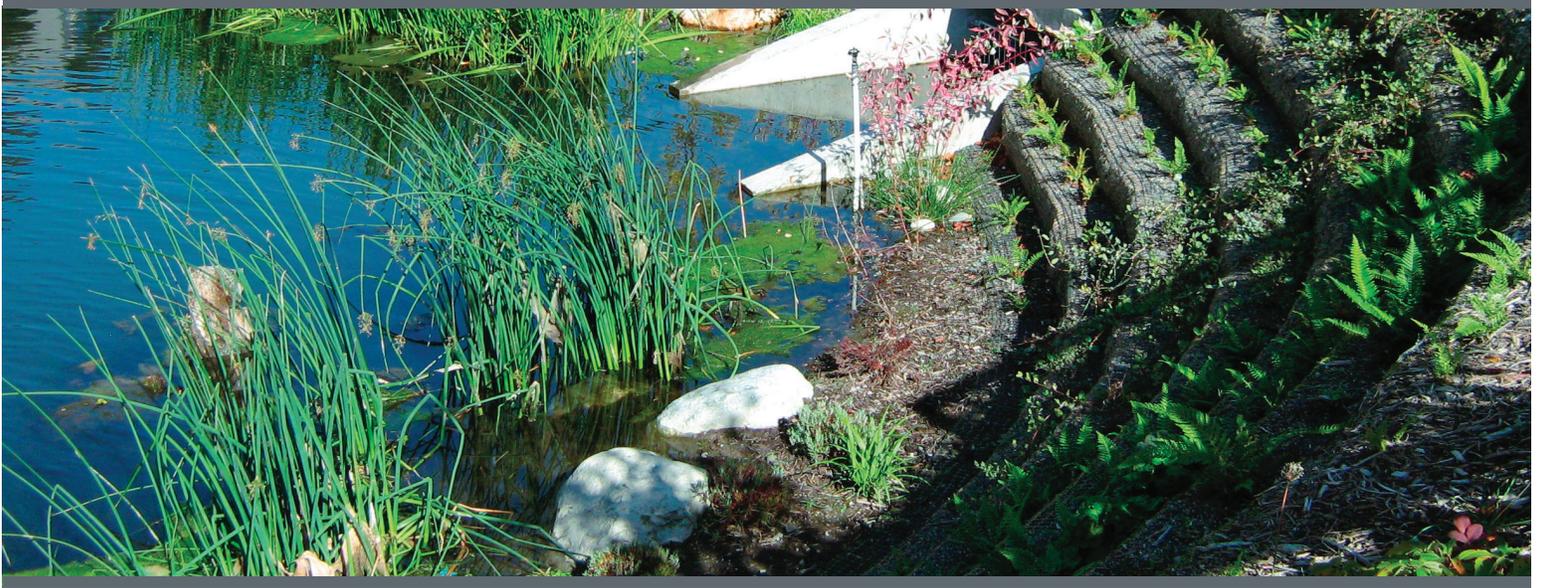




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*Subsurface Exploration, Geologic Hazard, and  
Geotechnical Engineering Report*

## **TROMBLEY HILL AC WATER MAIN REPLACEMENT**

Monroe, Washington

Prepared For:

**AKS ENGINEERING & FORESTRY, LLC**

Project No. 20250076E001

August 5, 2025



Associated Earth Sciences, Inc.

[www.aesgeo.com](http://www.aesgeo.com)

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a s s o c i a t e d  
e a r t h s c i e n c e s  
i n c o r p o r a t e d

August 5, 2025  
Project No. 20250076E001

AKS Engineering & Forestry, LLC  
405 Corporate Center, Building W  
11321-B NE 120<sup>th</sup> Street  
Kirkland, Washington 98034

Attention: Matt Hough, P.E.

Subject: Subsurface Exploration, Geologic Hazard,  
and Geotechnical Engineering Report  
Trombley Hill AC Water Main Replacement  
Monroe, Washington

Dear Matt Hough:

We are pleased to present this geotechnical engineering report for the above-referenced project. This report summarizes the results of our subsurface exploration, geologic hazard, and geotechnical engineering studies, and offers recommendations for the design and development of the proposed water main replacement. We should be allowed to review the recommendations presented in this report and modify them, if needed, once final project plans have been formulated.

We have enjoyed working with you on this study and are confident that the recommendations presented in this report will aid in the successful completion of your project. If you should have any questions or if we can be of additional help to you, please do not hesitate to call.

Sincerely,  
**ASSOCIATED EARTH SCIENCES, INC.**  
Kirkland, Washington

---

G. Bradford Drew, P.E.  
Associate Engineer

BD/ld – 20250076E001-001

**SUBSURFACE EXPLORATION, GEOLOGIC HAZARD, AND  
GEOTECHNICAL ENGINEERING REPORT**

**TROMBLEY HILL AC WATER MAIN REPLACEMENT**

**Monroe, Washington**

*Prepared for:*

**AKS Engineering & Forestry, LLC**  
405 Corporate Center, Building W  
11321-B NE 120<sup>th</sup> Street  
Kirkland, Washington 98034

*Prepared by:*

**Associated Earth Sciences, Inc.**  
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425-827-7701

August 5, 2025

Project No. 20250076E001

## I. PROJECT AND SITE CONDITIONS

### 1.0 INTRODUCTION

This report, prepared by Associated Earth Sciences, Inc. (AESI), presents the results of our subsurface exploration, geologic hazard, and geotechnical engineering study for the subject project. Our understanding of the project is based on our email correspondence with the Client and a site walk made with the Client and City of Monroe personnel on June 10, 2025. The site location is shown on the “Vicinity Map,” Figure 1. The approximate locations of the explorations completed for this study are shown on the “Existing Site and Exploration Plan,” Figure 2, “LIDAR Based Topography,” Figure 3, and “Critical Slope Areas,” Figure 4. Copies of the exploration logs are included in Appendix A.

#### 1.1 Purpose and Scope

The purpose of this study was to provide subsurface data to be used in the design and development of the subject project. Our study included reviewing available geologic literature and historical exploration data by others in the project vicinity, excavating six exploration pits along the proposed water main alignment, and performing geologic studies to assess the type, thickness, distribution, and physical properties of the subsurface sediments and groundwater conditions. Geotechnical engineering studies were completed to assess geologic hazards and to formulate geotechnical recommendations and construction considerations for the water main replacement. This report summarizes our fieldwork and offers our recommendations based on our present understanding of the project. We recommend that we be allowed to review the recommendations presented in this report and revise them, if needed, when the project design has been finalized.

#### 1.2 Authorization

Our study was accomplished in general accordance with our scope of work and budget contained in our subconsultant agreement with AKS Engineering & Forestry, LLC (AKS), dated July 18, 2025. This report has been prepared for the exclusive use of AKS and their agents for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering and engineering geology practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made.

## 2.0 PROJECT AND SITE DESCRIPTION

The subject site consists of a City of Monroe transmission corridor and easement located in Monroe, Snohomish County, Washington. A City of Monroe capital improvement project (CIP) W-D-03 proposes to replace an approximately 6,100-foot portion of the existing 16-inch Asbestos Cement (AC) water transmission main from the Trombley Hill reservoir to the 179<sup>th</sup> Avenue/Airport PRV station. The Trombley Hill transmission main corridor traverses both public and private properties in existing utility easements or rights-of-way areas comprised of a variety of land uses, vegetative cover, and topography. The Northwest Pipeline, a high-pressure natural gas pipeline owned by Williams Northwest Pipeline parallels the City's water main and shares the existing easements and/or rights-of-way over much of the project limits.

The existing utility corridor and easement alignment crosses and/or parallels existing stream, wetland, and critical area buffers according to City and County resources. Topography along the corridor varies from gently sloping within the upland northeastern portion of the project area, to steeply sloping down into the valley floor within the southwestern portion of the project area and adjacent to a reclaimed gravel pit, and gently sloping for the southern valley segment. Slope inclinations along the transmission corridor range from approximately 5 to 50 percent.

The transmission corridor and easement has been cleared of trees, and groundcover generally consists of grass and low-lying shrubs. Several paved roadways intersect the utility corridor along with sidewalks, gravel pathways, and paved walking trails. The parcels adjacent to the easement range from developed residential properties to undeveloped and heavily wooded areas. Surface water features in the vicinity of the proposed water main replacement include Cripple Creek which parallels the southwest portion of the project area.

It is our understanding that plans include replacement of the existing 16-inch AC water main with a new, high-density polyethylene (HDPE) transmission line. Alternative pipe materials or a combination of materials are also being considered. We understand that the new water main will be installed approximately 5 to 6 feet below existing grades using conventional cut and cover trenching methods. AESI has been requested to provide a geotechnical report for use in developing the design and construction methods for the proposed water main replacement.

## 3.0 SUBSURFACE EXPLORATION

Our field study included geologic reconnaissance and excavating six exploration pits (EP-1 through EP-6) to gain subsurface information along the proposed alignment of the new water main. The various types of materials, as well as the depths where characteristics of the materials changed, are indicated on the exploration logs presented in Appendix A. The depths

indicated on the logs where conditions changed may represent gradational variations between material types in the field.

The conclusions and recommendations presented in this report are based, in part, on the exploration pits completed for this study, as well as our review of previous explorations completed in the project vicinity. The number, locations, and depths of the explorations were completed within site and budgetary constraints. Because of the nature of exploratory work below ground, interpolation of subsurface conditions between field explorations is necessary. It should be noted that subsurface conditions differing from those depicted on the logs may be present at the site due to the random nature of deposition and the alteration of topography by past grading and/or filling. The nature and extent of variations between the field explorations may not become fully evident until construction. If variations are observed at that time, it may be necessary to re-evaluate specific recommendations in this report and make appropriate changes.

### 3.1 Exploration Pits

The exploration pits were excavated with a track-mounted excavator under subcontract to AESI on June 30, 2025. The pits permitted direct, visual observation of subsurface conditions. Materials encountered in the exploration pits were studied and classified in the field by a geologist from our firm. The exploration pits were backfilled with the excavator and lightly tamped in layers after examination and logging. Samples collected from the exploration pits were classified in the field and representative portions placed in watertight containers. The samples were then transported to our laboratory for further visual classification. The approximate locations of the exploration pits, noted as EP-1 through EP-6, are displayed on Figures 2, 3, and 4.

### 3.2 Previous Explorations By Others

As part of our study, we reviewed previous subsurface explorations completed by others in the project vicinity. Our review included seven test pits located near the central upland portion of the water main alignment, completed by Terra Associates Inc. (Terra) in August 2024. The approximate locations of the test pits, noted as TP-4 through TP-10, are displayed on Figures 2, 3, and 4, and the exploration logs are included in Appendix B.

## 4.0 SUBSURFACE CONDITIONS

Subsurface conditions at the project site were inferred from the field explorations accomplished for this study, our visual reconnaissance of the site, and review of selected geologic literature. Detailed descriptions of the materials encountered in our explorations are

provided on the exploration logs in Appendix A, and copies of the historical exploration logs by others are included in Appendix B. The following section presents more detailed subsurface information organized from the shallowest (youngest) to the deepest (oldest) sediment types.

#### 4.1 Stratigraphy

##### *Topsoil*

A surficial organic topsoil horizon was encountered in all of our exploration pits, as well as the historical exploration logs reviewed as part of our study. The thickness of the organic topsoil horizon ranged from approximately 4 to 12 inches. The topsoil is not suitable for use as trench backfill due to its high organic content. The topsoil could be set aside during excavation and trenching for surficial landscaping uses.

##### *Fill*

Existing fill soils (those not naturally deposited) were encountered at the location of EP-3 and extended to a depth of approximately 2 feet below existing grade. The fill soils generally consisted of medium dense, dark brown, silty fine sand with some gravel. The fill soils displayed a chaotic texture and contained scattered organics. We anticipate that fill is likely present in other unexplored portions of the water main alignment, particularly near underground utility trenches and other rights-of-way infrastructure.

Excavated existing fill is suitable for reuse in trench backfill applications provided that it is free of roots and other deleterious materials and contains a moisture content compatible with achieving the specified level of compaction. Because the existing fill soils encountered within our explorations contain a large percentage of fine-grained (silt-sized) sediments, these soils should be considered highly moisture-sensitive and subject to disturbance when wet.

##### *Holocene Alluvium*

Sediments generally consisting of medium dense, sandy fine to coarse gravel with varying quantities of silt were encountered directly below the surficial topsoil in exploration pits EP-5 and EP-6. Both exploration pits were excavated near the outflow of Cripple Creek. These sediments were observed to be interbedded and contained scattered fine organics. We interpret these sediments to be representative of Holocene alluvium. At this location, the Holocene alluvium sediments are interpreted as being part of a post-glacial alluvial fan emanating from the Cripple Creek drainage to the north. At the locations of exploration pits EP-5 and EP-6, the alluvium extended to the maximum depths explored of 11 feet.

Excavated Holocene alluvium is suitable for reuse in trench backfill applications provided that it is free of roots and other deleterious materials, contains a moisture content compatible with achieving the specified level of compaction, and where large cobbles or boulders are removed.

#### *Vashon Recessional Outwash*

Sediments generally consisting of medium dense, orangish brown and brown, silty fine sand with variable quantities of gravel were encountered directly below the topsoil/fill layers at the locations of exploration pits EP-2 through EP-4. The upper portion of these sediments were generally weathered, and the deposits were observed to be stratified with interbeds of sand and silt. We interpret these sediments to be representative of Vashon recessional outwash.

Vashon recessional outwash consists of sediments that were deposited by meltwater streams that emanated from the retreating glacial ice during the latter portion of the Vashon Stade of the Fraser Glaciation, approximately 12,500 to 15,000 years ago. The weathered soil horizon also typically contained abundant roots. At the locations encountered, the recessional outwash extended to depths ranging from approximately 5 to 11 feet and was underlain by Vashon lodgement till.

Excavated recessional outwash is suitable for reuse as trench backfill provided that it is free of roots and other deleterious materials and contains a moisture content compatible with achieving the specified level of compaction. Because the recessional outwash contains a large percentage of fine-grained (silt-sized) sediments, it is highly moisture-sensitive and subject to disturbance when wet.

#### *Vashon Lodgement Till*

Within EP-1 through EP-4, sediments encountered either directly below the surficial topsoil/fill, or below the recessional outwash (where present), generally consisted of dense to very dense, non-stratified, unsorted, silty sand with minor to moderate gravel content. We interpret these sediments to be representative of Vashon lodgement till. Lodgement till was also encountered directly below the topsoil horizon within the historical test pit logs by Terra (TP-4 through TP-10), located within the upland area near the center of the water main alignment. Within EP-1, the upper few feet of the lodgement till was weathered and in a medium dense condition to a depth of approximately 2 feet below the ground surface. Weathered till was also encountered within the Terra test pit logs TP-4 through TP-9 to depths of about 2 to 4 feet below existing grade.

Vashon lodgement till was deposited directly from basal, debris-laden glacial ice during the Vashon Stade of the Fraser Glaciation, approximately 12,500 to 15,000 years ago. The high relative density characteristic of lodgement till is due to its consolidation by the massive weight

of the glacial ice from which it was deposited. Where encountered, the lodgement till extended to the maximum depths explored of approximately 10 to 12 feet.

Excavated lodgement till is suitable for reuse as trench backfill provided that it is free of roots and other deleterious materials and contains a moisture content compatible with achieving the specified level of compaction. Because the lodgement till contains a large percentage of fine-grained (silt-sized) sediments, it is highly moisture-sensitive and subject to disturbance when wet.

#### 4.2 Geologic Mapping

We reviewed the regional geologic mapping of the project area (*Geologic Map of the Lake Roesiger 7.5-minute Quadrangle, Snohomish County, Washington* [J.D. Dragovich, 2015<sup>1</sup>] and *Geologic Map of the Monroe 7.5-minute Quadrangle, King and Snohomish Counties, Washington* [J.D. Dragovich, 2011<sup>2</sup>]), which indicates that the upper gently sloping portion of the project area is underlain by Vashon lodgement till, and the flat low-lying portion of the project area is underlain by Quaternary (Holocene) alluvium. The slope transition from upland to valley is mapped as Vashon lodgement till and Whidbey Formation. Our interpretation of the sediments encountered in our explorations is somewhat in agreement with the regional geologic map in that we encountered glacial till on the upland segment and Holocene alluvium on the valley segment; however, we encountered Vashon recessional outwash overlying the till in some explorations and did not encounter Whidbey Formation sediments.

#### 4.3 Soils Mapping

Review of regional soils mapping (*Soil Survey of Snohomish County Area, Washington, U.S. Department of Agriculture [USDA], Soils Conservation Service [SCS] now referred to as Natural Resources Conservation Service [NRCS]*) on the NRCS *Web Soil Survey*<sup>3</sup> indicates that the upland project area is underlain by Tokul gravelly medial loam, and the valley project area is underlain by Everett very gravelly sandy loam. The Tokul soils are formed from the weathering of volcanic ash and loess above glacial till, and the Everett soils are formed from the weathering of sandy and gravelly glacial outwash. The NRCS mapped a gravel pit area at the base of the slope near the southwestern extent of the water main alignment. The NRCS indicates that the erosion

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<sup>1</sup> Dragovich, J.D., Mahan, S.A., Anderson, M.L., MacDonald, J.H., Jr., Schilter, J.F., Frattali, C.L., Koger, C.J., Smith, D.T., Stoker, B.A., DuFrane, S.A., Eddy, M.P., Cakir, Recep, and Sauer, K. B., 2015, *Geologic Map of the Lake Roesiger 7.5-minute Quadrangle, Snohomish County, Washington*: Washington Division of Geology and Earth Resources, Map Series 2015-01.

<sup>2</sup> Dragovich, J.D., Anderson, M.L., Mahan, S.A., Koger, C.J., Saltonstall, J.H., MacDonald, J.H., Jr., Wessel, G.R., Stoker, B.A., Bethel, J.P., Labadie, J.E., Cakir, Recep, Bowman, J.D., and DuFrane, S.A., 2011, *Geologic Map of the Monroe 7.5-minute Quadrangle, King and Snohomish Counties, Washington*: Washington Division of Geology and Earth Resources, Open File Report 2011-1.

<sup>3</sup> <https://websoilsurvey.sc.egov.usda.gov>.

hazard rating of the Tokul and Everett soils is moderate where it is present on slopes with inclinations of 15 percent or greater. Our interpretation of the materials encountered in our explorations is generally consistent with the regional soils mapping.

#### 4.4 Groundwater

No groundwater seepage was encountered in our exploration pits at the time of excavation in late June 2025, and no springs were observed during our reconnaissance of the site and surrounding terrain. Several incised ravines which extend from the upland portion of the site down towards the valley floor are visible on Light Detection and Ranging (LIDAR)-based topography presented on Figure 3. Two of these features generally terminate between 20 to 40 feet above the valley floor. During our reconnaissance of these areas, we did not observe groundwater spring flow within the ravines or active eroded channels or signs of seasonal flow. It is our opinion that these features may be relict drainage features formed during glacial ice recession, conditions which are no longer present at the site. Surface water was observed in Cripple Creek near the southwest corner of the project area.

In areas underlain by lodgement till, it is common for shallow perched groundwater to accumulate seasonally at the base of the weathered till horizon. This perched seepage, known as “interflow,” occurs when stormwater infiltrates through the relatively permeable overlying sediments, and becomes perched atop the underlying, dense, low-permeability, unweathered till. Although no interflow was observed in any of our exploration pits or the explorations completed by others, the exploration for this study was conducted in late June. It is possible that interflow may be present in the wet season (typically between October and May). It should be noted that the depth or occurrence of groundwater seepage below the site may vary in response to such factors as changes in season, precipitation, and on- and off-site use.

#### 4.5 Laboratory Testing

As requested by AKS, we obtained two soil samples of the native alluvial sediments from explorations EP-5 and EP-6 for laboratory analysis to aid the project team in assessing the soil corrosivity potential. Both samples were collected from a depth of about 4 feet below the existing ground surface. The samples were delivered to AmTest Inc. and tested for pH, resistivity, and sulfides/chlorides. The test results are summarized in Table 1 below, and the laboratory analysis report is included in Appendix C.

**Table 1 - Laboratory Test Results**

<b>Exploration No.</b>	<b>Sample Depth (feet)</b>	<b>Geologic Unit</b>	<b>pH</b>	<b>Resistivity (Ohm-cm)</b>	<b>Sulfide (mg/kg)</b>	<b>Chloride (mg/kg)</b>
EP-5	4	Alluvium	6.2	430,000	ND	ND
EP-6	4	Alluvium	5.4	350,000	ND	ND

ND = Analyte not detected at or above the reporting limit (2.00 mg/kg for Sulfide and 2.85 mg/kg for Chloride)

Ohm-cm = Ohm-centimeter

mg/kg = milligram per kilogram

## II. GEOLOGIC HAZARDS AND MITIGATIONS

The following discussion of potential geologic hazards is based on the geologic conditions as observed and discussed herein.

### 5.0 LANDSLIDE HAZARDS AND RECOMMENDED MITIGATION

Title 22, Section 22.80.130.B.2 of the *Monroe Municipal Code* (MMC) defines Landslide Hazard Areas as follows:

1. Areas of historic failures;
2. Areas containing a combination of slopes steeper than 15 percent, springs or groundwater seepage, and hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock;
3. Areas that have shown movement during the Holocene epoch, or are underlain by mass wastage debris of that epoch;
4. Slopes that are parallel or subparallel to planes of weakness in subsurface materials;
5. Slopes having gradients steeper than 80 percent subject to rockfall during seismic shaking;
6. Areas potentially unstable as a result of rapid stream incision, stream bank erosion, and undercutting by wave action;
7. Areas located in a canyon or on an active alluvial fan, presently or potentially subject to inundation by debris flows or catastrophic flooding; and
8. Any area with a slope of 40 percent or more with a vertical relief of 10 feet or more.

The MMC requires that a buffer be established along the top, toe, and sides of landslide hazard areas. The minimum prescriptive buffer width is equal to the height of the slope or 50 feet, whichever is greater. This buffer may be reduced to a minimum of 10 feet when a qualified professional demonstrates to the zoning administrator's satisfaction that the reduction will adequately protect the proposed development, adjacent developments and uses, and the subject critical area. The buffer may be increased when the zoning administrator determines a larger buffer is necessary to prevent risk of damage to proposed and existing development. Alterations of an erosion or landslide hazard area and/or buffer may only occur for activities for which a geotechnical analysis is submitted and certifies that: the development will not increase surface water discharge or sedimentation to adjacent properties beyond the predevelopment condition; the development will not decrease slope stability on adjacent properties; and such alteration will not adversely impact other critical areas.

Our site reconnaissance included traversing the steeply sloping terrain along the utility easement as well as portions of the adjacent slopes. No evidence of historic landslide activity was observed along the steep slopes within the project area. No evidence of emergent seepage was noted along the slopes within the project area and groundwater was not encountered within any of the explorations completed as part of our study. Based on our review of topographic mapping along the project alignment, the proposed water main replacement intersects or is adjacent to slopes with inclinations of 40 percent or steeper over heights of 10 feet or more. Slopes in the project area with these geometries meet the criteria to be designated as Landslide Hazard Areas as defined by Section 22.80.130.B.2 of the MMC and are highlighted on Figure 4 of this report.

As part of our study, we reviewed the Washington Department of Natural Resources (WDNR) Geologic Information Portal<sup>4</sup> which indicates that no known landslides are mapped within the project area. The WDNR mapping does indicate that the valley area of the site near explorations EP-5 and EP-6 is mapped as an alluvial fan deposit. The presence of an alluvial fan emanating from the Cripple Creek drainage is consistent with the sediments encountered in explorations EP-5 and EP-6, which both encountered alluvial sand and gravel deposits directly below the topsoil horizon to their termination depth of 11 feet. The WDNR portal indicates that the relative age of the alluvial fan deposits is greater than 150 years. No signs of surface water or debris flow was noted in this area during our study. Our interpretation is consistent with the WDNR mapping which states that the alluvial fan is not active and does not constitute as a hazard to the water main replacement.

As discussed, the proposed water main alignment intersects Landslide Hazard Areas and their buffers. The designation of steeply sloping terrain within the project area as Landslide Hazard Areas is based on slope geometries, and not the presence of active landslides or adverse geologic conditions. Based on our study, it is our opinion that the risk of damage to the proposed water main replacement by landsliding is low as the core of the slopes are underlain by glacially consolidated sediments with no obvious signs of adverse geologic/groundwater conditions or historical landslide activity, and that no mitigation measures are warranted.

Additionally, the proposed water main replacement will be completed at similar grades to the existing transmission line, matching the current conditions along the utility easement, and should not increase the landslide hazard risk, surface water discharge, or sedimentation accumulation on neighboring parcels provided that temporary and final erosion control measures are properly implemented during construction. Refer to Section 7.0 for additional recommendations regarding erosion hazards and recommendation mitigations.

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<sup>4</sup> <https://geologyportal.dnr.wa.gov/>

## 6.0 SEISMIC HAZARDS AND RECOMMENDED MITIGATION

The following discussion is a general assessment of seismic hazards that is intended to be useful to the project design team in terms of understanding seismic issues, and to the structural engineer for design.

All of Western Washington is at risk of strong seismic events resulting from movement of the tectonic plates associated with the Cascadia Subduction Zone (CSZ), where the offshore Juan de Fuca plate subducts beneath the continental North American plate. The site lies within a zone of strong potential shaking from subduction zone earthquakes associated with the CSZ. The CSZ can produce earthquakes up to magnitude 9.0, and the recurrence interval is estimated to be on the order of 500 years. Geologists infer the most recent subduction zone earthquake occurred in 1700 (Goldfinger et al., 2012<sup>5</sup>). Three main types of earthquakes are typically associated with subduction zone environments: crustal, intraplate, and interplate earthquakes. Seismic records in the Puget Sound region document a distinct zone of shallow crustal seismicity (e.g., the Seattle Fault Zone). These shallow fault zones may include surficial expressions of previous seismic events, such as fault scarps, displaced shorelines, and shallow bedrock exposures. The shallow fault zones typically extend from the surface to depths ranging from 16 to 19 miles. A deeper zone of seismicity is associated with the subducting Juan de Fuca plate. Subduction zone seismic events produce intraplate earthquakes at depths ranging from 25 to 45 miles beneath the Puget Lowland including the 1949, 7.2-magnitude event; the 1965, 6.5-magnitude event; and the 2001, 6.8-magnitude event) and interplate earthquakes at shallow depths near the Washington coast including the 1700 earthquake, which had a magnitude of approximately 9.0. The 1949 earthquake appears to have been the largest in this region during recorded history and was centered in the Olympia area. Evaluation of earthquake return rates indicates that an earthquake of the magnitude between 5.5 and 6.0 is likely within a given 20-year period.

Generally, there are four types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture, 2) seismically induced landslides or lateral spreading, 3) liquefaction, 4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below.

### 6.1 Surficial Ground Rupture

The water main alignment is located about 2 miles northeast of the suspected traces of the southeastward extension of the Southern Whidbey Island Fault Zone (SWIFZ). A recent study by

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<sup>5</sup> Goldfinger, C., Nelson, C.H., Morey, A.E., Johnson, J.E., Patton, J.R., Karabanov, E., Gutierrez-Pastor, J., Eriksson, A.T., Gracia, E., Dunhill, G., Enkin, R.J., Dallimore, A., and Vallier, T., 2012, *Turbidite Event History—Methods and Implications for Holocene Paleoseismicity of the Cascadia Subduction Zone*: U.S. Geological Survey Professional Paper 1661–F, 170.

the U.S. Geological Survey (USGS) (Sherrod et al., 2005<sup>6</sup>) indicates that “strong” evidence of prehistoric earthquake activity has been observed along two fault strands thought to be part of the southeastward extension of the SWIFZ located about 8 miles southwest of the site. The study suggests as many as nine earthquake events along the SWIFZ may have occurred within the last 16,400 years. Understanding of this fault system is somewhat limited with studies still ongoing. The recurrence interval of movement along this fault system is still unknown, although it is hypothesized to be in excess of one thousand years. The water main alignment is also located about 2 miles northwest of the inferred fault traces of the Monroe Fault.

Due to the suspected long recurrence interval of the SWIFZ and distance between the water main alignment and the nearest inferred fault traces of the SWIFZ and Monroe Fault, the risk of surficial ground rupture due to fault movement impacting the proposed water main is considered to be low during the expected service life.

## 6.2 Seismically Induced Landslides

Similar to our discussion in Section 5.0, it is our opinion that the risk of damage to the proposed water main by seismically induced slope failure is low as the core of the slopes are underlain by glacially consolidated sediments with no obvious signs of adverse geologic/groundwater conditions or historical landslide activity, and that no mitigation measures are warranted.

## 6.3 Liquefaction

Liquefaction is a process through which unconsolidated soil loses strength as a result of vibrations, such as those which occur during a seismic event. During normal conditions, the weight of the soil is supported by both grain-to-grain contacts and by the fluid pressure within the pore spaces of the soil below the water table. Extreme vibratory shaking can disrupt the grain-to-grain contact, increase the pore pressure, and result in a temporary decrease in soil shear strength. The soil is said to be liquefied when nearly all of the weight of the soil is supported by pore pressure alone. Liquefaction can result in deformation of the sediment and settlement of overlying structures. Areas most susceptible to liquefaction include those areas underlain by non-cohesive silt and sand with low relative densities, accompanied by a shallow water table.

The slopes and upland area of the proposed water main alignment are underlain by glacially consolidated soils at shallow depths with a lack of adverse groundwater conditions. Within

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<sup>6</sup> Sherrod et al., 2005, *Holocene Fault Scarps and Shallow Magnetic Anomalies Along the Southern Whidbey Island Fault Zone near Woodinville, Washington*, Open-File Report 2005-1136, March 2005

these areas of the water main alignment, the potential risk of damage by liquefaction is low and no mitigation measures are warranted, in our opinion.

The southwest valley area of the water main alignment is underlain by medium dense alluvial soils. Alluvial soils are most susceptible to liquefaction when deposited in a loose condition, are comprised of sand with little silt and gravel content, and are saturated below a water table. Explorations EP-5 and EP-6 are located in this area and the alluvial sediments consisted of medium dense sandy gravel with no groundwater seepage observed to the termination depth of 11 feet, and thus are not considered liquefiable. Although it is possible that liquefiable soils may be present at greater depths in this area, it is our opinion that any liquefaction-induced settlement would be mitigated by the thick cover of unsaturated sandy gravel as encountered in our explorations. Additionally, provided that the water main pipe is comprised of a relatively flexible material (such as HDPE), the differential settlements that may manifest at the ground surface are expected to be gradual and within the deflection tolerances of the water main pipe. We recommend that AESI coordinate with the pipe designer/supplier to confirm deflection tolerances for the selected pipe material.

## 7.0 EROSION HAZARDS AND RECOMMENDED MITIGATION

The sediments underlying the proposed project area contain significant quantities of silt and fine sand and are considered to be highly sensitive to disturbance and erosion where present along sloping areas. The NRCS has mapped the upland project area as underlain by Tokul gravelly medial loam, and the valley project area as underlain by Everett very gravelly sandy loam. The NRCS indicates that the erosion hazard rating of the Tokul and Everett soils are moderate where it is present on slopes with inclinations of 15 percent or greater. Based on our review of topographic mapping along the project alignment, the proposed water main replacement intersects or is adjacent to slopes with inclinations of 15 percent ranging up to 50 percent. Therefore, care should be taken during construction to reduce the potential for erosion and off-site sediment transport.

In order to mitigate erosion and the potential for off-site sediment transport, we recommend the following best management practices (BMPs):

1. To the extent practical, earthwork should be avoided during the wet season, typically October 1<sup>st</sup> through April 30<sup>th</sup>.
2. The winter performance of a site is dependent on a well-conceived plan for control of site erosion and stormwater runoff. The site plan should include ground-cover measures and staging areas. The contractor should be prepared to implement and maintain the required measures to reduce the amount of exposed ground.

3. Temporary erosion and sedimentation control (TESC) elements and perimeter flow control should be established prior to the start of earthwork.
4. During the wetter months of the year, or when significant storm events are predicted during the summer months, the work area should be stabilized so that if showers do occur, it can receive the rainfall without excessive erosion or sediment transport. The stabilization process should include establishing temporary stormwater conveyance channels through work areas to route runoff to the approved treatment/discharge facilities.
5. All areas of disturbed soil should be revegetated as soon as possible. If it is outside of the growing season, the disturbed areas should be covered with mulch. Straw mulch provides a cost-effective cover measure and can be made wind-resistant with the application of a tackifier after it is placed.
6. Surface runoff and discharge should be controlled during and following development. Uncontrolled discharge may promote erosion and sediment transport.
7. Soils that are to be reused around the site should be stored in such a manner as to reduce erosion from the stockpile. Protective measures may include, but are not limited to, covering stockpiles with plastic sheeting, or the use of silt fences around pile perimeters.
8. If the area of development will cover an area greater than 1 acre in size, it will be required to obtain a Construction Stormwater General Permit per the Washington State Department of Ecology (Ecology). Under this permit, a Certified Erosion and Sediment Control Lead (CESCL) will be required to make weekly site visits to monitor erosion control, BMPs, and levels for turbidity and pH. AESI is available to help prepare permit application documents and can provide CESCL monitoring as requested.

It is our opinion that with the proper implementation of the TESC plans and by field-adjusting appropriate erosion mitigation (BMPs) throughout construction, the potential adverse impacts from erosion hazards on the project may be mitigated.

### III. DESIGN RECOMMENDATIONS

#### 8.0 INTRODUCTION

Our explorations indicate that, from a geotechnical engineering standpoint, the proposed project is feasible provided the recommendations contained herein are properly followed. It is our understanding that the proposed project includes replacing approximately 6,100 lineal feet of existing 16-inch Asbestos Cement (AC) water transmission main between the Trombley Hill reservoir and the 179<sup>th</sup> Avenue/Airport PRV station with a new, HDPE transmission line. Alternative pipe materials or a combination of materials are also being considered. We understand that the new water main will be installed approximately 5 to 6 feet below existing grades using conventional cut and cover trenching methods.

Based on our subsurface exploration data and site observations, conventional trench excavation equipment and methods may be utilized during construction. Pipe bedding and trench backfill materials should conform to City of Monroe specifications. Our recommendations for site preparation, drainage control, temporary and permanent cut slopes, trench excavation considerations, trench backfill materials and compaction, and soil parameters for thrust block design are provided below.

#### 9.0 SITE PREPARATION

Site preparation should include removal of all vegetation, topsoil, and any other deleterious materials from the proposed work areas. Once excavation and demolition of any existing structures has been completed, any depressions below final grade should be backfilled and compacted with suitable material as discussed under the “Trench Backfill” section of this report.

##### 9.1 Temporary and Permanent Cut Slopes

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction based on the local conditions encountered at that time. For planning purposes, we anticipate that temporary, unsupported cut slopes in areas of existing fill or loose to medium dense, alluvium and recessional outwash sediments can be made at a maximum slope of 1.5H:1V (Horizontal:Vertical). Temporary, unsupported cut slopes within the dense to very dense, unweathered till can be planned at a maximum slope of 1H:1V. Temporary vertical cuts up to 4 feet in height may be feasible in dry weather conditions. Flatter inclinations may be needed in areas of seepage or wet weather. As is typical with earthwork

operations, some sloughing and raveling may occur, and cut slopes may have to be adjusted in the field. In addition, WISHA/OSHA regulations should be followed at all times.

Permanent cut slopes should not exceed an inclination of 2H:1V.

## 9.2 Site Disturbance

The sediments underlying the proposed development area contain a high percentage of fine-grained (silt- and clay-sized) material. These soils are considered to be highly moisture-sensitive and subject to disturbance when wet. The contractor must use care during site preparation and excavation operations so that the underlying soils are not softened. If disturbance occurs, the softened soils should be removed and replaced with suitable fill.

Consideration should be given to protecting access and staging areas with an appropriate section of crushed rock or asphalt treated base (ATB). If crushed rock is considered for the access and staging areas, it should be underlain by engineering stabilization fabric (such as Mirafi® 500X or approved equivalent) to reduce the potential of fine-grained materials pumping up through the crushed rock during wet weather and turning the area to mud. The fabric will also aid in supporting construction equipment, thus reducing the amount of crushed rock required. We recommend that at least 10 inches of crushed rock be placed over the fabric. Crushed rock used for access and staging areas should have a particle size of at least 2 inches.

## 9.3 Site Drainage Control

Groundwater was not encountered within any of the explorations completed or reviewed as part of our study, but the occurrence of groundwater seepage may vary in response to such factors as changes in season, precipitation, site use, and may vary in depth due to site topography. We recommend that the contractor be prepared to encounter zones of minor perched groundwater seepage during construction of the new water main and provide drainage and subgrade protection as necessary. If encountered, we anticipate that the groundwater seepage can be managed using conventional pumping and bailing techniques.

## 10.0 TRENCHING CONSIDERATIONS

### 10.1 Excavation

Our explorations indicate that a variety of soil types will be encountered during trenching for the new water main. At the southwest portion of the alignment along the valley floor, we encountered loose to medium dense alluvial sand and gravel deposits. The contractor should anticipate moderate caving and raveling to occur when trenching through alluvial sediments.

Along the slope and within the upland area to the northeast, our test pits encountered medium dense recessional outwash overlying dense to very dense lodgement till. We anticipate that minor caving and raveling will occur when trenching through these sediments. Where dense to very dense lodgement till is encountered, excavation progress may be slowed depending on the excavation equipment used. The contractor should consider the appropriate excavation equipment and construction schedule in areas underlain by dense lodgement till at shallow depths.

Shallow groundwater was not encountered within any of the explorations completed or reviewed as part of our study, but the contractor should be prepared to encounter zones of perched seepage, particularly during the wet season.

We understand that portions of the new water main alignment will run below paved and gravel-surfaced areas which will need to be stripped prior to excavation. There may also be existing buried utilities that either parallel or cross the new alignment, which may complicate and slow the excavation process. Where present, overhead power lines and nearby tree limbs may limit the pick and swing radius of the trenching equipment.

Trenches less than 4 feet in depth may be open-cut for access. Where loose soils or groundwater seepage is encountered, caving of the trench walls may occur, resulting in a widening of the trench leading up to the ground surface. For this reason, the contractor should consider using temporary shoring in trenches under 4 feet to maintain the size of the excavation, particularly in paved areas or where the trench is adjacent to existing structures.

For trenches 4 feet or deeper, or where caving, sloughing, or groundwater seepage is encountered, Washington state law requires the use of trench boxes or temporary cut slopes to maintain stability and worker safety. The trench box should be structurally certified. Laborers within the trench must remain within the trench box at all times. The project-designated “competent person” should make daily observations of trench excavations. The appearance of any visual indications of instability, such as tension cracks, sloughing, spalling, bulging, significant groundwater seepage, or similar conditions, are cause for immediate action.

## 10.2 Pipe Subgrade

In our opinion, the undisturbed natural sediments are suitable for direct support of the new water main provided the pipe is properly bedded. Our explorations indicate that medium dense alluvium is expected to be encountered at the bottom of the trench within the southwest valley area of the alignment, and that medium dense recessional outwash or dense to very dense lodgement till are expected along the slope and within the upland area to the northeast. Where these sediments are disturbed during excavation, the trench subgrade should be recompacted

to a firm and unyielding condition. An AESI representative should be onsite to observe trench subgrade conditions and document backfill operations.

### 10.3 Pipe Bedding

Pipe bedding materials and placement should conform to City of Monroe standard details. The City's detail for Trench Backfill (detail 102) indicates that water lines should be bedded with utility sand. The bedding material should extend a minimum of 6 inches below the pipe and 12 inches above the pipe.

### 10.4 Trench Backfill

Utility trench backfill should be placed and compacted in accordance with the City of Monroe code and standards. Per the City's standard details for Trench Backfill (detail 102) and Trench Compaction (detail 103), trench backfill within unpaved areas shall consist of suitable native material or crushed rock compacted to at least 90 percent of the modified Proctor maximum dry density (ASTM D-1557). Trench backfill within paved areas shall consist of Crushed Surfacing Top Course (CSTC) or Crushed Surfacing Base Course (CSBC) compacted to at least 95 percent. Mechanical compaction of the trench backfill should begin at 18 inches above the top of pipe.

The thickness of the trench backfill layers before compaction should not exceed 12 inches for a large, excavator-mounted, vibratory plate-type compactor. Smaller compaction equipment will require use of thinner lifts; hand-operated plate compactors or "jumping jacks" should be used to compact lifts no thicker than 4 inches. Final lift thickness should be based on field performance testing using actual materials under field conditions and uniform compactive effort.

### 10.5 Reuse of Native Soils as Trench Backfill

As previously mentioned, a variety of soil types were encountered within our explorations along the proposed water main alignment. The alluvium generally consisted of sandy gravel with trace silt, the recessional outwash generally consisted of sand ranging to silty sand, and the lodgement till generally consisted of silty sand with some gravel and scattered cobbles. These native soils are suitable for use as trench backfill provided they are free of roots/organics, oversized rocks, and other deleterious materials and exhibit a moisture content at the time of construction compatible with achieving the recommended compaction specification.

At the time of our field exploration, the native soils were generally in a moist condition, indicating that the moisture content is near optimum and not overly dry or wet. The contractor should be prepared to moisture-condition the excavated trench soils as needed to achieve the

specified compaction. Suitable compaction of native sediments that contain a high percentage of silt (such as the recessional outwash and lodgement till soils) will only be achievable over a narrow range of moisture contents. If the moisture content of silty soils is over optimum at the time of construction, moisture-conditioning could be achieved by aerating the soil during periods of warm, dry weather.

If fill is placed during wet weather or if proper compaction of the natural materials cannot be attained, a select import material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil with the amount of fine-grained material limited to 5 percent by weight when measured on the minus No. 4 sieve fraction.

### 10.6 Trench Backfill Testing

We recommend that proposed trench backfill soils be evaluated by AESI prior to their use. This would involve the contractor providing us with a sample of the material at least 3 business days in advance to perform a laboratory Proctor compaction test to determine its field compaction standard. A representative from our firm should observe the prepared trench subgrade and be present during placement of trench backfill to document the work and perform a representative number of in-place density tests. In this way, the adequacy of the earthwork may be evaluated as backfilling progresses and problem areas may be corrected at that time. It is important to understand that taking random compaction tests on a part-time basis will not assure uniformity or acceptable performance of the backfill. As such, we are available to aid the Client in developing a suitable monitoring and testing frequency.

### 11.0 SOIL PARAMETERS FOR THRUST BLOCK DESIGN

We anticipate that cast-in-place concrete thrust blocks will be used to secure segments of the water main alignment that traverse moderate to steeply sloping areas. The thrust blocks can be used to resist lateral forces of the water main pipe by passive pressure of the surrounding soil and the friction between the base of the thrust block and underlying soil. Our recommended design parameters for thrust blocks are provided below.

For thrust blocks bearing directly on firm and unyielding native soils, or on trench backfill placed above native soils and compacted to at least 95 percent of the modified Proctor maximum dry density, we recommend an allowable bearing pressure of 2,500 pounds per square foot (psf). An increase of one-third may be used for transient loads.

We recommend using an allowable passive equivalent fluid pressure of 250 pounds per cubic foot (pcf). The soils surrounding the thrust block must be compacted to at least 95 percent of the modified Proctor maximum dry density to achieve this value. This design parameter

includes a safety factor of 1.5. The passive pressure should be ignored to a depth of 12 inches below the ground surface.

We recommend using a coefficient of friction of 0.30 for sliding resistance. This value includes a safety factor of 1.5 and assumes the underlying soils are compacted to a firm and unyielding condition.

**12.0 PROJECT DESIGN AND CONSTRUCTION MONITORING**

We recommend that we be allowed to review project plans when they are completed and to revise the recommendations presented in this report, if appropriate. We are also available to provide geotechnical observation and testing services during construction. The integrity of the earthwork depends on proper site preparation and construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent.

We have enjoyed working with you on this study and are confident these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

Sincerely,  
**ASSOCIATED EARTH SCIENCES, INC.**  
Kirkland, Washington

  
Peter E. Linton, L.G.  
Project Geologist

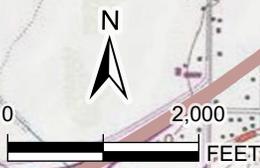
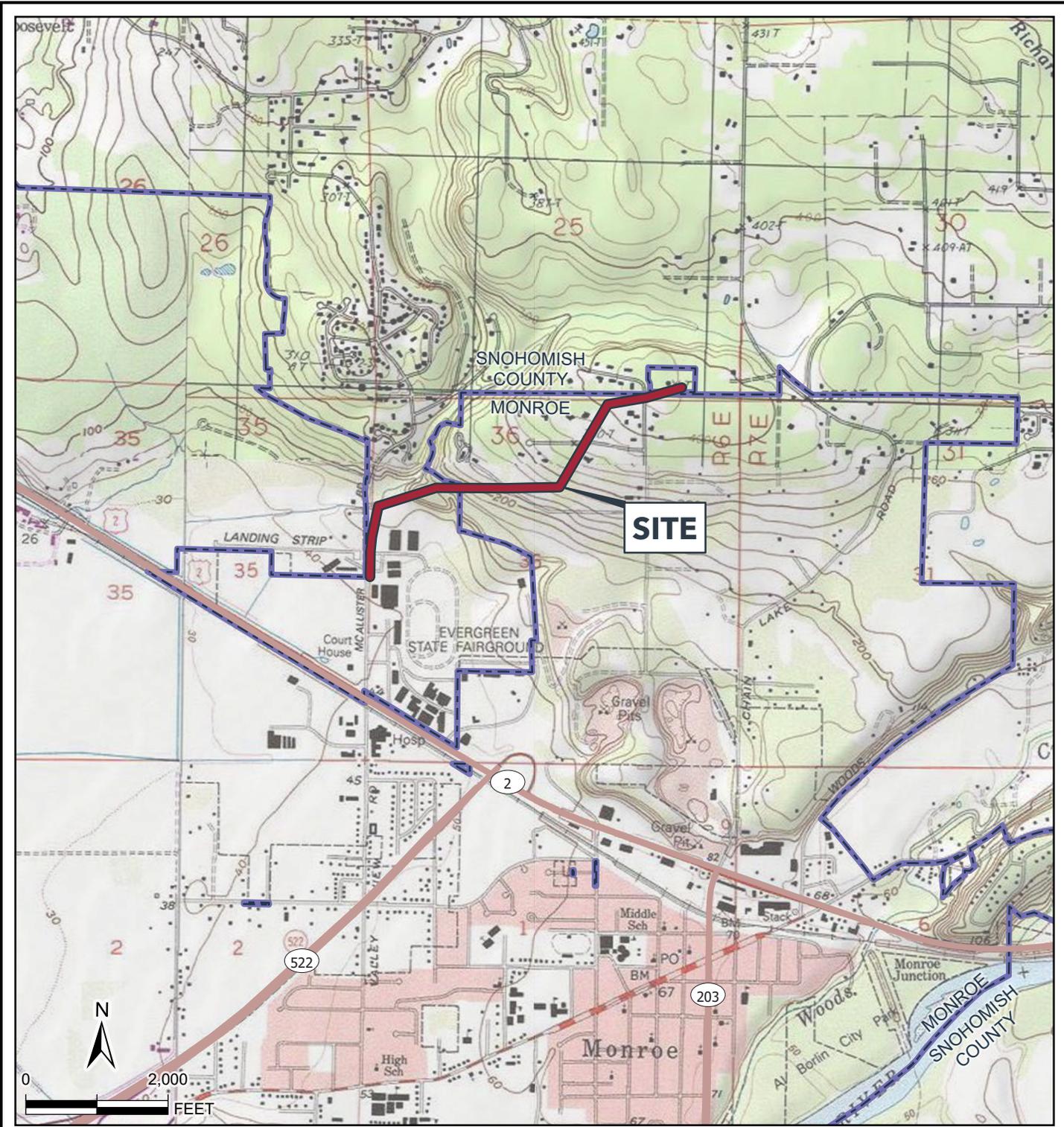
  
Matthew A. Miller, P.E.  
Principal Engineer



G. Bradford Drew, P.E.  
Associate Engineer

## **ATTACHMENTS**

- Figure 1: Vicinity Map
- Figure 2: Existing Site and Exploration Plan
- Figure 3: LIDAR Based Topography
- Figure 4: Critical Slope Areas
  
- Appendix A: Exploration Logs (AESI, 2025)
- Appendix B: Exploration Logs (Terra Associates Inc., 2024)
- Appendix C: Laboratory Analysis Report



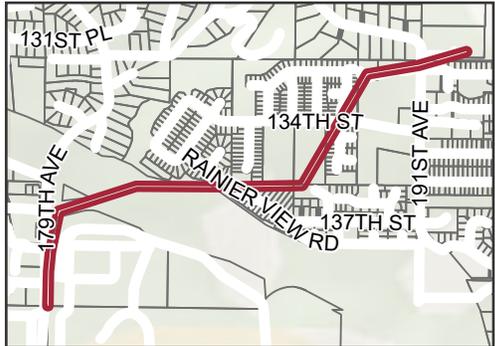
COUNTY LOCALE



ESRI, USGS, NATIONAL GEOGRAPHIC, DELORME, NATURALVUE, I-CUBED, GEBCO; ARCGIS ONLINE BASEMAP, WADOT STATE ROUTES 24K (12/20), SNOHOMISH CO: PARCELS, ROADS (3/24).

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE. BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION.

LOCATION



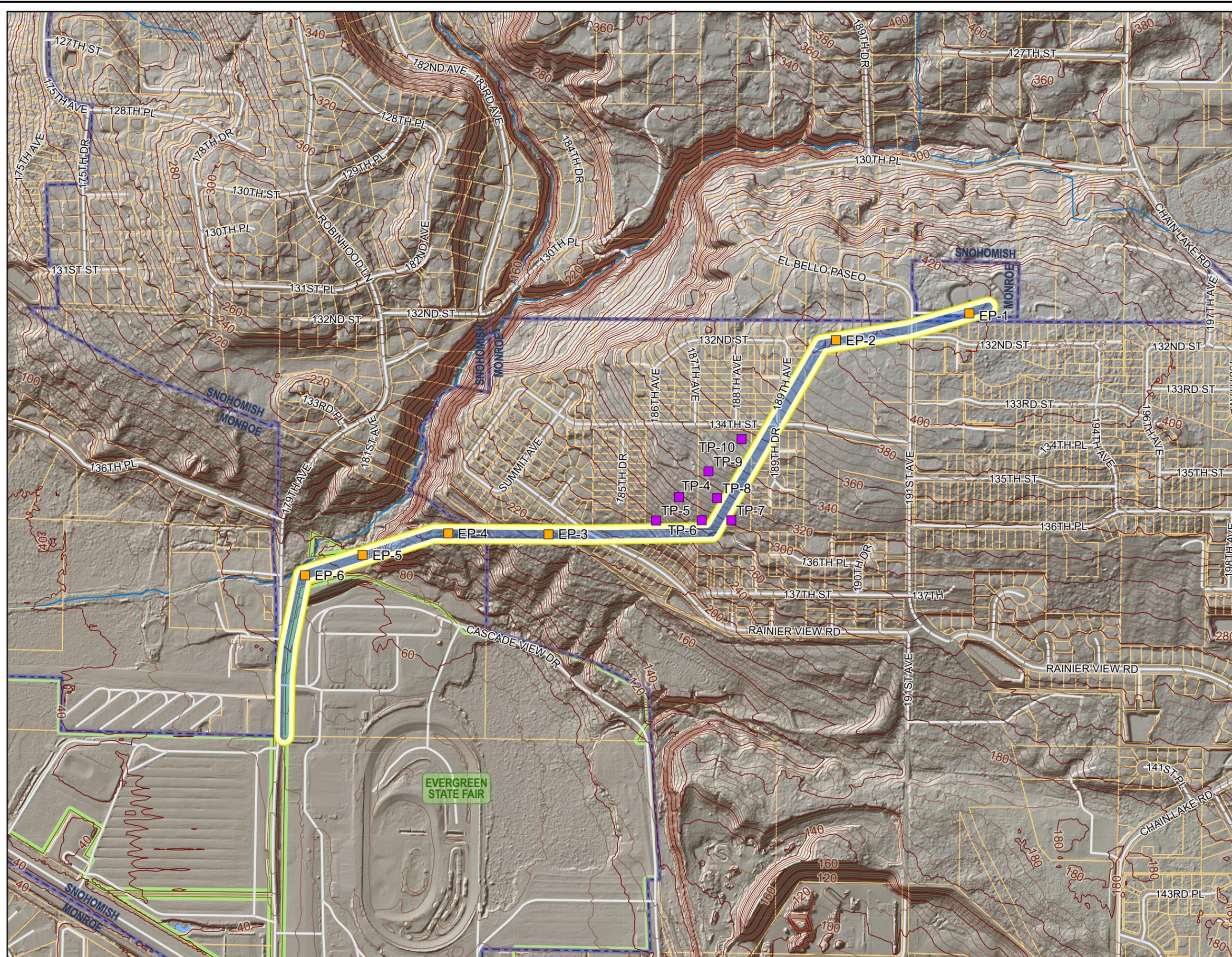
VICINITY MAP

TROMBLEY HILL AC WATER MAIN REPLACEMENT  
MONROE, WASHINGTON

PROJECT NO. 20250076E001	DATE 6/25	FIGURE 1
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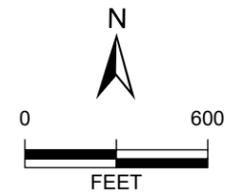


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LEGEND

-  SITE
-  EXPLORATION PIT (AESI, 2025)
-  EXPLORATION PIT (TERRA ASSOCIATES, INC., 2024)
-  CONTOUR 20 FT
-  CONTOUR 5 FT
-  WATER EASEMENT
-  CITY BOUNDARY
-  PARCEL
-  COUNTY PARK



DATA SOURCES/REFERENCES:  
SNOHOMISH COUNTY: TAX PARCELS, PARKS, STREETS, TRAILS, CITY BOUNDARY (3/24), WATERBODIES AND STREAMS (11/21). AERIAL IMAGERY (2024). WADNR LIDAR: NORTH PUGET 2017 ACQUIRED MARCH TO SEPT 2016, 3' CELL SIZE. PSLC: CEDAR RIVER A 2014 ACQUIRED 10/13 TO 07/14, 3' CELL SIZE. CONTOURS DERIVED FROM LIDAR.

BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION. LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

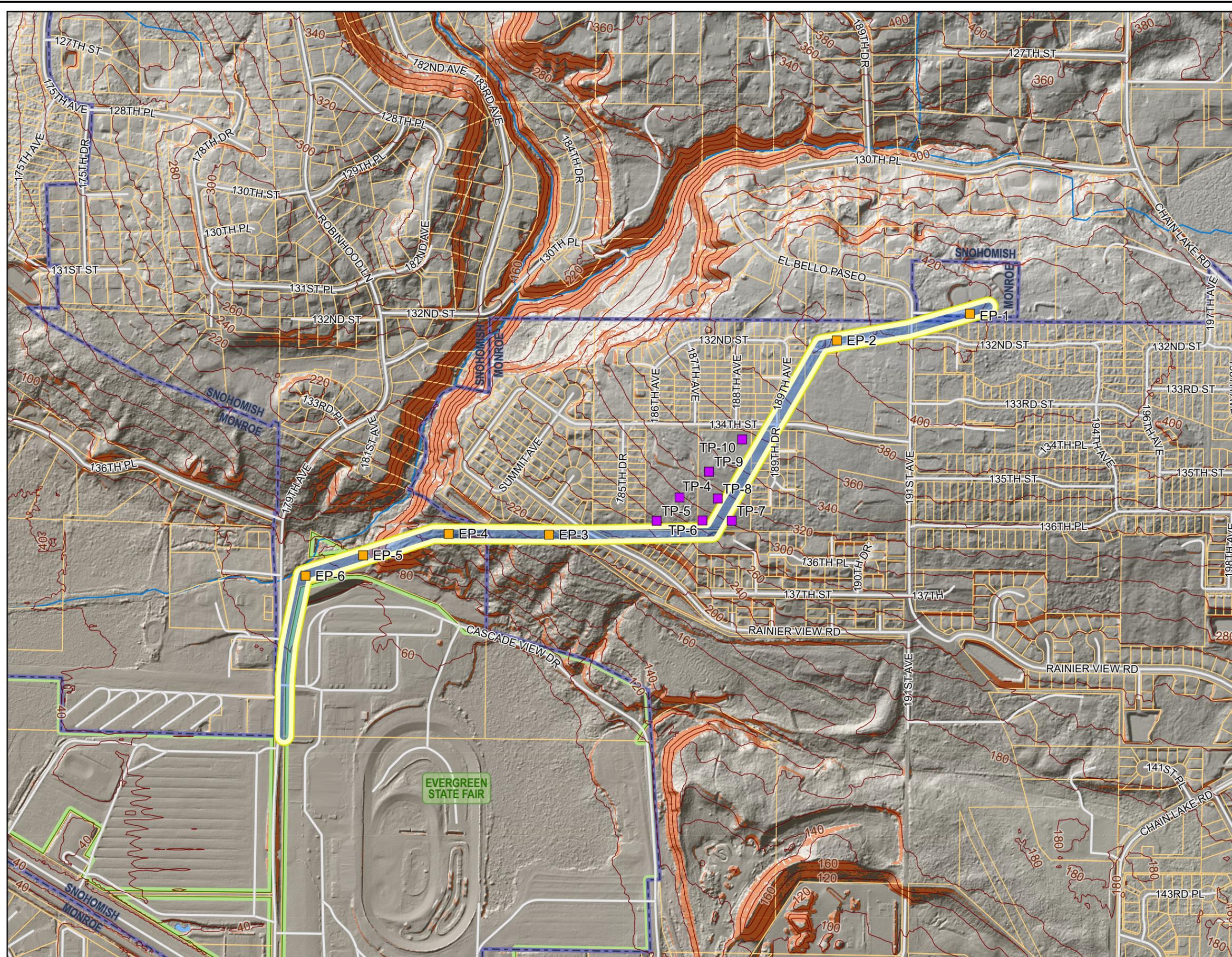


LIDAR BASED TOPOGRAPHY

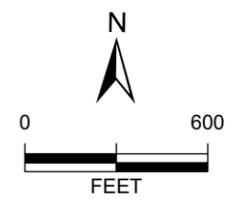
TROMBLEY HILL AC WATER MAIN REPLACEMENT  
MONROE, WASHINGTON

PROJECT NO. 20250076E001	DATE 7/25	FIGURE 3
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- LEGEND**
- SITE
  - EXPLORATION PIT (AESI, 2025)
  - EXPLORATION PIT (TERRA ASSOCIATES, INC., 2024)
  - CONTOUR 20 FT
  - CRITICAL SLOPE AREA (>40%)
  - WATER EASEMENT
  - CITY BOUNDARY
  - PARCEL
  - COUNTY PARK



DATA SOURCES/REFERENCES:  
SNOHOMISH COUNTY: TAX PARCELS, PARKS, STREETS, TRAILS, CITY BOUNDARY (3/24), WATERBODIES AND STREAMS (11/21). AERIAL IMAGERY (2024). WADNR LIDAR: NORTH PUGET 2017 ACQUIRED MARCH TO SEPT 2016, 3' CELL SIZE. PSLC: CEDAR RIVER A 2014 ACQUIRED 10/13 TO 07/14, 3' CELL SIZE. CONTOURS DERIVED FROM LIDAR.

BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION. LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.



### CRITICAL SLOPE AREAS

TROMBLEY HILL AC WATER MAIN REPLACEMENT  
MONROE, WASHINGTON

PROJECT NO. 20250076E001	DATE 7/25	FIGURE 4
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## **APPENDIX A**

### **Exploration Logs (AESI, 2025)**

Coarse-Grained Soils - More than 50% <sup>(1)</sup> Retained on No. 200 Sieve	Gravels - More than 50% <sup>(1)</sup> of Coarse Fraction Retained on No. 4 Sieve		<b>GW</b> Well-graded gravel and gravel with sand, little to no fines
			<b>GP</b> Poorly-graded gravel and gravel with sand, little to no fines
	Sands - 50% <sup>(1)</sup> or More of Coarse Fraction Passes No. 4 Sieve		<b>GM</b> Silty gravel and silty gravel with sand
			<b>GC</b> Clayey gravel and clayey gravel with sand
Fine-Grained Soils - 50% <sup>(1)</sup> or More Passes No. 200 Sieve	Sands - 50% <sup>(1)</sup> or More of Coarse Fraction Passes No. 4 Sieve		<b>SW</b> Well-graded sand and sand with gravel, little to no fines
			<b>SP</b> Poorly-graded sand and sand with gravel, little to no fines
	Sils and Clays Liquid Limit Less than 50		<b>SM</b> Silty sand and silty sand with gravel
			<b>SC</b> Clayey sand and clayey sand with gravel
Highly Organic Soils	Sils and Clays Liquid Limit 50 or More		<b>ML</b> Silt, sandy silt, gravelly silt, silt with sand or gravel
			<b>CL</b> Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay
	Sils and Clays Liquid Limit 50 or More		<b>OL</b> Organic clay or silt of low plasticity
			<b>MH</b> Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt
Highly Organic Soils	Sils and Clays Liquid Limit 50 or More		<b>CH</b> Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel
			<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

### Terms Describing Relative Density and Consistency

Coarse-Grained Soils	<u>Density</u>	<u>SPT<sup>(3)</sup> blows/foot</u>	<b>Test Symbols</b> G = Grain Size M = Moisture Content A = Atterberg Limits C = Chemical DD = Dry Density K = Permeability
	Very Loose	0 to 4	
	Loose	4 to 10	
	Medium Dense	10 to 30	
	Dense	30 to 50	
Fine-Grained Soils	Very Dense	>50	
	<u>Consistency</u>	<u>SPT<sup>(3)</sup> blows/foot</u>	
	Very Soft	0 to 2	
	Soft	2 to 4	
	Medium Stiff	4 to 8	
Stiff	8 to 15		
Very Stiff	15 to 30		
Hard	>30		

### Component Definitions

<u>Descriptive Term</u>	<u>Size Range and Sieve Number</u>
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)

### (4) Estimated Percentage

<u>Component</u>	<u>Percentage by Weight</u>
Trace	<5
Some	5 to <12
<i>Modifier</i> (silty, sandy, gravelly)	12 to <30
Very <i>modifier</i> (silty, sandy, gravelly)	30 to <50

### Moisture Content

Dry - Absence of moisture, dusty, dry to the touch

Slightly Moist - Perceptible moisture

Moist - Damp but no visible water

Very Moist - Water visible but not free draining

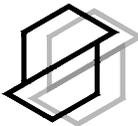
Wet - Visible free water, usually from below water table

### Symbols

<u>Sampler Type and Description</u>	<u>Groundwater depth</u>	
	ATD	Cement grout surface seal
	At time of drilling	Bentonite seal
		Filter pack with blank casing section
	Static water level (date)	Screened casing or Hydrotip with filter pack
		End cap

Classifications of soils in this report 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 D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

(1) Percentage by dry weight  
 (2) Combined USCS symbols used for fines between 5% and 12%  
 (3) (SPT) Standard Penetration Test (ASTM D-1586)  
 (4) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)



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**EXPLORATION LOG KEY**

FIGURE: **A1**



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**Exploration Pit**

**EP-1**

**Trombley Hill AC Water Main Replacement**

Sheet: 1 of 1

Monroe, WA

Date: 6-30-25

Logged By: PL

20250076E001

Total Depth (ft): 11

Approved By: JHS

Depth (ft)	Description	USCS
	Elev.: ≈423 ft NAVD88	
0	<p><b>Topsoil - 6 inches</b> Loose, moist, dark brown, silty, fine SAND, some gravel; fine roots, organics (SM).</p>	
	<p><b>Vashon Lodgement Till</b> Medium dense, moist, orangish brown, silty, fine SAND, some gravel; unsorted (SM).</p>	
2.5	Dense, moist, brownish gray, silty, fine SAND, some gravel; unsorted; scattered cobbles (SM).	
5	Very dense, moist, brownish gray, silty, fine SAND, some gravel; unsorted (SM).	
10	No seepage. No caving.	
12.5		
15		
17.5		
20		

7/25/2025  
20250076E001



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**Exploration Pit**

**EP-2**

**Trombley Hill AC Water Main Replacement**

Sheet: 1 of 1

Monroe, WA

Date: 6-30-25

Logged By: PL

20250076E001

Total Depth (ft): 12

Approved By: JHS

Depth (ft)	Description	USCS
	Elev.: ≈402 ft NAVD88	
0	<b>Topsoil - 12 inches</b> Loose, moist, dark brown, silty, fine SAND, some gravel; fine roots and organics (SM).	SM
2.5	<b>Vashon Recessional Outwash</b> Medium dense, moist, orangish brown, silty, fine SAND, trace gravel; stratified (SM).  Medium dense, moist, brown, silty, fine SAND, trace gravel; stratified (SM).	SM
7.5	Medium dense, moist, grayish brown, fine SAND, some silt, some gravel; stratified; thin beds of silty, fine sand (SP-SM).	SM
12.5	<b>Vashon Lodgement Till</b> Very dense, moist, brownish gray, silty, fine SAND, some gravel; unsorted; scattered cobbles (SM).  No seepage. No caving.	SM
15		
17.5		
20		

7/25/2025  
20250076E001



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earth sciences  
incorporated

**Exploration Pit**

**EP-3**

**Trombley Hill AC Water Main Replacement**

Sheet: 1 of 1

Monroe, WA

Date: 6-30-25

Logged By: PL

20250076E001

Total Depth (ft): 11

Approved By: JHS

Depth (ft)	Description	USCS
	Elev.: ≈212 ft NAVD88	
0	<b>Topsoil - 4 inches</b> Loose, moist, dark brown, silty, fine SAND, trace gravel; fine roots and organics (SM).	
	<b>Fill</b> Medium dense, moist, dark brown, silty, fine SAND, some gravel; chaotic texture; scattered fine organics (SM).	
2.5	<b>Vashon Recessional Outwash</b> Medium dense, moist, orangish brown, silty, fine SAND, some gravel; stratified; fine roots (SM).	
5	<b>Vashon Lodgement Till</b> Dense, moist, brownish gray, silty, fine SAND, some gravel; unsorted; scattered cobbles (SM).	
7.5	Very dense, moist, brownish gray, silty, fine SAND, some gravel; unsorted (SM).	
10	No seepage. No caving.	
12.5		
15		
17.5		
20		

7/25/2025  
20250076E001



associated  
earth sciences  
incorporated

**Exploration Pit**

**EP-4**

**Trombley Hill AC Water Main Replacement**

Sheet: 1 of 1

Monroe, WA

Date: 6-30-25

Logged By: PL

20250076E001

Total Depth (ft): 10

Approved By: JHS

Depth (ft)	Description	USCS
	Elev.: ≈145 ft NAVD88	
0	<b>Topsoil</b> Loose, moist, dark brown, silty, fine SAND, some gravel; fine roots and organics (SM).	
	<b>Vashon Recessional Outwash</b> Medium dense, moist, orangish brown, silty, fine SAND, trace gravel; stratified; fine roots (SM).	
2.5	Medium dense, moist, brown, fine SAND, some silt, some gravel; stratified (SP-SM).	
5	Medium dense, moist, brown, gravelly, fine SAND, trace silt; stratified (SP).	
	<b>Vashon Lodgement Till</b> Dense, moist, brownish gray, silty, fine SAND, some gravel; unsorted; scattered cobbles (SM).	
7.5	Very dense, moist, brownish gray, silty, fine SAND, some gravel; unsorted (SM).	
10	No seepage. Minor caving 0 to 6 feet.	
12.5		
15		
17.5		
20		

7/25/2025  
20250076E001



associated  
earth sciences  
incorporated

**Exploration Pit**

**EP-5**

**Trombley Hill AC Water Main Replacement**

Sheet: 1 of 1

Monroe, WA

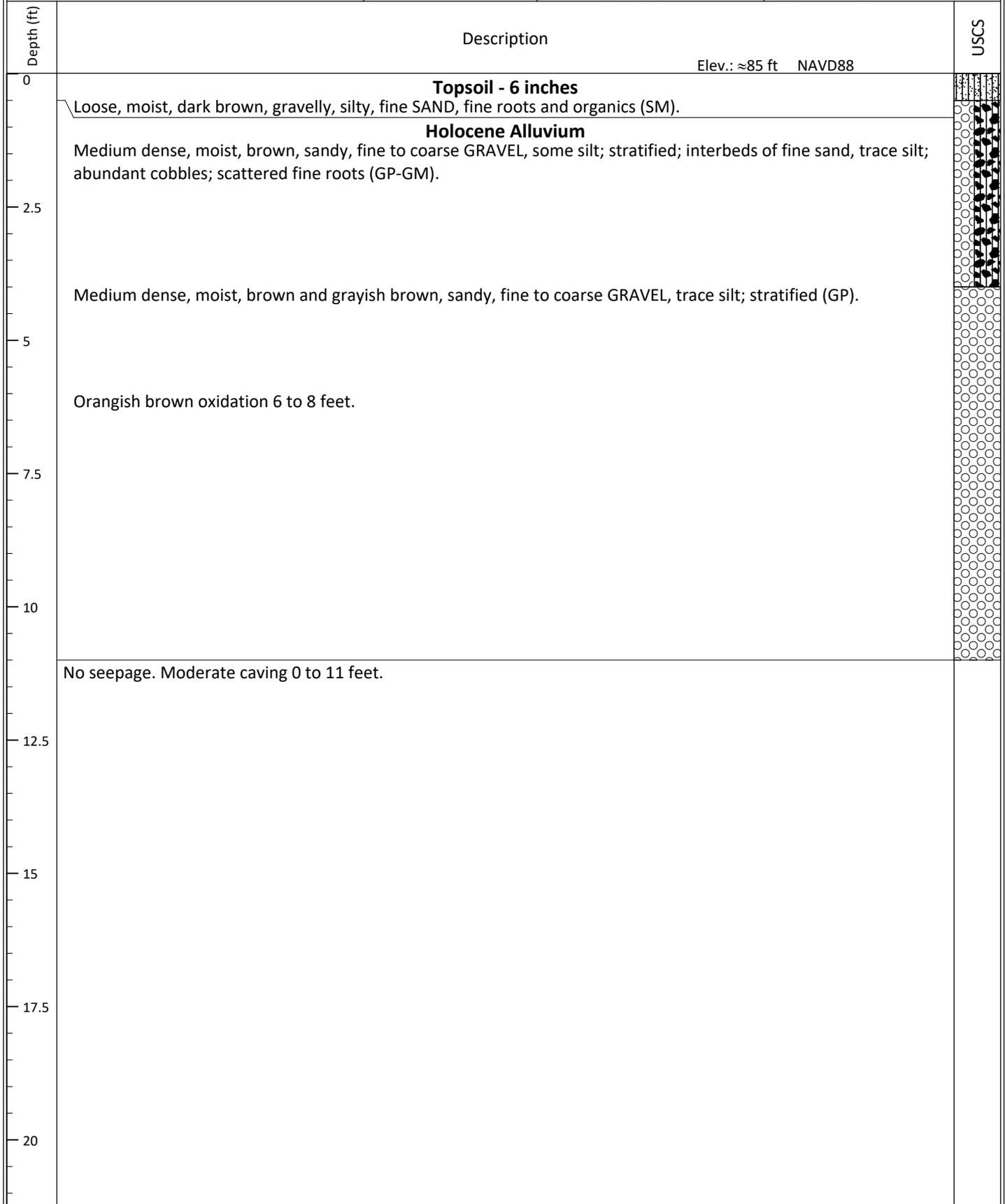
Date: 6-30-25

Logged By: PL

20250076E001

Total Depth (ft): 11

Approved By: JHS



7/25/2025  
20250076E001



associated  
earth sciences  
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**Exploration Pit**

**EP-6**

**Trombley Hill AC Water Main Replacement**

Sheet: 1 of 1

Monroe, WA

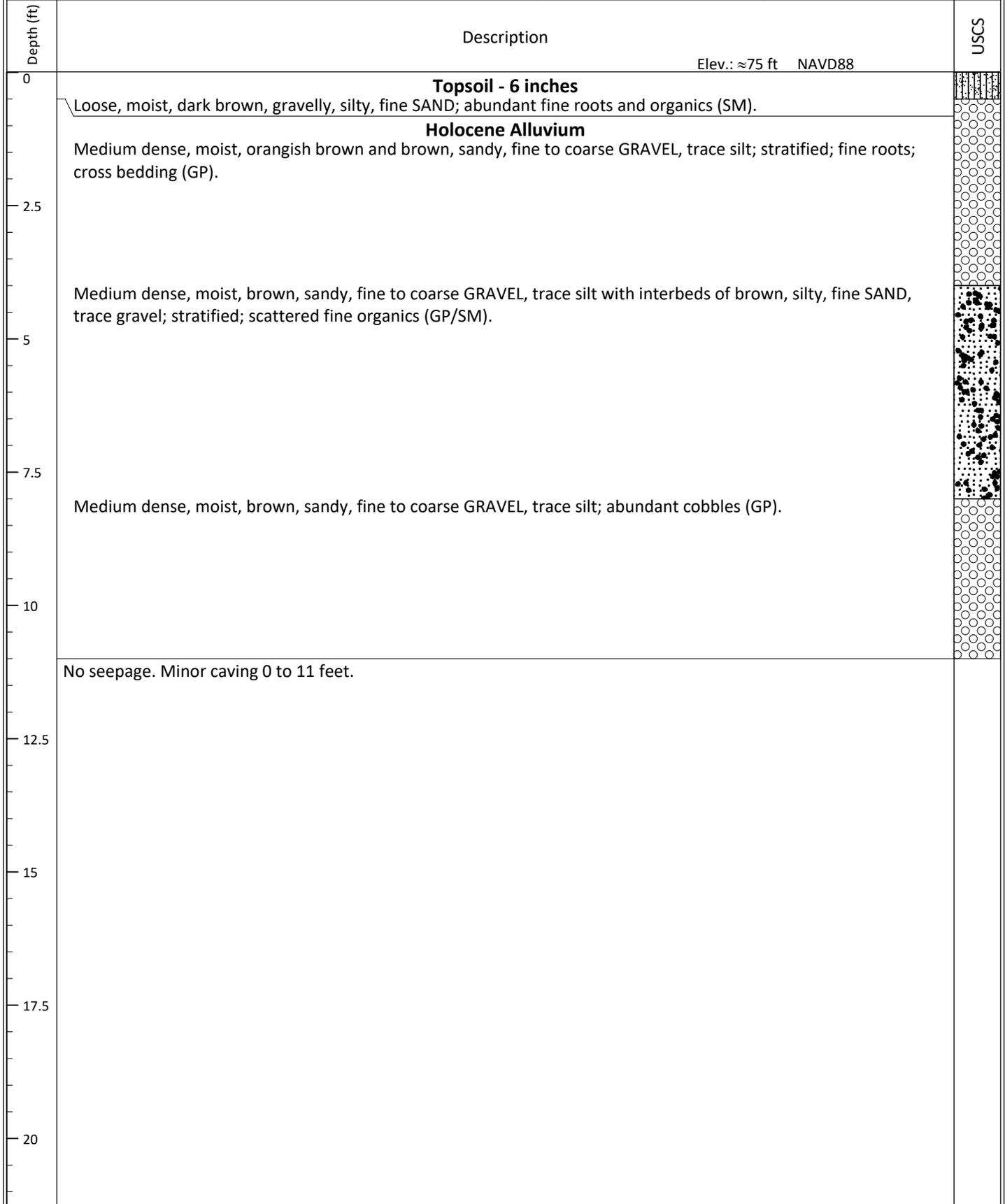
Date: 6-30-25

Logged By: PL

20250076E001

Total Depth (ft): 11

Approved By: JHS



7/25/2025  
20250076E001

## **APPENDIX B**

### **Exploration Logs (Terra Associates Inc., 2024)**

# LOG OF TEST PIT NO.TP-4

FIGURE A-5

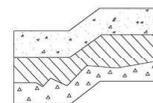
PROJECT NAME: Monroe West PROJ. NO: T-9077 LOGGED BY: MJX

LOCATION: Monroe, Washington SURFACE CONDITIONS: Tall Grass APPROX. ELEV: NA

DATE LOGGED: August 16, 2024 DEPTH TO GROUNDWATER: NA DEPTH TO CAVING: NA

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(8-inches organic TOPSOIL)		
1		Brown sandy SILT, fine to medium sand, dry, trace rootlets, trace gravel, trace cobbles. (SM) (Weathered Till)	Medium Dense	16.9
2		Gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, dry to moist, scattered cobbles, moderate to strong cementation. (SM) (Unweathered Till)		6.9
3			Dense	
4				9.2
5				
6			Very Dense	
7				
8				9.3
9		Test Pit terminated at approximately 8 feet. No groundwater seepage observed. No caving observed.		
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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# LOG OF TEST PIT NO.TP-5

FIGURE A-6

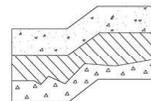
PROJECT NAME: Monroe West PROJ. NO: T-9077 LOGGED BY: MJX

LOCATION: Monroe, Washington SURFACE CONDITIONS: Tall Grass APPROX. ELEV: NA

DATE LOGGED: August 16, 2024 DEPTH TO GROUNDWATER: NA DEPTH TO CAVING: NA

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(4-inches organic TOPSOIL)		
1		Brown silty GRAVEL with sand, fine to coarse sand, fine to coarse gravel, dry, trace rootlets, trace cobbles, occasional boulder. (GM) (Weathered Till)	Medium Dense	14.9
2				
3				
4		Gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist, trace cobbles, strong cementation. (SM) (Unweathered Till)		10.5
5				
6			Very Dense	
7				
8		Test Pit terminated at approximately 8 feet. No groundwater seepage observed. No caving observed.		9.7
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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# LOG OF TEST PIT NO.TP-6

FIGURE A-7

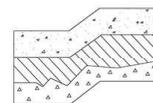
PROJECT NAME: Monroe West PROJ. NO: T-9077 LOGGED BY: MJX

LOCATION: Monroe, Washington SURFACE CONDITIONS: Grass APPROX. ELEV: NA

DATE LOGGED: August 16, 2024 DEPTH TO GROUNDWATER: NA DEPTH TO CAVING: NA

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(6-inches organic TOPSOIL)		
1		Brown sandy SILT with gravel, fine to coarse sand, fine to coarse gravel, dry, trace rootlets, trace cobbles, occasional boulder. (ML) (Weathered Till)	Medium Dense	14.0
2				
3				
4		Gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist, trace cobbles, strong cementation. (SM) (Unweathered Till)	Very Dense	15.1
5				
6				
7				
8		Test Pit terminated at approximately 8 feet. No groundwater seepage observed. No caving observed.		7.8
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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 Environmental Earth Sciences

# LOG OF TEST PIT NO.TP-7

FIGURE A-8

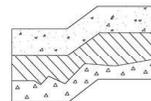
PROJECT NAME: Monroe West PROJ. NO: T-9077 LOGGED BY: MJX

LOCATION: Monroe, Washington SURFACE CONDITIONS: Grass APPROX. ELEV: NA

DATE LOGGED: August 16, 2024 DEPTH TO GROUNDWATER: NA DEPTH TO CAVING: NA

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(6-inches organic TOPSOIL)		
1		Brown sandy SILT with gravel, fine to coarse sand, fine to coarse gravel, dry, trace rootlets, trace cobbles. (ML) (Weathered Till)	Medium Dense	12.3
2				
3		Gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, dry to moist, slightly mottled, trace cobbles, strong cementation. (SM) (Unweathered Till)		4.7
4				
5			Very Dense	
6				
7				
8		Test Pit terminated at approximately 8 feet. No groundwater seepage observed. No caving observed.		10.3
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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 Environmental Earth Sciences

# LOG OF TEST PIT NO.TP-8

FIGURE A-9

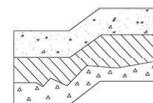
PROJECT NAME: Monroe West PROJ. NO: T-9077 LOGGED BY: MJX

LOCATION: Monroe, Washington SURFACE CONDITIONS: Grass APPROX. ELEV: NA

DATE LOGGED: August 16, 2024 DEPTH TO GROUNDWATER: NA DEPTH TO CAVING: NA

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(7-inches organic TOPSOIL)		
1		Brownish-gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, dry, trace cobbles, occasional rootlet. (SM) (Weathered Till)	Medium Dense	10.8
2		----- Gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, dry to moist, slightly mottled, trace cobbles, moderate to strong cementation. (SM) (Unweathered Till)		7.7
3				
4				
5			Very Dense	
6				
7				
8		Test Pit terminated at approximately 8 feet. No groundwater seepage observed. No caving observed.		7.1
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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 Environmental Earth Sciences

# LOG OF TEST PIT NO.TP-9

FIGURE A-10

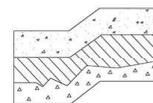
PROJECT NAME: Monroe West PROJ. NO: T-9077 LOGGED BY: MJX

LOCATION: Monroe, Washington SURFACE CONDITIONS: Grass APPROX. ELEV: NA

DATE LOGGED: August 16, 2024 DEPTH TO GROUNDWATER: NA DEPTH TO CAVING: NA

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(5-inches organic TOPSOIL)		
1		FILL: Brown silty SAND with gravel, fine to coarse sand, fine to coarse gravel, dry, trace rootlets, occasional small-sized organic fragment. (SM)	Medium Dense	5.2
2		Brown sandy SILT, fine to medium sand, moist, trace gravel, trace cobbles, occasional rootlet. (ML) (Weathered Till)		17.6
3		Gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist, slightly mottled, trace cobbles, occasional boulder, moderate to strong cementation. (SM) (Unweathered Till)	Very Dense	8.6
4				
5				
6				
7				
8				
9		Test Pit terminated at approximately 8 feet. No groundwater seepage observed. No caving observed.		8.6
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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# LOG OF TEST PIT NO.TP-10

FIGURE A-11

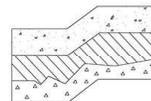
PROJECT NAME: Monroe West PROJ. NO: T-9077 LOGGED BY: MJX

LOCATION: Monroe, Washington SURFACE CONDITIONS: Grass APPROX. ELEV: NA

DATE LOGGED: August 16, 2024 DEPTH TO GROUNDWATER: NA DEPTH TO CAVING: NA

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(6-inches organic TOPSOIL)		
1		Gray silty SAND with gravel, fine to coarse sand, fine to coarse gravel, dry to moist, slightly mottled, trace cobbles, occasional rootlet, moderate to strong cementation. (SM) (Unweathered Till)	Dense	4.1
2				
3			6.7	
4			Very Dense	
5				
6				
7				
8		Test Pit terminated at approximately 8 feet. No groundwater seepage observed. No caving observed.		9.0
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



**Terra Associates, Inc.**  
 Consultants in Geotechnical Engineering  
 Geology and  
 Environmental Earth Sciences

## **APPENDIX C**

### **Laboratory Analysis Report**

**Am Test Inc.**  
13600 NE 126th Place Suite C  
Kirkland, WA  
(425) 885-1664  
www.amtestlab.com



**Professional  
Analytical  
Services**

August 05, 2025

Associated Earth Sciences  
911 - 5th Avenue Suite 100  
Kirkland, WA 98033  
Attention: Peter Linton

**Project:** Trombley Hill AC Water Main Replacement

**Project Number:** 20250076E001

**COC Number:** A25G0272

Peter Linton:

Enclosed please find the analytical data for your Trombley Hill AC Water Main Replacement project.

Your sample(s) were received on Thursday, July 10, 2025 and properly maintained prior to the subsequent analysis. The analytical procedures used at AmTest are well documented and are typically derived from the protocols of the EPA, USDA, FDA, Standard Methods or the Army Corps of Engineers.

Following the analytical results you will find the Quality Control (QA/QC) results.

Please note that the detection limits that are listed in the body of the report refer to the Practical Quantitation Limits (PQL's), as opposed to the Method Detection Limits (MDL's).

If you should have any questions pertaining to the data package, please feel free to contact me.

Sincerely,

A handwritten signature in black ink that reads "Aaron Young". The signature is written in a cursive style with a long, sweeping tail on the letter "j".

**Aaron Young**

**President**

**aarony@amtestlab.com**

**Am Test Inc.**  
13600 NE 126th Place Suite C  
Kirkland, WA  
(425) 885-1664  
www.amtestlab.com



**Professional  
Analytical  
Services**

## ANALYSIS REPORT

**Date Received:** 07/10/25  
**Date Reported:** 08/05/25

**Associated Earth Sciences**

911 - 5th Avenue Suite 100  
Kirkland, WA 98033

Attention: Peter Linton

Project Name: Trombley Hill AC Water Main Replacement

Project #: 20250076E001

---

### Reported Samples

Lab ID	Sample	Matrix	Qualifiers	Date Sampled	Date Received
A25G0272-01	20250076E001_EP-5@4'	Solid		06/30/2025	07/10/2025
A25G0272-02	20250076E001_EP-6@4'	Solid		06/30/2025	07/10/2025

**ANALYSIS REPORT**

**Date Received:** 07/10/25  
**Date Reported:** 08/05/25

**Associated Earth Sciences**

911 - 5th Avenue Suite 100  
 Kirkland, WA 98033

Attention: Peter Linton

Project Name: Trombley Hill AC Water Main Replacement

Project #: 20250076E001

**AMTEST Identification Number: A25G0272-01**

**Client Identification: 20250076E001\_EP-5@4'**

**Sampling Date: 06/30/25 13:00**

**Conventional Chemistry Parameters by APHA/EPA Methods**

PARAMETER	RESULT	UNITS	Q	R.L.	METHOD	ANALYST	DATE
% Solids	97.8	%			SM 2540G_2011	HV	07/14/2025
pH	6.2	pH Units			SM 4500-H+B_2011	HS	07/28/2025
Resistivity	430,000	Ohms/cm			ASTM G-187	HV	07/15/2025
Sulfide	ND	mg/kg dry	U	2.00	SM 4500-S2-D_2011	KH	07/28/2025

**Anions by EPA Method 300.0**

PARAMETER	RESULT	UNITS	Q	R.L.	METHOD	ANALYST	DATE
Chloride	ND	mg/kg dry	U	2.85	EPA 300.0_2.1_1993	EZ	07/21/2025

**AMTEST Identification Number: A25G0272-02**

**Client Identification: 20250076E001\_EP-6@4'**

**Sampling Date: 06/30/25 13:15**

**Conventional Chemistry Parameters by APHA/EPA Methods**

PARAMETER	RESULT	UNITS	Q	R.L.	METHOD	ANALYST	DATE
% Solids	93.9	%			SM 2540G_2011	HV	07/14/2025
pH	5.4	pH Units			SM 4500-H+B_2011	HS	07/28/2025
Resistivity	350,000	Ohms/cm			ASTM G-187	HV	07/15/2025
Sulfide	ND	mg/kg dry	U	2.00	SM 4500-S2-D_2011	KH	07/28/2025

**Anions by EPA Method 300.0**

PARAMETER	RESULT	UNITS	Q	R.L.	METHOD	ANALYST	DATE
Chloride	ND	mg/kg dry	U	6.85	EPA 300.0_2.1_1993	EZ	07/21/2025

**ANALYSIS REPORT**

**Date Received:** 07/10/25  
**Date Reported:** 08/05/25

**Associated Earth Sciences**

911 - 5th Avenue Suite 100  
 Kirkland, WA 98033

Attention: Peter Linton

Project Name: Trombley Hill AC Water Main Replacement

Project #: 20250076E001

**Quality Control**

**Conventional Chemistry Parameters by APHA/EPA Methods**

Analyte	Result	Qual	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>Batch: BCG0192 - No Prep - WC Soil</b>										
<b>Calibration Blank (BCG0192-CCB1)</b>					Prepared: 07/11/25 Analyzed: 07/14/25					
% Solids	99.8			%						
<b>Calibration Blank (BCG0192-CCB2)</b>					Prepared: 07/11/25 Analyzed: 07/14/25					
% Solids	100			%						
<b>Calibration Blank (BCG0192-CCB3)</b>					Prepared: 07/11/25 Analyzed: 07/14/25					
% Solids	100			%						
<b>Calibration Blank (BCG0192-CCB4)</b>					Prepared: 07/11/25 Analyzed: 07/14/25					
% Solids	99.9			%						
<b>Calibration Blank (BCG0192-CCB5)</b>					Prepared: 07/11/25 Analyzed: 07/14/25					
% Solids	100			%						
<b>Calibration Blank (BCG0192-CCB6)</b>					Prepared: 07/11/25 Analyzed: 07/14/25					
% Solids	99.8			%						
<b>Calibration Blank (BCG0192-CCB7)</b>					Prepared: 07/11/25 Analyzed: 07/14/25					
% Solids	99.9			%						
<b>Duplicate (BCG0192-DUP1)</b>					<b>Source: A25G0069-01</b> Prepared: 07/11/25 Analyzed: 07/14/25					
% Solids	91.7			%		91.8			0.2	20
<b>Duplicate (BCG0192-DUP2)</b>					<b>Source: A25G0161-03</b> Prepared: 07/11/25 Analyzed: 07/14/25					
% Solids	80.0			%		79.5			0.6	20
<b>Duplicate (BCG0192-DUP3)</b>					<b>Source: A25G0170-01</b> Prepared: 07/11/25 Analyzed: 07/14/25					
% Solids	91.8			%		94.6			3	20
<b>Duplicate (BCG0192-DUP4)</b>					<b>Source: A25G0193-01</b> Prepared: 07/11/25 Analyzed: 07/14/25					
% Solids	90.4			%		90.5			0.08	20
<b>Duplicate (BCG0192-DUP5)</b>					<b>Source: A25G0219-02</b> Prepared: 07/11/25 Analyzed: 07/14/25					
% Solids	22.1			%		22.1			0.05	20
<b>Duplicate (BCG0192-DUP6)</b>					<b>Source: A25G0220-04</b> Prepared: 07/11/25 Analyzed: 07/14/25					
% Solids	21.8			%		21.3			2	20

**ANALYSIS REPORT**

**Date Received:** 07/10/25

**Date Reported:** 08/05/25

**Associated Earth Sciences**

911 - 5th Avenue Suite 100  
 Kirkland, WA 98033

Attention: Peter Linton

Project Name: Trombley Hill AC Water Main Replacement

Project #: 20250076E001

**Quality Control  
 (Continued)**

**Conventional Chemistry Parameters by APHA/EPA Methods (Continued)**

Analyte	Result	Qual	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
---------	--------	------	-----------------	-------	-------------	---------------	------	-------------	-----	-----------

**Batch: BCG0192 - No Prep - WC Soil (Continued)**

**Duplicate (BCG0192-DUP7)**

**Source: A25G0220-08**

Prepared: 07/11/25 Analyzed: 07/14/25

% Solids	21.8			%		21.4			2	20
----------	------	--	--	---	--	------	--	--	---	----

**Batch: BCG0240 - No Prep - WC Soil**

**Duplicate (BCG0240-DUP1)**

**Source: A25G0272-02**

Prepared & Analyzed: 07/15/25

Resistivity	340,000			Ohms/cm		350,000			3	25
-------------	---------	--	--	---------	--	---------	--	--	---	----

**Batch: BCG0266 - No Prep - WC Soil**

**Calibration Check (BCG0266-CCV1)**

Prepared: 07/17/25 Analyzed: 07/28/25

pH	6.8			pH Units	6.860		99%	85-115%		
----	-----	--	--	----------	-------	--	-----	---------	--	--

**Calibration Check (BCG0266-CCV2)**

Prepared: 07/17/25 Analyzed: 07/28/25

pH	7.0			pH Units	6.860		102%	85-115%		
----	-----	--	--	----------	-------	--	------	---------	--	--

**Calibration Check (BCG0266-CCV3)**

Prepared: 07/17/25 Analyzed: 07/28/25

pH	7.0			pH Units	6.860		102%	85-115%		
----	-----	--	--	----------	-------	--	------	---------	--	--

**Calibration Check (BCG0266-CCV4)**

Prepared: 07/17/25 Analyzed: 07/28/25

pH	7.0			pH Units	6.860		102%	85-115%		
----	-----	--	--	----------	-------	--	------	---------	--	--

**Calibration Check (BCG0266-CCV5)**

Prepared: 07/17/25 Analyzed: 07/28/25

pH	6.9			pH Units	6.860		101%	85-115%		
----	-----	--	--	----------	-------	--	------	---------	--	--

**Duplicate (BCG0266-DUP1)**

**Source: A25G0100-02**

Prepared: 07/17/25 Analyzed: 07/28/25

pH	6.9			pH Units		6.9			0.3	10
----	-----	--	--	----------	--	-----	--	--	-----	----

**Duplicate (BCG0266-DUP2)**

**Source: A25G0362-04**

Prepared: 07/17/25 Analyzed: 07/28/25

pH	6.2			pH Units		6.2			0.5	10
----	-----	--	--	----------	--	-----	--	--	-----	----

**Duplicate (BCG0266-DUP3)**

**Source: A25G0362-15**

Prepared: 07/17/25 Analyzed: 07/28/25

pH	6.7			pH Units		6.7			0.2	10
----	-----	--	--	----------	--	-----	--	--	-----	----

**Duplicate (BCG0266-DUP4)**

**Source: A25G0362-26**

Prepared: 07/17/25 Analyzed: 07/28/25

pH	6.4			pH Units		6.4			0.5	10
----	-----	--	--	----------	--	-----	--	--	-----	----

**Duplicate (BCG0266-DUP5)**

**Source: A25G0362-37**

Prepared: 07/17/25 Analyzed: 07/28/25

**ANALYSIS REPORT**

Date Received: 07/10/25

Date Reported: 08/05/25

**Associated Earth Sciences**

911 - 5th Avenue Suite 100

Kirkland, WA 98033

Attention: Peter Linton

Project Name: Trombley Hill AC Water Main Replacement

Project #: 20250076E001

**Quality Control  
 (Continued)**

**Conventional Chemistry Parameters by APHA/EPA Methods (Continued)**

Analyte	Result	Qual	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
---------	--------	------	-----------------	-------	-------------	---------------	------	-------------	-----	-----------

**Batch: BCG0266 - No Prep - WC Soil (Continued)**

**Duplicate (BCG0266-DUP5)**

Source: A25G0362-37

Prepared: 07/17/25 Analyzed: 07/28/25

pH	7.2			pH Units		7.4			3	10
----	-----	--	--	----------	--	-----	--	--	---	----

**Batch: BCG0424 - No Prep - WC Soil**

**LCS (BCG0424-BS1)**

Prepared: 07/25/25 Analyzed: 07/28/25

Sulfide	10.9		2.00	mg/kg wet	9.860		110%	80-120%		
---------	------	--	------	-----------	-------	--	------	---------	--	--

**Calibration Blank (BCG0424-CCB1)**

Prepared: 07/25/25 Analyzed: 07/28/25

Sulfide	ND	U		mg/kg wet						
---------	----	---	--	-----------	--	--	--	--	--	--

**Calibration Check (BCG0424-CCV1)**

Prepared: 07/25/25 Analyzed: 07/28/25

Sulfide	21.1		2.00	mg/kg wet	24.65		85%	85-115%		
---------	------	--	------	-----------	-------	--	-----	---------	--	--

**Matrix Spike (BCG0424-MS1)**

Source: A25G0272-02

Prepared: 07/25/25 Analyzed: 07/28/25

Sulfide	7.09		2.00	mg/kg dry	9.507	0.21	72%	50-150%		
---------	------	--	------	-----------	-------	------	-----	---------	--	--

**Matrix Spike Dup (BCG0424-MSD1)**

Source: A25G0272-02

Prepared: 07/25/25 Analyzed: 07/28/25

Sulfide	7.22		2.00	mg/kg dry	9.738	0.21	72%	50-150%	2	25
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**Quality Control  
 (Continued)**

**Anions by EPA Method 300.0**

Analyte	Result	Qual	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
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**Batch: BCG0330 - Water Leach**

**Blank (BCG0330-BLK1)**

Prepared & Analyzed: 07/21/25

Chloride	ND	U	5.00	mg/kg wet						
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**LCS (BCG0330-BS1)**

Prepared & Analyzed: 07/21/25

Chloride	1.00		0.10	mg/kg wet	1.000		100%	80-120%		
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**Calibration Blank (BCG0330-CCB1)**

Prepared & Analyzed: 07/21/25

Chloride	ND	U		mg/kg wet						
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**ANALYSIS REPORT**

**Date Received:** 07/10/25

**Date Reported:** 08/05/25

**Associated Earth Sciences**

911 - 5th Avenue Suite 100  
 Kirkland, WA 98033

Attention: Peter Linton

Project Name: Trombley Hill AC Water Main Replacement

Project #: 20250076E001

**Quality Control  
 (Continued)**

**Anions by EPA Method 300.0 (Continued)**

Analyte	Result	Qual	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>Batch: BCG0330 - Water Leach (Continued)</b>										
<b>Calibration Blank (BCG0330-CCB2)</b>					Prepared & Analyzed: 07/21/25					
Chloride	ND	U		mg/kg wet						
<b>Calibration Check (BCG0330-CCV1)</b>					Prepared & Analyzed: 07/21/25					
Chloride	2.02		0.10	mg/kg wet	2.000		101%	85-115%		
<b>Calibration Check (BCG0330-CCV2)</b>					Prepared & Analyzed: 07/21/25					
Chloride	2.02		0.10	mg/kg wet	2.000		101%	85-115%		
<b>Duplicate (BCG0330-DUP1)</b>					<b>Source: A25G0196-01</b> Prepared & Analyzed: 07/21/25					
Chloride	3.25	DUP, U	16.2	mg/kg wet		5.03			43	40
<b>Duplicate (BCG0330-DUP2)</b>					<b>Source: A25G0448-06</b> Prepared & Analyzed: 07/21/25					
Chloride	4.20	U, DUP	8.72	mg/kg dry		1.86			77	40
<b>Matrix Spike (BCG0330-MS1)</b>					<b>Source: A25G0196-01</b> Prepared & Analyzed: 07/21/25					
Chloride	156		7.46	mg/kg wet	149.1	5.03	101%	70-130%		
<b>Matrix Spike (BCG0330-MS2)</b>					<b>Source: A25G0448-06</b> Prepared & Analyzed: 07/21/25					
Chloride	88.2		4.26	mg/kg dry	85.11	1.86	101%	70-130%		
<b>Reference (BCG0330-SRM1)</b>					Prepared & Analyzed: 07/21/25					
Chloride	5.05		0.10	mg/kg wet	5.000		101%	0-200%		



**ANALYSIS REPORT**

**Date Received:** 07/10/25  
**Date Reported:** 08/05/25

**Associated Earth Sciences**

911 - 5th Avenue Suite 100  
Kirkland, WA 98033

Attention: Peter Linton

Project Name: Trombley Hill AC Water Main Replacement

Project #: 20250076E001

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**Notes and Definitions**

<b>Item</b>	<b>Definition</b>
U	The compound was analyzed for but was not detected (Non-detect) at or above the MRL/MDL.
<b>Dry</b>	Sample results reported on a dry weight basis.
<b>ND</b>	Analyte NOT DETECTED at or above the reporting limit.
<b>RPD</b>	Relative Percent Difference
<b>%REC</b>	Percent Recovery
<b>Source</b>	Sample that was matrix spiked or duplicated.

