipate cuts and fills of up to ten to 15 feet or less will be necessary to achieve the proposed finish grade elevations following the demolition of the existing buildings, based on the sloped nature of the site. More extensive earthwork operations will likely be required to install site utilities and construct the stormwater facilities. Block retaining walls and rockeries can be utilized to facilitate grade changes where necessary. ESNW can provide retaining wall and rockery designs upon request.

Based on our experience with similar projects, the proposed residential structures are anticipated to be two to three stories in height and constructed utilizing relatively lightly loaded wood framing supported on conventional foundations. Perimeter footing loads are anticipated be 1 to 2 kips per linear foot, isolated footing loads will be less than 20 kips, and we anticipate slab-on-grade loading of 150 pounds per square foot (psf).

If the above design assumptions either change or are incorrect, ESNW should be contacted to review the recommendations provided in this report. ESNW should also be contacted to review final designs to confirm that our geotechnical recommendations have been incorporated into the plans.

## **SITE CONDITIONS**

### **Surface**

The subject site is located on the west side of 191<sup>st</sup> Avenue Southeast, north of the intersection with 134<sup>th</sup> Street Southeast in Monroe, Washington. The site is comprised of a single tax parcel (parcel number 28063600101200). The parcel is currently developed with a single-family residence and outbuildings. The remainder of the site is comprised of an agricultural field, and is moderately sloped with 40 feet of elevation change in across the site.

### **Subsurface**

An ESNW representative observed, logged, and sampled eight test pits on May 21, 2025. The test locations were within accessible site locations using an excavator and operator contracted by ESNW. The subsurface exploration was completed to evaluate soil conditions, classify site soils, perform an infiltration investigation and characterize groundwater conditions within the proposed development area.

The maximum exploration depth was nine feet below the existing ground surface (bgs), and terminated within native soil depositional environments.

The approximate locations of the explorations are depicted on Plate 2 (Subsurface Exploration Plan). Please refer to the logs provided in Appendix A for a more detailed description of subsurface conditions. Representative soil samples collected at the exploration locations were analyzed in general accordance with both Unified Soil Classification System (USCS) and United States Department of Agriculture (USDA) methods and procedures. Laboratory test results are provided in Appendix B.

### **Topsoil**

Topsoil was observed at the test locations in depths ranging between 6 to 16 inches below the surface. Topsoil is characterized by its dark brown color, the presence of fine organic material, and small root intrusions, and is not suitable for use as structural fill material.

## **Fill**

Fill was not encountered at the test locations during the site exploration. However, existing fill may be encountered within the current parking areas, and surrounding road and existing building alignments.

## **Native Soil**

Underlying the topsoil, native soils encountered at the test locations were observed to be medium dense grading to dense silty sand with gravel (Unified Soil Classification, SM) and poorly graded sand with silt (SP-SM) observed to the limits of excavation. These soils are consistent with the typical makeup of the mapped geological deposits. Density was observed to increase with depth. In general, the native soil was generally encountered in a moist condition during the time of exploration.

## **Geologic Setting**

Geologic mapping identifies Younger glacial till deposits (Qvt) mapped for the area. These deposits are typified by silty sand (SM) and sandy silt (ML) soils.

The referenced Web Soil Survey (WSS) identifies Tokul gravelly medial loam (0 to 8 percent slopes) as the primary unit underlying the subject site. Tokul gravelly medial loam series of soils are described as glacial till deposits. Based on our field observations, the site soils are comprised of glacial till deposits.

## **Groundwater**

Perched groundwater was observed at four of the test locations during the May 2025 subsurface exploration. The seepage was exposed at depths between two to six feet and flow amounts were characterized as light to moderate. Zones of perched groundwater seepage are expected to develop within the soil substratum depending on the time of year and may be encountered during general earthwork activities. Groundwater seepage rates and elevations fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. Groundwater seepage flow rates are typically higher during the winter, spring, and early summer months.

## **GEOLOGIC HAZARD AREAS EVALUATION**

A review of the City of Monroe (COM) information was completed to evaluate whether geologically hazardous areas are present within the subject site. The city provides the following description of a landslide hazard:

- a. *Areas of historic failure, such as:*
  - i. *Those areas delineated by the U.S. Department of Agriculture's Natural Resources Conservation Service as having a "severe" limitation for building site development; or*
  - ii. *Areas designated as quaternary slumps, earthflows, mudflows, lahars, or landslides on maps published by the U.S. Geological Survey or Department of Natural Resources;*
- b. *Areas with all three of the following characteristics:*
  - i. *Slopes steeper than fifteen percent; and*
  - ii. *Hillsides intersecting geologic contacts with a relatively permeable sediment overlaying a relatively impermeable sediment or bedrock; and*
  - iii. *Springs or groundwater seepage;*
- c. *Areas that have shown movement during the Holocene epoch (from ten thousand years ago to the present) or that are underlain or covered by mass wastage debris of that epoch;*
- d. *Slopes that are parallel or subparallel to planes of weakness (such as bedding planes, joint systems, and faults) in subsurface materials;*
- e. *Slopes having a gradient steeper than eighty percent subject to rock fall during seismic shaking;*
- f. *Areas potentially unstable because of rapid stream incision, stream bank erosion, and undercutting by wave action;*
- g. *Areas located in a canyon or on an active alluvial fan, presently or potentially subject to inundation by debris flows or catastrophic flooding; and*
- h. *Any area with a slope of forty percent or steeper and with a vertical relief of ten or more feet except areas composed of consolidated rock. A slope delineated by establishing its toe and top and measured by averaging the inclination over at least ten feet of vertical relief.*

The COM defines erosion hazards as:

*1. Erosion Hazard Areas. Erosion hazard areas are at least those areas identified by the U.S. Department of Agriculture's Natural Resources Conservation Service as having "severe" or "very severe" rill and inter-rill erosion hazard.*

Based on ESNW review of the soil conditions on the site, surface conditions, and topography; there are no geologic critical areas on the subject site.

## **DISCUSSION AND RECOMMENDATIONS**

### **General**

Based on the results of our investigation, construction of the proposed residential re-development is feasible from a geotechnical standpoint. The primary geotechnical considerations associated with the proposed development include site grading and grade changes, stormwater control, and the suitability of using on-site soils as structural fill.

After completing earthwork activities in accordance with recommendations in this report, the proposed residential structures can be supported on conventional spread and continuous foundations bearing on undisturbed, competent native soil, re-compacted native soil, re-compacted existing fill or new structural fill. If structural building pads are disturbed during wet weather, remediation measures such as cement treatment or overexcavation and replacement with rock may be necessary in some areas.

From a geotechnical standpoint, infiltration on the subject site should be considered infeasible based on the presence of the glacial till on the subject site and the results of the PIT testing.

### **Site Preparation and Earthwork**

Initial site preparation activities will consist of demolition, installing temporary erosion control measures, establishing grading limits, and site clearing and stripping activities. Subsequent earthwork activities will involve mass site grading and installation of infrastructure and stormwater management improvements.

## **Temporary Erosion Control**

The following temporary erosion and sediment control (TESC) BMPs are offered:

- Temporary construction entrances and drive lanes, consisting of at least six inches of quarry spalls, should be considered to both minimize off-site soil tracking and provide a stable access entrance surface. Placing geotextile fabric underneath the quarry spalls will provide greater stability, if needed.
- Silt fencing should be placed around the construction site perimeter.
- When not in use, soil stockpiles should be covered or otherwise protected.
- Temporary measures for controlling surface water runoff, such as interceptor trenches, sumps, or swales, should be installed prior to beginning earthwork activities.
- Dry soils disturbed during construction should be wetted to minimize dust and airborne soil erosion.
- When appropriate, permanent planting or hydroseeding will help to stabilize on-site soil.

Additional TESC BMPs, as specified by the project civil engineer and indicated on the plans, should be incorporated into construction activities. TESC BMPs may be modified during construction as site conditions require and as approved by the site erosion control lead.

## **Stripping**

Topsoil will likely be encountered within the upper six to eighteen inches on the subject site. Topsoil is not suitable for load bearing and should be removed where encountered within building footprints and other structural areas to be developed. Topsoil is not suitable for use as structural fill material, but may be considered for placement in landscape zones of the site. Particularly where water quality treatment is required by the city. Root intrusions generally extend below the topsoil into the upper weathered soil. The organic-rich topsoil should be stripped and segregated into a stockpile for later use on site or to haul off site. The material remaining immediately below the topsoil may have some root zones and will likely be variable in composition, density, and/or moisture content. The material exposed after initial topsoil stripping will likely be suitable for direct structural support as is but will need to be evaluated during construction for load-bearing capacities as it is exposed. ESNW should observe initial stripping activities to provide recommendations regarding stripping depths and material suitability.

## Excavations and Slopes

Excavation activities on site are likely to expose medium dense to dense native soil. Based on the soil conditions observed at the test locations, the following maximum allowable temporary slope inclinations may be used. The weathered soil should be considered Type B, and the unweathered till should be considered Type A. The applicable Federal Occupation Safety and Health Administration and Washington Industrial Safety and Health Act soil classifications are also provided:

- Areas exposing groundwater seepage or fill 1.5H:1V (Type C)
- Loose soil 1.5H:1V (Type C)
- Medium dense soil (weathered till) 1H:1V (Type B)
- Dense soil (unweathered till) 0.75H:1V (Type A)

Permanent slopes should be planted with vegetation to both enhance stability and minimize erosion and should maintain a gradient of 2H:1V or flatter. The presence of perched groundwater may cause localized sloughing of temporary slopes. An ESNW representative should be requested to observe temporary and permanent slopes to confirm the slope inclinations are suitable for the exposed soil conditions and to provide additional excavation and slope recommendations, as necessary.

Care must be taken when considering the placement of structures on the site requiring temporary excavations. ESNW recommends excavations not extend into an area where the roadway or other neighboring structures will be creating a surcharge on the excavation walls. The excavations should maintain a minimum 1H:1V (Horizontal:Vertical) setback from the road or any adjacent structures on or off-site. If the recommended temporary slope inclinations cannot be achieved, temporary shoring may be necessary to support excavations.

## In-situ and Imported Soil

The on-site soil is moisture sensitive, and successful use of the on-site soil as structural fill will largely be dictated by the moisture content at the time of placement and compaction. Remedial measures may be necessary as part of site grading and earthwork activities. Remedial measures would include aeration or cement modification of the site soils in order to moisture-condition the targeted soils for use as structural fill. If the on-site soil cannot be successfully compacted in its natural moisture or through moisture conditioning, the use of an imported soil may be necessary. In our opinion, a contingency should be provided in the project budget for the export of soil that cannot be successfully compacted as structural fill, particularly if grading activities take place during the wet season. In general, soils with appreciable fines contents (greater than 5 percent) typically degrade rapidly when exposed to rainfall and construction traffic.

Imported soil intended for use as structural fill should consist of a well-graded, granular soil with a moisture content that is at (or slightly above) the optimum level. During wet weather conditions, imported soil intended for use as structural fill should consist of a well-graded, granular soil with a fines content of 5 percent or less (where the fines content is defined as the percent passing the Number 200 sieve, based on the minus three-quarter-inch fraction).

### **Cement Modified Soil (CMS)**

The on-site soil intended to be used within roadway subgrades and building pad subgrades are primarily comprised of silty sand soil. The soil is considered moisture sensitive when above optimum moisture levels. The following percentages of cement modification are recommended for placement and compaction of structural fill, where allowed by COM on the site:

- General Earthwork 3 Percent to 5 Percent

Note that the percentage of cement needed will vary depending on the moisture content of the soil. The above percentages of soil-cement shall be based on the unit weight (approximately 125 pcf) of the soil to be modified.

For general earthwork applications, a backhoe or excavator can be used to mix the soil-cement prior to placement and compaction. The cement must be thoroughly mixed with the soil. Modified soil used as structural fill shall be placed and compacted to a minimum of 95 percent of the soil maximum dry density determined in accordance with Modified Proctor (ASTM D1557). For in-place slab subgrade fill that became wet and unstable during recent precipitation events, a rototiller and plate compactor can be utilized to mix the slab subgrade soil with cement to a depth of at least 12 to 18 inches.

ESNW representatives should be on-site during soil amendment and related earthwork activities to provide compaction testing following the soil modification. Care should be taken to maintain containment of cement stockpiles during the soil modification. All modified surfaces must be thoroughly compacted and “sealed” at the end of each day. Plastic sheeting placed over modified areas can be considered to further protect grades from precipitation. Following a 48-hour curing period, ESNW should confirm general acceptability of cement modified structural fill areas. Pavement areas or areas subject to construction traffic should be proof-rolled with a loaded dump truck or similar vehicle. Areas of subgrade identified by the proof-roll to be unstable should be re-treated with cement. Supplemental recommendations for achieving the appropriate level of soil amendment and compaction may be provided by ESNW, as necessary.



A one-third increase in the allowable soil bearing capacity may be assumed for short-term wind and seismic loading conditions. The passive earth pressure and coefficient of friction values include a safety factor of 1.5. With structural loading as expected, total settlement in the range of one inch is anticipated, with differential settlement of about one-half inch. Most of the anticipated settlement should occur during construction as dead loads are applied.

**Seismic Design**

The 2021 International Building Code (2021 IBC) recognizes ASCE 7-16 (formally known as the Minimum Design Loads and Associated Criteria for Buildings and Other Structures manual) for seismic design, specifically with respect to earthquake loads. Based on the soil conditions encountered at the test pit locations, the parameters and values provided below are recommended for seismic design per the 2021 IBC.

Parameter	Value
Site Class	C*
Mapped short period spectral response acceleration, $S_s (g)$	1.14
Mapped 1-second period spectral response acceleration, $S_1 (g)$	0.40
Short period site coefficient, $F_a$	1.20
Long period site coefficient, $F_v$	1.50
Adjusted short period spectral response acceleration, $S_{Ms} (g)$	1.37
Adjusted 1-second period spectral response acceleration, $S_{M1} (g)$	0.60
Design short period spectral response acceleration, $S_{Ds} (g)$	0.91
Design 1-second period spectral response acceleration, $S_{D1} (g)$	0.40

\* Assumes dense soil conditions, encountered to a maximum depth of nine feet bgs during the field exploration, remain dense to at least 100 feet bgs. Based on our experience with the project geologic setting (lacustrine deposits) across the Puget Sound region, soil conditions are likely consistent with this assumption.

**Liquefaction**

Liquefaction is a phenomenon that can occur within a soil profile as a result of an intense ground shaking or loading condition. Most commonly, liquefaction is caused by ground shaking during an earthquake. Sand or silt soil profiles that are loose, cohesionless, and present below the groundwater table are most susceptible to liquefaction. During the ground shaking, the soil contracts, and porewater pressure increases. The increased porewater pressure occurs quickly and without sufficient time to dissipate, resulting in water flowing upward to the ground surface and a liquefied soil condition. Soil in a liquefied condition possesses very little shear strength in comparison to the drained condition, which can result in a loss of foundation support for structures.

Based on the soil conditions underlying the site, the risk of liquefaction on the subject site is negligible. The relative density of the soil underlying the site is the primary basis for this opinion.

### **Slab-on-Grade Floors**

Slab-on-grade floors for the proposed structures should be supported on firm and unyielding subgrades. Unstable or yielding subgrade areas should be recompacted or overexcavated and replaced with suitable structural fill prior to slab construction.

A capillary break consisting of a minimum of four inches of free-draining crushed rock or gravel should be placed below each slab. The free-draining material should have a fines content of 5 percent or less (percent passing the Number 200 sieve, based on the minus three-quarter-inch fraction). In areas where slab moisture is undesirable, installation of a vapor barrier below the slab should be considered. If a vapor barrier is to be utilized, it should be a material specifically designed for use as a vapor barrier and should be installed per manufacturer specifications.

### **Retaining Walls**

Retaining walls must be designed to resist earth pressures and applicable surcharge loads. Retaining wall subgrade must be prepared in the same fashion as is recommended within the “Foundations” section of this report. The following parameters may be used for design:

- Active earth pressure (unrestrained condition)                      35 pcf (equivalent fluid)
- At-rest earth pressure (restrained condition)                              55 pcf
- Traffic surcharge\* (passenger vehicles)                                      70 psf (rectangular distribution)
- Passive earth pressure    300 pcf (equivalent fluid)
- Coefficient of friction    0.40
- Seismic surcharge    8H psf\*\*
- Allowable soil bearing capacity    2,500 psf

\* Where applicable.

\*\* Where H equals the retained height (in feet).

The above passive earth pressure and coefficient of friction values include a safety factor of 1.5 and are based on a level backfill condition and level grade at the wall toe. Revised design values will be necessary if sloping grades are to be used above or below retaining walls. Additional surcharge loading from adjacent foundations, sloped backfill, or other relevant loads should be included in the retaining wall design.

Retaining walls should be backfilled with free-draining material that extends along with the height of the wall and a distance of at least 18 inches behind the wall. The upper 12 inches of the wall backfill may consist of less permeable soil if desired. A sheet drain may be considered instead of free-draining backfill. A perforated drainpipe should be placed along the base of the wall and connected to an approved discharge location. A typical retaining wall drainage detail is provided on Plate 3. If drainage is not provided, hydrostatic pressures should be included in the wall design.

### **Drainage**

Perched seepage should be anticipated within site excavations. Temporary measures to control surface water runoff and groundwater seepage during construction will be critical to minimizing the potential for on-site soils to degrade. ESNW should be consulted during preliminary grading to identify areas effected by groundwater and provide recommendations to reduce the potential for water-related instability.

Finish grades must be designed to direct surface drain water away from structures and slopes. Water must not be allowed to pond adjacent to structures or slopes. Grades adjacent to buildings should be sloped away from the buildings at a gradient of either at least 2 percent for a horizontal distance of 10 feet or the maximum allowed by adjacent structures. In our opinion, foundation drains should be installed along building perimeter footings. A typical foundation drain detail is provided on Plate 4. If footing drains are omitted, there is a higher potential for moisture issues for slabs-on-grade or crawl space areas.

If construction will incorporate crawl spaces rather than slab-on-grade, a crawl space drain system can be used in lieu of perimeter footing drains. The crawl space drain must provide positive drainage to an appropriate outlet.

### **Preliminary Infiltration Evaluation**

As indicated in the *Subsurface* section of this report, the native soil encountered during our fieldwork was primarily characterized as glacial till deposits. In our opinion, infiltration potential within the dense to very dense glacial till deposits is negligible. The near-surface, loose to medium dense soil horizon (weathered till) may possess a limited infiltration capacity. However, following site stripping and mass earthwork activities, this horizon will likely be altered or removed to the extent that would render it unsuitable for infiltration purposes.

Per our scope of services, infiltration testing was included in the fieldwork. The testing was completed at a depth of approximately four feet at TP-1. Measured PIT rates were minimal, with little to no change over the course of the drop period. The very low hydrologic capacity is attributed to both the presence of the relatively high in-situ fines content and cemented condition of the native soil.

From a geotechnical standpoint, full stormwater infiltration on the subject site should be considered infeasible on the subject site due to the presence of glacial till.

### **Preliminary Pavement Sections**

The performance of site pavements is largely related to the condition of the underlying subgrade. To ensure adequate pavement performance, the subgrade should be in a firm and unyielding condition when subjected to proof rolling with a loaded dump truck. Structural fill in pavement areas should be compacted to the specifications previously detailed in this report. Soft, wet, or otherwise unsuitable subgrade areas may still exist after base grading activities. Areas containing unsuitable or yielding subgrade conditions will require remedial measures, such as overexcavation and/or placement of thicker crushed rock or structural fill sections, prior to pavement.

We anticipate new pavement sections will be subjected primarily to passenger vehicle traffic. For lightly loaded pavement areas subjected primarily to passenger vehicles, the following preliminary pavement sections may be considered:

- A minimum of two inches of hot-mix asphalt (HMA) placed over four inches of crushed rock base (CRB).
- A minimum of two inches of HMA placed over three inches of asphalt-treated base (ATB).

The HMA, ATB, and CRB materials should conform to WSDOT and/or the City of Monroe specifications. All soil base material should be compacted to a relative compaction of 95 percent, based on the laboratory maximum dry density as determined by ASTM D1557. Final pavement design recommendations, including recommendations for heavy traffic areas, access roads, and frontage improvement areas, can be provided once final traffic loading has been determined. Road standards utilized by the county may supersede the recommendations provided in this report.

If an inverted crown will be used for roadway surfaces, drainage measures should be included in the design to drain water in the subgrade adjacent to catch basins. Such measures can consist of finger drains extending from the catch basins.

### **Utility Support and Trench Backfill**

In our opinion, the on-site native soil will generally be suitable for support of utilities where groundwater does not affect trench-bottoms. However, existing fill may be unsuitable in its current condition, if encountered. Remedial measures may be necessary in some areas to provide support for utilities, such as overexcavation and replacement with structural fill or placement of geotextile fabric. Groundwater may be encountered within utility excavations, and caving of trench walls may occur where groundwater or unsuitable fill are encountered. Depending on the time of year, depth-of-excavation, and conditions encountered, dewatering or temporary trench shoring may be necessary during utility excavation and installation.

The on-site soil may not be suitable for use as structural backfill throughout utility trench excavations unless the soil is at (or slightly above) the optimum moisture content at the time of placement and compaction. Moisture conditioning of the soil may be necessary at some locations prior to use as structural fill. Each section of the utility lines must be adequately supported in the bedding material. Utility trench backfill should be placed and compacted to the structural fill specifications previously detailed in this report or to the applicable specifications of the presiding jurisdiction.

### **LIMITATIONS**

This study has been prepared for the exclusive use of Reid Development Group, LLC., and their representatives. The recommendations and conclusions provided in this study are professional opinions consistent with the level of care and skill that is typical of other members in the profession currently practicing under similar conditions in this area. No warranty, express or implied, is made. Variations in the subsurface conditions observed at the test locations may exist and may not become evident until construction. ESNW should reevaluate the conclusions provided in this study if variations are encountered.

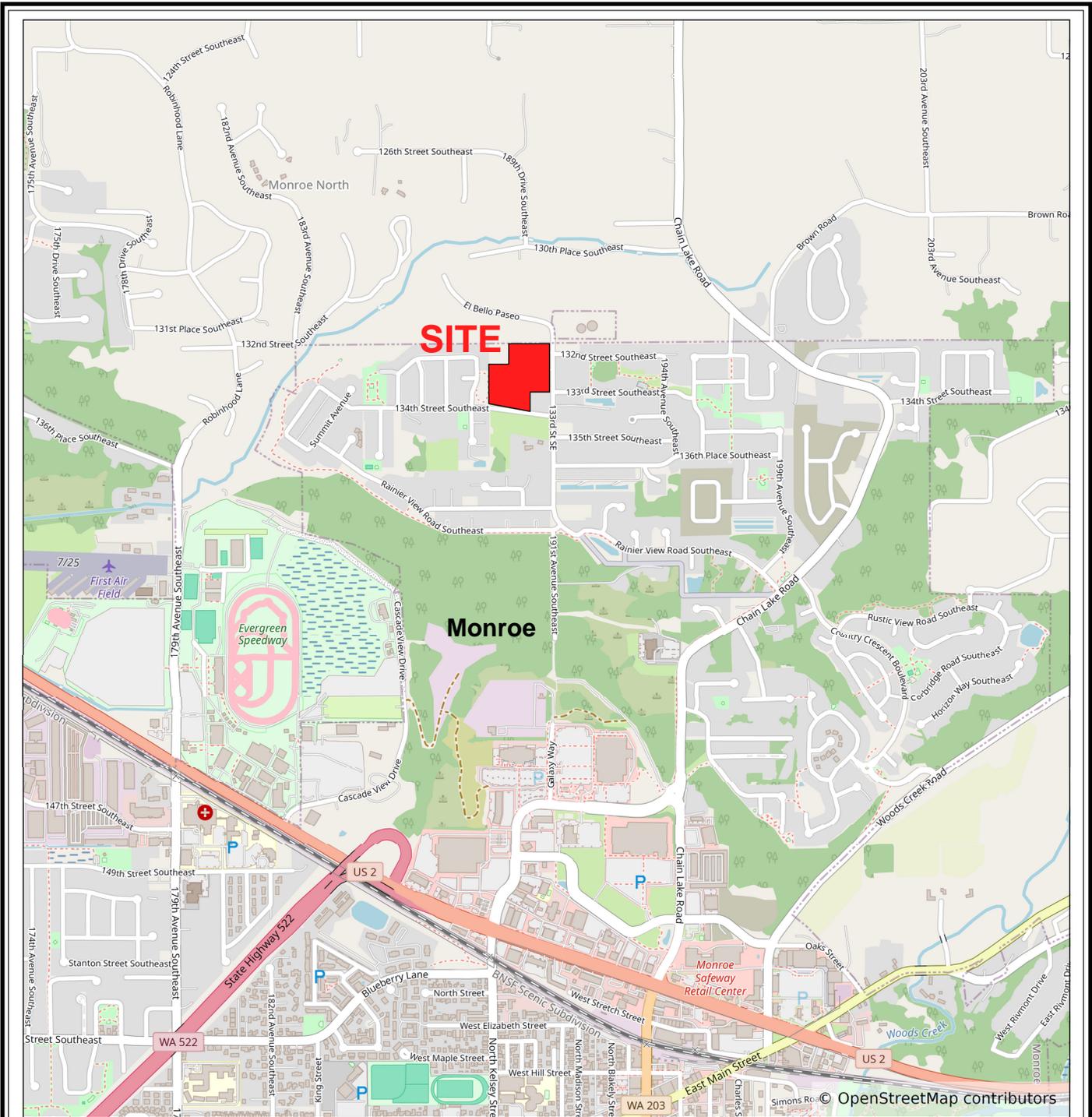
### **Additional Services**

ESNW should have an opportunity to review the final design with respect to the geotechnical recommendations provided in this report. ESNW should also be retained to provide testing and consultation services during construction.

### **REFERENCES**

The following documents were reviewed as part of the preparation of this study:

- Boundary and Topographic Survey, provided by Core Design, dated October 23, 2024
- COM municipal code (MMC – Chapter 22.80)
- Conceptual Site Plan, provided by Core Design, dated April 4, 2025
- Geologic map of the Lake Roesiger 7.5-minute quadrangle, Snohomish County, Washington, compiled by Joe D. Dragovich et al., October 2015
- WSS, provided by the USDA Natural Resources Conservation Service



Reference:  
 Snohomish County, Washington  
 OpenStreetMap.org



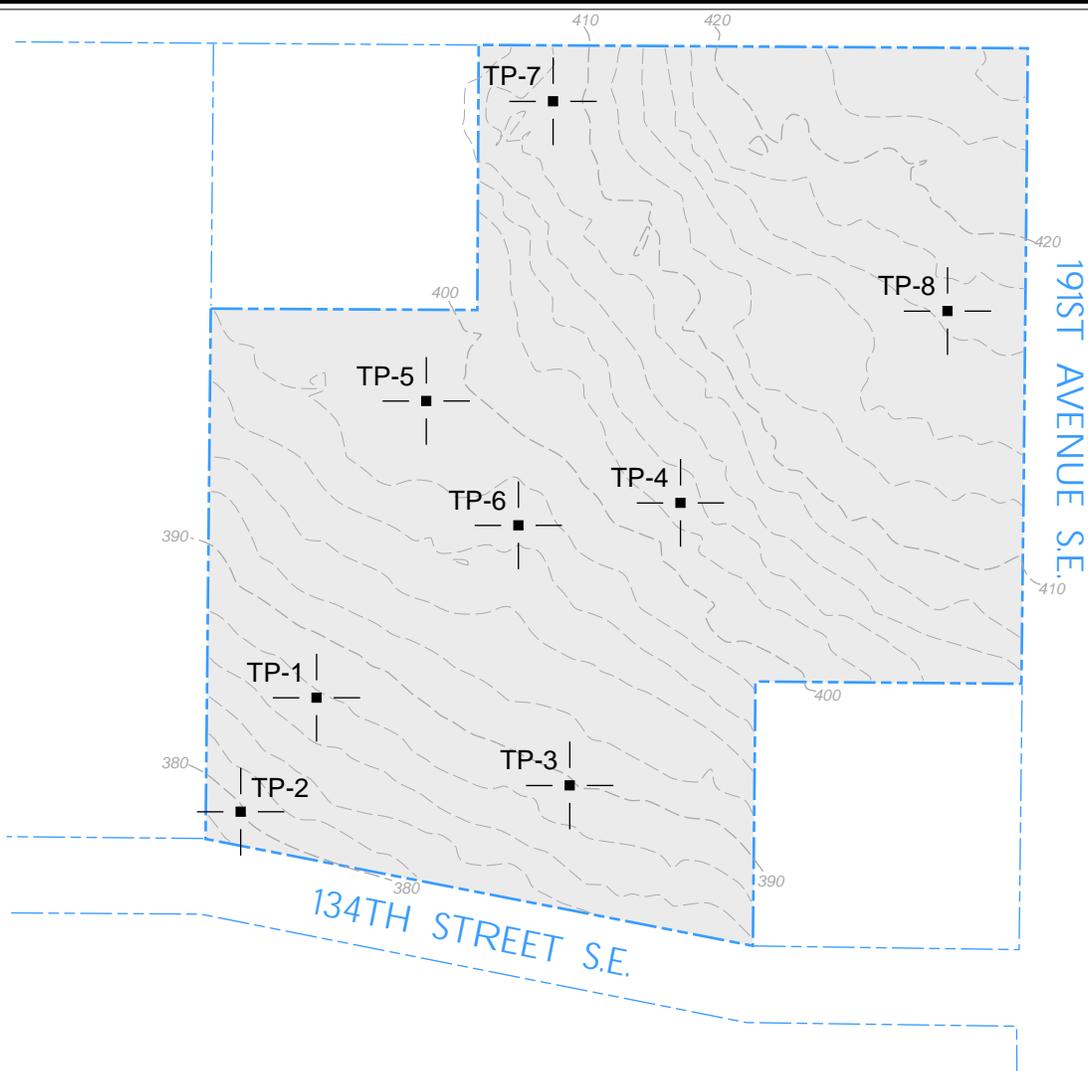
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.



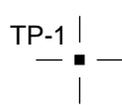
Geotechnical Engineering  
 Environmental Services  
 Earthwork Observation & Testing  
 CESCL & Stormwater Services

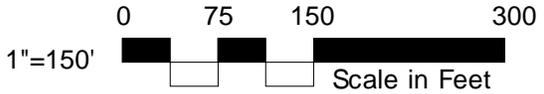
Vicinity Map  
 Trombley Short Plat  
 Monroe, Washington

Drawn CAM	Date 06/18/2025	Proj. No. 10296
Checked AZS	Date June 2025	Plate 1



**LEGEND**

- 
 TP-1 | Approximate Location of ESNW Test Pit, Proj. No. ES-10296, May 2025
- 
 Subject Site



NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided by the client at the time of our study. ESNW cannot be responsible for subsequent design changes or interpretation of the data by others.

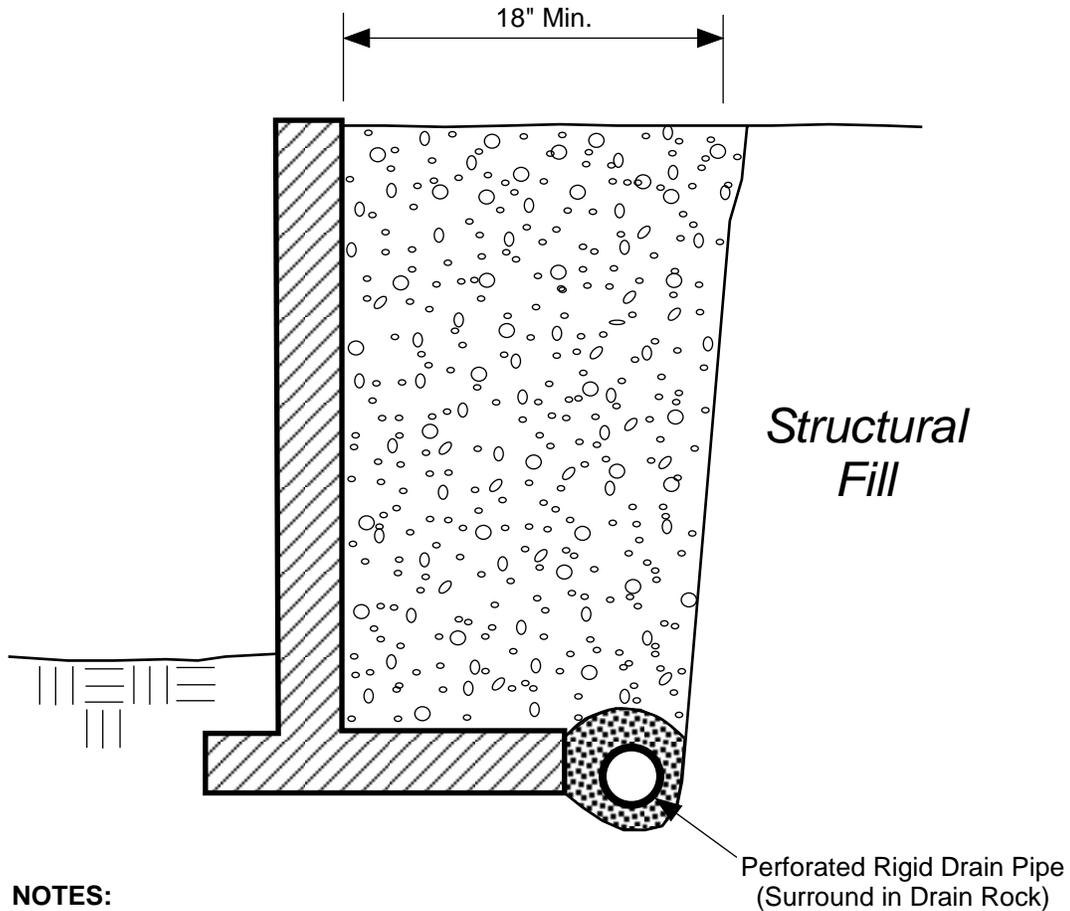
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.



Geotechnical Engineering  
 Environmental Services  
 Earthwork Observation & Testing  
 CESCL & Stormwater Services

**Subsurface Exploration Plan  
 Trombley Short Plat  
 Monroe, Washington**

Drawn CAM	Date 06/18/2025	Proj. No. 10296
Checked AZS	Date June 2025	Plate 2

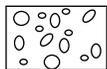


**NOTES:**

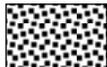
- Free-draining Backfill should consist of soil having less than 5 percent fines. Percent passing No. 4 sieve should be 25 to 75 percent.
- Sheet Drain may be feasible in lieu of Free-draining Backfill, per ESNW recommendations.
- Drain Pipe should consist of perforated, rigid PVC Pipe surrounded with 1-inch Drain Rock.

SCHMATIC ONLY - NOT TO SCALE  
NOT A CONSTRUCTION DRAWING

**LEGEND:**

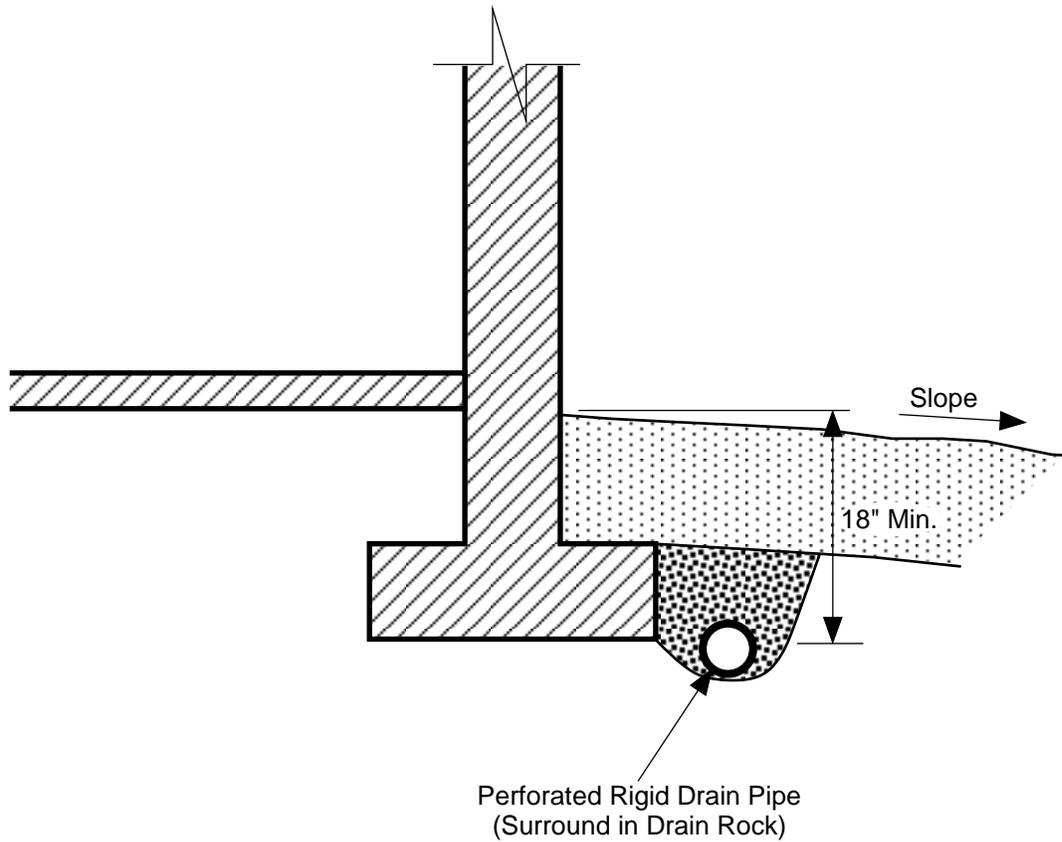


Free-draining Structural Backfill



1-inch Drain Rock

		Geotechnical Engineering Environmental Services Earthwork Observation & Testing CESCL & Stormwater Services	
<b>Retaining Wall Drainage Detail</b> <b>Trombley Short Plat</b> <b>Monroe, Washington</b>			
Drawn	CAM	Date	06/18/2025
Proj. No.	10296		
Checked	AZS	Date	June 2025
Plate	3		

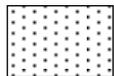


**NOTES:**

- Do NOT tie roof downspouts to Footing Drain.
- Surface Seal to consist of 12" of less permeable, suitable soil. Slope away from building.

SCHMATIC ONLY - NOT TO SCALE  
NOT A CONSTRUCTION DRAWING

**LEGEND:**



Surface Seal: native soil or other low-permeability material.



1-inch Drain Rock



Geotechnical Engineering  
Environmental Services  
Earthwork Observation & Testing  
CESCL & Stormwater Services

**Footing Drain Detail  
Trombley Short Plat  
Monroe, Washington**

Drawn CAM	Date 06/18/2025	Proj. No. 10296
Checked AZS	Date June 2025	Plate 4

## **Appendix A**

### **Subsurface Exploration Logs**

#### **ES-10296**

Subsurface conditions at the subject site were explored in May of 2025. A total of eight test pits were excavated using an excavator and operator contracted by the ESNW. The approximate locations of the explorations are illustrated on Plate 2 of this study. The test logs are provided in this Appendix. The maximum exploration depth was nine feet bgs.

The final logs represent the interpretations of the field logs and the results of laboratory analyses. The stratification lines on the logs represent the approximate boundaries between soil types. In actuality, the transitions may be more gradual.

Coarse-Grained Soils - More Than 50% Retained on No. 200 Sieve		Moisture Content		Symbols																							
Gravels - More Than 50% of Coarse Fraction Retained on No. 4 Sieve		<b>GW</b>	Well-graded gravel with or without sand, little to no fines	Dry - Absence of moisture, dusty, dry to the touch																							
		<b>GP</b>	Poorly graded gravel with or without sand, little to no fines	Damp - Perceptible moisture, likely below optimum MC																							
		<b>GM</b>	Silty gravel with or without sand	Moist - Damp but no visible water, likely at/near optimum MC																							
		<b>GC</b>	Clayey gravel with or without sand	Wet - Water visible but not free draining, likely above optimum MC																							
Sands - 50% or More of Coarse Fraction Passes No. 4 Sieve		<b>SW</b>	Well-graded sand with or without gravel, little to no fines	Saturated/Water Bearing - Visible free water, typically below groundwater table																							
		<b>SP</b>	Poorly graded sand with or without gravel, little to no fines																								
		<b>SM</b>	Silty sand with or without gravel																								
		<b>SC</b>	Clayey sand with or without gravel																								
Fine-Grained Soils - 50% or More Passes No. 200 Sieve		Terms Describing Relative Density and Consistency																									
Silt and Clays Liquid Limit Less Than 50		<b>ML</b>	Silt with or without sand or gravel; sandy or gravelly silt	<b>Coarse-Grained Soils:</b> <u>Density</u> <u>SPT blows/foot</u> Very Loose                      < 4 Loose                              4 to 9 Medium Dense                    10 to 29 Dense                                30 to 49 Very Dense                        ≥ 50																							
		<b>CL</b>	Clay of low to medium plasticity; lean clay with or without sand or gravel; sandy or gravelly lean clay	<b>Fine-Grained Soils:</b> <u>Consistency</u> <u>SPT blows/foot</u> Very Soft                         < 2 Soft                                  2 to 3 Medium Stiff                    4 to 7 Stiff                                 8 to 14 Very Stiff                        15 to 29 Hard                                ≥ 30																							
		<b>OL</b>	Organic clay or silt of low plasticity	<b>Test Symbols &amp; Units</b> Fines = Fines Content (%) MC = Moisture Content (%) DD = Dry Density (pcf) Str = Shear Strength (tsf) PID = Photoionization Detector (ppm) OC = Organic Content (%) CEC = Cation Exchange Capacity (meq/100 g) LL = Liquid Limit (%) PL = Plastic Limit (%) PI = Plasticity Index (%)																							
		<b>MH</b>	Elastic silt with or without sand or gravel; sandy or gravelly elastic silt																								
Silt and Clays Liquid Limit 50 or More		<b>CH</b>	Clay of high plasticity; fat clay with or without sand or gravel; sandy or gravelly fat clay	<b>Component Definitions</b> <table border="1"> <thead> <tr> <th>Descriptive Term</th> <th>Size Range and Sieve Number</th> </tr> </thead> <tbody> <tr> <td>Boulders</td> <td>Larger than 12"</td> </tr> <tr> <td>Cobbles</td> <td>3" to 12"</td> </tr> <tr> <td>Gravel</td> <td>3" to No. 4 (4.75 mm)</td> </tr> <tr> <td>  Coarse Gravel</td> <td>3" to 3/4"</td> </tr> <tr> <td>  Fine Gravel</td> <td>3/4" to No. 4 (4.75 mm)</td> </tr> <tr> <td>Sand</td> <td>No. 4 (4.75 mm) to No. 200 (0.075 mm)</td> </tr> <tr> <td>  Coarse Sand</td> <td>No. 4 (4.75 mm) to No. 10 (2.00 mm)</td> </tr> <tr> <td>  Medium Sand</td> <td>No. 10 (2.00 mm) to No. 40 (0.425 mm)</td> </tr> <tr> <td>  Fine Sand</td> <td>No. 40 (0.425 mm) to No. 200 (0.075 mm)</td> </tr> <tr> <td>Silt and Clay</td> <td>Smaller than No. 200 (0.075 mm)</td> </tr> </tbody> </table>		Descriptive Term	Size Range and Sieve Number	Boulders	Larger than 12"	Cobbles	3" to 12"	Gravel	3" to No. 4 (4.75 mm)	Coarse Gravel	3" to 3/4"	Fine Gravel	3/4" to No. 4 (4.75 mm)	Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)	Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)	Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)	Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)	Silt and Clay	Smaller than No. 200 (0.075 mm)
		Descriptive Term	Size Range and Sieve Number																								
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Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)																										
Silt and Clay	Smaller than No. 200 (0.075 mm)																										
<b>OH</b>	Organic clay or silt of medium to high plasticity																										
Highly Organic Soils		<b>PT</b>	Peat, muck, and other highly organic soils	<b>Modifier Definitions</b> <table border="1"> <thead> <tr> <th>Percentage by Weight (Approx.)</th> <th>Modifier</th> </tr> </thead> <tbody> <tr> <td>&lt; 5</td> <td>Trace (sand, silt, clay, gravel)</td> </tr> <tr> <td>5 to 14</td> <td>Slightly (sandy, silty, clayey, gravelly)</td> </tr> <tr> <td>15 to 29</td> <td>Sandy, silty, clayey, gravelly</td> </tr> <tr> <td>≥ 30</td> <td>Very (sandy, silty, clayey, gravelly)</td> </tr> </tbody> </table>		Percentage by Weight (Approx.)	Modifier	< 5	Trace (sand, silt, clay, gravel)	5 to 14	Slightly (sandy, silty, clayey, gravelly)	15 to 29	Sandy, silty, clayey, gravelly	≥ 30	Very (sandy, silty, clayey, gravelly)												
Percentage by Weight (Approx.)	Modifier																										
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15 to 29	Sandy, silty, clayey, gravelly																										
≥ 30	Very (sandy, silty, clayey, gravelly)																										
Fill		<b>FILL</b>	Made Ground	Classifications of soils in this geotechnical report and as shown on the exploration logs are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates, and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D2487 and D2488 were used as an identification guide for the Unified Soil Classification System.																							

PROJECT NUMBER ES-10296 PROJECT NAME Trombley Short Plat  
 DATE STARTED 5/21/25 COMPLETED 5/21/25 GROUND ELEVATION 388 ft  
 EXCAVATION CONTRACTOR NW Excavating LATITUDE 47.87612 LONGITUDE -121.97704  
 LOGGED BY AZS CHECKED BY SHA GROUND WATER LEVEL:  
 NOTES \_\_\_\_\_ ∇ AT TIME OF EXCAVATION \_\_\_\_\_  
 SURFACE CONDITIONS Field grass AFTER EXCAVATION \_\_\_\_\_

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0						
			TPSL		Dark brown TOPSOIL, roots	
				0.9		387.1
			SM		Brown silty SAND, loose, moist to wet -probed 10"	
2.5				2.5		385.5
	GB	MC = 9.9			Gray silty SAND with gravel, dense, moist (Unweathered glacial till) -probed 0.5" -infiltration test at 4'	
5.0	GB	MC = 9.4 Fines = 23.2	SM		-moderately cemented [USDA Classification: gravelly sandy LOAM]	
7.5						
	GB	MC = 11.3		9.0		379.0

Test pit terminated at 9.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

PROJECT NUMBER ES-10296 PROJECT NAME Trombley Short Plat  
 DATE STARTED 5/21/25 COMPLETED 5/21/25 GROUND ELEVATION 380 ft  
 EXCAVATION CONTRACTOR NW Excavating LATITUDE 47.87591 LONGITUDE -121.97730  
 LOGGED BY AZS CHECKED BY SHA GROUND WATER LEVEL:  
 NOTES \_\_\_\_\_  $\nabla$  AT TIME OF EXCAVATION \_\_\_\_\_  
 SURFACE CONDITIONS Field grass AFTER EXCAVATION \_\_\_\_\_

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0						
			TPSL		Dark brown TOPSOIL -roots	379.2
				0.8		
			SM		Brown silty SAND, loose, moist to wet  -probed 8-10"	
	GB	MC = 45.8				
2.5				2.5		377.5
					Gray silty SAND with gravel, dense, moist (Unweathered glacial till)	
					-probed 0-0.5"	
					-moderate groundwater seepage	
			SM		-moderately cemented	
	GB	MC = 13.0				
5.0						
7.5						
	GB	MC = 8.7 Fines = 21.4		8.5	[USDA Classification: very gravelly sandy LOAM]	371.5

Test pit terminated at 8.5 feet below existing grade. Groundwater seepage encountered at 4.0 feet during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 10296.GPJ - GINT US.GDT - 6/30/25

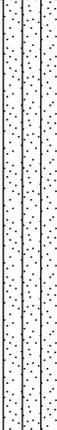
PROJECT NUMBER ES-10296 PROJECT NAME Trombley Short Plat  
 DATE STARTED 5/21/25 COMPLETED 5/21/25 GROUND ELEVATION 388 ft  
 EXCAVATION CONTRACTOR NW Excavating LATITUDE 47.87602 LONGITUDE -121.97626  
 LOGGED BY AZS CHECKED BY SHA GROUND WATER LEVEL:  
 NOTES \_\_\_\_\_ ∇ AT TIME OF EXCAVATION \_\_\_\_\_  
 SURFACE CONDITIONS Field grass AFTER EXCAVATION \_\_\_\_\_

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0						
			TPSL		Dark brown TOPSOIL, roots -probed 6"	386.7
				1.3		
			SM		Brown silty SAND, loose to medium dense, moist to wet	
2.5	GB	MC = 38.3				
				3.0		385.0
			SM		Gray silty SAND with gravel, dense, moist (Unweathered glacial till) -probed 0.5" -light groundwater seepage -moderately cemented	
5.0	GB	MC = 9.5				
7.5						
	GB	MC = 7.1				
				8.5		379.5

Test pit terminated at 8.5 feet below existing grade. Groundwater seepage encountered at 4.0 and 6.0 feet during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

PROJECT NUMBER ES-10296 PROJECT NAME Trombley Short Plat  
 DATE STARTED 5/21/25 COMPLETED 5/21/25 GROUND ELEVATION 403 ft  
 EXCAVATION CONTRACTOR NW Excavating LATITUDE 47.87659 LONGITUDE -121.97592  
 LOGGED BY AZS CHECKED BY SHA GROUND WATER LEVEL:  
 NOTES \_\_\_\_\_ ∇ AT TIME OF EXCAVATION \_\_\_\_\_  
 SURFACE CONDITIONS Field grass AFTER EXCAVATION \_\_\_\_\_

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0						
			TPSL		Dark brown TOPSOIL, roots	402.4
	GB	MC = 31.5	SM		Brown silty SAND, loose, moist to wet	
2.5					-probed 4-6"	401.0
	GB	MC = 12.8			Gray silty SAND with gravel, dense, moist (Unweathered glacial till)	
					-light groundwater seepage at 2'	
5.0			SM		-probed 0-0.5"	
					-moderately cemented	
					-light groundwater seepage	
	GB	MC = 9.0				396.0

Test pit terminated at 7.0 feet below existing grade. Groundwater seepage encountered at 2.0 and 6.0 feet during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

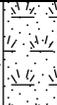
PROJECT NUMBER ES-10296 PROJECT NAME Trombley Short Plat  
 DATE STARTED 5/21/25 COMPLETED 5/21/25 GROUND ELEVATION 399 ft  
 EXCAVATION CONTRACTOR NW Excavating LATITUDE 47.87672 LONGITUDE -121.97679  
 LOGGED BY AZS CHECKED BY SHA GROUND WATER LEVEL:  
 NOTES \_\_\_\_\_  $\nabla$  AT TIME OF EXCAVATION \_\_\_\_\_  
 SURFACE CONDITIONS Field grass AFTER EXCAVATION \_\_\_\_\_

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0						
			TPSL		Dark brown TOPSOIL, roots -probed 2"	
				1.3		397.7
			SM		Brown silty SAND, medium dense, moist to wet [USDA Classification: gravelly silt LOAM]	
2.5	GB	MC = 49.2 Fines = 49.5		3.0		396.0
					Gray silty SAND with gravel, dense, moist (Unweathered glacial till)	
			SM		-moderately cemented -probed 0.5"	
5.0	GB	MC = 7.7				
	GB	MC = 9.7		7.0		392.0

Test pit terminated at 7.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

PROJECT NUMBER ES-10296 PROJECT NAME Trombley Short Plat  
 DATE STARTED 5/21/25 COMPLETED 5/21/25 GROUND ELEVATION 397 ft  
 EXCAVATION CONTRACTOR NW Excavating LATITUDE 47.87654 LONGITUDE -121.97648  
 LOGGED BY AZS CHECKED BY SHA GROUND WATER LEVEL:  
 NOTES \_\_\_\_\_  $\nabla$  AT TIME OF EXCAVATION \_\_\_\_\_  
 SURFACE CONDITIONS Field grass AFTER EXCAVATION \_\_\_\_\_

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0						
			TPSL		Dark brown TOPSOIL, roots -probed 6-8"	395.7
				1.3		
			SM		Brown silty SAND, loose to medium dense, moist to wet	
2.5	GB	MC = 38.9		2.5		394.5
					Gray silty SAND with gravel, dense, moist (Unweathered glacial till)  -moderately cemented, probed 0.5"  -light groundwater seepage	
			SM			
5.0	GB	MC = 11.0				
	GB	MC = 7.9		7.0		390.0

Test pit terminated at 7.0 feet below existing grade. Groundwater seepage encountered at 4.0 feet during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

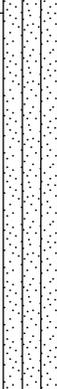
PROJECT NUMBER ES-10296 PROJECT NAME Trombley Short Plat  
 DATE STARTED 5/21/25 COMPLETED 5/21/25 GROUND ELEVATION 409 ft  
 EXCAVATION CONTRACTOR NW Excavating LATITUDE 47.87742 LONGITUDE -121.97638  
 LOGGED BY AZS CHECKED BY SHA GROUND WATER LEVEL:  
 NOTES \_\_\_\_\_  AT TIME OF EXCAVATION \_\_\_\_\_  
 SURFACE CONDITIONS Blackberries AFTER EXCAVATION \_\_\_\_\_

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0						
			TPSL		Dark brown TOPSOIL -probed 2-3"	408.5
					Brown silty SAND, medium dense, moist to wet	
	GB	MC = 36.6				
2.5			SM			406.5
					Gray poorly graded SAND with silt and gravel, medium dense to dense, moist	
			SP-SM		-probed 1-2"	405.0
	GB	MC = 8.9 Fines = 5.5			Gray silty SAND with gravel, dense to very dense, moist (Unweathered glacial till) [USDA Classification: gravelly coarse SAND]	
5.0			SM		-moderately cemented	403.5
	GB	MC = 7.4				

Test pit terminated at 5.5 feet below existing grade. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

PROJECT NUMBER ES-10296 PROJECT NAME Trombley Short Plat  
 DATE STARTED 5/21/25 COMPLETED 5/21/25 GROUND ELEVATION 418 ft  
 EXCAVATION CONTRACTOR NW Excavating LATITUDE 47.87700 LONGITUDE -121.97504  
 LOGGED BY AZS CHECKED BY SHA GROUND WATER LEVEL:  
 NOTES \_\_\_\_\_  $\nabla$  AT TIME OF EXCAVATION \_\_\_\_\_  
 SURFACE CONDITIONS Field grass AFTER EXCAVATION \_\_\_\_\_

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0						
			TPSL		Dark brown TOPSOIL, roots -probed 6-8"	417.0
					Brown silty SAND, loose, moist to wet	
	GB	MC = 38.1	SM			
2.5					Gray silty SAND with gravel, dense, moist (Unweathered glacial till)	415.5
	GB	MC = 11.3 Fines = 25.9			-probed 0.5" [USDA Classification: gravelly sandy LOAM] -moderately cemented	
5.0			SM			
	GB	MC = 8.8				411.0

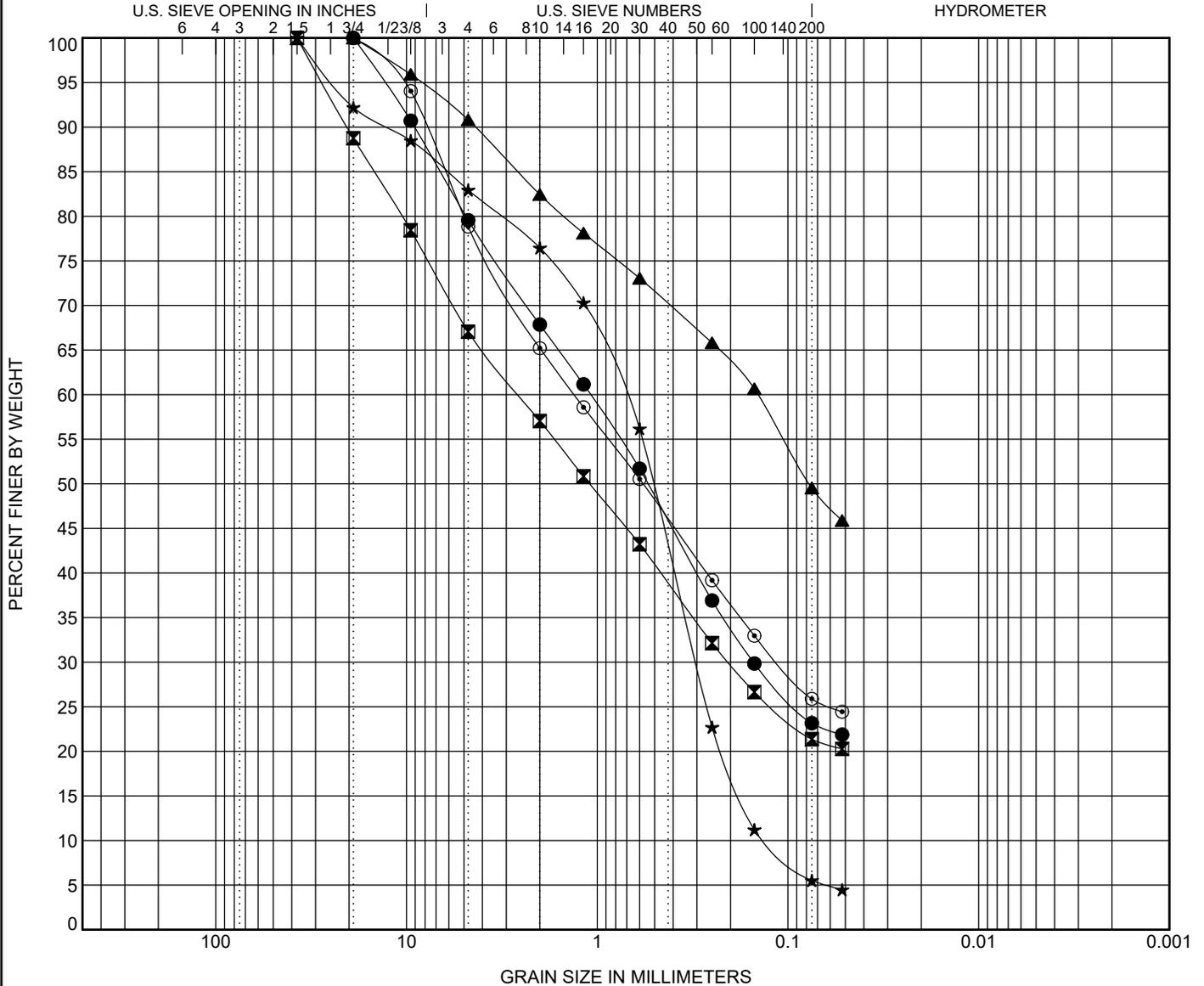
Test pit terminated at 7.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

**Appendix B**  
**Laboratory Test Results**  
**ES-10296**

PROJECT NUMBER ES-10296

PROJECT NAME Trombley Short Plat



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification						Cc	Cu	
●	TP-01	5.00ft.	<b>USDA: Gray Gravelly Sandy Loam. USCS: SM with Gravel.</b>								
■	TP-02	8.50ft.	<b>USDA: Gray Very Gravelly Sandy Loam. USCS: SM with Gravel.</b>								
▲	TP-05	2.00ft.	<b>USDA: Brown Gravelly Silt Loam. USCS: SM.</b>								
★	TP-07	4.00ft.	<b>USDA: Gray Gravelly Coarse Sand. USCS: SP-SM with Gravel.</b>						0.98	5.57	
○	TP-08	3.50ft.	<b>USDA: Gray Gravelly Sandy Loam. USCS: SM with Gravel.</b>								
Specimen Identification			D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
●	TP-01	5.0ft.	19	1.086	0.152					23.2	
■	TP-02	8.5ft.	37.5	2.581	0.205					21.4	
▲	TP-05	2.0ft.	19	0.144						49.5	
★	TP-07	4.0ft.	37.5	0.72	0.303	0.129				5.5	
○	TP-08	3.5ft.	19	1.321	0.112					25.9	

GRAIN SIZE USDA ES-10296 TROMBLEY SHORT PLAT.GPJ GINT US LAB.GDT 6/4/25



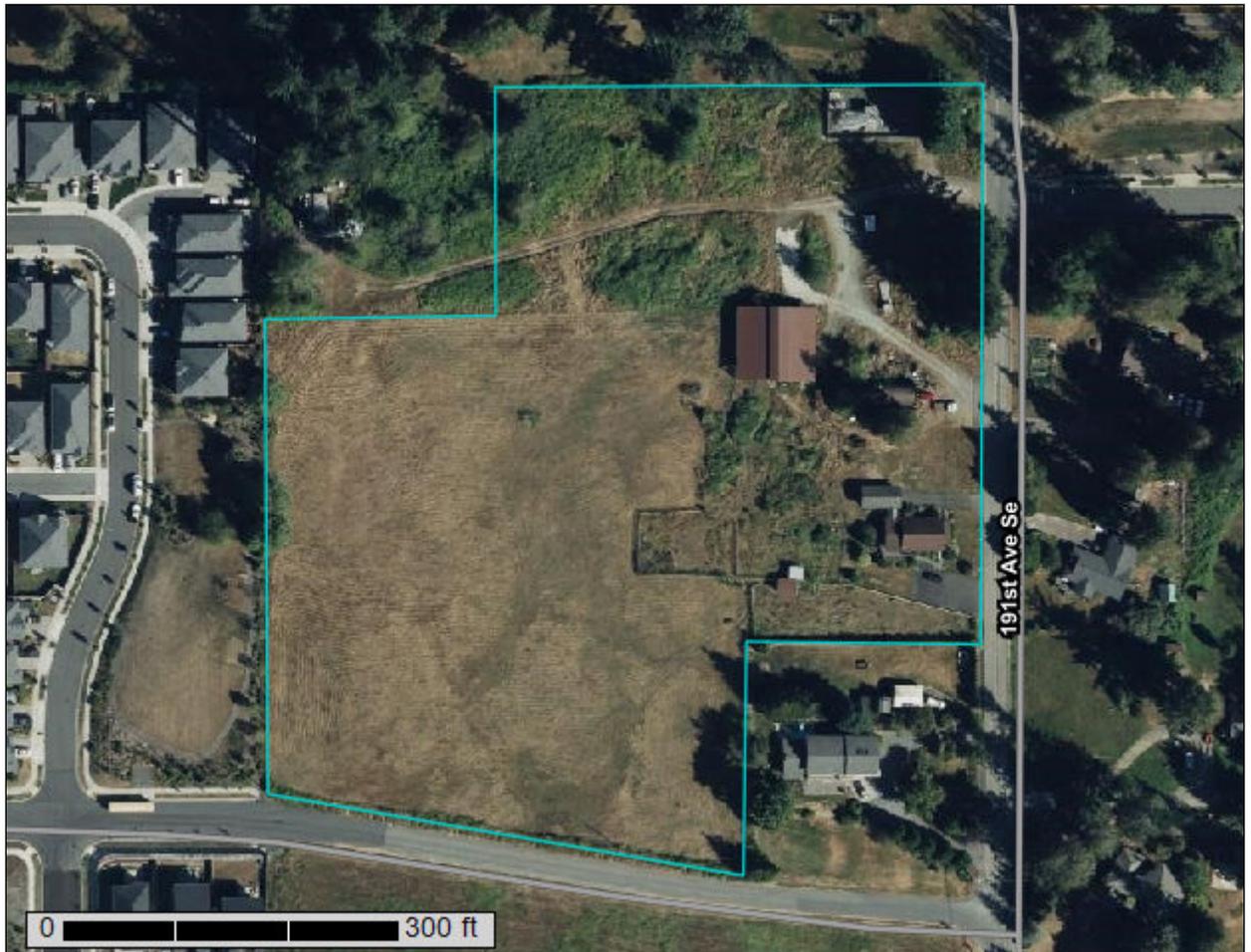
United States  
Department of  
Agriculture

**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 Snohomish County Area, Washington



# Preface

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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](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.

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# How Soil Surveys Are Made

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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

## Custom Soil Resource Report

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

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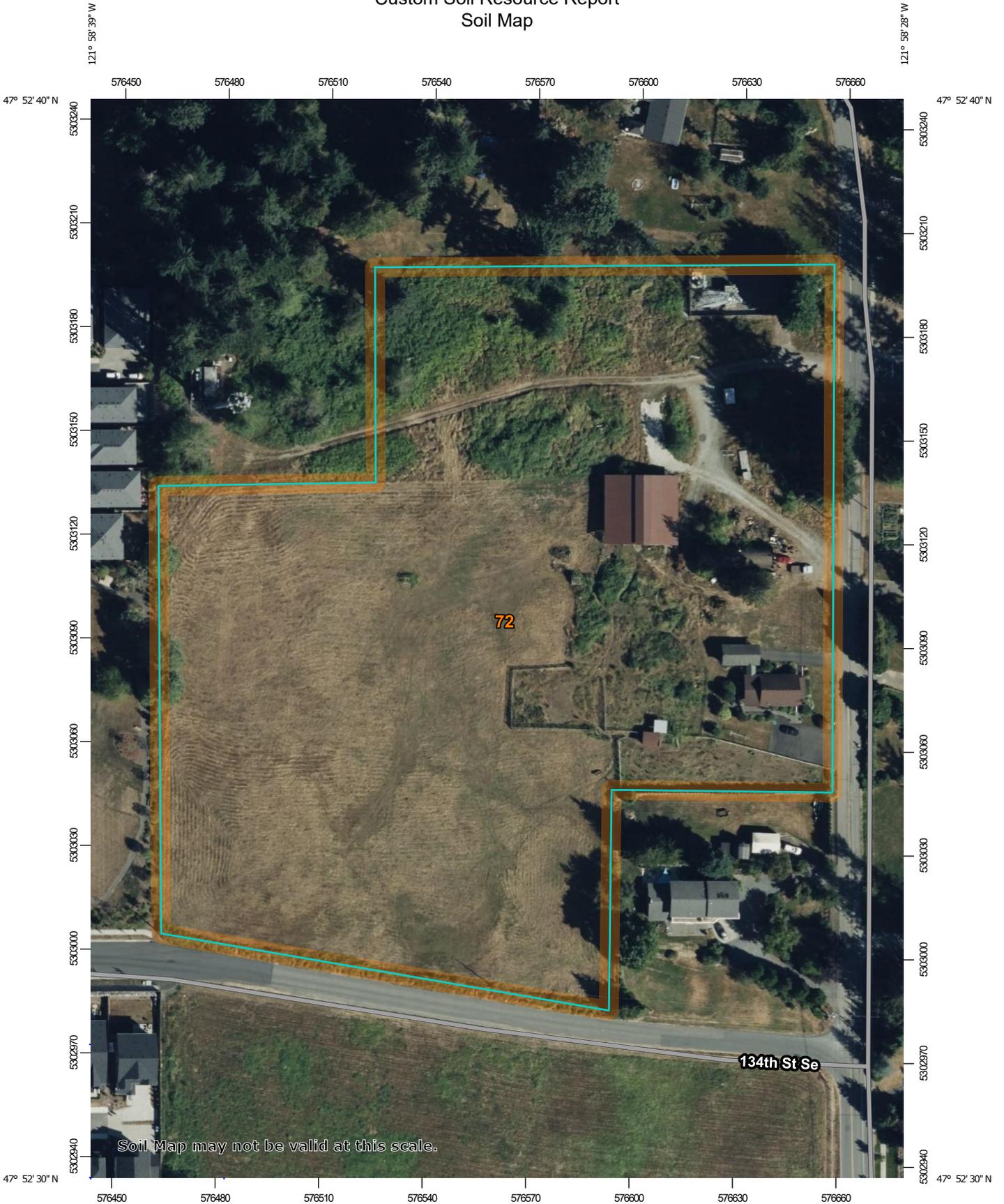
identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

# 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.

# Custom Soil Resource Report Soil Map



Soil Map may not be valid at this scale.

Map Scale: 1:1,520 if printed on A portrait (8.5" x 11") sheet.



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: Snohomish County Area, Washington  
 Survey Area Data: Version 26, Aug 27, 2024

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 6, 2022—Sep 8, 2022

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
72	Tokul gravelly medial loam, 0 to 8 percent slopes	8.1	100.0%
<b>Totals for Area of Interest</b>		<b>8.1</b>	<b>100.0%</b>

## Map Unit Descriptions

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.

## Custom Soil Resource Report

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.

## Snohomish County Area, Washington

### 72—Tokul gravelly medial loam, 0 to 8 percent slopes

#### Map Unit Setting

*National map unit symbol:* 2t61k  
*Elevation:* 160 to 1,150 feet  
*Mean annual precipitation:* 45 to 70 inches  
*Mean annual air temperature:* 46 to 52 degrees F  
*Frost-free period:* 140 to 200 days  
*Farmland classification:* All areas are prime farmland

#### Map Unit Composition

*Tokul and similar soils:* 85 percent  
*Minor components:* 15 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Tokul

##### Setting

*Landform:* Hillslopes, till plains  
*Landform position (two-dimensional):* Toeslope  
*Landform position (three-dimensional):* Side slope, tread  
*Down-slope shape:* Convex  
*Across-slope shape:* Convex  
*Parent material:* Volcanic ash mixed with loess over glacial till

##### Typical profile

*Oi - 0 to 1 inches:* slightly decomposed plant material  
*Oa - 1 to 2 inches:* highly decomposed plant material  
*A - 2 to 6 inches:* gravelly medial loam  
*Bs1 - 6 to 9 inches:* gravelly medial loam  
*Bs2 - 9 to 17 inches:* gravelly medial loam  
*Bs3 - 17 to 24 inches:* gravelly medial loam  
*BC - 24 to 33 inches:* gravelly medial fine sandy loam  
*2Bsm - 33 to 62 inches:* cemented material

##### Properties and qualities

*Slope:* 0 to 8 percent  
*Depth to restrictive feature:* 20 to 39 inches to densic material; 20 to 39 inches to cemented horizon  
*Drainage class:* Moderately well 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 18 to 36 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water supply, 0 to 60 inches:* Moderate (about 8.7 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 3s  
*Hydrologic Soil Group:* B  
*Ecological site:* F002XA005WA - Puget Lowlands Moist Forest

## Custom Soil Resource Report

*Forage suitability group:* Limited Depth Soils (G002XF303WA), Limited Depth Soils (G002XN302WA)

*Other vegetative classification:* Limited Depth Soils (G002XF303WA), Limited Depth Soils (G002XN302WA)

*Hydric soil rating:* No

### Minor Components

#### **Barneston**

*Percent of map unit:* 5 percent

*Landform:* Moraines, eskers, kames

*Landform position (two-dimensional):* Summit, shoulder

*Landform position (three-dimensional):* Interflue, crest

*Down-slope shape:* Convex

*Across-slope shape:* Convex

*Hydric soil rating:* No

#### **Pastik**

*Percent of map unit:* 5 percent

*Landform:* Terraces

*Landform position (three-dimensional):* Tread

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Hydric soil rating:* No

#### **Norma**

*Percent of map unit:* 3 percent

*Landform:* Drainageways, depressions

*Landform position (three-dimensional):* Dip

*Down-slope shape:* Linear, concave

*Across-slope shape:* Concave

*Hydric soil rating:* Yes

#### **Mckenna**

*Percent of map unit:* 2 percent

*Landform:* Drainageways, depressions

*Landform position (three-dimensional):* Dip

*Down-slope shape:* Linear, concave

*Across-slope shape:* Concave

*Hydric soil rating:* Yes

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# Appendix B

WWHM Report

**WWHM2012**  
**PROJECT REPORT**

## General Model Information

WWHM2012 Project Name: 8-21-2025 24299 Prelim Sizing

Site Name:

Site Address:

City:

Report Date: 8/27/2025

Gage: Everett

Data Start: 1948/10/01

Data End: 2009/09/30

Timestep: 15 Minute

Precip Scale: 1.200

Version Date: 2024/09/14

Version: 4.3.1

## POC Thresholds

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Low Flow Threshold for POC1: 50 Percent of the 2 Year

High Flow Threshold for POC1: 50 Year

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## Landuse Basin Data

### Predeveloped Land Use

#### Predeveloped

Bypass:	No
GroundWater:	No
Pervious Land Use C, Forest, Mod	acre 8.314
Pervious Total	8.314
Impervious Land Use	acre
Impervious Total	0
Basin Total	8.314

#### Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

*Mitigated Land Use*

Developed Basin

Bypass:	No
GroundWater:	No
Pervious Land Use C, Lawn, Mod	acre 3.32
Pervious Total	3.32
Impervious Land Use ROADS FLAT	acre 4.994
Impervious Total	4.994
Basin Total	8.314

Element Flow Components:

Surface	Interflow	Groundwater
Component Flows To:		
Vault 1	Vault 1	

*Routing Elements*  
*Predeveloped Routing*

## Mitigated Routing

### Vault 1

Width: 100 ft.  
 Length: 120 ft.  
 Depth: 11.15 ft.  
 Discharge Structure  
 Riser Height: 10.15 ft.  
 Riser Diameter: 18 in.  
 Orifice 1 Diameter: 1.650 in. Elevation:0 ft.  
 Orifice 2 Diameter: 1.800 in. Elevation:4.85 ft.  
 Orifice 3 Diameter: 2.500 in. Elevation:6.6 ft.  
 Element Outlets:  
 Outlet 1                      Outlet 2  
 Outlet Flows To:

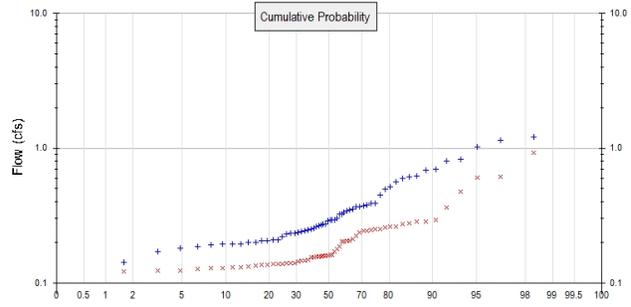
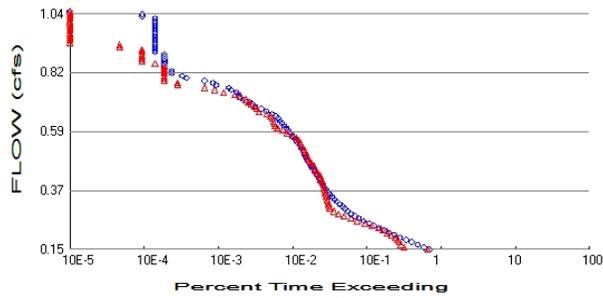
Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.275	0.000	0.000	0.000
0.1239	0.275	0.034	0.026	0.000
0.2478	0.275	0.068	0.036	0.000
0.3717	0.275	0.102	0.045	0.000
0.4956	0.275	0.136	0.052	0.000
0.6194	0.275	0.170	0.058	0.000
0.7433	0.275	0.204	0.063	0.000
0.8672	0.275	0.238	0.068	0.000
0.9911	0.275	0.273	0.073	0.000
1.1150	0.275	0.307	0.078	0.000
1.2389	0.275	0.341	0.082	0.000
1.3628	0.275	0.375	0.086	0.000
1.4867	0.275	0.409	0.090	0.000
1.6106	0.275	0.443	0.093	0.000
1.7344	0.275	0.477	0.097	0.000
1.8583	0.275	0.511	0.100	0.000
1.9822	0.275	0.546	0.104	0.000
2.1061	0.275	0.580	0.107	0.000
2.2300	0.275	0.614	0.110	0.000
2.3539	0.275	0.648	0.113	0.000
2.4778	0.275	0.682	0.116	0.000
2.6017	0.275	0.716	0.119	0.000
2.7256	0.275	0.750	0.122	0.000
2.8494	0.275	0.785	0.124	0.000
2.9733	0.275	0.819	0.127	0.000
3.0972	0.275	0.853	0.130	0.000
3.2211	0.275	0.887	0.132	0.000
3.3450	0.275	0.921	0.135	0.000
3.4689	0.275	0.955	0.137	0.000
3.5928	0.275	0.989	0.140	0.000
3.7167	0.275	1.023	0.142	0.000
3.8406	0.275	1.058	0.144	0.000
3.9644	0.275	1.092	0.147	0.000
4.0883	0.275	1.126	0.149	0.000
4.2122	0.275	1.160	0.151	0.000
4.3361	0.275	1.194	0.153	0.000
4.4600	0.275	1.228	0.156	0.000

4.5839	0.275	1.262	0.158	0.000
4.7078	0.275	1.296	0.160	0.000
4.8317	0.275	1.331	0.162	0.000
4.9556	0.275	1.365	0.193	0.000
5.0794	0.275	1.399	0.208	0.000
5.2033	0.275	1.433	0.220	0.000
5.3272	0.275	1.467	0.231	0.000
5.4511	0.275	1.501	0.240	0.000
5.5750	0.275	1.535	0.249	0.000
5.6989	0.275	1.569	0.257	0.000
5.8228	0.275	1.604	0.265	0.000
5.9467	0.275	1.638	0.272	0.000
6.0706	0.275	1.672	0.279	0.000
6.1944	0.275	1.706	0.285	0.000
6.3183	0.275	1.740	0.292	0.000
6.4422	0.275	1.774	0.298	0.000
6.5661	0.275	1.808	0.304	0.000
6.6900	0.275	1.843	0.361	0.000
6.8139	0.275	1.877	0.394	0.000
6.9378	0.275	1.911	0.420	0.000
7.0617	0.275	1.945	0.442	0.000
7.1856	0.275	1.979	0.462	0.000
7.3094	0.275	2.013	0.480	0.000
7.4333	0.275	2.047	0.497	0.000
7.5572	0.275	2.081	0.513	0.000
7.6811	0.275	2.116	0.529	0.000
7.8050	0.275	2.150	0.543	0.000
7.9289	0.275	2.184	0.557	0.000
8.0528	0.275	2.218	0.571	0.000
8.1767	0.275	2.252	0.584	0.000
8.3006	0.275	2.286	0.597	0.000
8.4244	0.275	2.320	0.609	0.000
8.5483	0.275	2.354	0.621	0.000
8.6722	0.275	2.389	0.633	0.000
8.7961	0.275	2.423	0.645	0.000
8.9200	0.275	2.457	0.656	0.000
9.0439	0.275	2.491	0.667	0.000
9.1678	0.275	2.525	0.678	0.000
9.2917	0.275	2.559	0.688	0.000
9.4156	0.275	2.593	0.699	0.000
9.5394	0.275	2.627	0.709	0.000
9.6633	0.275	2.662	0.719	0.000
9.7872	0.275	2.696	0.729	0.000
9.9111	0.275	2.730	0.739	0.000
10.035	0.275	2.764	0.748	0.000
10.159	0.275	2.798	0.771	0.000
10.283	0.275	2.832	1.534	0.000
10.407	0.275	2.866	2.788	0.000
10.531	0.275	2.901	4.202	0.000
10.654	0.275	2.935	5.473	0.000
10.778	0.275	2.969	6.368	0.000
10.902	0.275	3.003	6.958	0.000
11.026	0.275	3.037	7.453	0.000
11.150	0.275	3.071	7.915	0.000
11.274	0.275	3.105	8.350	0.000
11.398	0.000	0.000	8.762	0.000

# Analysis Results

## POC 1



+ Predeveloped x Mitigated

### Predeveloped Landuse Totals for POC #1

Total Pervious Area: 8.314  
 Total Impervious Area: 0

### Mitigated Landuse Totals for POC #1

Total Pervious Area: 3.32  
 Total Impervious Area: 4.994

Flow Frequency Method: Log Pearson Type III 17B

### Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.307336
5 year	0.491477
10 year	0.638003
25 year	0.852845
50 year	1.035594
100 year	1.238777

### Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.181743
5 year	0.269153
10 year	0.340579
25 year	0.448251
50 year	0.542478
100 year	0.649939

## Annual Peaks

### Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.342	0.144
1950	0.347	0.161
1951	0.294	0.137
1952	0.239	0.130
1953	0.194	0.130
1954	1.216	0.157
1955	0.368	0.250
1956	0.322	0.274
1957	0.446	0.237
1958	0.388	0.146

1959	0.303	0.160
1960	0.294	0.205
1961	0.610	0.245
1962	0.295	0.139
1963	0.498	0.140
1964	0.392	0.122
1965	0.242	0.185
1966	0.142	0.136
1967	0.288	0.139
1968	0.352	0.224
1969	1.138	0.146
1970	0.201	0.139
1971	0.378	0.284
1972	0.234	0.156
1973	0.230	0.156
1974	0.622	0.155
1975	0.238	0.130
1976	0.250	0.156
1977	0.180	0.141
1978	0.210	0.129
1979	0.696	0.148
1980	0.326	0.126
1981	0.205	0.134
1982	0.266	0.262
1983	0.565	0.137
1984	0.274	0.362
1985	0.366	0.246
1986	0.822	0.609
1987	0.372	0.474
1988	0.193	0.257
1989	0.247	0.124
1990	0.260	0.243
1991	0.268	0.180
1992	0.204	0.205
1993	0.196	0.124
1994	0.186	0.171
1995	0.273	0.277
1996	0.514	0.261
1997	1.020	0.919
1998	0.170	0.133
1999	0.222	0.203
2000	0.193	0.292
2001	0.067	0.108
2002	0.253	0.203
2003	0.199	0.160
2004	0.334	0.285
2005	0.233	0.159
2006	0.802	0.249
2007	0.593	0.211
2008	0.688	0.605
2009	0.210	0.161

### Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	1.2158	0.9194
2	1.1377	0.6093
3	1.0197	0.6049

4	0.8223	0.4740
5	0.8022	0.3619
6	0.6963	0.2921
7	0.6879	0.2849
8	0.6218	0.2841
9	0.6097	0.2767
10	0.5926	0.2739
11	0.5645	0.2619
12	0.5140	0.2608
13	0.4976	0.2569
14	0.4462	0.2505
15	0.3922	0.2493
16	0.3881	0.2459
17	0.3784	0.2454
18	0.3719	0.2427
19	0.3683	0.2373
20	0.3661	0.2242
21	0.3515	0.2112
22	0.3472	0.2053
23	0.3419	0.2046
24	0.3340	0.2033
25	0.3261	0.2030
26	0.3219	0.1855
27	0.3031	0.1796
28	0.2950	0.1712
29	0.2939	0.1611
30	0.2937	0.1607
31	0.2883	0.1600
32	0.2743	0.1597
33	0.2726	0.1594
34	0.2681	0.1568
35	0.2661	0.1565
36	0.2603	0.1563
37	0.2535	0.1556
38	0.2498	0.1548
39	0.2475	0.1480
40	0.2425	0.1464
41	0.2390	0.1455
42	0.2377	0.1438
43	0.2336	0.1412
44	0.2325	0.1396
45	0.2301	0.1393
46	0.2223	0.1391
47	0.2101	0.1386
48	0.2095	0.1374
49	0.2051	0.1368
50	0.2043	0.1363
51	0.2007	0.1335
52	0.1986	0.1334
53	0.1955	0.1302
54	0.1939	0.1299
55	0.1933	0.1297
56	0.1926	0.1291
57	0.1860	0.1265
58	0.1802	0.1243
59	0.1703	0.1237
60	0.1423	0.1218
61	0.0670	0.1080



## Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1537	14974	13999	93	Pass
0.1626	12506	6765	54	Pass
0.1715	10312	6203	60	Pass
0.1804	8605	5839	67	Pass
0.1893	7174	5553	77	Pass
0.1982	5970	5116	85	Pass
0.2071	5020	4552	90	Pass
0.2160	4259	4040	94	Pass
0.2249	3666	3529	96	Pass
0.2338	3108	3056	98	Pass
0.2428	2663	2496	93	Pass
0.2517	2280	2036	89	Pass
0.2606	1936	1592	82	Pass
0.2695	1656	1302	78	Pass
0.2784	1472	1046	71	Pass
0.2873	1309	879	67	Pass
0.2962	1180	764	64	Pass
0.3051	1077	677	62	Pass
0.3140	1001	663	66	Pass
0.3229	927	652	70	Pass
0.3318	846	635	75	Pass
0.3407	783	623	79	Pass
0.3497	722	608	84	Pass
0.3586	674	598	88	Pass
0.3675	635	586	92	Pass
0.3764	610	575	94	Pass
0.3853	583	565	96	Pass
0.3942	552	555	100	Pass
0.4031	518	540	104	Pass
0.4120	498	528	106	Pass
0.4209	481	515	107	Pass
0.4298	456	495	108	Pass
0.4387	437	465	106	Pass
0.4476	417	449	107	Pass
0.4566	397	432	108	Pass
0.4655	382	412	107	Pass
0.4744	363	384	105	Pass
0.4833	348	367	105	Pass
0.4922	336	355	105	Pass
0.5011	323	343	106	Pass
0.5100	312	331	106	Pass
0.5189	299	320	107	Pass
0.5278	288	307	106	Pass
0.5367	277	293	105	Pass
0.5456	265	278	104	Pass
0.5545	245	266	108	Pass
0.5635	236	253	107	Pass
0.5724	222	237	106	Pass
0.5813	210	214	101	Pass
0.5902	197	183	92	Pass
0.5991	187	158	84	Pass
0.6080	175	134	76	Pass
0.6169	164	125	76	Pass

0.6258	154	121	78	Pass
0.6347	146	117	80	Pass
0.6436	135	113	83	Pass
0.6525	126	108	85	Pass
0.6614	112	95	84	Pass
0.6704	94	75	79	Pass
0.6793	80	70	87	Pass
0.6882	67	65	97	Pass
0.6971	61	59	96	Pass
0.7060	56	54	96	Pass
0.7149	46	50	108	Pass
0.7238	41	42	102	Pass
0.7327	40	36	90	Pass
0.7416	37	25	67	Pass
0.7505	32	19	59	Pass
0.7594	30	14	46	Pass
0.7683	20	6	30	Pass
0.7773	18	6	33	Pass
0.7862	14	4	28	Pass
0.7951	8	4	50	Pass
0.8040	7	4	57	Pass
0.8129	5	4	80	Pass
0.8218	5	4	80	Pass
0.8307	4	4	100	Pass
0.8396	4	4	100	Pass
0.8485	4	3	75	Pass
0.8574	4	2	50	Pass
0.8663	4	2	50	Pass
0.8752	4	2	50	Pass
0.8842	4	2	50	Pass
0.8931	3	2	66	Pass
0.9020	3	2	66	Pass
0.9109	3	1	33	Pass
0.9198	3	1	33	Pass
0.9287	3	0	0	Pass
0.9376	3	0	0	Pass
0.9465	3	0	0	Pass
0.9554	3	0	0	Pass
0.9643	3	0	0	Pass
0.9732	3	0	0	Pass
0.9821	3	0	0	Pass
0.9911	3	0	0	Pass
1.0000	3	0	0	Pass
1.0089	3	0	0	Pass
1.0178	3	0	0	Pass
1.0267	2	0	0	Pass
1.0356	2	0	0	Pass

## Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume: 0.2659 acre-feet

On-line facility target flow: 0.1343 cfs.

Adjusted for 15 min: 0.1343 cfs.

Off-line facility target flow: 0.0882 cfs.

Adjusted for 15 min: 0.0882 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.

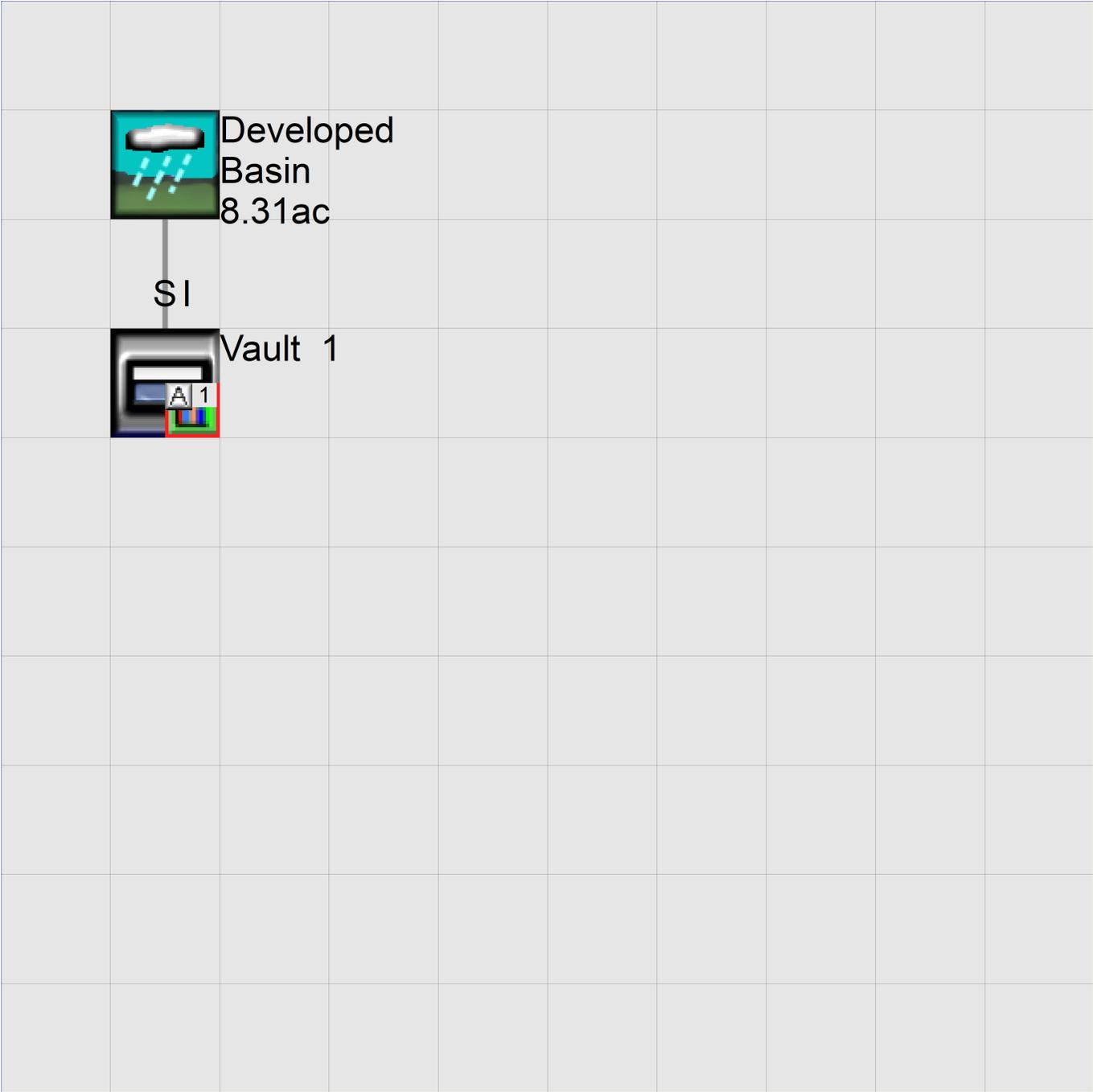
*Appendix*  
*Predeveloped Schematic*



Predeveloped

8.31ac

Mitigated Schematic



# Predeveloped UCI File

RUN

GLOBAL

WVHM4 model simulation  
START 1948 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	8-21-2025 24299 Prelim Sizing.wdm	
MESSU	25	Pre8-21-2025 24299 Prelim Sizing.MES	
	27	Pre8-21-2025 24299 Prelim Sizing.L61	
	28	Pre8-21-2025 24299 Prelim Sizing.L62	
	30	POC8-21-2025 24299 Prelim Sizing1.dat	

END FILES

OPN SEQUENCE

INGRP INDELT 00:15  
PERLND 11  
COPY 501  
DISPLY 1

END INGRP

END OPN SEQUENCE

DISPLY

DISPLY-INFO1

#	-	#	<-----Title----->	***	TRAN	PIVL	DIG1	FIL1	PYR	DIG2	FIL2	YRND
1			Predeveloped		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

PARAM

#	#	K	***

END PARAM

END GENER

PERLND

GEN-INFO

<PLS >	<-----Name----->	NBLKS	Unit-systems	Printer	***		
#	-	#	User	t-series	Engl	Metr	***
				in	out		***

11			C, 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	***
11			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	*****		
11			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 ***
11 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
11 0 4.5 0.08 400 0.1 0.5 0.996
END PWAT-PARM2

PWAT-PARM3
<PLS > PWATER input info: Part 3 ***
# - # ***PETMAX PETMIN INFEXP INFILD DEEPFR BASETP AGWETP
11 0 0 2 2 0 0 0
END PWAT-PARM3

PWAT-PARM4
<PLS > PWATER input info: Part 4 ***
# - # CEPSC UZSN NSUR INTFW IRC LZETP ***
11 0.2 0.5 0.35 6 0.5 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
11 0 0 0 0 2.5 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

```



```
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> <-Grp> <-Member-> # #***
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

```
WVHM4 model simulation
START      1948 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      8-21-2025 24299 Prelim Sizing.wdm
MESSU    25      Mit8-21-2025 24299 Prelim Sizing.MES
          27      Mit8-21-2025 24299 Prelim Sizing.L61
          28      Mit8-21-2025 24299 Prelim Sizing.L62
          30      POC8-21-2025 24299 Prelim Sizing1.dat
```

END FILES

OPN SEQUENCE

```
INGRP          INDELT 00:15
  PERLND        17
  IMPLND         1
  RCHRES         1
  COPY           1
  COPY          501
  DISPLY         1
```

END INGRP

END OPN SEQUENCE

DISPLY

```
DISPLY-INF01
# - #<-----Title----->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
1      Vault 1      MAX      1      2      30      9
END DISPLY-INF01
```

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      ***
17      C, 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 ***
17      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  *****
```

17 0 0 4 0 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 \*\*\*  
17 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  
17 0 4.5 0.03 400 0.1 0.5 0.996  
END PWAT-PARM2

PWAT-PARM3  
<PLS > PWATER input info: Part 3 \*\*\*  
# - # \*\*\*PETMAX PETMIN INFEXP INFILD DEEPFR BASETP AGWETP  
17 0 0 2 2 0 0 0  
END PWAT-PARM3

PWAT-PARM4  
<PLS > PWATER input info: Part 4 \*\*\*  
# - # CEPSC UZSN NSUR INTFW IRC LZETP \*\*\*  
17 0.1 0.25 0.25 6 0.5 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  
17 0 0 0 0 2.5 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  
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 \*\*\*



```

1          1          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 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
92      4
Depth      Area      Volume      Outflowl Velocity      Travel Time***
(ft)      (acres) (acre-ft) (cfs)      (ft/sec)      (Minutes)***
0.000000  0.275482  0.000000  0.000000  0.000000
0.123889  0.275482  0.034129  0.034129  0.026004
0.247778  0.275482  0.068258  0.036775
0.371667  0.275482  0.102388  0.045041
0.495556  0.275482  0.136517  0.052008
0.619444  0.275482  0.170646  0.058147
0.743333  0.275482  0.204775  0.063697
0.867222  0.275482  0.238904  0.068801
0.991111  0.275482  0.273033  0.073551
1.115000  0.275482  0.307163  0.078012
1.238889  0.275482  0.341292  0.082232
1.362778  0.275482  0.375421  0.086246
1.486667  0.275482  0.409550  0.090081
1.610556  0.275482  0.443679  0.093759
1.734444  0.275482  0.477808  0.097299
1.858333  0.275482  0.511938  0.100714
1.982222  0.275482  0.546067  0.104017
2.106111  0.275482  0.580196  0.107218
2.230000  0.275482  0.614325  0.110326
2.353889  0.275482  0.648454  0.113349
2.477778  0.275482  0.682583  0.116294
2.601667  0.275482  0.716713  0.119166
2.725556  0.275482  0.750842  0.121970
2.849444  0.275482  0.784971  0.124712
2.973333  0.275482  0.819100  0.127394
3.097222  0.275482  0.853229  0.130021
3.221111  0.275482  0.887358  0.132596
3.345000  0.275482  0.921488  0.135122
3.468889  0.275482  0.955617  0.137601
3.592778  0.275482  0.989746  0.140037
3.716667  0.275482  1.023875  0.142431
3.840556  0.275482  1.058004  0.144785
3.964444  0.275482  1.092133  0.147102
4.088333  0.275482  1.126263  0.149383
4.212222  0.275482  1.160392  0.151629
4.336111  0.275482  1.194521  0.153843
4.460000  0.275482  1.228650  0.156025
4.583889  0.275482  1.262779  0.158177
4.707778  0.275482  1.296908  0.160300
4.831667  0.275482  1.331038  0.162396
4.955556  0.275482  1.365167  0.193030
5.079444  0.275482  1.399296  0.208623
5.203333  0.275482  1.433425  0.220789
5.327222  0.275482  1.467554  0.231259
5.451111  0.275482  1.501684  0.240660
5.575000  0.275482  1.535813  0.249305
5.698889  0.275482  1.569942  0.257377
5.822778  0.275482  1.604071  0.264994
5.946667  0.275482  1.638200  0.272237
6.070556  0.275482  1.672329  0.279166
6.194444  0.275482  1.706459  0.285824
6.318333  0.275482  1.740588  0.292248

```

6.442222	0.275482	1.774717	0.298463
6.566111	0.275482	1.808846	0.304493
6.690000	0.275482	1.842975	0.361237
6.813889	0.275482	1.877104	0.394506
6.937778	0.275482	1.911234	0.420211
7.061667	0.275482	1.945363	0.442324
7.185556	0.275482	1.979492	0.462195
7.309444	0.275482	2.013621	0.480484
7.433333	0.275482	2.047750	0.497572
7.557222	0.275482	2.081879	0.513702
7.681111	0.275482	2.116009	0.529045
7.805000	0.275482	2.150138	0.543722
7.928889	0.275482	2.184267	0.557826
8.052778	0.275482	2.218396	0.571429
8.176667	0.275482	2.252525	0.584589
8.300556	0.275482	2.286654	0.597351
8.424444	0.275482	2.320784	0.609754
8.548333	0.275482	2.354913	0.621832
8.672222	0.275482	2.389042	0.633611
8.796111	0.275482	2.423171	0.645115
8.920000	0.275482	2.457300	0.656366
9.043889	0.275482	2.491429	0.667380
9.167778	0.275482	2.525559	0.678174
9.291667	0.275482	2.559688	0.688762
9.415556	0.275482	2.593817	0.699157
9.539444	0.275482	2.627946	0.709369
9.663333	0.275482	2.662075	0.719409
9.787222	0.275482	2.696204	0.729287
9.911111	0.275482	2.730334	0.739010
10.03500	0.275482	2.764463	0.748586
10.15889	0.275482	2.798592	0.771370
10.28278	0.275482	2.832721	1.534009
10.40667	0.275482	2.866850	2.788744
10.53056	0.275482	2.900979	4.202863
10.65444	0.275482	2.935109	5.473285
10.77833	0.275482	2.969238	6.368918
10.90222	0.275482	3.003367	6.958354
11.02611	0.275482	3.037496	7.453826
11.15000	0.275482	3.071625	7.915830
11.27389	0.275482	3.105755	8.350414

END FTABLE 1  
 END FTABLES

EXT SOURCES

<-Volume->	<Member>	SsysSgap<--Mult-->	Tran	<-Target	vols>	<-Grp>	<-Member->	***			
<Name>	#	<Name>	#	tem	strg<-factor->	strg	<Name>	#	#	***	
WDM	2	PREC	ENGL	1.2			PERLND	1	999	EXTNL	PREC
WDM	2	PREC	ENGL	1.2			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	STAGE	1	1	1	WDM	1001	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

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		16				
RCHRES	ROFLOW			COPY	INPUT	MEAN
END MASS-LINK		16				
END MASS-LINK						
END RUN						

*Predeveloped HSPF Message File*

*Mitigated HSPF Message File*

## *Disclaimer*

### *Legal Notice*

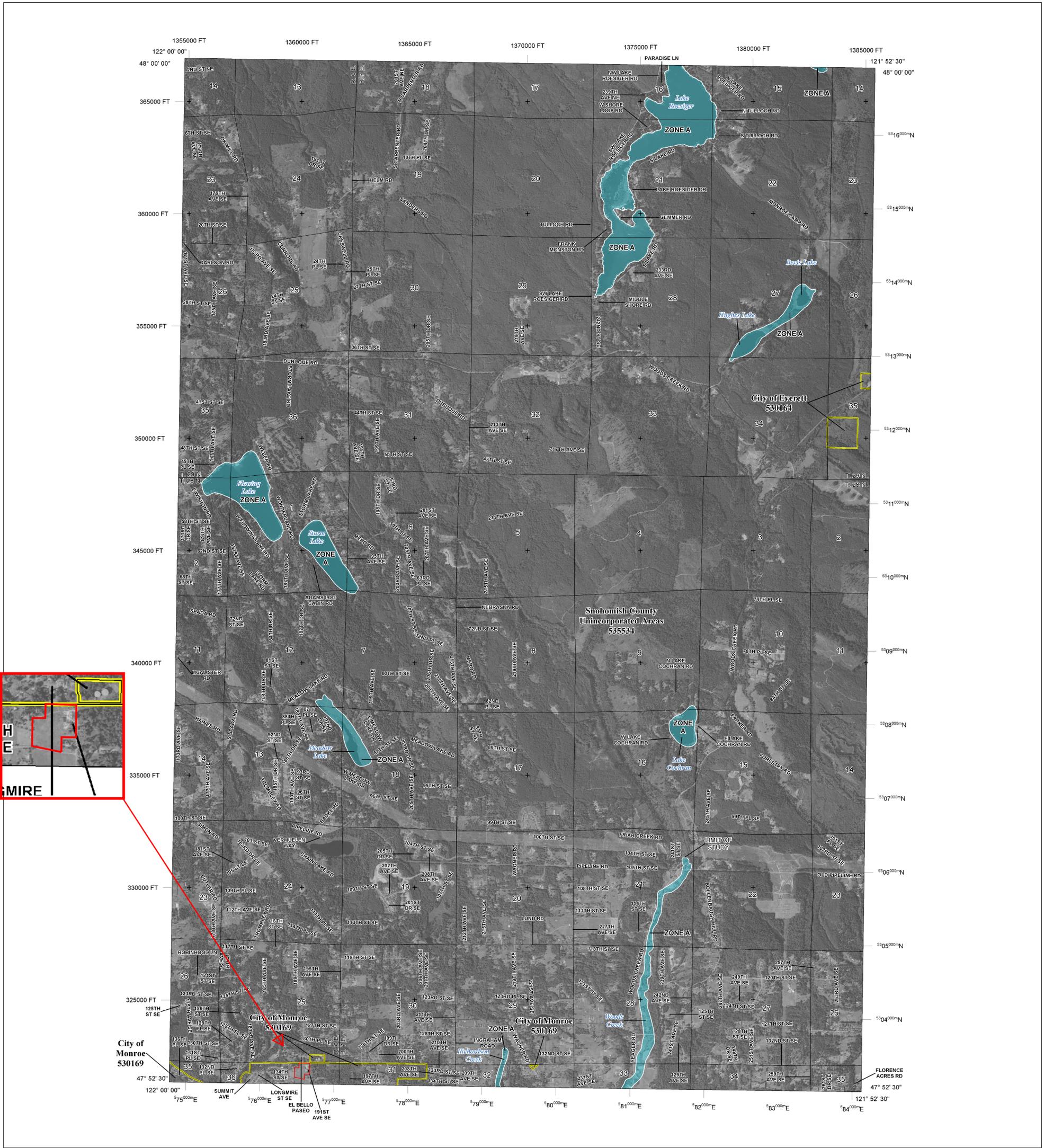
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# Appendix C

FEMA FIRMette



**FLOOD HAZARD INFORMATION**

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP  
 THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING  
 DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT  
[HTTPS://MSC.FEMA.GOV](https://MSC.FEMA.GOV)

	Without Base Flood Elevation (BFE) Zone A, V, A99
	With BFE or Depth Zone AE, AO, AH, VE, AR
	Regulatory Floodway
	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
	Areas Determined to be Outside the 0.2% Annual Chance Floodplain Zone X
	Area of Undetermined Flood Hazard Zone D
	Channel, Culvert, or Storm Sewer
	Accredited or Provisionally Accredited Levee, Dike, or Floodwall
	Non-accredited Levee, Dike, or Floodwall
	18.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
	Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
	Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary

**NOTES TO USERS**

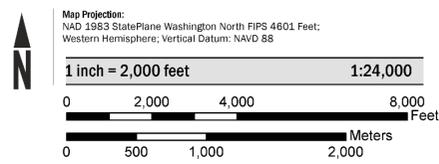
For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at <https://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

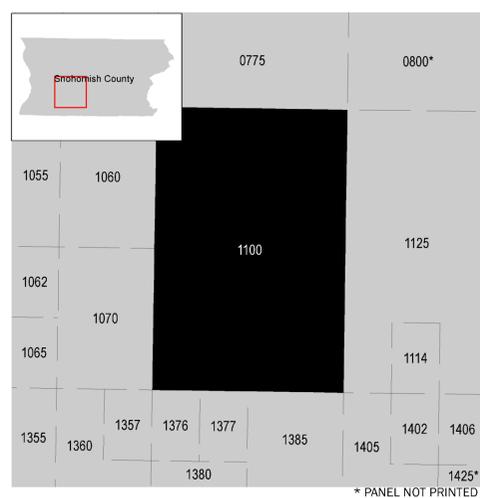
For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction. To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on this panel was provided by the USDA-FSA Aerial Photography Field Office. This information was derived from digital orthophotography at a scale of 1:12,000 and 1-meter pixel resolution from photography dated 2009.

**SCALE**



**PANEL LOCATOR**



**National Flood Insurance Program**

**NATIONAL FLOOD INSURANCE PROGRAM**  
 FLOOD INSURANCE RATE MAP

**SNOHOMISH COUNTY, WASHINGTON**  
 AND INCORPORATED AREAS

PANEL 1100 OF 1575

COMMUNITY	NUMBER	PANEL	SUFFIX
EVERETT, CITY OF	530164	1100	F
MONROE, CITY OF	530169	1100	F
SNOHOMISH COUNTY	535534	1100	F

VERSION NUMBER  
2.3.2.1

MAP NUMBER  
53061C1100F

MAP REVISED  
JUNE 19, 2020