WALLULA GAP BUSINESS PARK ROADS 2023
GEOTECHNICAL REPORT

JUNE 2023

Prepared for the
Port of Walla Walla

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ANDERSON PERRY & ASSOCIATES, INC.

Walla Walla, Washington
La Grande, Redmond, Hermiston, and Enterprise, Oregon

Job No. 385-399

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Chapter 1 - Introduction and Scope of Work

This report provides an assessment of the on-site conditions for the proposed Port of Walla Walla (Port) Wallula Gap Business Park Roads 2023 project located in Walla Walla County, Washington. The information presented describes the *in-situ* soil conditions; a liquefaction assessment; observations of groundwater conditions; soil percolation information; slope considerations; and provides recommendations for site preparation, roadway and embankment design, and construction.

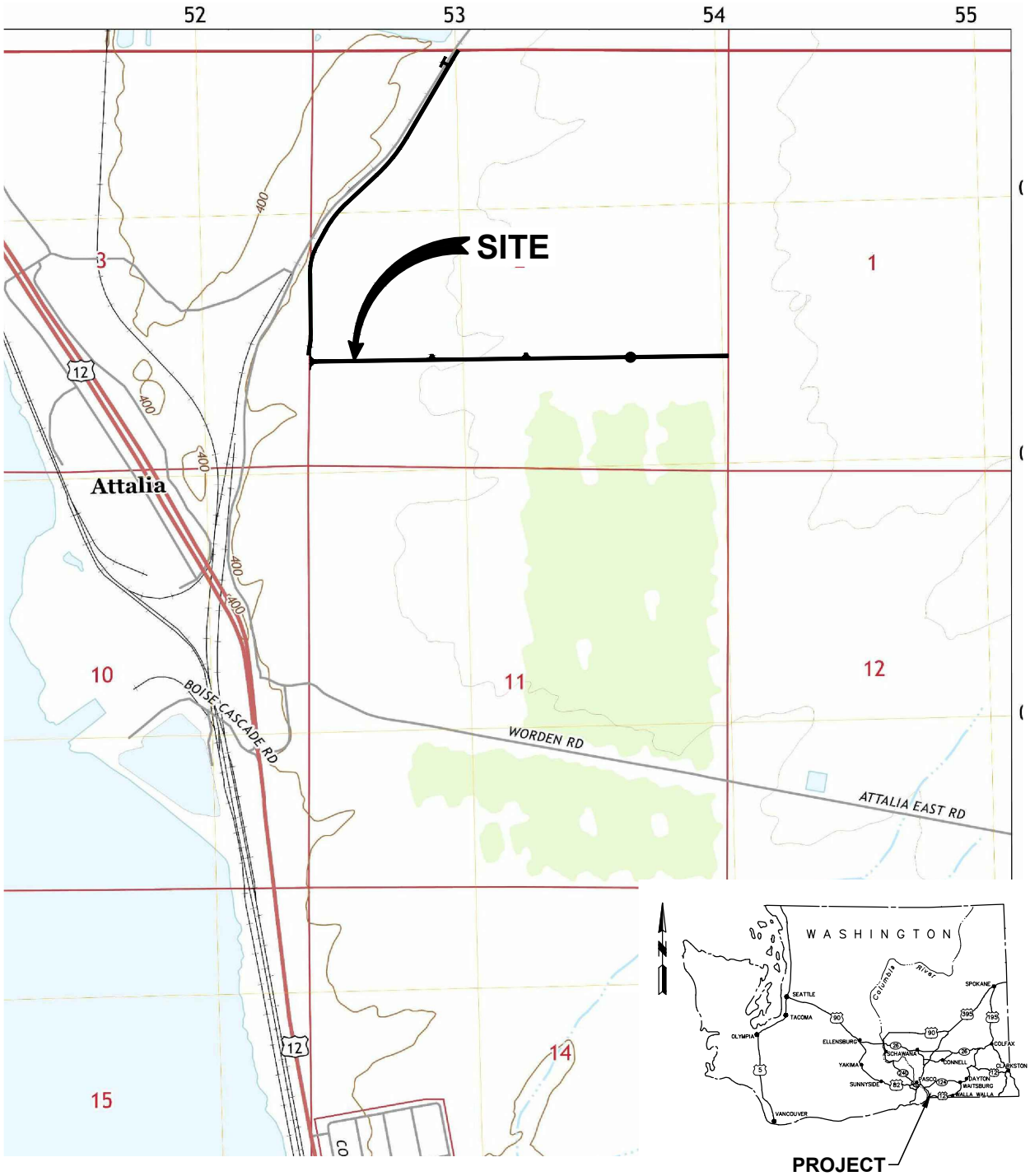
This report has been prepared for the exclusive use of the Port and the design team on the proposed Wallula Gap Business Park Roads 2023 project. The information was prepared in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made. The recommendations presented are based on observed soil conditions in the field. Anderson Perry & Associates, Inc.'s (AP) opinion is the results of this investigation generally define the soil conditions, or the subsurface material, in a reasonable manner for the purpose intended.

Chapter 2 - Existing Site Conditions

The Wallula Gap Business Park Roads 2023 project will be constructed approximately 2,900 to 10,400 feet east of Highway 12 and north of the intersection of Boise Cascade Road and Attalia East Road in Wallula, Washington. A location and vicinity map showing the site's general location is included as Figure 2-1.

The new roadways will initially connect to the existing intersection of Attalia Road and Peterson Road and will be generally located in Section 2, Township 7 North, Range 31 East. Future roads may be constructed in Section 11, Township 7 North, Range 31 East. The existing site is currently used for farming and includes two whole crop circles and portions of three additional crop circles. The ground around the crop circles is undeveloped and covered with vegetation consisting of grasses and sagebrush. The topography across the site generally consists of gently rolling foothills of an old sand dune formation. The site generally slopes down toward the west with the slope of the ground generally ranging from relatively flat to a few areas that are steeper than 15 percent. A site plan showing the existing topography is shown on Figure 2-2.

Utilities crossing the new roadway alignments include several irrigation lines, a large-diameter process water transmission line, gas lines, underground and overhead power lines, and possibly overhead fiber optics communication lines. These utilities are shown on the site plan (Figure 2-2).



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PORT OF WALLA WALLA

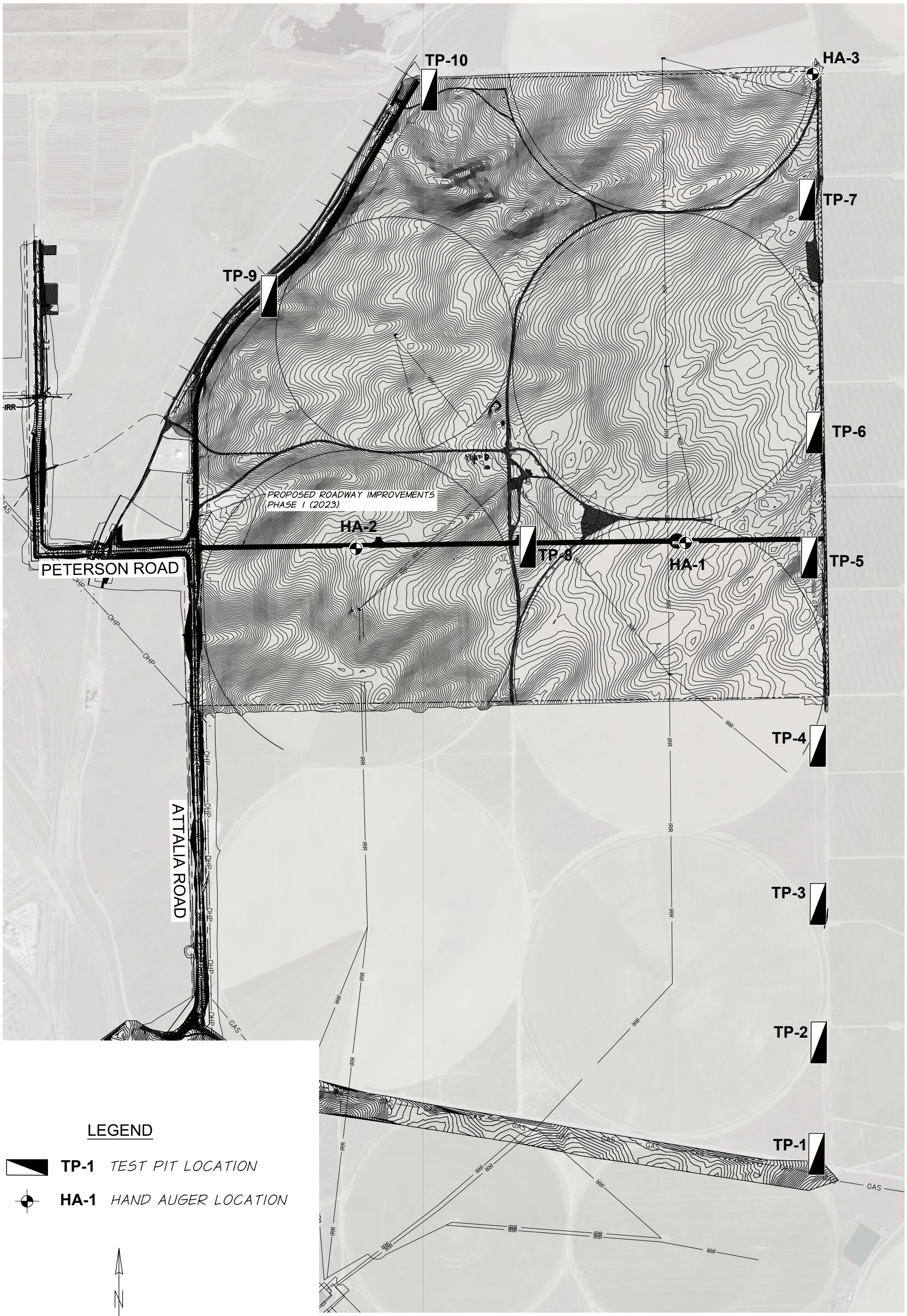
WALLULA GAP BUSINESS PARK ROADS 2023

WALLA WALLA COUNTY, WASHINGTON

LOCATION AND VICINITY MAP

FIGURE

2-1



LEGEND

TP-1 *TEST PIT LOCATION*

HA-1 *HAND AUGER LOCATION*

N

400 0 400 800 1200
SCALE IN FEET

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SITE PLAN

FIGURE
2-2

Chapter 3 - General Site Improvement Considerations

The new roadways will consist of approximately 2 to 4 miles of new and future roadways. The new roadways will be a continuation of Attalia Road, Peterson Road, and roadways not presently named.

Peterson Road will continue east for approximately one mile from its intersection with Attalia Road. Attalia Road will head north for approximately 1,400 feet, then head northeast for approximately 3,300 feet, and then head east for approximately 3,300 feet. A new roadway may be constructed along the east side of Section 2 and Section 11, Township 7 North, Range 31 East, and connect the new roadways with Worden Road or a new Highway 12 alignment in the future.

The pavement section for the new roadways will consist of 4.0 inches of hot mix asphalt (HMA) over 12.0 inches of crushed aggregate. The HMA section will be 36 feet wide. The road will have 6- to 8-foot-wide gravel shoulders (on both sides of the pavement section) that slope down with 6 horizontal:1 vertical (6H:1V) slopes. Proposed slopes adjacent to the gravel shoulders include 2.2H:1V cut and 2H:1V fill slopes.

Stormwater runoff will be managed on site through infiltration utilizing roadside ditches and rock check dams. Culverts will be placed beneath the new roadways within the bottom of existing low points and drainage basins on an as-needed basis.

The first phase of the proposed new roadway alignments is shown on the site plan (Figure 2-2).

Chapter 4 - Local Geology and Seismicity

The proposed site is centrally located within the Columbia Plateau Physiographic Province. Geologic mapping (Schuster, 1994) indicates the site is overlain by Holocene-age dune sand.

The Natural Resource Conservation Service (NRCS) Soil Survey indicates the project site is overlain by soils consisting of silty sand (SM), sand with silt (SP-SM), and sandy silt (ML).

Through previous explorations, AP has found this area to be generally overlain by eolian sand with occasional interbedded layers of loess consisting of silt with varying amounts of sand. The eolian sand is typically underlain by gravel alluvium and the eolian and alluvial layers are underlain by basalt.

Test pit logs provide a record of the subsurface exploration for this project and are included in Appendix A. Well reports for wells and logs for soil borings and test pits located in the regional vicinity were reviewed and are included in Appendix B.

AP's observation during the subsurface exploration and the information from the reviewed well reports, test pit logs, and boring logs generally concur with the geologic mapping, the NRCS Soil Survey, and AP's experience in the area. The formations encountered at the site during the subsurface exploration are described in more detail in Chapter 5 - Characteristics of Subsurface Materials.

Faulting

The following potentially active quaternary fault systems identified by the U.S. Geological Survey (USGS) are located in the site's regional vicinity:

- The west-to-northwest trending Wallula fault (Class A, Fault No. 846) is 2.9 miles southwest.
- A section of the northwest-trending portion of the Horse Heaven Hills Structure (Class A, Fault No. 567) is 8.0 miles west.
- Sections of the north-to-northeast trending Hite Fault System (Class A, Fault No. 845) are located southeast of the site. The Thorn Hollow section is 26.8 miles southeast and the Agency section is 33.4 miles southeast.

These faults have slip rates of less than 0.008 inches (0.2 millimeters) per year.

The faults near the site have the potential to generate a crustal earthquake with a Moment Magnitude (M_W) of 6.7 within 8 miles of the site with a 2.0 percent probability in 50 years. In addition to a possible local crustal earthquake, an intraslab earthquake with an M_W of 7.5 approximately 180 miles from the site and an interface earthquake with an M_W of 8.5 approximately 260 miles from the site does not increase the spectral accelerations above the values mapped in the 2021 International Building Code (IBC). Seismic design parameters are discussed in Chapter 7, Engineering Analysis.

Ground Rupture

Due to the site's location relative to the faults in the site's general vicinity, the risk associated with a fault rupture is low.

Liquefaction and Lateral Spreading

Ideal soils for liquefaction include loose saturated sands with little or no fines. The saturated silt layers are generally not expected to liquefy due to their high fines content. The gravel layers are not expected to be susceptible to liquefaction due to their high in-place relative densities. Conversely, sand near the ground surface may be susceptible to liquefaction if it becomes saturated during periods of high groundwater. A liquefaction assessment is described in further detail in Chapter 7, Engineering Analysis.

Erosion

The various soils overlying the project site are highly susceptible to erosion (wind and water). Areas that are disturbed through earthwork should be stabilized with permanent vegetation or gravel surfacing. Source and flow control best management practices (BMPs) should be used to manage construction and post-construction runoff to prevent erosion.

Slope Stability

Unsaturated 2 horizontal to 1 vertical (2H:1V) existing and cut slopes without surcharge loading will remain stable during static conditions and unsaturated 2.2H:1V existing and cut slopes without surcharge loading remain stable during seismic loading. These slopes have factors of safety greater than 1.0. Factors of safety that are less than 1.0 are considered unstable.

2H:1V fill slopes that have been constructed with adequate compaction will remain stable during static and seismic loading.

High groundwater will reduce the stability of steep slopes. Groundwater seepage through slopes indicates that slopes are saturated. Saturated 2.2H:1V slopes will not remain stable.

Surcharge loading from structures or traffic near slopes will also reduce the stability of existing and cut slopes. If surcharge loads are setback using the criteria from the 2021 IBC, the slopes will remain stable. The 2021 IBC setback criteria are conservative for some scenarios and loaded slopes may be evaluated on a case-by-case basis.

Chapter 5 - Characteristics of Subsurface Materials

Subsurface Exploration

On May 18, 2023, three hand auger holes were advanced and on May 22 and May 23, 2023, ten test pits were excavated at the proposed site to assess the general nature of the subsurface soils. The test pit and hand auger locations are shown on the site plan (Figure 2-2), and the test pit and hand auger logs are included in Appendix A. The test pits were excavated with a Caterpillar 315 excavator and a Caterpillar 325F excavator owned and operated by C&E Trenching, LLC.

The materials in each test pit and hand auger were visually classified, and soil samples were obtained during the explorations and retained for possible laboratory testing. The test pits and hand auger holes were logged during the subsurface investigation, and the final logs were prepared based on a review of the field logs and an examination of the soil samples. The soils were classified according to ASTM International (ASTM) D2488 classification of soils for engineering purposes.

Soil Profile Summary

In general, a similar soil profile was observed in each test pit and hand auger hole. Topsoil generally consisting of sand to silty sand was encountered near the ground surface. The topsoil is underlain by Aeolian Dune Sand consisting of sand to silty sand. A layer of sandy silt was encountered in test pit TP-7. The Aeolian Dune Sand is underlain by alluvial gravel. The alluvial gravel was encountered only in TP-9. The test pits and hand augers were dug to a depth of 12.0 to 14.0 feet below the existing ground surface. Although bedrock was not encountered during the subsurface exploration, boring logs for soil borings and well reports for wells in the general vicinity of the site indicate basalt bedrock underlies the Aeolian Dune Sand and gravel alluvium formations. The Aeolian Dune Sand formation is also interbedded with various layers of silt to sandy silt (loess). The soil groups encountered at the site are discussed below.

Topsoil

Topsoil generally consisting of sand to silty sand was encountered near the existing ground surface. The topsoil is light brown, nonplastic, and has an apparent density ranging from very loose to loose. The sand is generally fine. At the time of the exploration, the topsoil was damp. Scattered organics consisting of grass rootlets were encountered in the upper 6- to 8-inches.

Aeolian Dune Sand

Aeolian Dune Sand consisting of sand to silty sand was encountered to a depth of approximately 13 feet below the existing ground surface. The sand is light brown to brown, dark brown, and black, nonplastic, and has an apparent density ranging from very loose to dense. The sand is mostly fine. Occasional layers of fine to coarse sand and layers of sand with traces of some fine to coarse gravel were also encountered during the subsurface exploration. Occasional weak cementation (caliche) was encountered in thin layers within the Dune Sand formation. At the time of the exploration, the Dune Sand ranged from dry to damp.

Interbedded Silt Layers

A layer of sandy silt was encountered in TP-7. The silt is light brown, nonplastic, and has a consistency ranging from medium stiff to stiff. The silt was found to be dry during the subsurface exploration. Additional interbedded layers of silt to sandy silt are anticipated within the Aeolian Dune Sand formation.

Gravel Alluvium

The gravel alluvium consists of gravel with sand, trace silt, and scattered cobbles. The gravel is subrounded and fine to coarse in size with colors ranging from brown to gray. The apparent density of the gravel alluvium ranges from dense to very dense. At the time of the exploration, the gravel alluvium was dry. Boring logs for soil borings and well reports for wells in the general vicinity of the site indicate the gravel layers may be encountered between a depth of 7 to over 230 feet.

Basalt

Basalt bedrock was not encountered during the subsurface exploration. Boring logs for soil borings and well reports for wells in the general vicinity of the site indicate the surface of the underlying basalt formation ranges from about 45 to over 230 feet below the existing ground surface.

Groundwater

Groundwater was not encountered in any of the test pits or hand auger holes. Boring logs for soil borings and well reports for wells in the general vicinity of the site indicate the static groundwater level ranges from 5.5 to 150 feet below the existing ground surface. Based on the subsurface exploration and the topography of the site along the proposed roadway alignments, seasonal high groundwater is generally anticipated below a depth of 12 feet below the existing ground surface. The natural groundwater level can be expected to fluctuate seasonally by several feet in this area, generally being highest in the late winter and early spring months. However, the groundwater level may also fluctuate in response to the irrigation season and cause the groundwater level to rise above natural levels.

Chapter 6 - Laboratory Testing

No laboratory testing was conducted as part of this phase of the project.

Chapter 7 - Engineering Analysis

Pavement Assessment and Design

The proposed pavement section for the new roadways is 4 inches of HMA over 12 inches of compacted crushed aggregate. The project's pavement section was evaluated considering the subgrade encountered during the subsurface exploration and material likely to be used for embankment fill.

The following assumptions were used in the structural section assessment: a design life of 20 years, reliability of 90 percent, overall standard deviation of 0.45, an initial serviceability of 4.2, and a terminal serviceability of 2.25. An estimated soil resilient modulus (M_R) of 15,000 pounds per square inch was selected for the anticipated compacted silty sand to sand subgrade. This value corresponds to a California Bearing Ratio value in the range of approximately 10 to 15.

The results of the assessment indicate the pavement section will provide a design Structural Number (SN) of approximately 3.3. This design will provide support for approximately 4.0 million equivalent single-axle loads (ESALs). If more than 4.0 million ESALs are anticipated on the new roadway over their design life, the pavement section should be modified to provide additional support.

Slope Stability Assessment

The stability of the on-site and proposed slopes was calculated by dividing the forces resisting slope movement (soil strength) by the forces driving slope movement (surcharge loads, soil weight, seismic loading, and water). Slide2 is a computer program developed by Rocscience used to perform slope stability analysis based on slope geometry, soil strength, and groundwater conditions. Slide2 was used to analyze the on-site slope conditions.

The stability analysis utilized a friction angle of 32 degrees for cut slopes based on the assumption that the underlying soils will consist of undisturbed silty sand or sand. A friction angle of 34 degrees was utilized for fill slopes based on the assumption that embankment fill will consist of compacted silty sand or sand. A surcharge load of 240 pounds per square foot was applied to the roadway surface.

A peak ground acceleration (PGA) value of 0.262 g was calculated using ASCE 7-16. This PGA is associated with Site Class D and an earthquake event with a 2.0 percent probability in 50 years (2,475-year return period). Based on this PGA value, a horizontal seismic coefficient, k_h of 0.131, and a vertical seismic coefficient, k_v of 0.052 were calculated and utilized for seismic loading.

The results of the analysis indicate that 2H:1V unsaturated fill slopes will remain stable during seismic and static loading. The results of the analysis also indicate unsaturated 2 horizontal to 1 vertical (2H:1V or 50 percent) existing and cut slopes without surcharge loading (structure or traffic) remain stable during static conditions. 2H:1V unsaturated cut slopes may not remain stable during seismic conditions and could experience surface raveling, however, deep-seated failures (deeper than 18 inches) are not expected during seismic events. Unsaturated 2.2H:1V (45 percent) slopes without surcharge loading remain stable during seismic loading. These slopes have factors of safety greater than 1.0. Factors of safety that are less than 1.0 are considered unstable. AP is available to evaluate cut slopes with surcharge loading if these become part of the roadway designs.

High groundwater will reduce the stability of steep slopes. Groundwater seepage through slopes indicates that slopes are saturated. The results of the analysis indicate saturated 2H:1V (50 percent) and 2.2H:1V (45 percent) slopes will not remain stable during seismic loading. High groundwater can be mitigated by installing trench drains at the toe of slopes and above slopes under certain groundwater conditions. Although high groundwater is not anticipated during roadway construction, AP is available to provide recommendations for trench drain installation if groundwater is encountered.

The results of the stability analysis are included in Appendix C and a summary of the result for the various cut and fill conditions shown on Table 7-1.

TABLE 7-1
Stability Analysis Results

Soil Type	Friction Angle (degrees)	Load Condition	Slope	Factor of Safety (Surface Raveling)	Factor of Safety (Deep Seated)
Silty Sand (SM) to Sand (SP)	32	Static	2H:1V (cut)	1.23	1.45
Silty Sand (SM) to Sand (SP)	32	Seismic	2H:1V (cut)	0.94	1.00
Silty Sand (SM) to Sand (SP)	32	Static	2.2H:1V (cut)	1.37	1.50
Silty Sand (SM) to Sand (SP)	32	Seismic	2.2H:1V (cut)	1.02	1.10
Silty Sand (SM) to Sand (SP)	32	Static / High GWT	2H:1V (cut)	1.07	1.20
Silty Sand (SM) to Sand (SP)	32	Seismic / High GWT	2H:1V (cut)	0.80	0.90
Silty Sand (SM) to Sand (SP)	32	Seismic / Trench Drain	2H:1V (cut)	0.94	1.00
Silty Sand (SM) to Sand (SP)	32	Seismic / Trench Drain	2.2H:1V (cut)	1.02	1.10
Silty Sand (SM) to Sand (SP)	34	Static	2H:1V (fill)	1.35	1.50
Silty Sand (SM) to Sand (SP)	34	Seismic	2H:1V (fill)	1.01	1.20

Seismic Considerations

Spectral accelerations are mapped in the 2021 IBC and the 2016 edition of American Society of Civil Engineers (ASCE) Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7-16). The mapped values of these accelerations are based on a 2 percent probability of exceedance in 50 years, or a 2,475-year return period for Site Class B, and are shown as a percentage of gravity (g). Site Class B is defined as a geologic profile of the upper 100 feet consisting of rock. For the proposed site, the mapped spectral bedrock acceleration for short periods (S_s) is 0.413 g and for 1-second period (S_1) is 0.152 g. The mapped Maximum Considered Earthquake Geometric Mean (MCE_G) value, also described as Peak Ground Acceleration (*PGA*), is 0.183 g.

Subsurface information was obtained from well reports for wells near the vicinity of the proposed site (copies of these well reports are included in Appendix B). This information was used to evaluate the site class for the proposed structures. Site Class D is appropriate for this site. Site Class D is defined as a geologic profile of the upper 100 feet consisting of a stiff soil profile with an average standard penetration resistance ($\overline{N}$) value between 15 and 50 blows per foot. Site coefficient factors, F_a, F_v, *and* F_{PGA} are applied to the mapped spectral accelerations to calculate the maximum considered earthquake spectral response accelerations.

Based on Site Class D and the mapped spectral accelerations, the following site coefficients were calculated for the project site: the maximum considered earthquake spectral response acceleration for short period (S_{MS}) is 0.607 g and for a 1-second period (S_{M1}) is 0.350 g. The 5 percent damped design spectral response acceleration for short period (S_{DS}) is 0.404 g and for a 1-second period (S_{D1}) is 0.233 g. The site-adjusted PGA (PGA_M) is 0.262 g. A summary of the 2018 IBC and ASCE 7-16 seismic design parameters is shown in Table 7-2.

TABLE 7-2
Summary of 2021 IBC and ASCE 7-16 Seismic Design Parameters

Symbol	Definitions	Value (g)
S_s	Mapped spectral bedrock acceleration for short periods	0.413
S_1	Mapped spectral bedrock acceleration for 1-second period	0.152
PGA	Spectral bedrock acceleration for MCE_G	0.183
F_a	Site coefficient factor	1.470
F_v	Site coefficient factor	2.295
F_{PGA}	Site coefficient factor	1.434
S_{MS} ($S_{MS} = F_a S_s$)	Maximum considered earthquake spectral response acceleration for short period	0.607
S_{M1} ($S_{M1} = F_v S_1$)	Maximum considered earthquake spectral response acceleration for 1-second period	0.350
S_{DS} ($S_{DS} = 2/3\ S_{MS}$)	5 percent damped design spectral response acceleration for short period	0.404
S_{D1} ($S_{D1} = 2/3\ S_{M1}$)	5 percent damped design spectral response acceleration for 1-second period	0.233
PGA_M	Site-adjusted MCE_G	0.262

Liquefaction

An M_W of 6.70 was calculated using USGS seismic deaggregation data associated with the potential seismic sources. A shear wave velocity of 1,200 feet per second (Site Class D) and a 2 percent probability of exceedance in 50 years, or a 2,475-year return period, were used in the analysis. In addition to the 2,475-year return period, the 975- and 475-year return periods were also evaluated.

A 50-foot soil profile was developed for the proposed site using information from the subsurface exploration, boring logs, and well reports. Standard penetration test blow counts (N values) were correlated for the soil profile based on information from the subsurface exploration, boring logs, and well reports.

Liquefaction by definition occurs when saturated cohesionless soils experience deformation as a result of a disturbance such as a seismic event. Consequently, soils that may be susceptible to liquefaction include loose, saturated sands with little or no fines.

The on-site saturated soils do not exhibit the properties of soils expected to facilitate liquefaction. The silt layers are not expected to liquefy due to their high fines content, and the gravel alluvium is not expected to liquefy due to its relative density. The Aeolian sand is generally not expected to liquefy as groundwater in the vicinity of the new roadways is expected to be deeper than 12 feet from the existing ground surface and the saturated layers of sand in these areas are anticipated to have sufficient density to resist liquefaction. However, loose sand near the ground surface may become susceptible to liquefaction if it becomes saturated during periods of high groundwater.

The results of the liquefaction analysis are included in Appendix D. Based on these results, a minimum safety factor against liquefaction of 1.8 was calculated for the 2,475-year event. A liquefaction hazards assessment is generally conducted, and hazard mitigation measures are evaluated if the safety factor against liquefaction is less than 1.2. Given the minimum safety factor of 1.8, liquefaction and lateral spreading are not anticipated during the design earthquake events (475-, 975-, or 2,475-year return periods).

Chapter 8 - Geotechnical Recommendations

Site Preparation

To prepare the site for the proposed improvements, the improvement areas should be stripped and grubbed within the limits of new construction to remove all grass, weeds, roots, and organic soil. Based on AP's explorations, stripping should generally remove the upper 6 inches. In drainage areas, where the ground receives more runoff, roots extend slightly deeper, and stripping should remove the upper 8 inches.

Additional stripping may also be required in localized areas if soil containing numerous organics is encountered. Topsoil may be stockpiled and used as cover soil over the proposed cut slopes but should not be used for fill material beneath the proposed roadway.

After the site has been stripped and excavated to the proposed subgrade elevation, the subgrade beneath the proposed roadway should be compacted to a minimum of 92 percent of the maximum dry density as determined by ASTM D1557 (American Association of State Highway and Transportation Officials [AASHTO] T180) or 95 percent of the maximum density as determined by ASTM D698 (AASHTO T99). If practical, after the subgrade is compacted, the improvement areas should be proof-rolled with a loaded dump truck to reveal any soft, unsuitable areas existing in the subgrade. Any soft areas should be over-excavated and backfilled with structural fill.

Reusability of On-Site Soil

The on-site soil consisting of silty sand to sand may be utilized as structural fill material, provided the soil is at or below optimum moisture content at the time of placement and is basically free of debris and organic material.

Structural Fill and Embankment Construction

Embankment construction or restoration of the grade in over-excavated areas beneath the proposed roadway will require the placement of structural fill. If the on-site silty sand-to-sand material is used as fill beneath the proposed roadway, it should be compacted to a minimum of 92 percent of the maximum dry density as determined by ASTM D1557 (AASHTO T180) or 95 percent of the maximum density as determined by ASTM D698 (AASHTO T99).

Based on various methods of conventional analysis, AP estimates the new roadway embankments could experience up to 4.0 inches of total settlement if the site is prepared as recommended herein. Most of this settlement will occur during construction of the embankments. Up to 1.0 inch of total settlement may occur after the roadway has been completed.

Import material consisting of any combination of silty sand, sand, or gravel may be utilized for structural fill provided the material is at or below optimum moisture content at the time of placement and is free of debris or deleterious material. The import material may be naturally occurring or be a manufactured product. The material should not exceed a maximum size of 4.0 inches in diameter.

Import material used as fill under the proposed roadway should be placed in 9-inch loose lifts and compacted to a minimum of 92 percent of the maximum dry density as determined by ASTM D1557

(AASHTO T180), 92 percent of Washington State Department of Transportation (WSDOT) Test Method 606, or 95 percent of ASTM D698 (AASHTO T99), as applicable for the material being used. If the imported material is too coarse to be tested pursuant to the test procedures, it should be compacted to a uniform, non-yielding condition. If heavy compaction equipment is utilized, the Engineer should be contacted to provide an alternate lift thickness recommendation if the contractor would prefer to use thicker lifts of fill.

The uniform and non-yielding condition of compacted fill should be verified with deflection testing. A deflection test should be conducted over the non-density testable in-place material for every 2 feet of fill placement. The deflection test should include the observation of compacted fill material beneath compaction equipment to verify the fill material has received adequate compaction and that no soft or pumping areas remain. Compaction should continue until there is negligible defection under the compaction equipment. Negligible defection is defined as being less than 1/8-inch of deflection or reaction under the compaction equipment.

Any structural fill or backfill placed on-site must be inspected and tested by a qualified materials testing laboratory to verify the specified compaction requirements are achieved.

Excavation Characteristics and Temporary Slope Considerations

When applying Occupational Safety and Health Administration (OSHA) regulations, AP anticipates silt layers to be Type B soils and the Aeolian Dune Sand and gravel alluvium to be Type C soils. OSHA recommends a maximum temporary slope inclination of 1H:1V for Type B soils and 1.5H:1V for Type C soils.

Permanent Slope Considerations

Based on the stability analysis, permanent cut and fill slopes should be no steeper than 2H:1V. Surface raveling of the cut slopes should be expected during an earthquake event with a 2.0 percent probability in 50 years (2,475-year return period). Surface raveling will most likely be limited to the upper 18 inches and can be repaired in the event of an earthquake of this magnitude. Alternatively cut slope should be no steeper than 2.2H:1V if surface raveling is undesirable during a seismic event.

High groundwater will reduce the stability of steep slopes. AP should be contacted to provide recommendations for trench drain installation if groundwater is encountered during roadway construction.

Although the cut and fill slopes generally appear to remain stable during the various loading conditions, the on-site soils are still highly susceptible to erosion (wind and runoff) and should be stabilized with permanent vegetation.

Site Stabilization

The disturbed cut and fill slopes should be vegetated with hydroseed as soon as possible after summer and cooler weather permits seed germination. The hydroseed should be a specifically designed hydromulch consisting of fiber, fertilizer, seed, and tackifier. The seed mix should be appropriate for the Wallula climate.

Best management practices should be utilized to manage runoff until permanent vegetation has become established. Straw wattles (or similar product) appear to be a suitable solution to manage runoff. If wattles are utilized, they should be installed perpendicular to the runoff flow direction and parallel to the slope contour. Narrow trenches should be dug across the slope to seat wattles and prevent runoff passing beneath or around the wattles. The wattles should be staked in place. Wattles should be spaced approximately 5 to 10 feet apart up the slopes within the erodible soil formations.

In disturbed areas, where permanent vegetation may be difficult to establish due to the lack of nutrient-rich soils, the slopes should be covered with a minimum of 6.0 inches of topsoil. The topsoil removed during clearing and grubbing may be utilized for cover soil. Alternatively, a natural fiber matting (staked in place) that satisfies the requirements of the National Pollutant Discharge Elimination System Construction Stormwater Discharge Permit 1200-C (construction stormwater permit) may be utilized.

Utility Trenches

Depending on the depths of utilities, all excavation sidewalls should be properly sloped or shored to conform to applicable OSHA regulations. In many locations the Aeolian Dune Sand has very little silt material binding the formation and caving should be expected if temporary slopes and trench walls are excavated steeper than recommended.

Trench backfills should be placed and compacted in general accordance with Section 7-08 of the current version of the WSDOT Standard Specifications for Road, Bridge, and Municipal Construction (Standard Specifications).

The on-site soils should not be used as backfill in the pipe zone. Backfill placed and compacted in the pipe zone should consist of gravel backfill for pipe zone bedding material in accordance with Section 9-03.12(3) of the Standard Specifications or crushed aggregate in accordance with Section 9-03.9(3) of the Standard Specifications.

The on-site soils may be utilized for general trench backfill above the pipe zone if the material meets the same criteria described for structural fill. If the on-site soils do not meet the criteria of structural fill, they should be removed and replaced with gravel backfill for foundations in accordance with Section 9-03.12 of the current version of the Standard Specifications.

Backfill placed 2.0 feet or more from the surface should be compacted to a minimum of 88 percent of the maximum dry density as determined by ASTM D1557 (AASHTO T180), 88 percent of WSDOT Test Method 606, or 90 percent of ASTM D698 (AASHTO T99), as applicable for the material being used. Backfill placed in the upper 2.0 feet beneath the proposed improvements should be compacted to a minimum of 92 percent of the maximum dry density as determined by ASTM D1557 (AASHTO T180), 92 percent of WSDOT Test Method 606, or 95 percent of ASTM D698 (AASHTO T99), as applicable for the material being used.

When hand-operated compaction equipment is used, the backfill should be placed in loose lifts less than 4.0 inches thick. If heavy compaction equipment is used, the loose lifts may be 9.0 inches thick. Heavy compaction equipment should not be used over the pipe until pipe zone bedding material and the trench backfill are at least 2.0 feet above the crown of the pipe.

If groundwater is encountered in the utility trenches, free-draining granular backfill such as sand, sandy gravel, or crushed rock with less than 2 percent passing the No. 200 sieve should be used as backfill below the groundwater surface. A geotextile meeting the requirements in Section 9-33.2 of the Standard Specifications for Class C, nonwoven, moderate survivability, underground drainage fabric should be placed over free-draining backfill prior to placing additional backfill. If standing water is encountered, dewatering of the trenches will be required prior to backfilling.

Pavement Design

The subgrade beneath the proposed roadway should be compacted to a minimum of 92 percent of the maximum dry density as determined by ASTM D1557 (AASHTO T180) or 95 percent of the maximum density as determined by ASTM D698 (AASHTO T99). After the subgrade is compacted, the subgrade should be proof-rolled with a loaded dump truck to reveal any soft, unsuitable areas existing in the subgrade. Any soft areas should be over-excavated and backfilled with structural fill.

The proposed pavement section for the Wallula Gap Business Park roads is 4 inches of HMA over 12 inches of compacted crushed aggregate. The crushed aggregate will include 4.0 inches of crushed surfacing top course over 8.0 inches of crushed surfacing base course. The crushed surfacing should meet Section 9-03.9(3) of the Standard Specifications. The crushed aggregate beneath the asphalt section should be compacted to a minimum of 95 percent of the maximum density as determined by WSDOT Test Method 606 or 95 percent of the maximum dry density as determined by ASTM D1557. The HMA should be compacted to a minimum of 91 percent of the maximum theoretical density.

AP recommends a geotextile meeting the requirements in Section 9-33.2 of the Standard Specifications for soil stabilization fabric be used to reinforce the subgrade prior to placing the structural base rock. Fabric should be stretched taut and wrinkle-free. Adjacent pieces of fabric should be overlapped a minimum of 18 inches and staked in place prior to placing crushed aggregate.

Site Drainage

Stormwater runoff may be managed on-site through infiltration. Roadside ditches were identified by the design team as the most likely system to infiltrate runoff.

Based on the soils encountered during the subsurface exploration, a coefficient of percolation, K, of approximately 0.15 gallon per minute per square foot (0.02 cubic foot per minute per square foot) of bottom area may be used for sizing the roadside ditches. This rate is equivalent to 14 inches per hour. The percolation rate should be adjusted using a degradation factor selected by the design engineer responsible for stormwater management.

Roadside ditches should be constructed with a minimum of 5 feet of separation between the bottoms of the ditches and the highest anticipated groundwater levels.

Inclement Weather Construction

If earthwork is scheduled during freezing conditions, care should be taken to prevent subgrade materials in improvement areas from freezing. If subgrade materials freeze, they should be over-excavated and replaced with structural fill. Alternatively, frozen subgrade may be allowed to thaw and compacted to a

minimum of 92 percent of the maximum dry density as determined by ASTM D1557 (AASHTO T180) or 95 percent of the maximum density as determined by ASTM D698 (AASHTO T99).

Proof-rolling frozen subgrade material with a loaded dump truck will be ineffective to identify soft areas or verify non-yielding conditions. Proof-rolling should be conducted after compaction has been completed and when the subgrade is not frozen.

Chapter 9 - Conclusions

This report was prepared in a general manner and should provide adequate information for the design team to prepare site preparation specifications and design roadway and infrastructure improvements for the proposed Wallula Gap Business Park Roads 2023 project.

Should specific problems arise during the course of the project that may not be covered adequately in this report, if changes occur in any of the assumptions made, or if the site excavation reveals anything different than what is described herein, we recommend contacting the engineer so appropriate action can be taken. Any questions regarding this investigation should be directed to Andrew Robinson, P.E., with AP, 214 East Birch Street, Walla Walla, Washington 99362, telephone (509) 529-9260.

Chapter 10 - References

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APPENDIX A
Classification Format and Legend and Test Pit Logs

GENERAL SOIL DESCRIPTIVE SEQUENCE

1. CONSISTENCY (FINE-GRAINED SOILS) / APPARENT DENSITY (COARSE-GRAINED SOILS)
2. SOIL NAME
3. USCS DESIGNATION
4. COLOR
5. PLASTICITY
6. MOISTURE
7. GRAIN SIZE DISTRIBUTION
8. ANGULARITY
9. OTHER CHARACTERISTICS: CEMENTATION, TEXTURE, DILATANCY, STRUCTURE ETC.
10. ADDITIONAL CONSTITUENTS: FILL MATERIALS, DEBRIS, ORGANIC MATTER, ETC.
11. ORIGIN / FORMATION NAME

CONSISTENCY OF COHESIVE SOILS

TERM	UNDRAINED SHEAR STRENGTH	SPT N-VALUE
VERY SOFT	≤0.125 TSF	≤2 BLOWS/FT.
SOFT	0.125 - 0.25 TSF	2 - 4 BLOWS/FT.
MEDIUM STIFF	0.25 - 0.50 TSF	5 - 8 BLOWS/FT.
STIFF	0.5 - 1.0 TSF	9 - 15 BLOWS/FT.
VERY STIFF	1.0 - 2.0 TSF	16 - 30 BLOWS/FT.
HARD	2.0+ TSF	30+ BLOWS/FT.

APPARENT DENSITY (NON-COHESIVE) SOILS

TERM	SPT N-VALUE
VERY LOOSE	≤4 BLOWS/FT.
LOOSE	5 - 10 BLOWS/FT.
MEDIUM DENSE	11 - 30 BLOWS/FT.
DENSE	31 - 50 BLOWS/FT.
VERY DENSE	50+ BLOWS/FT.

SOIL CONSTITUENT DEFINITIONS
(BASED ON PARTICLE SIZE)

BOULDERS	RETAINED ON A 12-INCH OPENING.
COBBLES	PASSING A 12-INCH OPENING AND RETAINED ON THE 3.0-INCH SIEVE.
COARSE GRAVEL	PASSING THE 3.0-INCH SIEVE AND RETAINED ON THE 3/4-INCH SIEVE.
FINE GRAVEL	PASSING THE 3/4-INCH SIEVE AND RETAINED ON THE NO.4 SIEVE.
COARSE SAND	PASSING THE NO.4 SIEVE AND RETAINED ON THE NO.10 SIEVE.
MEDIUM SAND	PASSING THE NO.10 SIEVE AND RETAINED ON THE NO.40 SIEVE.
FINE SAND	PASSING THE NO.40 SIEVE AND RETAINED ON THE NO.200 SIEVE.
SILT	SOIL PASSING THE NO. 200 SIEVE. PLASTICITY INDEX (PI) PLOTS BELOW THE A-LINE ON THE PLASTICITY CHART.
CLAY	SOIL PASSING THE NO. 200 SIEVE. PI PLOTS ON OR ABOVE THE A-LINE ON THE PLASTICITY CHART.

SOIL COLOR

1. SOIL SAMPLES CHANGE COLOR AFTER THEY ARE REMOVED FROM THEIR IN-SITU ENVIRONMENT. SOIL COLORS ARE DESCRIBED AS SOON AS SAMPLES ARE TAKEN.
2. COMMON COLORS ARE UTILIZED: BROWN, YELLOW, GRAY, RED, GREEN, WHITE, ETC.
3. SECONDARY COLORS MAY BE UTILIZED TO PROVIDE MORE CLARIFICATION. FOR EXAMPLE, GRAY BROWN
4. ADDITIONAL ADJECTIVES MAY BE UTILIZED TO PROVIDE MORE DETAIL: DARK, LIGHT, MOTTLED, STREAKED, ETC.

MOISTURE

DRY	ABSENCE OF MOISTURE, DRY TO THE TOUCH. DUSTY.
DAMP	SLIGHT PRESENCE OF MOISTURE. MOISTURE CONTENT IS BELOW PLASTIC LIMIT FOR COHESIVE SOILS.
MOIST	SOIL IS DARKENED, BUT MOISTURE IS NOT VISIBLE. MOISTURE CONTENT IS NEAR OR SLIGHTLY ABOVE PLASTIC LIMIT FOR COHESIVE SOILS.
WET	VISIBLE FREE WATER. TYPICALLY SATURATED.

CEMENTATION

WEAK	SOIL CRUMBLES WITH HANDLING OR SLIGHT FINGER PRESSURE.
MODERATE	SOIL CRUMBLES WITH CONSIDERABLE FINGER PRESSURE.
STRONG	SOIL DOES NOT NOT CRUMBLE WITH CONSIDERABLE FINGER PRESSURE.

SOIL CLASSIFICATION (SOIL NAME)

1. PRIMARY AND SECONDARY SOIL CONSTITUENTS ARE UTILIZED TO SELECT A SOIL NAME IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) FLOW CHARTS PROVIDED ON FIGURES A2 AND A3.
2. ADDITIONAL SOIL CONSTITUENTS ARE UTILIZED IN THE SOIL NAME IN ACCORDANCE WITH THE USCS CHARTS.
3. THE FOLLOWING QUANTIFYING TERMS ARE OFTEN UTILIZED TO PROVIDE ADDITIONAL CLARITY:

TERM	PERCENTAGE BY WEIGHT	
TRACE	<5%	THESE TERMS ARE GENERALLY USED FOR SOIL CONSTITUENTS.
SOME	30% TO 50%	
MOSTLY	≥50%	
OCCASIONAL	<10%	THESE TERMS ARE USED FOR ADDITIONAL CONSTITUENTS INCLUDING: COBBLES, BOULDERS, FILL, DEBRIS AND ORGANIC MATTER.
SCATTERED	10 TO 20%	
NUMEROUS	≥20%	

PLASTICITY

NONPLASTIC	AN 1/8-INCH TREAD CANNOT BE ROLLED AT ANY MOISTURE CONTENT. VERY LOW DRY STRENGTH. (DRY SOIL CUBE FALLS APART).
LOW	AN 1/8-INCH TREAD CAN BARELY BE ROLLED. SOIL LUMP CANNOT BE FORMED WHEN DRIER THAN THE PLASTIC LIMIT. LOW DRY STRENGTH (EASY TO CRUSH DRY SOIL CUBE WITH FINGERS).
MEDIUM	AN 1/8-INCH TREAD CAN EASILY BE ROLLED IN A SHORT TIME. THE TREAD CANNOT BE RE-ROLLED AFTER REACHING PLASTIC LIMIT. SOIL LUMP CRUMBLES WHEN DRIER THAN THE PLASTIC LIMIT. MEDIUM DRY STRENGTH (DIFFICULT TO CRUSH DRY SOIL CUBE WITH FINGERS).
HIGH	A LONG TIME IS TAKEN IN ROLLING TO REACH THE PLASTIC LIMIT. THE THREAD CAN BE RE-ROLLED SEVERAL TIMES AFTER REACHING PLASTIC LIMIT. SOIL LUMP CAN BE FORMED WITHOUT CRUMBLING AFTER REACHING THE PLASTIC LIMIT. HIGH DRY STRENGTH (CAN NOT CRUSH DRY SOIL CUBE WITH FINGERS).

GRAIN SIZE DISTRIBUTION

1. GRAVEL IS DESCRIBED AS FINE AND/OR COARSE.
2. SAND IS DESCRIBED AS FINE, MEDIUM AND/OR COARSE.
3. COBBLES AND BOULDERS ARE DESCRIBED IN TERMS OF INCHES IN DIAMETER.

ANGULARITY (COARSE SAND TO BOULDER SIZE)

ANGULAR	PARTICLES HAVE SHARP EDGES, RELATIVELY FLAT SIDES AND UNPOLISHED SURFACES.
SUBANGULAR	SIMILAR TO ANGULAR PARTICLES BUT PARTICLES HAVE ROUNDED EDGES.
SUBROUNDED	PARTICLES HAVE NEARLY PLANE SIDE BUT WELL-ROUNDED EDGES AND CORNERS.
ROUNDED	PARTICLES HAVE SMOOTH CURVED SIDES AND NO EDGES.

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CLASSIFICATION FORMAT AND LEGEND

FIGURE
A1

ORIGIN / SOIL FORMATION

FILL	SOIL HAS BEEN PLACED BY HUMAN MEANS.
ALLUVIUM	DEPOSITED BY FLOWING WATER (STREAM, RIVER, ETC.)
LACUSTRINE	DEPOSITED AT THE BOTTOM OF LAKES.
CALICHE	CEMENTED SOIL FORMATION (CALCIUM CARBONATE).
COLLUVIUM	ROCK DEPOSITED AT THE BASE OF STEEP SLOPE (TALUS).
AEOLIAN	WIND BLOW DEPOSIT (DUNE SAND, LOESS).
LOESS	WIND BLOW SILT.

FLOW CHART FOR IDENTIFYING COARSE-GRAINED SOILS

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) > 50% RETAINED ON N0.200 SIEVE			<15% SAND		≥15% SAND		USCS SYMBOL	
			SOIL NAME	GRAPHIC SYMBOL	SOIL NAME	GRAPHIC SYMBOL	WELL-GRADED	POORLY-GRADED
GRAVEL % GRAVEL > % SAND	≤5% FINES		GRAVEL		GRAVEL WITH SAND		GW	GP
	10% FINES	SILT FINES	GRAVEL WITH SILT		GRAVEL WITH SILT AND SAND		GW-GM	GP-GM
		CLAY FINES	GRAVEL WITH CLAY		GRAVEL WITH CLAY AND SAND		GW-GC	GP-GC
	≥15% FINES	SILT FINES	SILTY GRAVEL		SILTY GRAVEL WITH SAND		GM	
		CLAY FINES	CLAYEY GRAVEL		CLAYEY GRAVEL WITH SAND		GC	

			<15% GRAVEL		≥15% GRAVEL		USCS SYMBOL	
			SOIL NAME	GRAPHIC SYMBOL	SOIL NAME	GRAPHIC SYMBOL	WELL-GRADED	POORLY-GRADED
SAND % SAND ≥ % GRAVEL	≤5% FINES		SAND		SAND WITH GRAVEL		SW	SP
	10% FINES	SILT FINES	SAND WITH SILT		SAND WITH SILT AND GRAVEL		SW-SM	SP-SM
		CLAY FINES	SAND WITH CLAY		SAND WITH CLAY AND GRAVEL		SW-SC	SP-SC
	≥15% FINES	SILT FINES	SILTY SAND		SILTY SAND WITH GRAVEL		SM	
		CLAY FINES	CLAYEY SAND		CLAYEY SAND WITH GRAVEL		SC	

SOIL LOG LEGEND

SAMPLE TYPE

2.0-INCH O.D. SPLIT-SPOON SAMPLE

3.0-INCH O.D. THIN-WALLED SAMPLE

GRAB SAMPLE

IN-SITU & LABORATORY TESTING RESULTS

■ TORVANE READING

TSF TON PER SQUARE FEET

▲ SPT, N-VALUE

● MOISTURE CONTENT, %

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CLASSIFICATION FORMAT AND LEGEND

FIGURE
A2

FLOW CHART FOR IDENTIFYING INORGANIC FINE-GRAINED SOIL

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

≥ 50% PASSING THE NO.200 SIEVE

					LIQUID LIMIT			
					LL < 50		LL ≥ 50	
				SOIL NAME	USCS SYMBOL	GRAPHIC SYMBOL	USCS SYMBOL	GRAPHIC SYMBOL
SILT PLASTIC INDEX (PI) PLOTS BELOW A-LINE	<15% RETAINED ON NO. 200 SIEVE			SILT	ML		MH	
	15 TO 25% RETAINED ON NO. 200 SIEVE	% SAND ≥ % GRAVEL		SILT WITH SAND	ML		MH	
		% SAND < % GRAVEL		SILT WITH GRAVEL	ML		MH	
	≥30% RETAINED ON NO. 200 SIEVE	% SAND ≥ % GRAVEL	<15% GRAVEL	SANDY SILT	ML		MH	
			≥15% GRAVEL	SANDY SILT WITH GRAVEL	ML		MH	
		% SAND < % GRAVEL	<15% SAND	GRAVELLY SILT	ML		MH	
			≥15% SAND	GRAVELLY SILT WITH SAND	ML		MH	
CLAY PLASTIC INDEX (PI) PLOTS ON OR ABOVE A-LINE	<15% RETAINED ON NO. 200 SIEVE			CLAY	CL		CH	
	15 TO 25% RETAINED ON NO. 200 SIEVE	% SAND ≥ % GRAVEL		CLAY WITH SAND	CL		CH	
		% SAND < % GRAVEL		CLAY WITH GRAVEL	CL		CH	
	≥30% RETAINED ON NO. 200 SIEVE	% SAND ≥ % GRAVEL	<15% GRAVEL	SANDY CLAY	CL		CH	
			≥15% GRAVEL	SANDY CLAY WITH GRAVEL	CL		CH	
		% SAND < % GRAVEL	<15% SAND	GRAVELLY CLAY	CL		CH	
			≥15% SAND	GRAVELLY CLAY WITH SAND	CL		CH	

ADDITIONAL SOIL LOG GRAPHIC SYMBOLS

TOPSOIL

FILL

ASPHALT

CLAYEY SILT

WELL INSTALLATION & BACKFILL GRAPHIC SYMBOLS

GROUNDWATER LEVEL MEASURED ON DATE SHOWN

COLD PATCH ASPHALT

SILICA SAND BACKFILL

CONCRETE BACKFILL

PVC WELL CASING

GRAVEL BACKFILL

BENTONITE CHIP BACKFILL

FLUSH MOUNT MONUMENT

SLOTTED WELL SCREEN

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CLASSIFICATION FORMAT AND LEGEND

FIGURE

A3

TEST PIT TP-1

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
456.0 (0)	LOOSE SAND (SP): TRACE SILT, BROWN, NONPLASTIC, DAMP, FINE SAND, OCCASIONAL ORGANICS (ROOTLETS), (TOPSOIL)				GRASS AND WEEDS AT SURFACE
	LOOSE SAND (SP); TRACE SILT, BROWN, NONPLASTIC, DAMP, FINE SAND, (AEOLIAN DUNE SAND)		☒ S-1-1		
451.0 (5.0)	LOOSE SAND WITH SILT (SP-SM): BROWN, NONPLASTIC, DAMP, FINE SAND, (AEOLIAN DUNE SAND)		☒ S-1-2		TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
	MEDIUM DENSE SAND (SP); TRACE SILT, BROWN, NONPLASTIC, DAMP, FINE SAND, (AEOLIAN DUNE SAND)		☒ S-1-3		
446.0 (10.0)			☒ S-1-4		NO GROUNDWATER OBSERVED ON 5/22/2023
	BOTTOM OF TEST PIT AT 12.0 FEET				

TEST PIT TP-2

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
497.0 (0)	VERY LOOSE SAND (SP): TRACE SILT, BROWN, NONPLASTIC, DAMP, FINE SAND, OCCASIONAL ORGANICS (ROOTLETS), (TOPSOIL)				GRASS AND WEEDS AT SURFACE
	VERY LOOSE SAND (SP): TRACE SILT, BROWN, NONPLASTIC, DAMP, FINE SAND, (AEOLIAN DUNE SAND)		☒ S-2-1		
492.0 (5.0)	BECOMES LIGHT BROWN, DRY		☒ S-2-2		TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
	LOOSE SAND WITH SILT (SP-SM): LIGHT BROWN, NONPLASTIC, DRY TO DAMP, FINE SAND, (AEOLIAN DUNE SAND)		☒ S-2-3		
487.0 (10.0)	LOOSE SAND (SP); TRACE SILT, LIGHT BROWN, NONPLASTIC, DAMP, FINE SAND, (AEOLIAN DUNE SAND)		☒ S-2-4		NO GROUNDWATER OBSERVED ON 5/22/2023
	BOTTOM OF TEST PIT AT 12.0 FEET				

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TEST PIT LOGS

FIGURE
A4

TEST PIT TP-3

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
534.0 (0)	LOOSE SILTY SAND (SM); LIGHT BROWN, NONPLASTIC, DAMP, FINE SAND, OCCASIONAL ORGANICS (ROOTLETS), (TOPSOIL)				GRASS AND WEEDS AT SURFACE
	LOOSE TO MEDIUM DENSE SILTY SAND (SM); LIGHT BROWN, NONPLASTIC, DAMP, FINE SAND, (AEOLIAN DUNE SAND)		S-3-1		
529.0 (5.0)	BECOMES DENSE, VERY WEAK CEMENTATION FROM 6 TO 8 FEET		S-3-2		TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
	BECOMES MEDIUM DENSE		S-3-3		
524.0 (10.0)	MEDIUM DENSE SAND WITH SILT (SP-SM); LIGHT BROWN, NONPLASTIC, DAMP, FINE SAND, (AEOLIAN DUNE SAND)		S-3-4		NO GROUNDWATER OBSERVED ON 5/22/2023
	BOTTOM OF TEST PIT AT 12.0 FEET				

TEST PIT TP-4

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
540.0 (0)	LOOSE SAND (SP); TRACE SILT, BROWN, NONPLASTIC, DRY TO DAMP, FINE SAND, OCCASIONAL ORGANICS (ROOTLETS), (TOPSOIL)				GRASS AND WEEDS AT SURFACE
	LOOSE SAND (SP); TRACE SILT, LIGHT BROWN, NONPLASTIC, DAMP, FINE SAND, (AEOLIAN DUNE SAND)		S-4-1		
535.0 (5.0)	BECOMES DRY TO DAMP		S-4-2		TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
			S-4-3		
530.0 (10.0)			S-4-4		NO GROUNDWATER OBSERVED ON 5/22/2023
	BOTTOM OF TEST PIT AT 12.0 FEET				

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TEST PIT LOGS

FIGURE
A5

TEST PIT TP-5

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
546.0 (0)	LOOSE SAND (SP): TRACE SILT, BROWN, NONPLASTIC, DAMP, FINE SAND, OCCASIONAL ORGANICS (ROOTLETS), (TOPSOIL)				GRASS AND WEEDS AT SURFACE
	LOOSE SAND (SP): TRACE SILT, BROWN, NONPLASTIC, DAMP, FINE SAND, (AEOLIAN DUNE SAND)		S-5-1		
541.0 (5.0)			S-5-2		TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
	BECOMES MEDIUM DENSE, DARK BROWN TO BLACK, FINE TO MEDIUM SAND		S-5-3		
536.0 (10.0)	BECOMES MEDIUM DENSE TO DENSE, BROWN, FINE SAND		S-5-4		NO GROUNDWATER OBSERVED ON 5/22/2023
	BOTTOM OF TEST PIT AT 12.0 FEET				

TEST PIT TP-6

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
544.1 (0)	LOOSE SAND (SP): TRACE SILT, BROWN, NONPLASTIC, DRY TO DAMP, FINE SAND, OCCASIONAL ORGANICS (ROOTLETS), (TOPSOIL)				GRASS AND WEEDS AT SURFACE
	LOOSE SAND (SP): TRACE SILT, BROWN, NONPLASTIC, DAMP, FINE SAND, (AEOLIAN DUNE SAND)		S-6-1		
539.1 (5.0)	BECOMES LIGHT BROWN, NONPLASTIC, DRY TO DAMP		S-6-2		TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
	BECOMES MEDIUM DENSE TO DENSE, DARK BROWN		S-6-3		
534.1 (10.0)			S-6-4		NO GROUNDWATER OBSERVED ON 5/22/2023
	BOTTOM OF TEST PIT AT 12.0 FEET				

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TEST PIT LOGS

FIGURE
A6

TEST PIT TP-7

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
534.2 (0)	LOOSE SAND WITH SILT (SP-SM): BROWN, NONPLASTIC, DRY, FINE SAND, OCCASIONAL ORGANICS (ROOTLETS), (TOPSOIL)				GRASS AND WEEDS AT SURFACE
	LOOSE SAND WITH SILT (SP-SM): LIGHT BROWN, NONPLASTIC, DRY TO DAMP, FINE SAND, (AEOLIAN DUNE SAND)		☒ S-7-1		
529.2 (5.0)	LOOSE SILTY SAND (SM): LIGHT BROWN, NONPLASTIC, DRY, FINE SAND, (AEOLIAN DUNE SAND)		☒ S-7-2		TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
	MEDIUM STIFF TO STIFF SANDY SILT (ML): LIGHT BROWN, NONPLASTIC, DRY, FINE SAND, (AEOLIAN DUNE SAND)		☒ S-7-3		
524.2 (10.0)			☒ S-7-4		NO GROUNDWATER OBSERVED ON 5/23/2023
	BOTTOM OF TEST PIT AT 12.0 FEET				

TEST PIT TP-8

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
498.7 (0)	LOOSE SAND WITH (SP-SM): BROWN, NONPLASTIC, DRY, FINE SAND, OCCASIONAL ORGANICS (ROOTLETS), (TOPSOIL)				GRASS AND WEEDS AT SURFACE
	LOOSE TO MEDIUM DENSE SAND WITH SILT (SP-SM): BROWN, NONPLASTIC, DAMP, FINE SAND, (AEOLIAN DUNE SAND)		☒ S-8-1		
493.7 (5.0)	LOOSE SAND (SP): TRACE SILT, DARK BROWN TO BLACK, NONPLASTIC, DRY TO DAMP, FINE SAND, (AEOLIAN DUNE SAND)		☒ S-8-2		TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
			☒ S-8-3		
488.7 (10.0)	BECOMES MEDIUM DENSE		☒ S-8-4		NO GROUNDWATER OBSERVED ON 5/23/2023
	BOTTOM OF TEST PIT AT 12.0 FEET				

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PORT OF WALLA WALLA
WALLULA GAP BUSINESS PARK ROADS 2023
WALLA WALLA COUNTY, WASHINGTON

TEST PIT LOGS

FIGURE
A7

TEST PIT TP-9

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
413.9 (0)	LOOSE SAND (SP): TRACE SILT, BROWN, NONPLASTIC, DRY, FINE TO COARSE SAND, OCCASIONAL ORGANICS (ROOTLETS), (TOPSOIL)				GRASS AND WEEDS AT SURFACE
	MEDIUM DENSE TO DENSE SAND (SP): TRACE SILT, LIGHT BROWN, NONPLASTIC, DRY, FINE TO COARSE SAND, WEAK CEMENTATION (CALICHE), (AEOLIAN DUNE SAND)		S-9-1		
408.9 (5.0)	MEDIUM DENSE TO DENSE SAND (SP): TRACE SILT AND GRAVEL, LIGHT BROWN, NONPLASTIC, DRY, FINE SAND, FINE TO COARSE GRAVEL, SUBROUNDED, OCCASIONAL COBBLES TO 8-INCH DIAMETER, (ALLUVIUM)		S-9-2		TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
403.9 (10.0)	DENSE TO VERY DENSE SAND WITH GRAVEL (SP): TRACE SILT, LIGHT BROWN, NONPLASTIC, DRY, FINE TO COARSE SAND, FINE TO COARSE GRAVEL, SUBROUNDED, OCCASIONAL COBBLES TO 8-INCH DIAMETER, (ALLUVIUM)		S-9-3		
	DENSE TO VERY DENSE GRAVEL WITH SAND (GP): LIGHT BROWN, NONPLASTIC, DRY, FINE TO COARSE SAND, FINE TO COARSE GRAVEL, SUBROUNDED, OCCASIONAL COBBLES TO 8-INCH DIAMETER, WEAK CEMENTATION (CALICHE), (ALLUVIUM)		S-9-4		NO GROUNDWATER OBSERVED ON 5/23/2023
	BOTTOM OF TEST PIT AT 14.0 FEET				

TEST PIT TP-10

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
445.0 (0)	LOOSE SAND WITH SILT (SP-SM): TRACE SILT, LIGHT BROWN, NONPLASTIC, DRY, FINE SAND, OCCASIONAL ORGANICS (ROOTLETS), (TOPSOIL)				GRASS AND WEEDS AT SURFACE
	MEDIUM DENSE TO DENSE SAND WITH SILT (SP-SM): LIGHT BROWN, NONPLASTIC, DRY TO DAMP, FINE SAND, (AEOLIAN DUNE SAND)		S-10-1		
440.0 (5.0)	MEDIUM DENSE TO DENSE SAND (SP): TRACE SILT, LIGHT BROWN, NONPLASTIC, DRY, FINE TO MEDIUM SAND, (AEOLIAN DUNE SAND)		S-10-2		TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
	BECOMES VERY WEAKLY CEMENTED		S-10-3		
435.0 (10.0)	BECOMES FINE SAND		S-10-4		NO GROUNDWATER OBSERVED ON 5/23/2023
	BOTTOM OF TEST PIT AT 12.0 FEET				

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PORT OF WALLA WALLA
WALLULA GAP BUSINESS PARK ROADS 2023
WALLA WALLA COUNTY, WASHINGTON

TEST PIT LOGS

FIGURE
A8

HAND AUGER HA-1

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
528.1 (0)	LOOSE SAND WITH SILT (SP-SM): BROWN, NONPLASTIC, DRY, FINE SAND, OCCASIONAL ORGANICS (ROOTLETS), (TOPSOIL)				WHEAT STUBBLE AT SURFACE
	LOOSE SAND WITH SILT (SP-SM): LIGHT BROWN, NONPLASTIC, DRY TO DAMP, FINE SAND, (AEOLIAN DUNE SAND)		S-1-1		
523.1 (5.0)			S-1-2		TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
	LOOSE TO MEDIUM DENSE SILTY SAND (SM): LIGHT BROWN, NONPLASTIC, DRY, FINE SAND, (AEOLIAN DUNE SAND)		S-1-3		
518.1 (10.0)	LOOSE SAND WITH SILT (SP-SM): LIGHT BROWN, NONPLASTIC, DAMP, FINE SAND, (AEOLIAN DUNE SAND)		S-1-4		
			S-1-5		NO GROUNDWATER OBSERVED ON 5/18/2023
	BOTTOM OF TEST PIT AT 13.0 FEET				

HAND AUGER HA-2

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
473.8 (0)	LOOSE SAND (SP): TRACE SILT, DARK BROWN TO GRAY, NONPLASTIC, DRY, FINE SAND, OCCASIONAL ORGANICS (ROOTLETS), (TOPSOIL)				WHEAT CROP AT SURFACE
	LOOSE SAND (SP): TRACE SILT, DARK BROWN TO GRAY, NONPLASTIC, DAMP, FINE SAND, (AEOLIAN DUNE SAND)		S-2-1		
468.8 (5.0)			S-2-2		TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
	LOOSE SAND WITH SILT (SP-SM): BROWN, NONPLASTIC, DAMP, FINE SAND, (AEOLIAN DUNE SAND)		S-2-3		
463.8 (10.0)	LOOSE SAND (SP): TRACE SILT, DARK BROWN TO GRAY, NONPLASTIC, DAMP, FINE SAND, (AEOLIAN DUNE SAND)		S-2-4		NO GROUNDWATER OBSERVED ON 5/18/2023
	BOTTOM OF TEST PIT AT 13.0 FEET				

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PORT OF WALLA WALLA
WALLULA GAP BUSINESS PARK ROADS 2023
WALLA WALLA COUNTY, WASHINGTON

TEST PIT LOGS

FIGURE
A9

HAND AUGER HA-3

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
546.9 (0)	LOOSE SAND WITH SILT (SP-SM): BROWN, NONPLASTIC, DRY, FINE SAND, OCCASIONAL ORGANICS (ROOTLETS), (TOPSOIL)				POTATO CROP AT SURFACE
	LOOSE SAND WITH SILT (SP-SM): BROWN, NONPLASTIC, DAMP, FINE SAND, (AEOLIAN DUNE SAND)		S-3-1		
541.9 (5.0)			S-3-2		TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
536.9 (10.0)			S-3-3		
			S-3-4		NO GROUNDWATER OBSERVED ON 5/18/2023
	BOTTOM OF TEST PIT AT 13.0 FEET				

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PORT OF WALLA WALLA
WALLULA GAP BUSINESS PARK ROADS 2023
WALLA WALLA COUNTY, WASHINGTON

TEST PIT LOGS

FIGURE
A10

APPENDIX B
Test Pit Logs, Boring Logs, and Well Reports

LEGEND

TP-1 *TEST PIT LOCATION*

HA-1 *HAND AUGER AND BORING LOCATIONS*

N

400 0 400 800 1200
SCALE IN FEET

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PORT OF WALLA WALLA
WALLULA GAP BUSINESS PARK ROADS 2023
WALLA WALLA COUNTY, WASHINGTON

SUBSURFACE EXPLORATION LOCATIONS

FIGURE
B1

TEST PIT TP-1

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
440.0 (0)	LOOSE SILTY SAND (SM); LIGHT BROWN, DAMP, NONPLASTIC, FINE SAND, SCATTERED ORGANICS (ROOTLETS) IN UPPER 6.0 INCHES, (TOPSOIL)		☒ S-1-1	■	0.10 TSF
				■	0.10 TSF
	LOOSE SAND WITH SILT (SP-SM); LIGHT BROWN, DAMP, NONPLASTIC, FINE SAND, (AEOLIAN DUNE SAND)		☒ S-1-2		
				■	0.20 TSF
	LOOSE TO MEDIUM DENSE SAND (SP); TRACE SILT, GRAY, DAMP, NONPLASTIC, FINE TO MEDIUM SAND, THIN INTERBEDDED LAYERS OF SLIGHT CEMENTATION, (AEOLIAN DUNE SAND)		☒ S-1-3	■	0.20 TSF
435.0 (5.0)					TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
	BECOMES WITH TRACE COARSE GRAVEL, SUBROUNDED, (ALLUVIAL)		☒ S-1-4		
430.0 (10.0)	BECOMES MOSTLY FINE SAND				
	BECOMES WITH TRACE FINE TO COARSE GRAVEL, SUBROUNDED, (ALLUVIAL)				NO GROUNDWATER OBSERVED ON 5/3/2018
	BOTTOM OF TEST PIT AT 14.0 FEET				
425.0 (15.0)					

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PORT OF WALLA WALLA
PROJECT ELK ROAD
WALLULA, WASHINGTON
JUNE 2018
TEST PIT LOGS

FIGURE
A2

TEST PIT TP-2

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
432.0 (0)	VERY LOOSE TO LOOSE SILTY SAND (SM); LIGHT BROWN, DAMP, NONPLASTIC, FINE SAND, SCATTERED ORGANICS (ROOTLETS) IN UPPER 6.0 INCHES, (TOPSOIL)			■	0.05 TSF
			☒ S-2-1	■	0.05 TSF
				■	0.10 TSF
	LOOSE SAND WITH SILT (SP-SM); LIGHT BROWN, DAMP, NONPLASTIC, FINE SAND, (AEOLIAN DUNE SAND)			■	0.20 TSF
	SOFT SILT (ML), LIGHT BROWN, LOW PLASTICITY, DAMP, (ALLUVIUM)				
427.0 (5.0)					TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
	LOOSE SILTY SAND (SM); LIGHT BROWN, DAMP, NONPLASTIC, FINE SAND, (AEOLIAN DUNE SAND)		☒ S-2-2		
422.0 (10.0)	BECOMES MEDIUM DENSE SAND WITH SILT (SP-SM)				
					NO GROUNDWATER OBSERVED ON 5/3/2018
	BOTTOM OF TEST PIT AT 14.0 FEET				
417.0 (15.0)					

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PORT OF WALLA WALLA
PROJECT ELK ROAD
WALLULA, WASHINGTON
JUNE 2018
TEST PIT LOGS

FIGURE
A3

TEST PIT TP-3

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
403.1 (0)	VERY LOOSE TO LOOSE SILTY SAND (SM); LIGHT BROWN, DAMP, NONPLASTIC, FINE SAND, SCATTERED ORGANICS (ROOTLETS) IN UPPER 8.0 INCHES, (TOPSOIL)		☒ S-3-1	■	0.05 TSF
	LOOSE SAND WITH SILT (SP-SM); LIGHT BROWN, DAMP, NONPLASTIC, FINE SAND, (AEOLIAN DUNE SAND)			■	0.05 TSF
			☒ S-3-2	■	0.10 TSF
				■	0.10 TSF
398.1 (5.0)					TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
393.1 (10.0)					
	LOOSE SAND WITH TRACE SILT (SP); GRAY, DAMP, NONPLASTIC, FINE SAND, (AEOLIAN DUNE SAND)				NO GROUNDWATER OBSERVED ON 5/3/2018
	BOTTOM OF TEST PIT AT 14.0 FEET				
388.1 (15.0)					

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PORT OF WALLA WALLA
PROJECT ELK ROAD
WALLULA, WASHINGTON
JUNE 2018
TEST PIT LOGS

FIGURE
A4

TEST PIT TP-4

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
424.7 (0)	VERY LOOSE TO LOOSE SILTY SAND (SM); LIGHT BROWN, DAMP, NONPLASTIC, FINE SAND, SCATTERED ORGANICS (ROOTLETS) IN UPPER 6.0 INCHES, (TOPSOIL)		☒ S-4-1	■	0.05 TSF
	SOFT TO MEDIUM STIFF SANDY SILT (ML); LIGHT BROWN, DAMP, NONPLASTIC, FINE SAND, (LOESS)		☒ S-4-2	■ ■ ■	0.05 TSF 0.10 TSF 0.15 TSF
419.7 (5.0)	LOOSE SILTY SAND (SM); LIGHT BROWN, DAMP, NONPLASTIC, FINE SAND, (AEOLIAN DUNE SAND)				
	INTERBEDDED SANDY SILT LAYERS				TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
414.7 (10.0)	LOOSE TO MEDIUM DENSE SAND WITH SILT (SP-SM); LIGHT BROWN, DAMP, NONPLASTIC, FINE SAND, (AEOLIAN DUNE SAND)		☒ S-4-3		
	INTERBEDDED SILTY SAND LAYERS				
	MEDIUM STIFF TO STIFF SILT WITH SAND (ML); TRACE GRAVEL, LIGHT BROWN, DAMP, NONPLASTIC, COARSE GRAVEL, SUBROUNDED, OCCASIONAL COBBLES, FINE TO MEDIUM SAND, (ALLUVIUM).		☒ S-4-4		NO GROUNDWATER OBSERVED ON 5/3/2018
409.7 (15.0)	BOTTOM OF TEST PIT AT 14.0 FEET				

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PORT OF WALLA WALLA
PROJECT ELK ROAD
WALLULA, WASHINGTON
JUNE 2018
TEST PIT LOGS

FIGURE
A5

TEST PIT TP-5

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
362.4 (0)	VERY LOOSE TO LOOSE SILTY SAND (SM); TRACE GRAVEL, LIGHT BROWN, DAMP, NONPLASTIC, FINE SAND, FINE TO COARSE GRAVEL, SUBROUNDED, SCATTERED ORGANICS (ROOTLETS) IN UPPER 8.0 INCHES, (TOPSOIL)		☒ S-5-1	■	0.05 TSF
	VERY LOOSE TO LOOSE SAND WITH SILT (SP-SM); TRACE GRAVEL, LIGHT BROWN, DAMP, NONPLASTIC, FINE SAND, FINE TO COARSE GRAVEL, SUBROUNDED, OCCASIONAL COBBLES UP TO 6-INCH DIAMETER, (ALLUVIUM)			■	0.05 TSF
			☒ S-5-2	■	0.05 TSF
	THIN INTERBEDDED GRAVEL LAYERS			■	0.05 TSF
357.4 (5.0)					TEST PIT BACKFILLED WITH EXCAVATED MATERIAL
	MEDIUM DENSE TO DENSE SANDY GRAVEL (GP); TRACE SILT, GRAY TO BROWN, DAMP, FINE TO COARSE GRAVEL, SUBROUNDED, SCATTERED COBBLES UP TO 18-INCH DIAMETER, (ALLUVIUM)				
352.4 (10.0)					NO GROUNDWATER OBSERVED ON 5/3/2018
	BOTTOM OF TEST PIT AT 12.0 FEET				

TEST PIT TP-6

ELEVATION (DEPTH) FEET	CLASSIFICATION OF MATERIAL	LOG	SAMPLES	TESTS	COMMENTS
425.0 (0)	LOOSE SAND WITH SILT (SP-SM), TRACE GRAVEL, LIGHT BROWN, DAMP, FINE GRAVEL, SUBROUNDED, SCATTERED ORGANICS IN UPPER 6 INCHES, (TOPSOIL)			■	0.10 TSF
	LOOSE SAND WITH SILT (SP-SM); TRACE GRAVEL, LIGHT BROWN, DAMP, FINE GRAVEL, SUBROUNDED, (AEOLIAN DUNE SAND)		☒ S-6-1	■	0.10 TSF
	BECOMES WITH SOME GRAVEL,			■	0.15 TSF
420.0 (5.0)	LOOSE SAND WITH SILT AND GRAVEL (SP-SM); TRACE GRAVEL, LIGHT BROWN, DAMP, FINE GRAVEL, SUBROUNDED, SLIGHT CEMENTATION IN LAYERS AND AROUND GRAVEL, (CALICHE)			■	0.15 TSF
	LOOSE SAND WITH SILT (SP-SM); TRACE GRAVEL, GRAY, DRY TO DAMP, FINE TO COARSE SAND, FINE TO COARSE GRAVEL, SUBROUNDED, SCATTERED COBBLES UP TO 8-INCH DIAMETER, (AEOLIAN DUNE SAND)		☒ S-6-2		
	MEDIUM DENSE SAND (SP); TRACE SILT, LIGHT BROWN, DAMP, FINE SAND, (AEOLIAN DUNE SAND)				
415.0 (10.0)	BOTTOM OF TEST PIT AT 10.0 FEET				

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PORT OF WALLA WALLA
PROJECT ELK ROAD
WALLULA, WASHINGTON
JUNE 2018
TEST PIT LOGS

FIGURE
A6

RECORD OF BOREHOLE: BH-05

CLIENT:	Rockwool	START DATE:	February 06, 2023	ELEVATION:	491.4 ft (Existing Ground)
PROJECT:	Project 67 Due Diligence	END DATE:	February 07, 2023	COORDINATES:	N: 289254.2 ft E: 2045746.2 ft
PROJECT NO:	31405932	INCLINATION:	-90.0°	COORD SYS:	SP WA South FIPS 4602 Ft
LOCATION:	Atallia, WA	CONTRACTOR:	Holt Services, Inc.	HORZ DATUM:	NAD83 VERT DATUM: NAVD88

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS (Hammer: Automatic, 140lb, 30" drop, ASTM D1586, Blows per 6 in, 140-lb hammer, 30-in drop)	N-VALUE	WATER CONTENT (Plastic & Liquid Limits (%), Water Content (%), NP Nonplastic)	GRADATION % GRAVEL	SAND	FINES	ORGANIC CONTENT %	ADDITIONAL LAB TESTING	SPT N Value (PENETRATION RESISTANCE BLOWS/FT)	GROUNDWATER OBSERVATIONS
0	B-58 truck mount	Mud Rotary	Topsoil; grass. Qd (Dune sand)			0.0 / 490.4													
1			(SP-SM) Poorly graded SAND with silt, fine, few non-plastic fines; tannish gray, locally lamindated; medium dense to dense.	SP-SM		1.0													
5							S-1	SS	87	6-6-10	16							▲ 16	
8						483.4													
8			(SM) Silty SAND, fine to medium, subangular, little non-plastic fines; gray, laminated to stratified with sand; moist, dense to very dense. Qfs (Touchet beds)			8.0													
10							S-2	SS	100	13-17-17	34	○	0	80	20		23965: Sieve Analysis	▲ 34	
15			- 15.5 ft: 1/4-inch silt lens	SM			S-3	SS	80	22-28-29	57							▲ 57	
20							S-4	SS	100	26-27-31	58							▲ 58	
25																			

Continued on Next Page

HAMMER TYPE: Automatic, 140lb, 30" drop

REV: 2

LOGGED: J. Anderson DATE: Feb 06, 2023

CHECKED: J. Anderson DATE: Apr 10, 2023

RECORD OF BOREHOLE: BH-05

CLIENT: Rockwool
PROJECT: Project 67 Due Diligence
PROJECT NO: 31405932
LOCATION: Atallia, WA

START DATE: February 06, 2023
END DATE: February 07, 2023
INCLINATION: -90.0°
CONTRACTOR: Holt Services, Inc.

ELEVATION: 491.4 ft (Existing Ground)
COORDINATES: N: 289254.2 ft E: 2045746.2 ft
COORD SYS: SP WA South FIPS 4602 Ft
HORZ DATUM: NAD83 VERT DATUM: NAVD88

DEPTH (ft)	DRILL RIG	DRILL METHOD	DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	NUMBER	TYPE	REC %	BLOWS	N-VALUE	WATER CONTENT (Plastic & Liquid Limits (%), Water Content (%), NP Nonplastic)	GRAVEL	SAND	FINES	ORGANIC CONTENT %	ADDITIONAL LAB TESTING	SPT N Value (PENETRATION RESISTANCE BLOWS/FT)	GROUNDWATER OBSERVATIONS
26	B-58 truck mount	Mud Rotary	(SM) Silty SAND, fine to medium, subangular, little non-plastic fines; gray, laminated to stratified with sand; moist, dense to very dense. Qfs (Touchet beds)	SM			S-5	SS	100	25-37-46	83							▲	
27																			
28						463.4 / 28.0														
29			(SM) Silty SAND, fine, little non-plastic fines; gray, laminated; moist, very dense.																
30							S-6	SS	100	23-49-44	93							▲	
31																			
32																			
33						458.4 / 33.0														
34			(SP-SM) Poorly graded SAND with silt, fine to medium, few non-plastic fines; gray, laminated to stratified with silty sand; moist, very dense.	SP-SM															
35							S-7	SS	100	24-35-40	75							▲	
36																			
37																			
38																			
39																			
40																			
41							S-8	SS	100	24-40-50	90							▲	
42																			
43			(SM) Silty SAND, fine to medium, little non-plastic fines; gray with tan, laminated to stratified in 3-inch lenses; moist, very dense.			448.4 / 43.0													
44																			
45							S-9	SS	100	35-45-46	91							▲	
46				SM															
47																			
48																			
49																			
50																			

Continued on Next Page

HAMMER TYPE: Automatic, 140lb, 30" drop

REV: 2

LOGGED: J. Anderson DATE: Feb 06, 2023
CHECKED: J. Anderson DATE: Apr 10, 2023

RECORD OF BOREHOLE: BH-05

CLIENT:	Rockwool	START DATE:	February 06, 2023	ELEVATION:	491.4 ft (Existing Ground)
PROJECT:	Project 67 Due Diligence	END DATE:	February 07, 2023	COORDINATES:	N: 289254.2 ft E: 2045746.2 ft
PROJECT NO:	31405932	INCLINATION:	-90.0°	COORD SYS:	SP WA South FIPS 4602 Ft
LOCATION:	Atallia, WA	CONTRACTOR:	Holt Services, Inc.	HORZ DATUM:	NAD83 VERT DATUM: NAVD88

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS (Hammer: Automatic, 140lb, 30" drop, ASTM D1586, Blows per 6 in, 140-lb hammer, 30-in drop)	N-VALUE	WATER CONTENT: Plastic & Liquid Limits (%), Water Content (%), NP Nonplastic (0, 25, 50, 75, 100, 125, 150)	GRADATION %: GRAVEL	SAND	FINES	ORGANIC CONTENT %	ADDITIONAL LAB TESTING	SPT N Value: PENETRATION RESISTANCE BLOWS/FT (20, 40, 60, 80)	GROUNDWATER OBSERVATIONS
51	B-58 truck mount	Mud Rotary	(SM) Silty SAND, fine to medium, little non-plastic fines; gray with tan, laminated to stratified in 3-inch lenses; moist, very dense.	SM			S-10	SS	100	33-50/6"								▲	
52																			
53						438.4													
			(SM) Silty SAND with gravel, fine to medium, some coarse gravel; gray with light tan, heterogeneous; mosit, very dense, pulverized highly altered cobble. Tcs (Ringold Fm)			53.0													
54																			
55							S-11	SS	100	50/6"								▲	
56																			
57																			
58						433.4													
			(ML) Sandy SILT, mostly non-plastic fines, some fine sand; gray; moist, very dense.			58.0													
59																			
60							S-12	SS	100	40-50/5"								▲	
61																			
62																			
63																			
64																			
65							S-13	SS	80	50/6"								▲	
66				ML															
67																			
68						423.4													
			(ML) Sandy SILT with gravel, mostly non-plastic fines, some fine to coarse sand, few fine subrounded gravel; light tannish gray; moist, very dense.			68.0													
69																			
70							S-14	SS	100	50/6"								▲	
71																			
72																			
73																			
74																			
75																			

Continued on Next Page

HAMMER TYPE: Automatic, 140lb, 30" drop

REV: 2

LOGGED: J. Anderson DATE: Feb 06, 2023

CHECKED: J. Anderson DATE: Apr 10, 2023

RECORD OF BOREHOLE: MW-01

CLIENT: Rockwool
PROJECT: Project 67 Due Diligence
PROJECT NO: 31405932
LOCATION: Atallia, WA

DATE: January 19, 2023
INCLINATION: -90.0°
CONTRACTOR: Holt Services, Inc.

ELEVATION: 447.7 ft (Existing Ground)
COORDINATES: N: 291360.3 ft E: 2045046.9 ft
COORD SYS: SP WA South FIPS 4602 Ft
HORZ DATUM: NAD83 VERT DATUM: NAVD88

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS (Hammer: Automatic, 140lb, 30" drop, ASTM D1586, Blows per 6 in, 140-lb hammer, 30-in drop)	N-VALUE	WATER CONTENT (Plastic & Liquid Limits (%), Water Content (%), NP Nonplastic)	GRADATION % GRAVEL	SAND	FINES	ORGANIC CONTENT %	ADDITIONAL LAB TESTING	SPT N Value (PENETRATION RESISTANCE BLOWS/FT)	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
0	B-58 truck mount	Mud Rotary	Topsoil; grass. Qd (Dune sand)			0.0 446.7														Pipe Stickup: 2.20 ft
1			(SM) Silty SAND, fine, some non-plastic fines; gray; dry, medium dense, few organic fragments.			1.0														0.0 - 2.0 ft bgs: cement
2																				
3							S-1	SS	87	22-12-10	22							▲		
4						443.2														
5			(SM) Silty SAND, fine to coarse, non-plastic fines, trace fine gravel; black to brown; moist, very dense. Qfs (Touchet beds)			4.5	S-2	SS	100	34-41-50	91								▲	
6																				
7																				
8							S-3	SS	100	46-31-30	61							▲		
9																				
10							S-4	SS	100	30-32-36	68							▲		
11																				
12			(SM) Silty SAND, fine to medium, subrounded to subangular, little non-plastic fines; yellowish brown with dark gray, laminated to stratified, iron oxide staining; dry to moist, dense to very dense.	SM		435.7 12.0														
13							S-5	SS	87	20-17-23	40							▲		
14																				
15							S-6	SS	93	19-21-24	45							▲		
16																				
17																				
18																				
19																				
20							S-7	SS	93	19-36-31	67							▲		
21																				
22																				
23																				
24																				
25																				

Continued on Next Page

HAMMER TYPE: Automatic, 140lb, 30" drop

REV: 2

LOGGED: E. Sampson DATE: Jan 19, 2023
CHECKED: J. Anderson DATE: Feb 17, 2023

RECORD OF BOREHOLE: MW-01

CLIENT: Rockwool
PROJECT: Project 67 Due Diligence
PROJECT NO: 31405932
LOCATION: Atallia, WA

DATE: January 19, 2023
INCLINATION: -90.0°
CONTRACTOR: Holt Services, Inc.

ELEVATION: 447.7 ft (Existing Ground)
COORDINATES: N: 291360.3 ft E: 2045046.9 ft
COORD SYS: SP WA South FIPS 4602 Ft
HORZ DATUM: NAD83 VERT DATUM: NAVD88

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS (Hammer: Automatic, 140lb, 30" drop, ASTM D1586, Blows per 6 in, 140-lb hammer, 30-in drop)	N-VALUE	WATER CONTENT (H Plastic & Liquid Limits (%), O Water Content (%), NP Nonplastic; 0 25 50 75 100 125 150)	GRADATION % GRAVEL	SAND	FINES	ORGANIC CONTENT %	ADDITIONAL LAB TESTING	SPT N Value (▲ PENETRATION RESISTANCE BLOWS/FT; 20 40 60 80)	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
26	B-58 truck mount	Mud Rotary	(SM) Silty SAND, fine to medium, subrounded to subangular, little non-plastic fines; yellowish brown with dark gray, laminated to stratified, iron oxide staining; dry to moist, dense to very dense.	SM			S-8	SS	100	23-29-40	69							▲		
27																				
28																				0 - 55 ft bgs: plain pipe 2.0 - 54.0 ft bgs: bentonite chips
29																				
30							S-9	SS	93	22-35-50/5"								▲		
31																				
32																				
33						414.7														
34			(ML) Sandy SILT, mostly non-plastic fines, some fine sand; golden brown to tan, laminated; dry to moist, very dense. Tcs (Ringold Fm)			33.0														
35			- 35.0 ft: tan lenses				S-10	SS	78	33-50/5"								▲		
36																				
37				ML																
38																				
39																				
40							S-11	SS	60	50/6"								▲		
41																				
42																				
43						404.7														
44			(SM) Silty SAND, fine, non-plastic fines; golden brown to gray, laminated; dry, very dense.			43.0														
45							S-12	SS	100	37-50/6"								▲		
46				SM																
47																				
48																				
49																				
50																				

Continued on Next Page

HAMMER TYPE: Automatic, 140lb, 30" drop

REV: 2

LOGGED: E. Sampson DATE: Jan 19, 2023
CHECKED: J. Anderson DATE: Feb 17, 2023

RECORD OF BOREHOLE: MW-01

CLIENT: Rockwool
PROJECT: Project 67 Due Diligence
PROJECT NO: 31405932
LOCATION: Atallia, WA

DATE: January 19, 2023
INCLINATION: -90.0°
CONTRACTOR: Holt Services, Inc.

ELEVATION: 447.7 ft (Existing Ground)
COORDINATES: N: 291360.3 ft E: 2045046.9 ft
COORD SYS: SP WA South FIPS 4602 Ft
HORZ DATUM: NAD83 VERT DATUM: NAVD88

DEPTH (ft)	DRILL RIG	DRILL METHOD	DESCRIPTION	USCS	ELEV. DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	REC %	BLOWS (Hammer: Automatic, 140lb, 30" drop, ASTM D1586, Blows per 6 in, 140-lb hammer, 30-in drop)	N-VALUE	WATER CONTENT (Plastic & Liquid Limits (%), Water Content (%), NP Nonplastic)	GRAVEL	SAND	FINES	ORGANIC CONTENT %	ADDITIONAL LAB TESTING	SPT N Value (PENETRATION RESISTANCE BLOWS/FT)	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
51	B-58 truck mount	Mud Rotary	(SM) Silty SAND, fine, non-plastic fines; golden brown to gray, laminated; dry, very dense.	SM		S-13	SS	86	39-45-50/5"										
52																			
53					394.7														
54			(ML) Sandy SILT, mostly low plasticity fines, some fine sand; brown and brown to gray, stratified; moist to dry, hard.	ML	53.0														
55			- 55.0 ft: 3-inch clay lens																
56						S-14	SS	80	35-45-50	95									
57																			
58					389.7														
59			(SM) Silty SAND, fine to coarse, subrounded to subangular, some non-plastic fines; golden brown; dry to moist, very dense.	SM	58.0														
60																			54.0 - 65.9 ft bgs: sand
61						S-15	SS	87	24-31-33	64								10Feb23	55.00 - 65.00 ft bgs: Screen Interval
62																			
63																			
64																			
65						S-16	SS	100	35-50/5"										
66			End of hole at 65.90 ft. No groundwater observed at time of drilling.		381.8														
67																			
68																			
69																			
70																			
71																			
72																			
73																			
74																			
75																			

Pipe Stickup: 2.20 ft

HAMMER TYPE: Automatic, 140lb, 30" drop

REV: 2

LOGGED: E. Sampson DATE: Jan 19, 2023
CHECKED: J. Anderson DATE: Feb 17, 2023

RECORD OF BOREHOLE: MW-09

CLIENT: Rockwool
PROJECT: Project 67 Due Diligence
PROJECT NO: 31405932
LOCATION: Atallia, WA

DATE: January 18, 2023
INCLINATION: -90.0°
CONTRACTOR: Holt Services, Inc.

ELEVATION: 435.7 ft (Existing Ground)
COORDINATES: N: 289365.3 ft E: 2043860.1 ft
COORD SYS: SP WA South FIPS 4602 Ft
HORZ DATUM: NAD83 VERT DATUM: NAVD88

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS (Hammer Automatic, 140lb, 30" drop, ASTM D1586, Blows per 6 in, 140-lb hammer, 30-in drop)	N-VALUE	WATER CONTENT (Plastic & Liquid Limits (%), Water Content (%), NP Nonplastic)	GRADATION % GRAVEL	SAND	FINES	ORGANIC CONTENT %	ADDITIONAL LAB TESTING	SPT N Value (PENETRATION RESISTANCE BLOWS/FT)	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
0			Topsoil; grass.			0.0														
1			QI (Loess)			434.7														0.0 - 2.0 ft bgs: cement
2			(SM) Silty SAND, fine, subangular, little non-plastic fines; brown; dry, medium dense.			1.0														
3							S-1	SS	73	6-6-7	13							▲ 20		
4						431.2														
5			(SM) Silty SAND, fine to coarse, subrounded to subangular, some non-plastic fines; light brown to dark gray, laminated to stratified; dry, medium dense to very dense. Qfs (Touchet beds)			4.5	S-2	SS	100	16-16-9	25	○	0	70	30		23975: Sieve Analysis	▲ 40		
6																				
7																				
8							S-3	SS	100	14-20-16	36	○	0	71	29		23976: Sieve with Hydrometer	▲ 60		
9																				
10							S-4	SS	87	16-25-28	53							▲ 80		
11	B-58 truck mount	Mud Rotary		SM																0 - 35 ft bgs: plain pipe
12																				
13							S-5	SS	87	14-27-24	51							▲ 80		
14																				
15																				
16							S-6	SS	87	11-14-7	21							▲ 20		
17																				
18																				2.0 - 34.0 ft bgs: bentonite chips
19																				
20																				
21							S-7	SS	87	16-31-32	63							▲ 80		
22																				
23																				
24																				
25																				

Continued on Next Page

HAMMER TYPE: Automatic, 140lb, 30" drop

REV: 2

LOGGED: E. Sampson DATE: Jan 18, 2023
CHECKED: J. Anderson DATE: Apr 10, 2023

RECORD OF BOREHOLE: MW-09

CLIENT: Rockwool
PROJECT: Project 67 Due Diligence
PROJECT NO: 31405932
LOCATION: Atallia, WA

DATE: January 18, 2023
INCLINATION: -90.0°
CONTRACTOR: Holt Services, Inc.

ELEVATION: 435.7 ft (Existing Ground)
COORDINATES: N: 289365.3 ft E: 2043860.1 ft
COORD SYS: SP WA South FIPS 4602 Ft
HORZ DATUM: NAD83 VERT DATUM: NAVD88

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	WATER CONTENT: Plastic & Liquid Limits (%), Water Content (%), NP Nonplastic	GRADATION % GRAVEL	SAND	FINES	ORGANIC CONTENT %	ADDITIONAL LAB TESTING	SPT N Value: PENETRATION RESISTANCE BLOWS/FT	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
			Hammer: Automatic, 140lb, 30" drop; ASTM D1586. Blows per 6 in; 140-lb hammer, 30-in drop									0 25 50 75 100 125 150						20 40 60 80		Pipe Stickup: 2.00 ft
26	B-58 truck mount	Mud Rotary	(SM) Silty SAND, fine to coarse, subrounded to subangular, some non-plastic fines; light brown to dark gray, laminated to stratified; dry, medium dense to very dense. Qfs (Touchet beds)	SM			S-8	SS	100	27-37-43	80							▲		
27																				
28																				
29																				
30																				
31							S-9	SS	100	29-46-50	96							▲		
32																				
33																				
34																				
35																				
36							S-10	SS	100	30-33-45	78							▲		
37																				
38																				
39																				
40																				34.0 - 46.0 ft bgs: sand
41							S-11	SS	93	43-34-47	81							▲		35.00 - 45.00 ft bgs: Screen Interval
42																				
43						392.7														
			(ML) Sandy SILT, mostly low plasticity fines, some fine sand, trace coarse rounded gravel; white to tan; moist, hard, trace carbonized organics. Tcs (Ringold Fm)	ML		43.0														
44																				
45							S-12	SS	100	32-50/6"								▲		
46						389.7														
			End of hole at 46.00 ft. No groundwater observed at time of drilling; monitoring well developed upon completion of installation.																	
47																				
48																				
49																				
50																				

HAMMER TYPE: Automatic, 140lb, 30" drop

REV: 2

LOGGED: E. Sampson DATE: Jan 18, 2023
CHECKED: J. Anderson DATE: Apr 10, 2023

RECORD OF BOREHOLE: MW-10

CLIENT: Rockwool
PROJECT: Project 67 Due Diligence
PROJECT NO: 31405932
LOCATION: Atallia, WA

DATE: January 30, 2023
INCLINATION: -90.0°
CONTRACTOR: Holt Services, Inc.

ELEVATION: 424.8 ft (Existing Ground)
COORDINATES: N: 288954.3 ft E: 2043845.5 ft
COORD SYS: SP WA South FIPS 4602 Ft
HORZ DATUM: NAD83 VERT DATUM: NAVD88

DEPTH (ft)	DRILL RIG	DRILL METHOD	DESCRIPTION	USCS	ELEV. DEPTH (ft)	NUMBER	TYPE	REC %	BLOWS	N-VALUE	WATER CONTENT (H Plastic & Liquid Limits (%), O Water Content (%), NP Nonplastic; 0 25 50 75 100 125 150)	GRAVEL	SAND	FINES	ORGANIC CONTENT %	ADDITIONAL LAB TESTING	SPT N Value (▲ PENETRATION RESISTANCE BLOWS/FT; 20 40 60 80)	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
			Topsoil; sandy, tannish gray. QI (Loess)		0.0														
1					423.8														0.0 - 2.0 ft bgs: cement
			(ML) SILT with sand, mostly non-plastic fines, little fine sand; tan; dry, medium dense to very dense.		1.0														
5			- 5.0 ft: trace wooden fragments	ML		S-1	SS	60	8-10-10	20							▲		
10			- 10.0 ft: laminated			S-2	SS	87	8-21-33	54	O	0	26	74		23977: Sieve with Hydrometer	▲		
	CME 85	HSA			411.8														
13			(SM) Silty SAND, fine, some non-plastic fines; tannish gray, locally laminated; dry, very dense.		13.0														
15						S-3	SS	93	8-25-26	51	O	0	53	47		23978: Sieve Analysis	▲		
				SM															
20						S-4	SS	87	16-32-41	73							▲		0 - 40 ft bgs: plain pipe 2.0 - 39.0 ft bgs: bentonite chips
25																			

Continued on Next Page

Pipe Stickup: 1.30 ft

HAMMER TYPE:

REV: 2

LOGGED: J. Anderson DATE: Jan 30, 2023
CHECKED: J. Anderson DATE: Apr 10, 2023

RECORD OF BOREHOLE: MW-10

CLIENT: Rockwool
PROJECT: Project 67 Due Diligence
PROJECT NO: 31405932
LOCATION: Atallia, WA

DATE: January 30, 2023
INCLINATION: -90.0°
CONTRACTOR: Holt Services, Inc.

ELEVATION: 424.8 ft (Existing Ground)
COORDINATES: N: 288954.3 ft E: 2043845.5 ft
COORD SYS: SP WA South FIPS 4602 Ft
HORZ DATUM: NAD83 VERT DATUM: NAVD88

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS (Hammer ASTM D1586, Blows per 6 in, 140-lb hammer, 30-in drop)	N-VALUE	WATER CONTENT: Plastic & Liquid Limits (%), Water Content (%), NP Nonplastic (0, 25, 50, 75, 100, 125, 150)	GRADATION %: GRAVEL	SAND	FINES	ORGANIC CONTENT %	ADDITIONAL LAB TESTING	SPT N Value: PENETRATION RESISTANCE BLOWS/FT (20, 40, 60, 80)	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
26	CME 85	HSA	(SM) Silty SAND, fine, some non-plastic fines; tannish gray, locally laminated; dry, very dense.	SM			S-5	SS	100	26-50/6"										Pipe Stickup: 1.30 ft
27																				
28																				
29																				
30							S-6	SS	100	26-50/5"										
31																				
32																				
33						391.8														
34			(SP-SM) Poorly graded SAND with silt, fine, few non-plastic fines; light gray; dry, very dense. Qfs (Touchet beds)	SP-SM		33.0														
35							S-7	SS	100	27-29-50/2"										
36																				
37																				
38						386.8														
39			(ML) Sandy SILT, moslty non-plastic fines, some fine sand, trace coarse rounded gravel; tan, laminated; moist, very dense. Tcs (Ringold Fm)	ML		38.0														
40							S-8	SS	100	50/5"										
41																				
42																				
43						381.8														
44			(SP-SM) Poorly graded SAND with silt and gravel, fine to medium, some fine to coarse rounded gravel, few non-plastic fines; brown, slight iron oxide staining; moist, very dense. Tcg (Ringold Fm)	SP-SM		43.0														
45							S-9	SS	100	50/4"									10Feb23 ▽	40.00 - 50.00 ft bgs: Screen Interval 39.0 - 51.5 ft bgs: sand
46																				
47																				
48						376.8														
49			(SW) Well graded SAND with gravel, fine to coarse, subrounded; gray, downward grading; wet, very dense.	SW		48.0														
50																				

Continued on Next Page

HAMMER TYPE:

REV: 2

LOGGED: J. Anderson DATE: Jan 30, 2023
CHECKED: J. Anderson DATE: Apr 10, 2023

RECORD OF BOREHOLE: MW-10

CLIENT: Rockwool
PROJECT: Project 67 Due Diligence
PROJECT NO: 31405932
LOCATION: Atallia, WA

DATE: January 30, 2023
INCLINATION: -90.0°
CONTRACTOR: Holt Services, Inc.

ELEVATION: 424.8 ft (Existing Ground)
COORDINATES: N: 288954.3 ft E: 2043845.5 ft
COORD SYS: SP WA South FIPS 4602 Ft
HORZ DATUM: NAD83 VERT DATUM: NAVD88

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS (Hammer ASTM D1586, Blows per 6 in 140-lb hammer, 30-in drop)	N-VALUE	WATER CONTENT: Plastic & Liquid Limits (%), Water Content (%), NP Nonplastic (0, 25, 50, 75, 100, 125, 150)	GRADATION % GRAVEL	SAND	FINES	ORGANIC CONTENT %	ADDITIONAL LAB TESTING	SPT N Value: PENETRATION RESISTANCE BLOWS/FT (20, 40, 60, 80)	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
51	CME 85	HSA	(SW) Well graded SAND with gravel, fine to coarse, subrounded; gray, downward grading; wet, very dense.	SW		373.3	S-10	SS	60	7-19-33	52							▲		Pipe Stickup: 1.30 ft
52			End of hole at 51.50 ft. Monitoring well developed upon completion of installation.																	
53																				
54																				
55																				
56																				
57																				
58																				
59																				
60																				
61																				
62																				
63																				
64																				
65																				
66																				
67																				
68																				
69																				
70																				
71																				
72																				
73																				
74																				
75																				

HAMMER TYPE:

REV: 2

LOGGED: J. Anderson DATE: Jan 30, 2023
CHECKED: J. Anderson DATE: Apr 10, 2023

RECORD OF BOREHOLE: MW-11

CLIENT: Rockwool
PROJECT: Project 67 Due Diligence
PROJECT NO: 31405932
LOCATION: Atallia, WA

DATE: January 31, 2023
INCLINATION: -90.0°
CONTRACTOR: Holt Services, Inc.

ELEVATION: 509.0 ft (Existing Ground)
COORDINATES: N: 288971.2 ft E: 2046589.5 ft
COORD SYS: SP WA South FIPS 4602 Ft
HORZ DATUM: NAD83 VERT DATUM: NAVD88

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS (Hammer ASTM D1586, Blows per 6 in, 140-lb hammer, 30-in drop)	N-VALUE	WATER CONTENT: Plastic & Liquid Limits (%), Water Content (%), NP Nonplastic (0, 25, 50, 75, 100, 125, 150)	GRADATION %: GRAVEL	SAND	FINES	ORGANIC CONTENT %	ADDITIONAL LAB TESTING	SPT N Value: PENETRATION RESISTANCE BLOWS/FT (20, 40, 60, 80)	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
0	CME 85	HSA	Topsoil; sandy, gray. Qfs (Touchet beds)			0.0														Pipe Stickup: 2.00 ft
						508.0														
1			(SM) Silty SAND, fine to coarse, little non-plastic fines; tan to gray, stratified in 4-inch lenses with sand; dry, very dense.	SM		1.0														0.0 - 2.0 ft bgs: cement
5			- 5.0 ft: hammer type: wireline hammer, 140 lbs, 30 inch drop				S-1	SS	80	17-32-34	66							▲		
14			- 14.0 ft: driller indicates gravel																	
15			- 15.0 ft: slight iron oxide staining				S-2	SS	100	36-50/5"								▲		0 - 35 ft bgs: plain pipe 2.0 - 34.0 ft bgs: bentonite chips
20			(SP-SM) Poorly graded SAND with silt, fine to medium, few non-plastic fines; gray; dry, very dense.	SP-SM		489.0 20.0														
25			Continued on Next Page																	

HAMMER TYPE:

REV: 2

LOGGED: J. Anderson DATE: Jan 31, 2023
CHECKED: J. Anderson DATE: Feb 24, 2023

RECORD OF BOREHOLE: MW-11

CLIENT: Rockwool
PROJECT: Project 67 Due Diligence
PROJECT NO: 31405932
LOCATION: Atallia, WA

DATE: January 31, 2023
INCLINATION: -90.0°
CONTRACTOR: Holt Services, Inc.

ELEVATION: 509.0 ft (Existing Ground)
COORDINATES: N: 288971.2 ft E: 2046589.5 ft
COORD SYS: SP WA South FIPS 4602 Ft
HORZ DATUM: NAD83 VERT DATUM: NAVD88

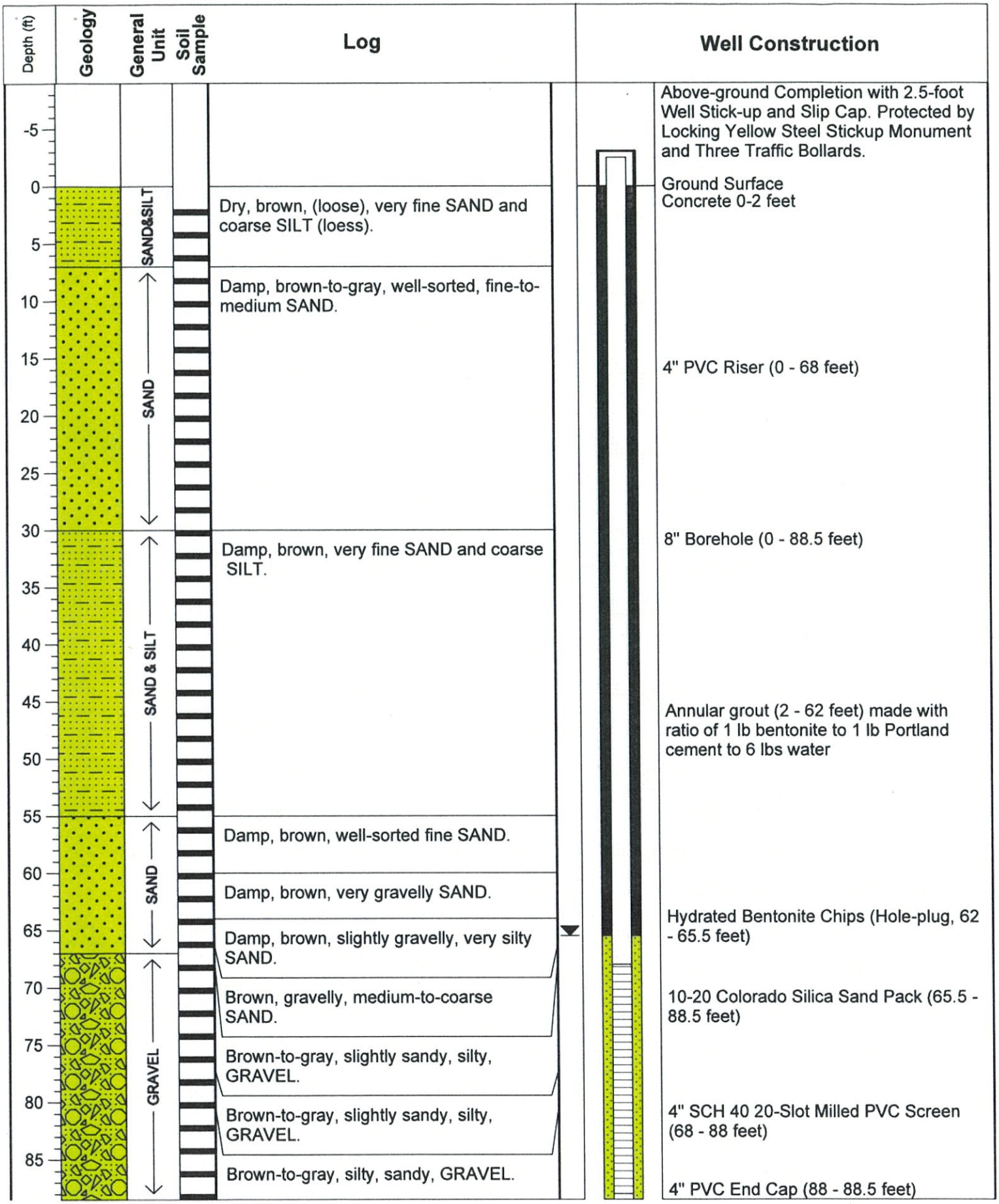
DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS (Hammer ASTM D1586, Blows per 6 in, 140-lb hammer, 30-in drop)	N-VALUE	WATER CONTENT: Plastic & Liquid Limits (%), Water Content (%), NP Nonplastic (0, 25, 50, 75, 100, 125, 150)	GRADATION % GRAVEL	SAND	FINES	ORGANIC CONTENT %	ADDITIONAL LAB TESTING	SPT N Value: PENETRATION RESISTANCE BLOWS/FT (20, 40, 60, 80)	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
26			(SP-SM) Poorly graded SAND with silt, fine to medium, few non-plastic fines; gray; dry, very dense.	SP-SM			S-3	SS	100	26-50/6"								▲		
27																				
28																				
29																				
30						479.0														
			(GW) Well graded GRAVEL with sand, fine to coarse, rounded, some fine to coarse sand; brown, heterogeneous; moist, very dense. Qfg (Pasco gravles) - 30.0 ft: coarse rounded gravel in cuttings	GW		30.0														
31																				
32																				
33																				
34																				
35	CME 85	HSA					S-4	SS	100	50/4"								▲		
36																				
37																				
38																				
39																				
40						469.0														
			(ML) Sandy SILT with gravel, mostly non-plastic fines, some fine to coarse subrounded sand, little fine to coarse subrounded gravel; gray, heterogeneous; moist, very dense.	ML		40.0													10Feb23 ▽	34.0 - 45.5 ft bgs: sand 35.00 - 45.00 ft bgs: Screen Interval
41																				
42																				
43																				
44																				
45						463.5	S-5	SS	100	50/6"								▲		
			End of hole at 45.50 ft. Monitoring well developed upon completion of installation.																	
46																				
47																				
48																				
49																				
50																				

Pipe Stickup: 2.00 ft

HAMMER TYPE:

REV: 2

LOGGED: J. Anderson DATE: Jan 31, 2023
CHECKED: J. Anderson DATE: Feb 24, 2023

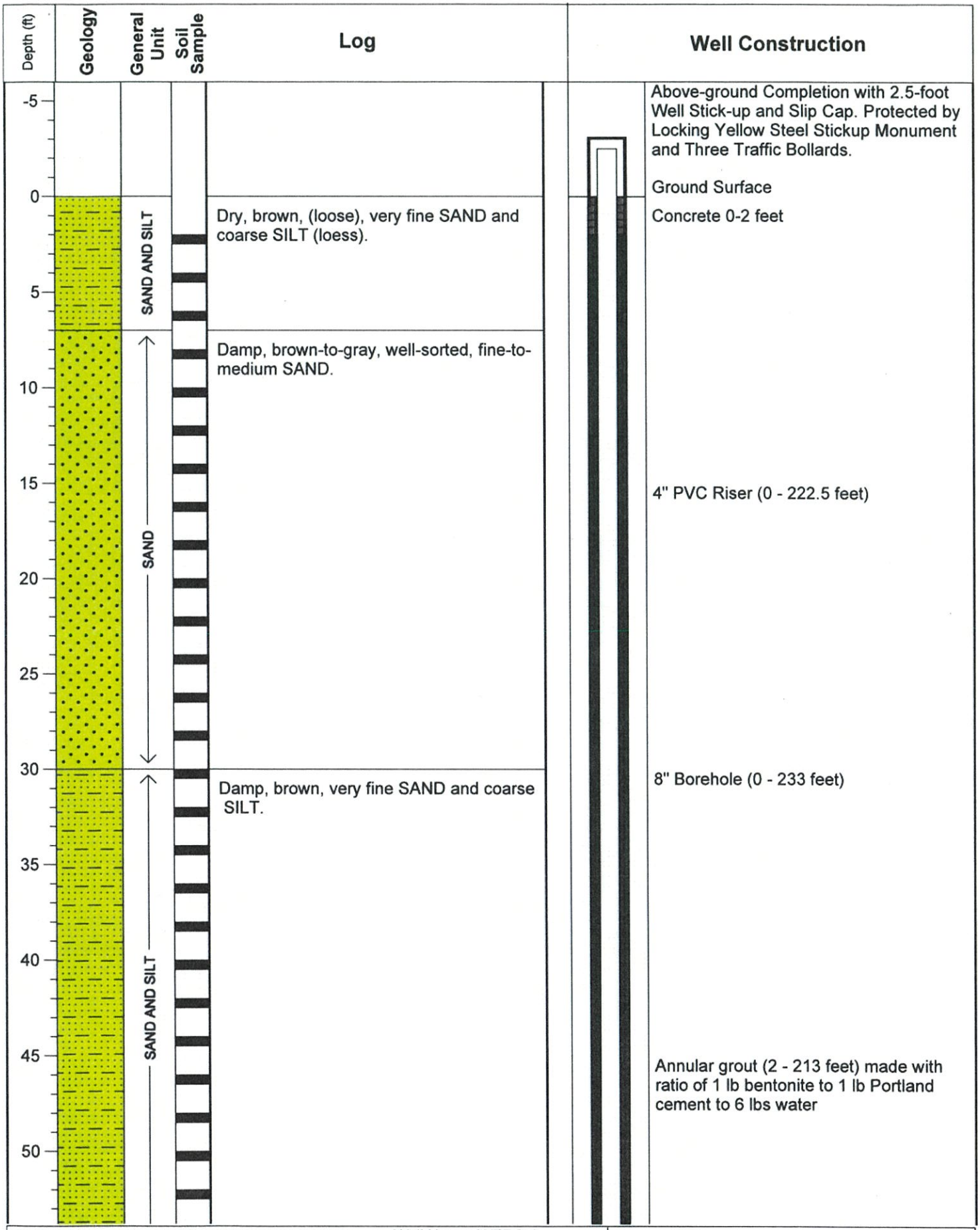


Project Name: Wallula Energy Resource Center
Drilling Method: Air Rotary
Driller: Ron Sink
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: assumed log is same as WERC-A
Location: SE1/4 of NE1/4 Section 2 T07N R31E

Well Name: WERC-As
Ecology ID: APA 364
MP Elevation: ??
Datum: -
Installed: 4/25/2007
DTW: 65.5' BGS on 4/26/2007

Figure XX
DRAFT GEOLOGIC LOG AND AS-BUILT FOR WELL WERC-As
Wallula Energy Resource Center
Wallula, Washington
JE0701, 4/2007

PgG

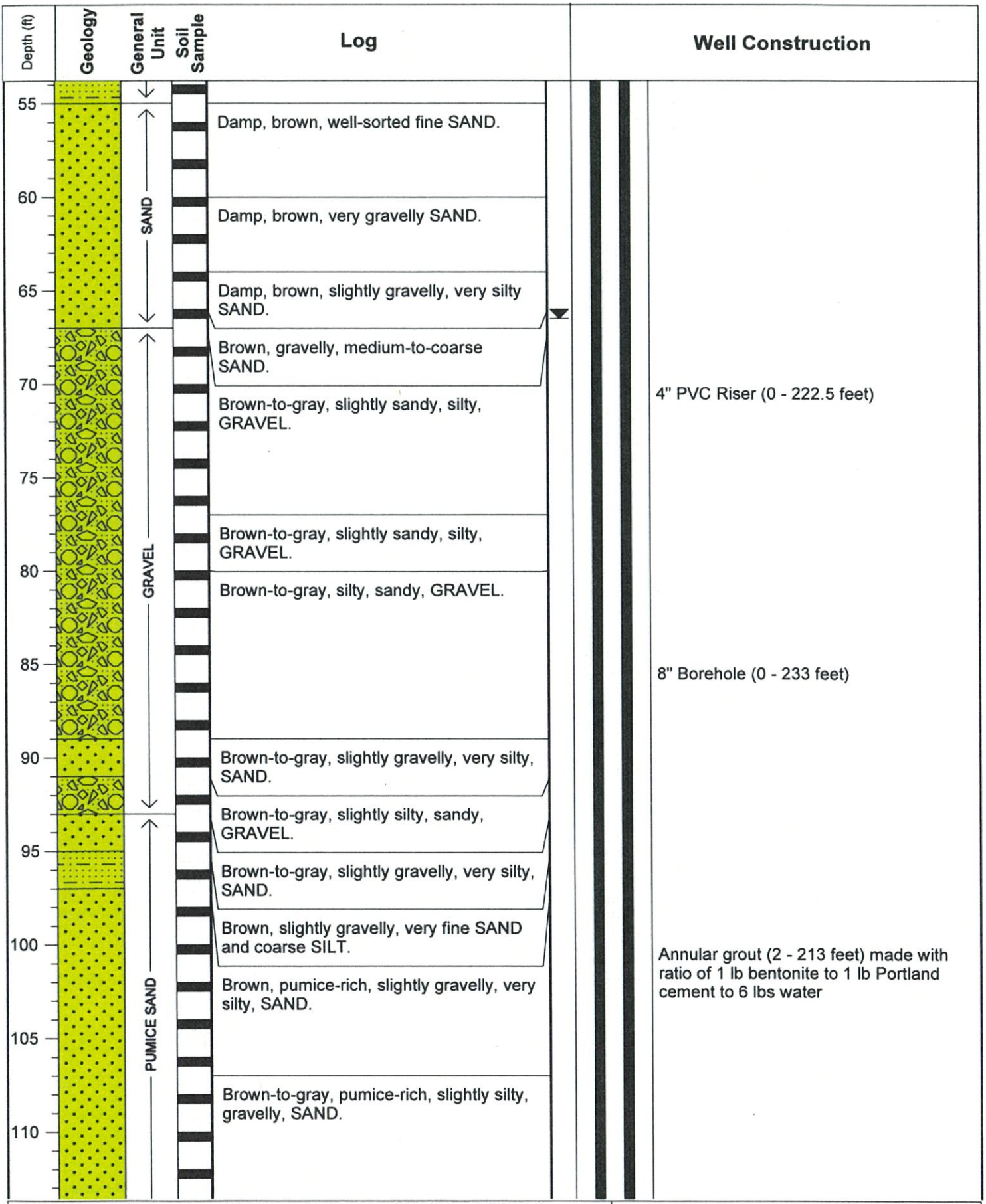


Project Name: Wallula Energy Resource Center
Drilling Method: Air Rotary
Driller: Ron Sink
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Jeff Witter
Location: SE1/4 of NE1/4 Section 2 T07N R31E

Well Name: WERC-A
Ecology ID: APA 363
MP Elevation: ??
Datum: -
Installed: 4/20/2007
DTW: 66.5' BGS on 4/20/2007

Figure XX
DRAFT GEOLOGIC LOG AND AS-BUILT FOR WELL WERC-A
Wallula Energy Resource Center
Wallula, Washington
JE0701, 4/2007

PgG

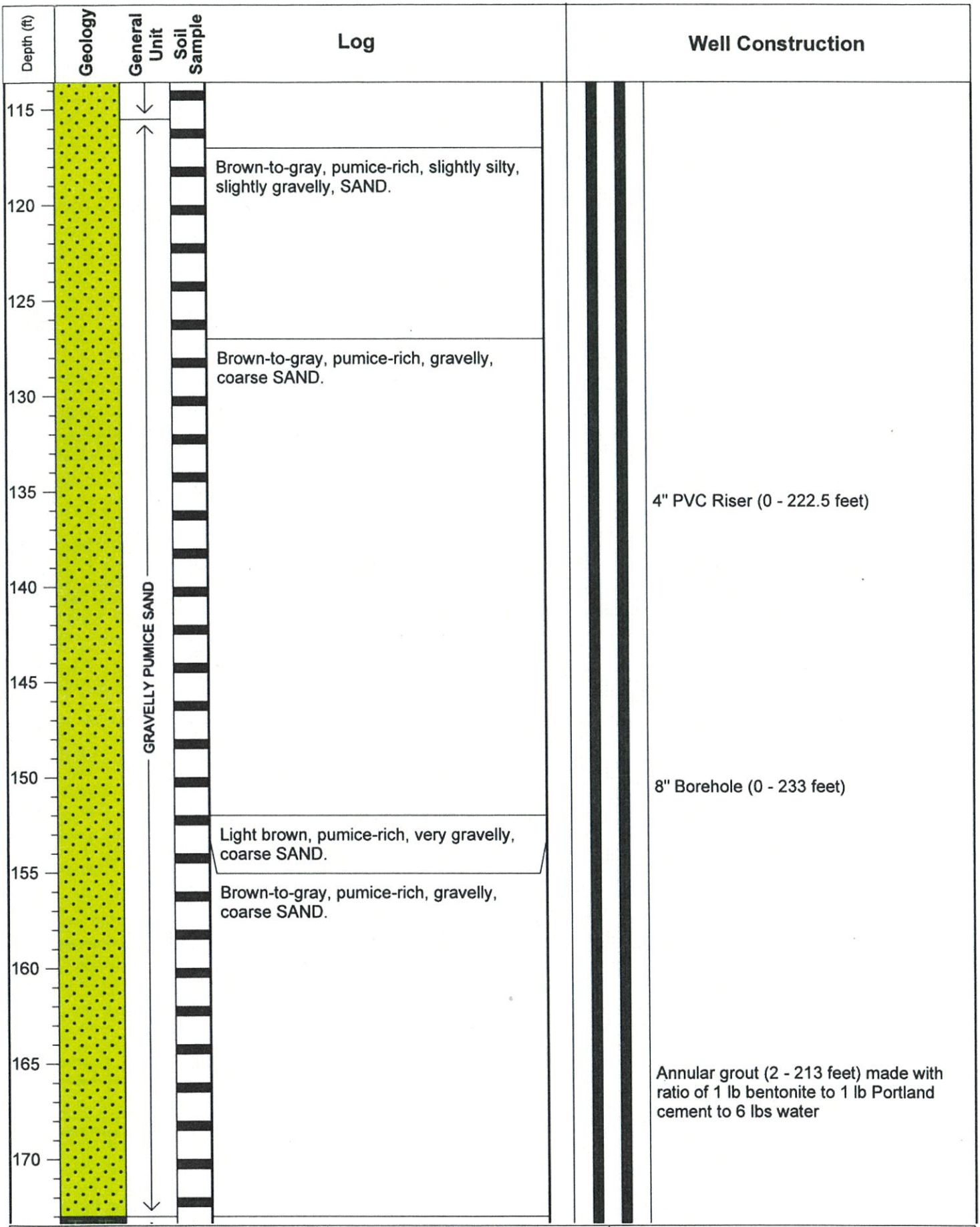


Project Name: Wallula Energy Resource Center
Drilling Method: Air Rotary
Driller: Ron Sink
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Jeff Witter
Location: SE1/4 of NE1/4 Section 2 T07N R31E

Well Name: WERC-A
Ecology ID: APA 363
MP Elevation: ??
Datum: -
Installed: 4/20/2007
DTW: 66.5' BGS on 4/20/2007

Figure XX
DRAFT GEOLOGIC LOG AND AS-BUILT FOR WELL WERC-A
Wallula Energy Resource Center
Wallula, Washington
JE0701, 4/2007

PgG

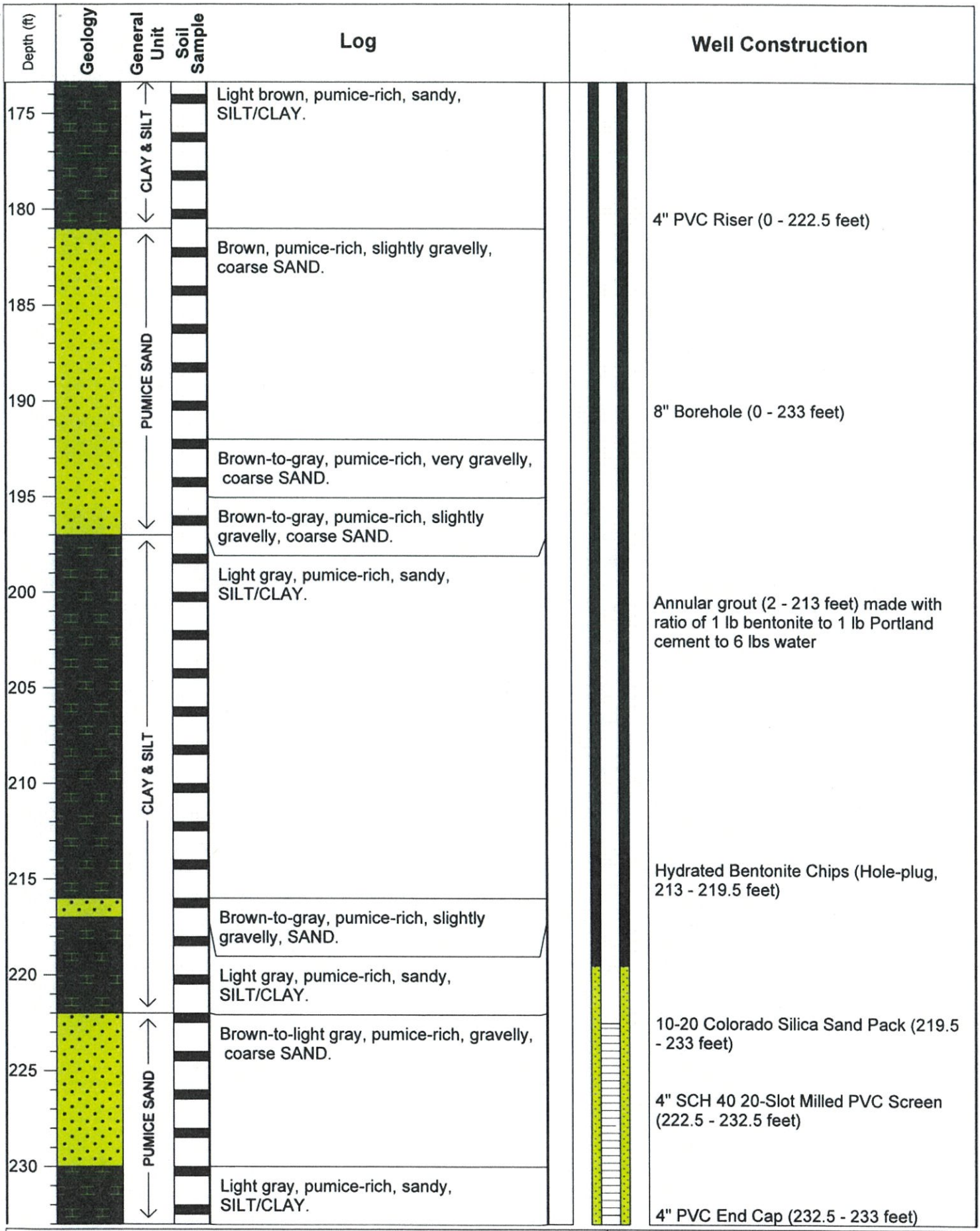


Project Name: Wallula Energy Resource Center
Drilling Method: Air Rotary
Driller: Ron Sink
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Jeff Witter
Location: SE1/4 of NE1/4 Section 2 T07N R31E

Well Name: WERC-A
Ecology ID: APA 363
MP Elevation: ??
Datum: -
Installed: 4/20/2007
DTW: 66.5' BGS on 4/20/2007

Figure XX
DRAFT GEOLOGIC LOG AND AS-BUILT FOR WELL WERC-A
Wallula Energy Resource Center
Wallula, Washington
JE0701, 4/2007

PgG

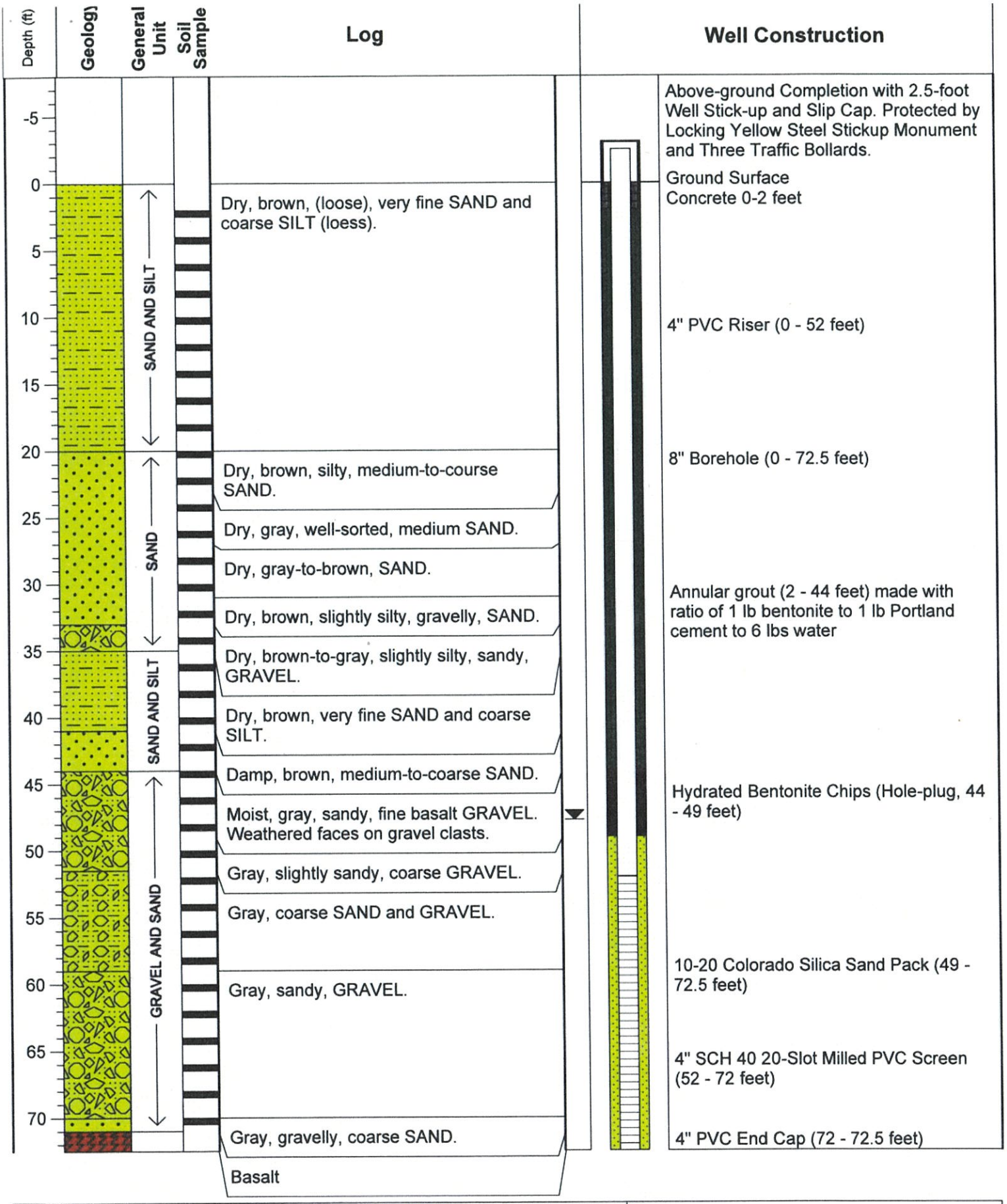


Project Name: Wallula Energy Resource Center
Drilling Method: Air Rotary
Driller: Ron Sink
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Jeff Witter
Location: SE1/4 of NE1/4 Section 2 T07N R31E

Well Name: WERC-A
Ecology ID: APA 363
MP Elevation: ??
Datum: -
Installed: 4/20/2007
DTW: 66.5' BGS on 4/20/2007

Figure XX
DRAFT GEOLOGIC LOG AND AS-BUILT FOR WELL WERC-A
Wallula Energy Resource Center
Wallula, Washington
JE0701, 4/2007

PgG

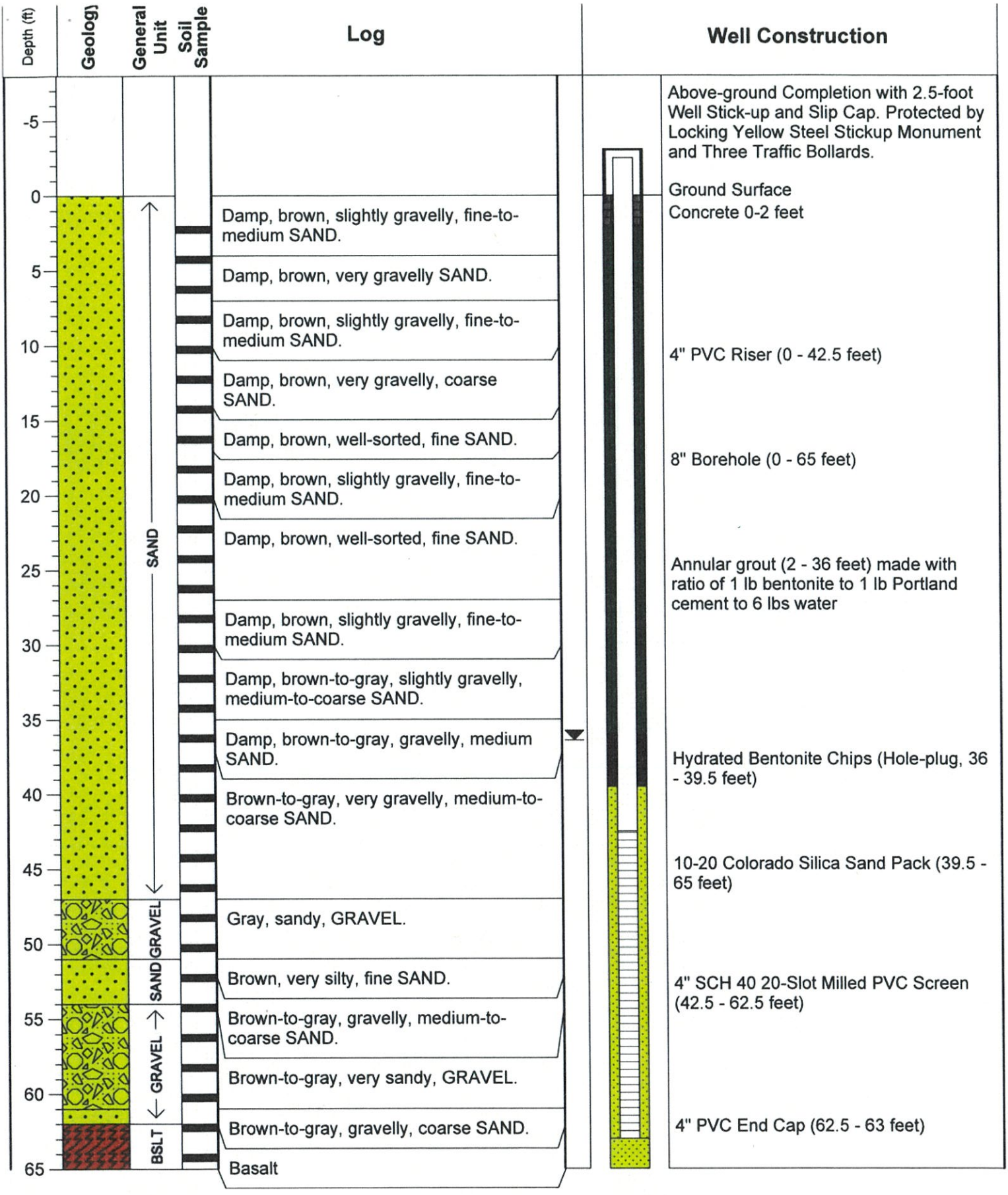


Project Name: Wallula Energy Resource Center
Drilling Method: Air Rotary
Driller: Ron Sink
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Jeff Witter
Location: NW1/4 of SW1/4 Section 2 T07N R31E

Well Name: WERC-B
Ecology ID: APA 361
MP Elevation: ??
Datum: -
Installed: 4/17/2007
DTW: 47.8' BGS on 4/17/2007
Page 1 of 1

Figure XX
DRAFT GEOLOGIC LOG AND AS-BUILT FOR WELL WERC-B
Wallula Energy Resource Center
Wallula, Washington
JE0701, 4/2007

PgG

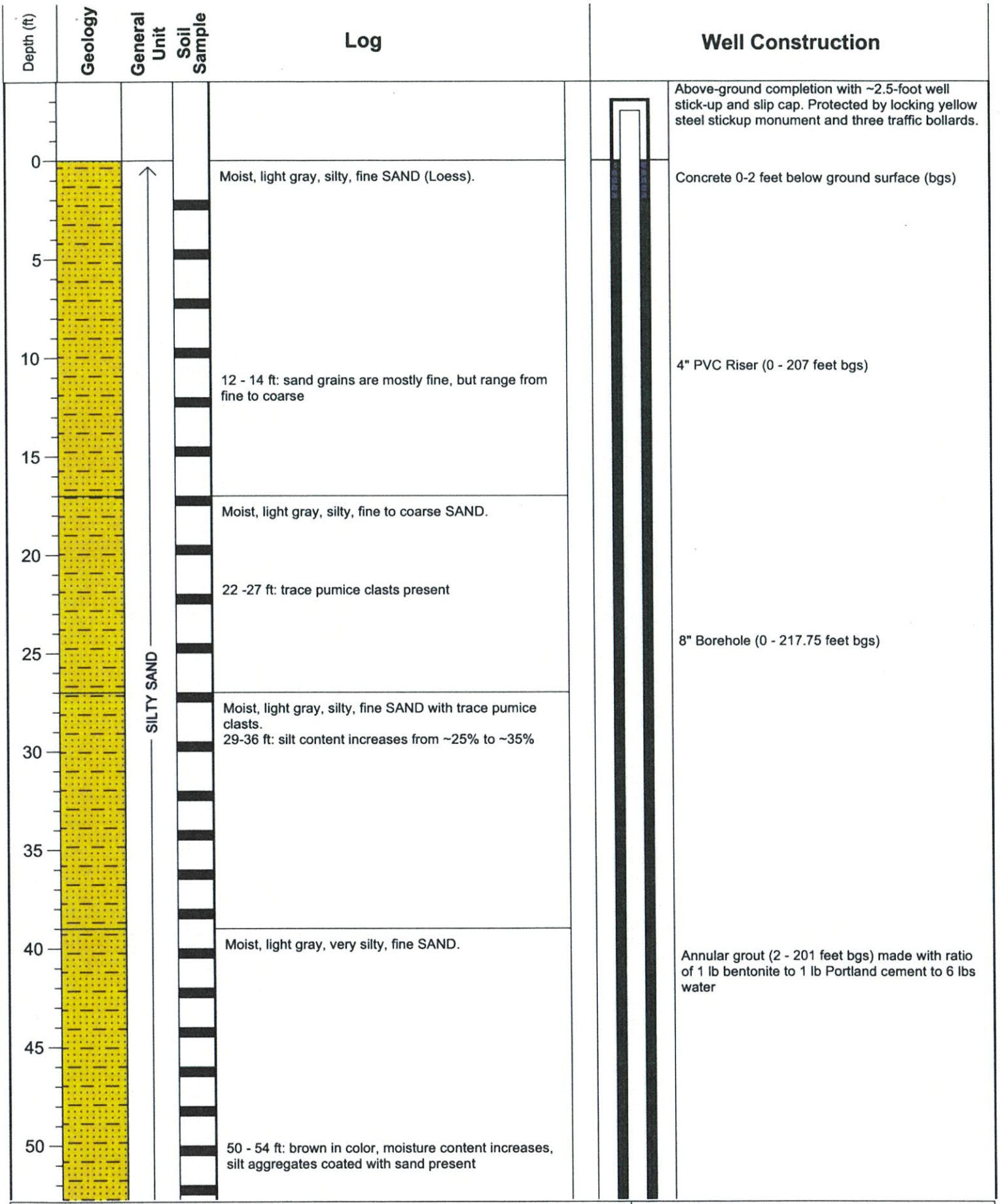


Project Name: Wallula Energy Resource Center
Drilling Method: Air Rotary
Driller: Ron Sink
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Jeff Witter
Location: NE1/4 of NW1/4 Section 2 T07N R31E

Well Name: WERC-C
Ecology ID: APA 362
MP Elevation: ??
Datum: -
Installed: 4/18/2007
DTW: 36.4' BGS on 4/18/2007
Page 1 of 1

Figure XX
DRAFT GEOLOGIC LOG AND AS-BUILT FOR WELL WERC-C
Wallula Energy Resource Center
Wallula, Washington
JE0701, 4/2007

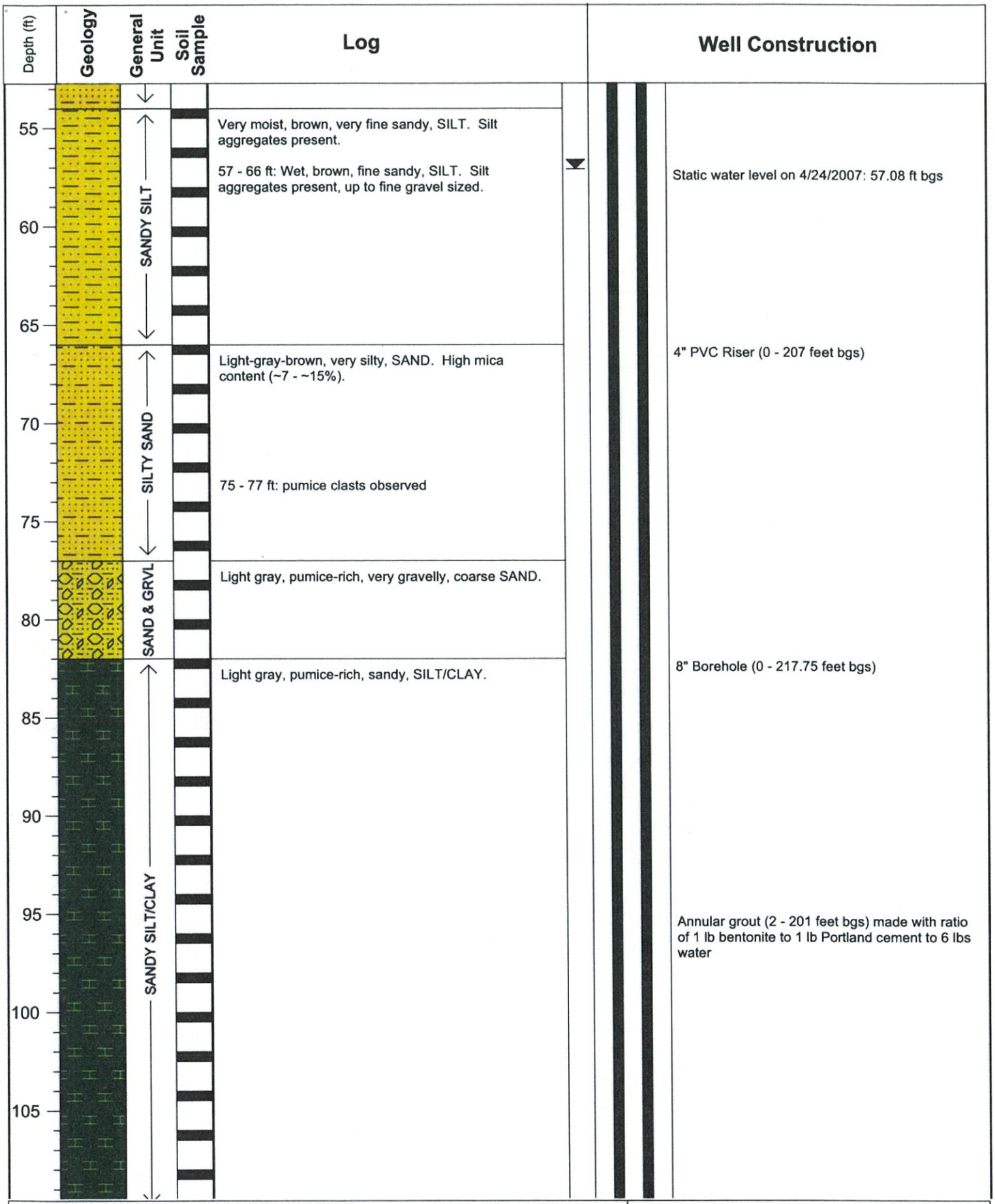
PgG



Project Name: Wallula Energy Resource Center
Drilling Method: Air Rotary
Driller: Ron Sink
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Glenn Mutti
Location: SE1/4 of SE1/4 Section 2 T07N R31E

Well Name: WERC-D
Ecology ID: APA 365
MP Elevation: ??
Datum: -
Installed: 4/23/2007 - 4/25/2007
DTW: 57.08' BGS on 4/24/2007

Figure XX
GEOLOGIC LOG AND AS-BUILT FOR WELL WERC-D
Wallula Energy Resource Center
Wallula, Washington
JE0701, 4/2007
PgG

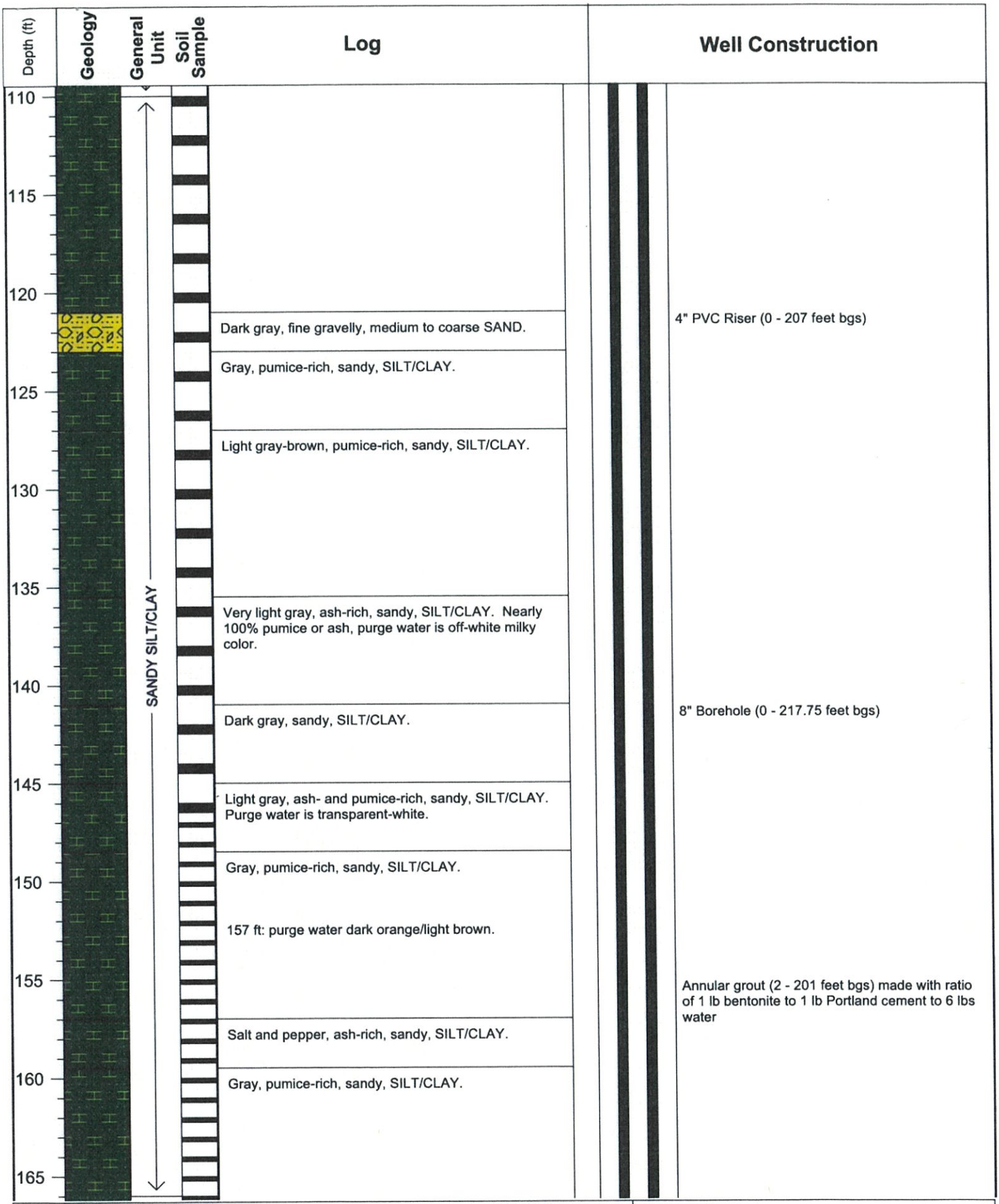


Project Name: Wallula Energy Resource Center
Drilling Method: Air Rotary
Driller: Ron Sink
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Glenn Mutti
Location: SE1/4 of SE1/4 Section 2 T07N R31E

Well Name: WERC-D
Ecology ID: APA 365
MP Elevation: ??
Datum: -
Installed: 4/23/2007 - 4/25/2007
DTW: 57.08' BGS on 4/24/2007

Figure XX
GEOLOGIC LOG AND AS-BUILT FOR WELL WERC-D
Wallula Energy Resource Center
Wallula, Washington
JE0701, 4/2007

PgG

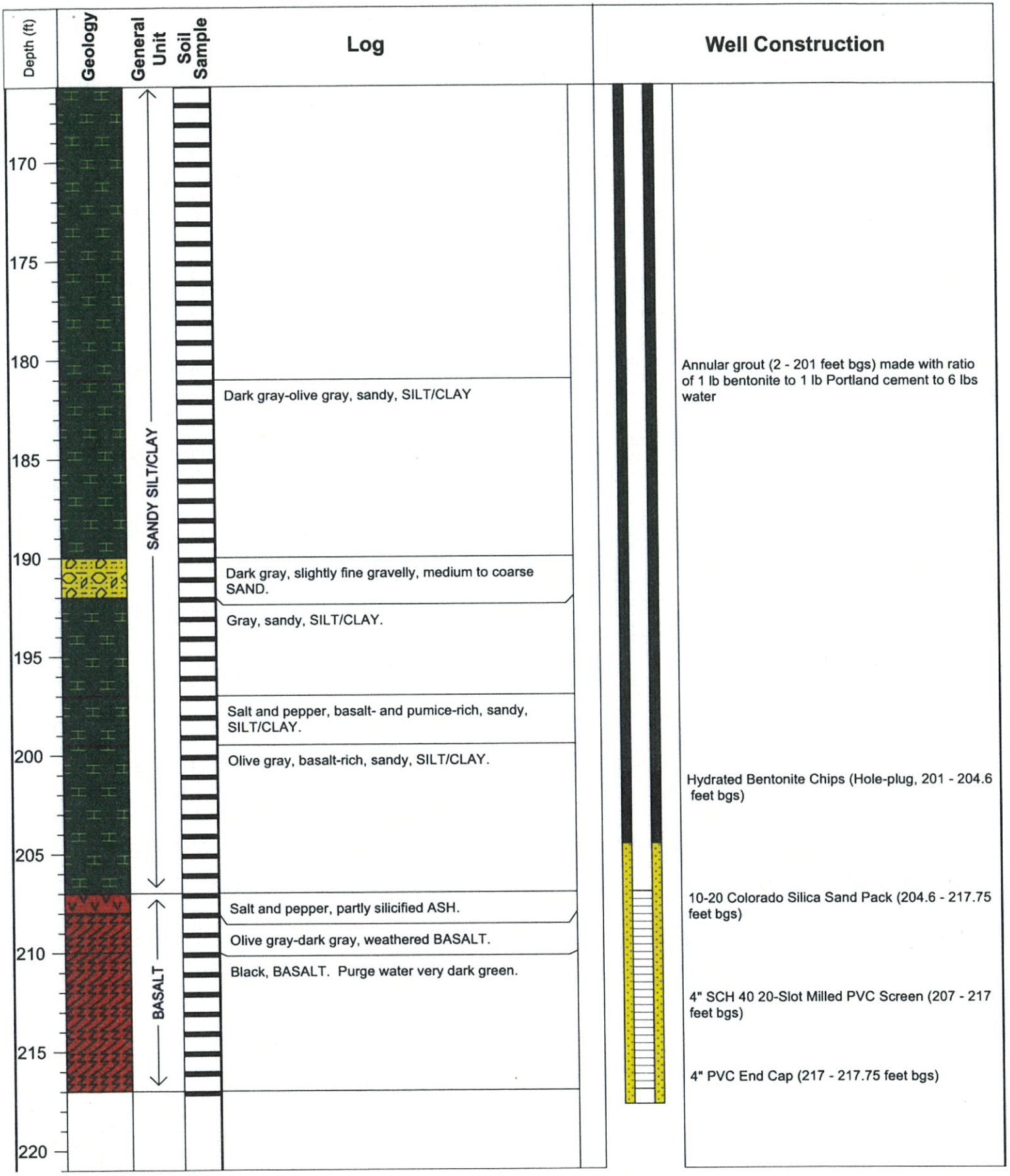


Project Name: Wallula Energy Resource Center
Drilling Method: Air Rotary
Driller: Ron Sink
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Glenn Mutti
Location: SE1/4 of SE1/4 Section 2 T07N R31E

Well Name: WERC-D
Ecology ID: APA 365
MP Elevation: ??
Datum: -
Installed: 4/23/2007 - 4/25/2007
DTW: 57.08' BGS on 4/24/2007

Figure XX
GEOLOGIC LOG AND AS-BUILT FOR WELL WERC-D
Wallula Energy Resource Center
Wallula, Washington
JE0701, 4/2007

PgG



Project Name: Wallula Energy Resource Center
Drilling Method: Air Rotary
Driller: Ron Sink
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Glenn Mutti
Location: SE1/4 of SE1/4 Section 2 T07N R31E

Well Name: WERC-D
Ecology ID: APA 365
MP Elevation: ??
Datum: -
Installed: 4/23/2007 - 4/25/2007
DTW: 57.08' BGS on 4/24/2007

Figure XX
GEOLOGIC LOG AND AS-BUILT FOR WELL WERC-D
Wallula Energy Resource Center
Wallula, Washington
JE0701, 4/2007
PgG

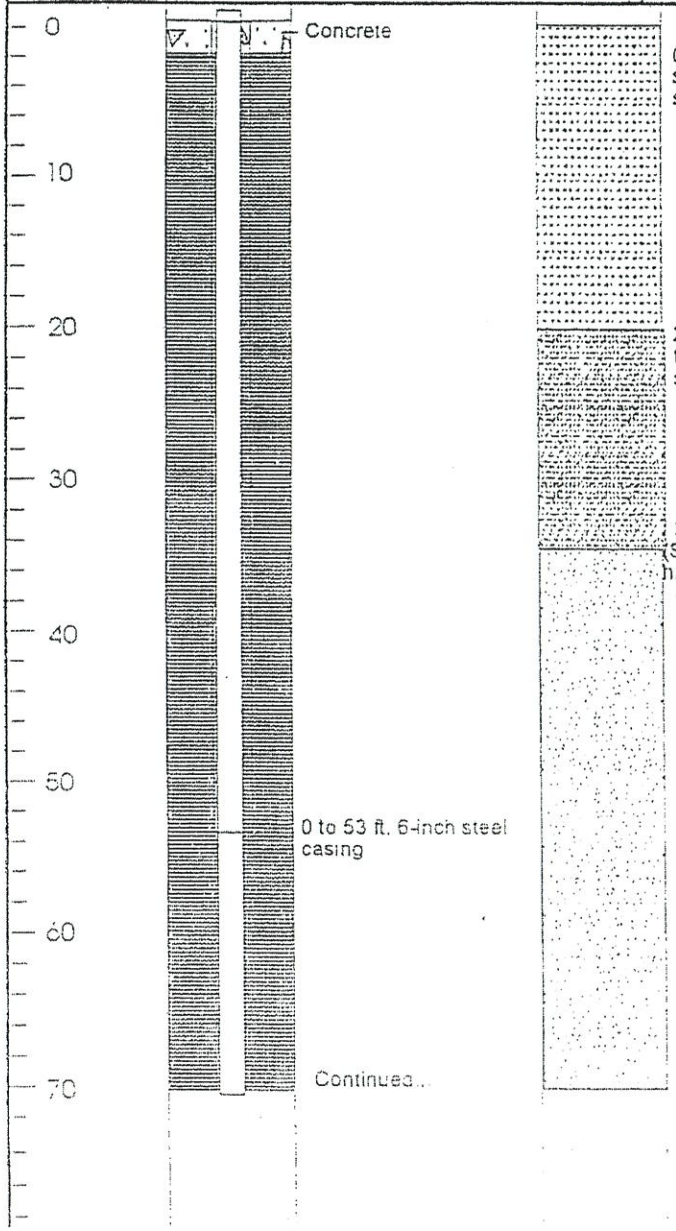
BORING LOG

Project: Boise Cascade - Wallula Page 1 of 2 Date: 7/3/96

Location: Fiber Farm Road Monitoring Well CW-3 Drilling Method: 6-inch air rotary

Drilled By: Ponderosa Drilling & Development, Inc. Logged By: Steven R. Ames

Start Date: 4/29/96 Total Depth: 73 feet TOC Elevation: 405.24 feet AMSL DTW: 100 ft. BGS



Lithologic Description

0 to 20 ft. SILT (ML): Low plasticity, low dry strengt slow dilancy, low toughness, dry to moist, light bro silt.

20 to 34 ft. SAND WITH SILT (SP-SM): About 80% fine, subrounded, poorly sorted, hard, moist, brow sand; about 20% low plastic fines, no dry strength.

34 to 75 ft. MODERATELY SORTED SAND (SP/SW): medium to fine, subangular to angular, hard, moist, predominately dark grey sand.

EGR & Associates, Inc.
Engineers, Geologists and Surveyors
2545 N. Prairie Road
Eugene, Oregon 97402

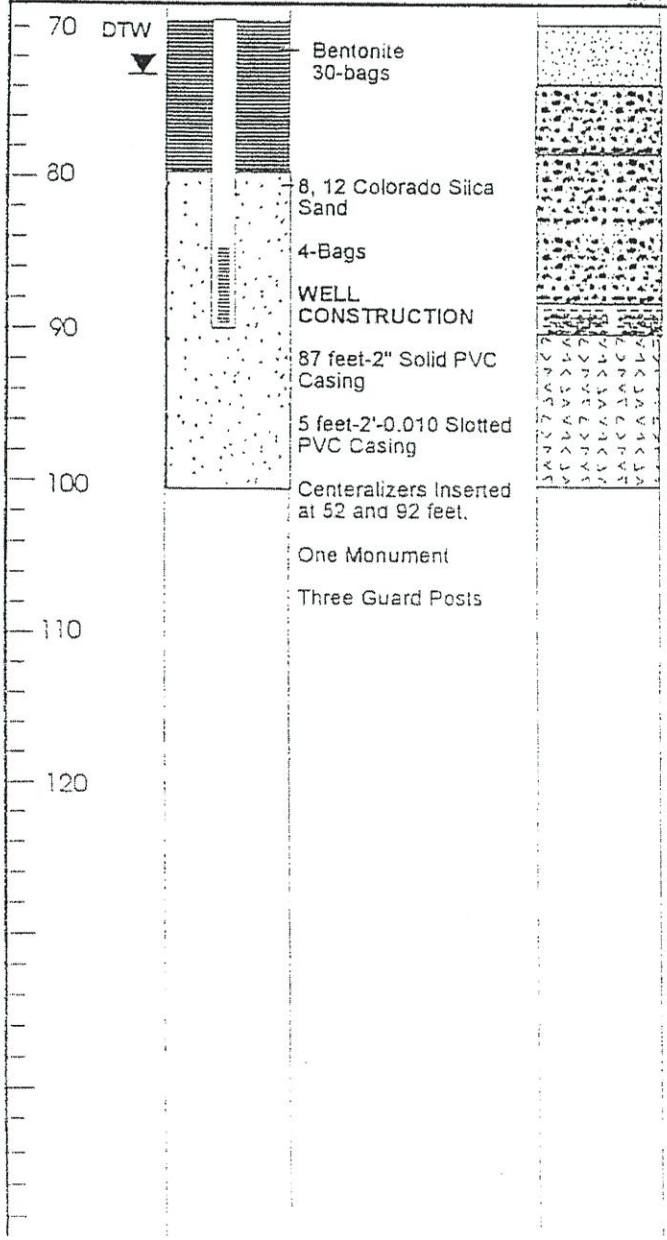
BORING LOG

Project: Boise Cascade - Wallula Page 2 of 2 Date: 7/3/96

Location: CW-3 Drilling Method: 6-inch air rotary

Drilled By: Ponderosa Drilling & Development, Inc. Logged By: Steven R. Ames

Start Date: 4/29/96 Total Depth: 100 ft. TOC Elevation: 405.24 feet AMSL DTW: 73 ft. BGS



Ground water encountered at 75 ft.

75 to 78 ft. GRAVEL WITH SAND (GP): About 80% fine, subrounded, elongated, wet dark gray gravel, maximum size, 3 cm.; about 20% dark grey sand.

78 to 88 ft. GRAVELLY SAND (SP-GP): About 65% poorly sorted, angular, hard, wet, dark grey sand; about 35% fine, angular, flat, dark grey gravel; maximum size, 1cm.

88 to 90 ft. CLAYEY GRAVEL (GC): About 65% fine angular, flat, dark grey gravel, maximum size 1 cm. about 35% plastic fines, medium dry strength, low toughness, slow dilancy, wet, blue-green clay.

90 to 100 ft. BASALT: Coarse, hard, angular, black bedrock; maximum size, 2 cm., wet.

EGR & Associates, Inc.
Engineers, Geologists and Scientists
3545 K Prairie Road
Eugene, Oregon 97403
(541) 688-8313

BORING LOG

Project: Boise Cascade - Wallula | Page 1 of 2 | Date: 7/5/96

Location: CW-4 | Drilling Method: 6-inch air rotary

Drilled By: Ponderosa Drilling & Development, Inc. | Logged By: Steven R. Ames

Start Date: 5/1/96 | Total Depth: 118 feet | TOC Elevation: 434.50 feet AMSL | DTW: 97 ft. BGS

Depth (ft)	As-Built	Lithology	Lithologic Description
0			0 to 33 feet (ft.) SILT(ML): Non-plastic, no dry strength, medium dilancy, low toughness, dry to moist, light brown silt.
10			
20			
30			
40			33 to 40 ft. SILT WITH SAND (ML): About 85% non-plastic, low dry strength, low toughness, rapic dilancy, moist, light brown silt; about 15% fine, subrounded, brown sand.
50			40 to 53 ft. SAND WITH SILT(SP-SM): About 85% fine, subrounded to sub angular, moist, brown sand: about 15% non-plastic silt.
60			53 to 60 ft. POORLY SORTED SAND (SP): Fine, subrounded to sub angular, hard, dry to moist, da grey and brown sand.
70	Continued...		60 to 88 ft. POORLY SORTED SAND WITH GRAVEL (SP): About 65% fine, subrounded to su angular, hard, dry to moist, dark brown and grey sand; about 35% fine to coarse subrounded to su angular gravel; maximum size, 1 cm.

EGR & Associates, Inc.
Engineers Geologists and Surveyor
2545 K Prairie Road,
Eugene, Oregon 97403

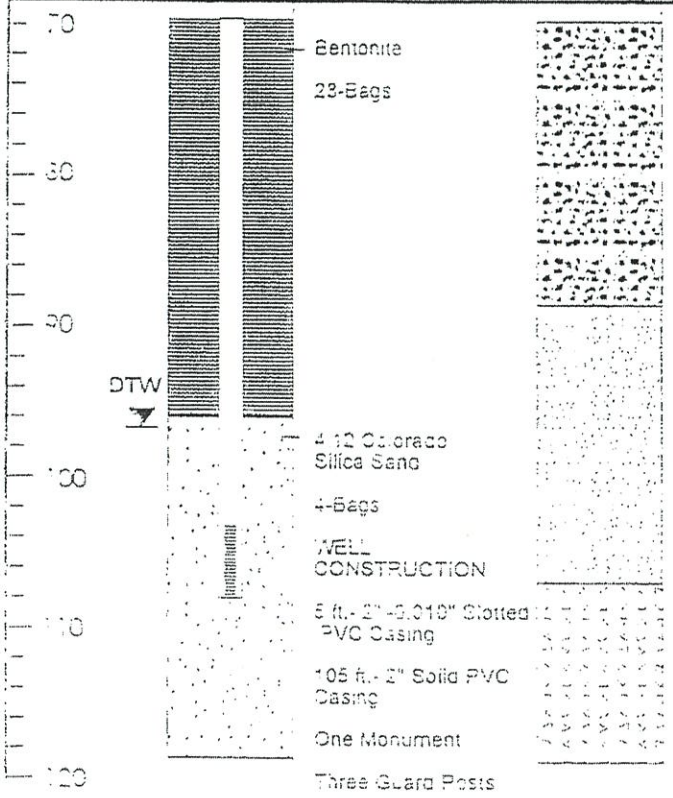
BORING LOG

Project: Boise Cascade - Wallula Page 2 of 2 Date: 7/5/96

Location: CW-4 Drilling Method: 8-inch air rotary

Drilled By: Ponderosa Drilling & Development, Inc. Logged By: Steven R. Ames

Start Date: 5/1/96 Total Depth: 118 feet TOC Elevation: 435.50 feet AMSL DTW: 97 feet BGS



88-95 ft. POORLY SORTED SAND (SP): Fine, subrounded, hard, moist, brown sand; about 5% fine, sub rounded gravel, maximum size 1cm.

95 to 108 ft. MODERATELY SORTED SAND (SP/SW): Medium to fine, subrounded to subangular, hard, wet, dark grey sand.

Ground Water Encountered at 97 ft.

108 to 118 ft. BASALT: Fine to coarse, angular, hard, black bedrock particles.

Depth to Casing Bottom = 90 ft.

Top of Concrete Elevation = 433.35

EGR & Associates, Inc.
Engineers, Geologists and Surveyors
1545 K Prairie Road
Eugene, Oregon 97402
(503) 688-8322

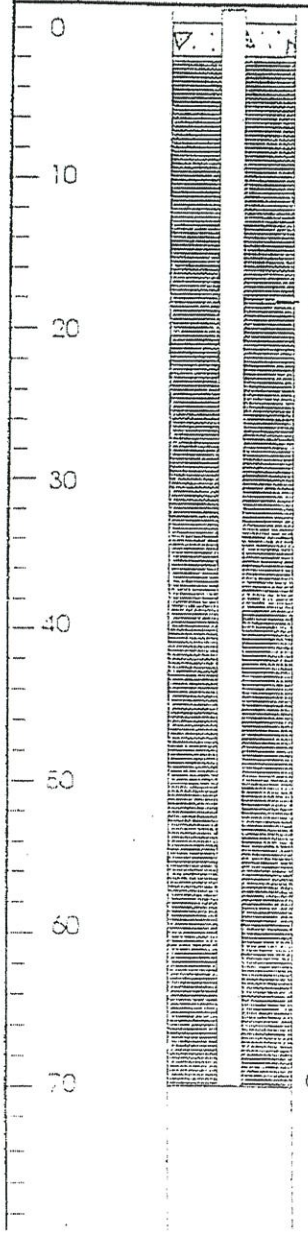
BORING LOG

Project: Boise Cascade - Wallula Page 1 of 3 Date: 6/17/96

Location: Fiber Farm Road Monitoring Well CW-5 Drilling Method: 6-inch air roatary

Drilled By: Ponderosa Drilling and Development, Inc. Logged By: Steven R. Ames

Start Date: 5/3/96 Total Depth: 175 feet TOC Elevation: 518.24 feet AMSL DTW: 134 ft. BGS



Lithologic Description

0 to 37 feet (ft.) SAND (SP): fine, hard, subangula to subrounded, moist to wet, brownish-grey sand.

37 to 41 ft. SILTY SAND (SM): About 60% fine, subangular to subrounded, moist, brown sand; about 35% plastic fines; about 5% fine to coarse gravel; maximum size 3 centimeters (cm.).

41 to 45 ft. SILTY SAND WITH GRAVEL (SM): About 50% sand; about 25% silt, about 25% grave

45 to 50 ft. SAND WITH SILT AND GRAVEL (SP) About 40% sand; about 25% silt; about 25% grave

50 to 56 ft. GRAVEL WITH SAND (GP): About 85% fine to medium, hard, sub angular gravel; maximum size 30 cm; about 15% fine to medium sand.

56 to 60 ft. POORLY GRADED GRAVEL WITH SAND (GP): About 50% fine to coarse, rounded gravel; maximum size 30 cm.; About 30 % fine, subrounded, moist to dry, brown sand.

60 to 70 ft. POORLY GRADED SAND WITH GRAVEL (SP): About 50% fine to coarse, subrounded, hard, moist to wet, brown sand; abou 40% fine, angular gravel; maximum size 10 cm; about 10% non-plastic fines.

EGR & Associates, Inc.
Engineers Geologists and Surveyors
1545 K Prairie Road
Eugene, Oregon 97402

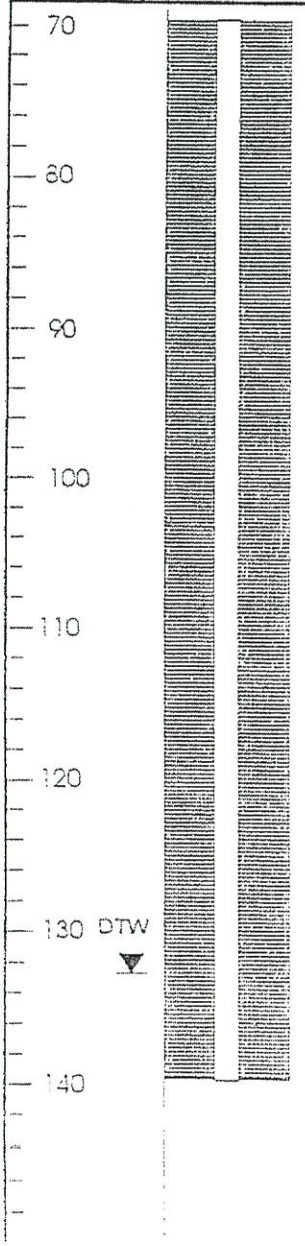
BORING LOG

Project: Boise Cascade - Wallula | Page 2 of 3 | Date: 6/17/96

Location: Fiber Farm Road Monitoring Well CW-5 | Drilling Method: 6-inch air rotary

Drilled By: Ponderosa Drilling & Development, Inc. | Logged By: Steven R. Ames

Start Date: 5/3/96 | Total Depth: 175 feet | TOC Elevation: 518.24 feet AMSL | DTW: 134 ft. BGS



Lithologic Description

70 to 101 ft. SILTY SAND (SM): About 80% very fine, subrounded, moist, brown sand; about 20% non-plastic silt

101 to 122 ft. CLAYEY SAND (SC): About 75% sand; about 25% plastic, medium dry strength, slow dilancy, high toughness, brown, wet clay.

122 to 135 ft. SANDY LEAN CLAY (CL): About 60% medium plastic, medium dry strength, no dilancy, medium to high toughness, light brown, wet clay; about 40% fine, subangular sand.

Ground water encountered at 134 ft.

135 to 140 ft. POORLY GRADED SAND WITH GRAVEL (SP): About 70% very fine, dry, light brown sand; about 30% fine, subrounded, hard subrounded gravel; maximum size 5 mm.

EGR & Associates, Inc.
Engineers, Geologists and Surveyors
2545 K Prairie Road
Eugene, Oregon 97402
(503) 688-8322

Total Depth:	50.1 ft.	Latitude:	~ 46.11723 N	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~	Longitude:	~ -118.90973 W	Drilling Company:	HazTech	Rod Diam.:	NWJ - 2 5/8"
Vert. Datum:		Station:	~	Drill Rig Equipment:	BK81	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Screen Design | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches

0 | 20 | 40 | 60

Loose, brown, *Silty Sand (SM)*; dry to moist; fine sand; nonplastic fines.

Dune Sand

5.0

Medium dense to dense, brown, *Silty Sand (SM) to Sandy Silt (ML)*; dry to moist; fine sand; nonplastic fines.

Outburst Flood Fine-Grained

22.5

Very dense, brown, *Silty Gravel with Sand (GM)*; dry to moist; subangular to subrounded gravel up to 1 inch; fine to coarse sand; nonplastic fines.

50/1st 4.5"

25.0

Outburst Flood Fine-Grained

Dense to very dense, brown, *Silty Sand (SM) to Sandy Silt (ML)*; dry to moist; fine sand; nonplastic fines.

77

Outburst Flood Fine-Grained

CONTINUED NEXT SHEET

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Cascade Natural Gas
Wallula HP 12-inch Pipeline
Walla Walla County, Washington

LOG OF BORING B-05

January 2019 | 22-1-40040-003

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-8
Sheet 1 of 2

REV 3 - Approved for Submittal

MASTER_LOG_JWT_SONIC_22-1-40040.GPJ SHAN_WIL.GDT 1/23/19 Log: JWT Rev: LJR Typ: JWT

Total Depth:	50.1 ft.	Latitude:	~ 46.11723 N	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~	Longitude:	~ -118.90973 W	Drilling Company:	HazTech	Rod Diam.:	NWJ - 2 5/8"
Vert. Datum:		Station:	~	Drill Rig Equipment:	BK81	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Medium dense to very dense, brown, *Silty Sand (SM) to Sandy Silt (ML)*; dry to moist; fine sand; nonplastic fines.

Outburst Flood Fine-Grained (Continued)

35.5

Medium dense to dense, brown/gray, *Poorly Graded Gravel with Silt and Sand (GP-GM)*; moist to wet; subangular to subrounded gravel up to 1 inch; fine to coarse sand; nonplastic fines.

Outburst Flood Gravels

42.5

Medium dense to dense, brown/gray, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; wet; subangular to subrounded gravel up to 1 inch; fine to coarse sand; nonplastic fines.

Outburst Flood Gravels

47.5

Weathered Basalt - drills like: Very dense, dark gray, *Poorly Graded Gravel (GP)*; wet; angular to subangular gravel up to 2 inches.

Saddle Mountains Basalt

50.1

Bottom of Boring
Completed 4/4/2018

Depth, ft. | Symbol | Samples | Screen Design | Depth, ft.

S-12 S-13 S-14 S-15 S-16 S-17 S-18 S-19 S-20 *

During Drilling

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches

0 20 40 60

35 40 45 50 55

50/2.5" 50/5" 75 95/11.5" 50/4" 50/1st 5" 50/1st 1"

0 20 40 60

◇ % Fines (<0.075mm)
● % Water Content

LEGEND

* Sample Not Recovered
2.0" O.D. Split Spoon Sample
Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Cascade Natural Gas
Wallula HP 12-inch Pipeline
Walla Walla County, Washington

LOG OF BORING B-05

January 2019 22-1-40040-003

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-8
Sheet 2 of 2

REV 3 - Approved for Submittal

Total Depth: 53.75 ft.	Latitude: ~ 46.11365 N	Drilling Method: Hollow Stem Auger	Hole Diam.: 8 in.
Top Elevation: ~	Longitude: ~ -118.91272 W	Drilling Company: HazTech	Rod Diam.: NWJ - 2 5/8"
Vert. Datum:	Station: ~	Drill Rig Equipment: BK81	Hammer Type: Automatic
Horiz. Datum:	Offset: ~	Other Comments:	

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Screen Design | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches

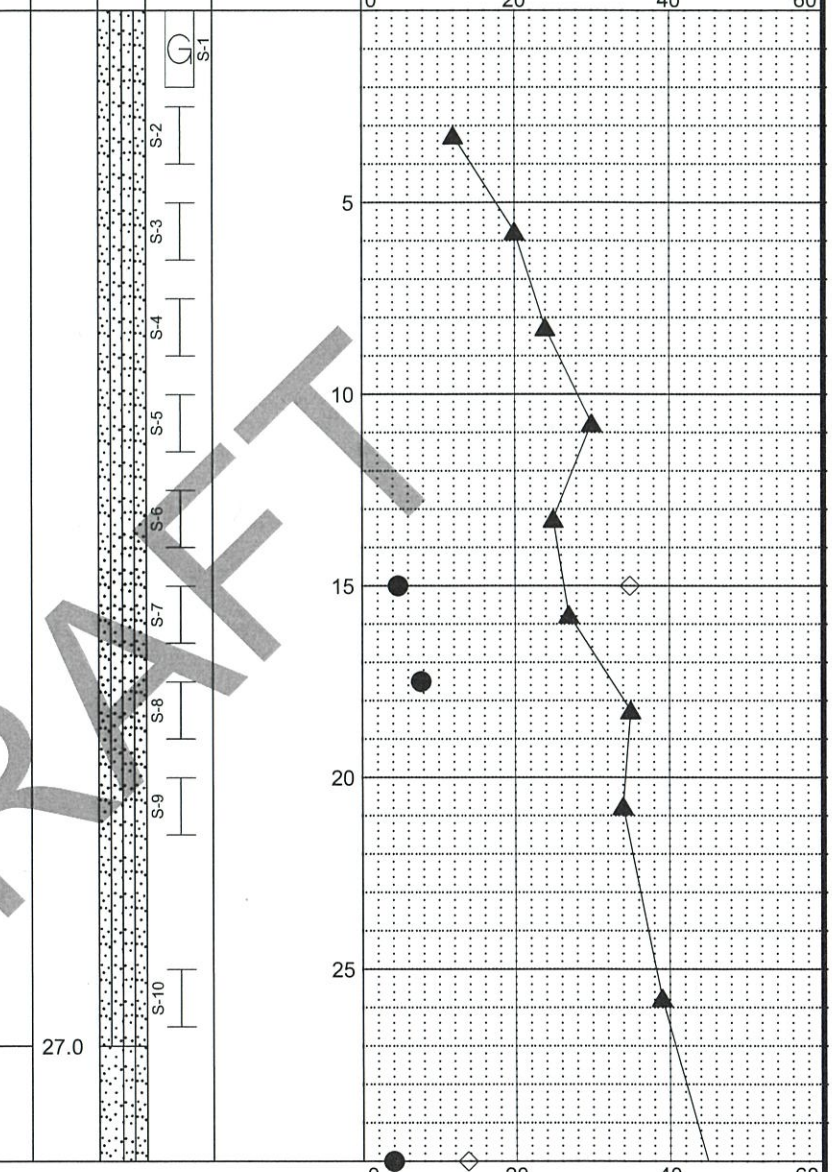
Medium dense to dense, brown, *Silty Sand (SM)*; dry to moist; fine to medium sand; nonplastic fines; trace rootlets in upper 2 feet; silt zones at 17.5 feet and 25.5 feet bgs.

Outburst Flood Fine-Grained

27.0

Dense to very dense, brown to brown-gray, *Poorly Graded Sand with Silt (SP-SM) to Poorly Graded Gravel with Silt and Sand*

CONTINUED NEXT SHEET



LEGEND

* Sample Not Recovered

Grab Sample

2.0" O.D. Split Spoon Sample

Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Cascade Natural Gas
Wallula HP 12-inch Pipeline
Walla Walla County, Washington

LOG OF BORING B-09

January 2019 | 22-1-40040-003

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-12
Sheet 1 of 2

REV 3 - Approved for Submittal

Total Depth:	53.75 ft.	Latitude:	~ 46.11365 N	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~	Longitude:	~ -118.91272 W	Drilling Company:	HazTech	Rod Diam.:	NWJ - 2 5/8"
Vert. Datum:		Station:	~	Drill Rig Equipment:	BK81	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Screen Design | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

0 20 40 60

(GP-GM); moist to wet; fine to coarse, subrounded to subangular gravel; fine to coarse sand.

Outburst Flood Gravels

S-11

S-12 *

During Drilling ▽

35 — 50/1st 1"

S-13

40 — 50/4"

S-14

45 — 50/1st 5.5"

49.5

Weathered Basalt - drills as: Very dense, orange-brown to dark gray, *Clayey Gravel with Sand (GC)* to *Clayey Sand (SC)*; moist; fine to coarse, subangular gravel; fine to coarse sand; low plasticity fines.

S-15

50 — 50/1st 3.5"

53.8

Saddle Mountains Basalt

S-16

55 — 50/1st 3"

Bottom of Boring - Auger Refusal on Basalt
Completed 9/7/2018

0 20 40 60

◇ % Fines (<0.075mm)

● % Water Content

LEGEND

* Sample Not Recovered

Grab Sample

2.0" O.D. Split Spoon Sample

▽ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Cascade Natural Gas
Wallula HP 12-inch Pipeline
Walla Walla County, Washington

LOG OF BORING B-09

January 2019 22-1-40040-003

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-12
Sheet 2 of 2

REV 3 - Approved for Submittal

MASTER_LOG_JWT_SONIC_22-1-40040.GPJ_SHAN_WIL.GDT 1/23/19 Log: BAL Rev: LJR Typ: BAL

Total Depth:	32.6 ft.	Latitude:	~ 46.11357 N	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~	Longitude:	~ -118.91360 W	Drilling Company:	HazTech	Rod Diam.:	NWJ - 2 5/8"
Vert. Datum:		Station:	~	Drill Rig Equipment:	CME 850	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Screen Design | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches

0 | 20 | 40 | 60

Dense, brown, *Silty Sand with Gravel (SM)*; moist; subangular to subrounded gravel up to 3/4-inch; fine sand; nonplastic fines.

Outburst Flood Fine-Grained

12.0

Dense to very dense, brown/gray, *Poorly Graded Gravel with Silt and Sand (GP-GM)*; moist to wet; subangular to subrounded gravel up to 2 inches; fine to coarse sand; nonplastic fines.

Outburst Flood Gravels

17.0

Dense, brown/gray, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; dry; trace to few subangular to subrounded gravel up to 2 inches; fine to coarse sand; nonplastic fines.

Outburst Flood Gravels

23.0

Weathered Basalt - Drills like: Dense to very dense, black, *Poorly Graded Gravel with Silt and Sand (GP-GM)*; moist to wet; subangular to angular gravel up to 2 inches; fine to coarse sand; nonplastic fines.

Saddle Mountains Basalt

S-1 | S-2 | S-3 | S-4 | S-5

During Drilling

5 | 10 | 15 | 20 | 25

50/5.5"

50/3"

CONTINUED NEXT SHEET

0 | 20 | 40 | 60

◇ % Fines (<0.075mm)

● % Water Content

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

▽ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Cascade Natural Gas
Wallula HP 12-inch Pipeline
Walla Walla County, Washington

LOG OF BORING B-10

January 2019 | 22-1-40040-003

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-13
Sheet 1 of 2

REV 3 - Approved for Submittal

MASTER LOG JWT SONIC 22-1-40040.GPJ SHAN WIL.GDT 1/23/19 Log: LJR Rev: LJR Typ: JWT

Total Depth:	32.6 ft.	Latitude:	~ 46.11357 N	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~	Longitude:	~ -118.91360 W	Drilling Company:	HazTech	Rod Diam.:	NWJ - 2 5/8"
Vert. Datum:		Station:	~	Drill Rig Equipment:	CME 850	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION	Depth, ft.	Symbol	Samples	Screen Design	Depth, ft.	PENETRATION RESISTANCE (blows/foot) ▲ Hammer Wt. & Drop: 140 lbs / 30 inches
Saddle Mountains Basalt (Continued) - More competent basalt beginning at approximately 30 feet.			S-6 S-7			50/1st 2" ▲ 50/1st 1" ▲
Bottom of Boring - Auger Refusal on Basalt Completed 11/9/2018	32.6					

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

0 20 40 60

35 40 45 50 55

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Cascade Natural Gas
Wallula HP 12-inch Pipeline
Walla Walla County, Washington

LOG OF BORING B-10

January 2019 22-1-40040-003

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-13
Sheet 2 of 2

REV 3 - Approved for Submittal

MASTER_LOG_JWT_SONIC_22-1-40040.GPJ SHAN_WIL.GDT 1/23/19 Log: LJR Rev: LJR Typ: JWT

Please print, sign and return by mail to Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE53114

SUBMIT ONE WELL REPORT PER WELL INSTALLED)

onstruction/Decommission *(select one)*

☐ Construction

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

onsulting Firm SHANNON & WILSON

nique Ecology Well ID

ag No. _____

Type of Well *(select one)*

☐ Resource Protection

☑ Geotech Soil Boring

Property Owner PORT OF WALLA WALLA

Site Address 46.120586 -118.907449

City WALLULA County WALLA WALLA

Location NW 1/4-1/4 NW 1/4 Sec 2 Twn 7N R 31 Select One ☒ EWM ☐ WWM

/ELL CONSTRUCTION CERTIFICATION: I constructed and/or cept responsibility for construction of this well, and its compliance with all ashington well construction standards. Materials used and the information reported ove are true to my best knowledge and belief.

Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

☐ Driller ☐ Engineer ☐ Trainee Name (Print) MIKE CORN

riller/Engineer /Trainee Signature Mike C

riller or Trainee License No. 2833

Cased or Uncased Diameter 8.5" Static Level 22

Work/Decommission Start Date 11/07/2014

Work/Decommission Completed Date 11/07/2014

trainee, licensed driller's ignature and License No. 2833

Construction/Design	Well Data	Formation Description
HSA TO A DEPTH OF 25' BGS.	# 4/7 TRANSMISSION LINE	0-7 SAND 7-35 DENSE SAND AND GRAVELS, W/LARGE COBBLES

RECEIVED

DEC 11 2014

Department of Ecology
Eastern Regional Office

NOT TO SCALE 1 1

Please print, sign and return by mail to Department of Ecology

Please print, sign and return by mail to Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE29477

SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *(select one)*

☐ Construction

☑ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* SE53113

Consulting Firm SHANNON & WILSON

Unique Ecology Well ID Tag No. ______

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☑ Driller ☐ Engineer ☐ Trainee Name (Print) MIKE CORN

Driller/Engineer /Trainee Signature [signature]

Driller or Trainee License No. 2833

If trainee, licensed driller's Signature and License No. 2833

Type of Well *(select one)*

☐ Resource Protection

☑ Geotech Soil Boring

Property Owner PORT OF WALLA WALLA

Site Address 46.123989 -118.903866

City WALLULA County WALLA WALLA

Location NE 1/4-1/4 NW1/4 Sec 2 Twn 7N R 31 Select One ☒ EWM ☐ WWM

Lat/Long (s, t, r still REQUIRED) Lat Deg ______ Lat Min/Sec ______ Long Deg ______ Long Min/Sec ______

Tax Parcel No. ______

Cased or (Uncased Diameter) 8.5" Static Level DRY

Work/Decommission Start Date 11/05/2014

Work/Decommission Completed Date 11/05/2014

Construction/Design	Well Data	Formation Description
HSA TO A DEPTH OF 25" BGS. FILL THE AUGERS WITH 3 BAGS OF 3/8" BENTONITE CHIPS, THEN PULL OUT THE AUGERS AND POUR IN 5 MORE BAGS TO 1 FOOT FROM THE SURFACE THEN DRILL CUTTINGS TO MATCH THE SURFACE.	# 4/3 TRANSMISSION LINE	0-13 SAND, TAN ,FINE 13-25 SAND W/GRAVEL LENSES

NOT TO SCALE

1 1

Please print, sign and return by mail to Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE29478

SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *(select one)*

☐ Construction

☑ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* SE53114

Type of Well *(select one)*

☐ Resource Protection

☑ Geotech Soil Boring

Consulting Firm SHANNON & WILSON

Unique Ecology Well ID

Tag No.

Property Owner PORT OF WALLA WALLA

Site Address 46.120586 -118.907449

City WALLULA County WALLA WALLA

Location NW1/4-1/4 NW1/4 Sec 2 Twn 7N R 31 Select One ☒ EWM ☐ WWM

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (Print) MIKE CORN

Driller/Engineer /Trainee Signature

Driller or Trainee License No. 2833

Lat/Long (s, t, r still REQUIRED) Lat Deg Lat Min/Sec

Long Deg Long Min/Sec

Tax Parcel No.

Cased or Uncased Diameter 8.5" Static Level 22

Work/Decommission Start Date 11/07/2014

Work/Decommission Completed Date 11/07/2014

If trainee, licensed driller's signature and License No. 2833

Construction/Design	Well Data	Formation Description
HSA TO A DEPTH OF 25' BGS. PULL OUT THE AUGERS AND POUR IN 12 BAGS OF 3/8" BENTONITE CHIPS TO 1 FOOT FROM THE SURFACE, THEN DRILL CUTTINGS TO MATCH THE SURFACE FOR THE REMAINDER.	# 4/7 TRANSMISSION LINE	0-7 SAND 7-35 DENSE SAND AND GRAVELS, W/LARGE COBBLES

RECEIVED

DEC 11 2014

Department of Ecology
Eastern Regional Office

NOT TO SCALE

1 1

The Department of Ecology does not warranty the data provided on this well report

Please print, sign and return by mail to Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE53113

SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *(select one)*

☑ Construction

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

Consulting Firm SHANNON & WILSON

Unique Ecology Well ID

Tag No. _____

Type of Well *(select one)*

☐ Resource Protection

☑ Geotech Soil Boring

Property Owner PORT OF WALLA WALLA

Site Address 46.123989 -118.903866

City WALLULA County WALLA WALLA

Location NE 1/4-1/4 NW 1/4 Sec 2 Twn 7N R 31 Select One ☒ EWM ☐ WWM

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (Print) MIKE CORN

Driller/Engineer /Trainee Signature _____

Driller or Trainee License No. 2833

Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 11/05/2014

Work/Decommission Completed Date 11/05/2014

If trainee, licensed driller's signature and License No. 2833

Construction/Design	Well Data	Formation Description
HSA TO A DEPTH OF 25" BGS.	# 4/3 TRANSMISSION LINE	0-13 SAND, TAN ,FINE 13-25 SAND W/GRAVEL LENSES

RECEIVED
DEC 11 2014
Department of Ecology
Eastern Regional Office

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The Department of Ecology does not warranty the data and/or the information on this well report

APPENDIX C
Stability and Seepage Analysis Results

rocscience

Wallula Gap Business Park Roads
Slope Stability Analysis
Anderson Perry
Date Created: 6/6/2023, 3:20:59 PM
Software Version: 9.027

Table of Contents

Slide2 Analysis Information

Wallula Gap Business Park Roads

Project Summary

File Name:	Wallula Gap Business Park Roads.slmd
Slide2 Modeler Version:	9.027
Project Title:	Slope Stability Analysis
Author:	Andrew Robinson, P.E.
Company:	Anderson Perry
Date Created:	6/6/2023, 3:20:59 PM

Currently Open Scenarios

Group Name	Scenario Name	Global Minimum	Compute Time
Static - 2H:1V Fill Slope	Master Scenario	Bishop Simplified: 1.349310 Janbu Simplified: 1.349030	00h:00m:00.517s
Seismic - 2H:1V Fill Slope	Master Scenario	Bishop Simplified: 1.012010 Janbu Simplified: 1.012750	00h:00m:00.600s
Static - 2H:1V Cut Slope	Master Scenario	Bishop Simplified: 1.250390 Janbu Simplified: 1.249750	00h:00m:00.519s
Seismic - 2H:1V Cut Slope	Master Scenario	Bishop Simplified: 0.938334 Janbu Simplified: 0.938491	00h:00m:00.656s
Static - 2.2H:1V Cut Slope	Master Scenario	Bishop Simplified: 1.375700 Janbu Simplified: 1.374720	00h:00m:00.534s
Seismic - 2.2H:1V Cut Slope	Master Scenario	Bishop Simplified: 1.017160 Janbu Simplified: 1.017960	00h:00m:00.599s
Static - 2H:1V Cut Slope - High GWT	Master Scenario	Bishop Simplified: 1.192890 Janbu Simplified: 1.067370	00h:00m:00.524s
Seismic - 2H:1V Cut slope - High GWT	Master Scenario	Bishop Simplified: 0.893788 Janbu Simplified: 0.799098	00h:00m:00.563s
2H:1V Cut Slope - High GWT Solution	Master Scenario	Bishop Simplified: 0.938334 Janbu Simplified: 0.938491	00h:00m:00.669s
2.2H:1V Cut Slope - Very High GWT Solution	Master Scenario	Bishop Simplified: 1.017160 Janbu Simplified: 0.947840	00h:00m:00.636s

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/day
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

All Open Scenarios

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Janbu simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes
Eliminate vertical segments in non-circular search	Yes

Groundwater Analysis

Static - 2H:1V Fill Slope

Groundwater Method:	Steady State FEA
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Tolerance:	0.001
Maximum number of iterations:	500
Use negative pore pressure cutoff:	No
Advanced Groundwater Method:	None
Mesh Element Type:	3 noded triangles
Number of Elements:	548
Number of Nodes:	329

Seismic - 2H:1V Fill Slope

Groundwater Method:	Steady State FEA
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Tolerance:	0.001
Maximum number of iterations:	500
Use negative pore pressure cutoff:	No
Advanced Groundwater Method:	None
Mesh Element Type:	3 noded triangles
Number of Elements:	548
Number of Nodes:	329

Static - 2H:1V Cut Slope

Groundwater Method:	Steady State FEA
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Tolerance:	0.001
Maximum number of iterations:	500
Use negative pore pressure cutoff:	No
Advanced Groundwater Method:	None
Mesh Element Type:	3 noded triangles
Number of Elements:	568
Number of Nodes:	338

Seismic - 2H:1V Cut Slope

Groundwater Method:	Steady State FEA
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Tolerance:	0.001
Maximum number of iterations:	500
Use negative pore pressure cutoff:	No
Advanced Groundwater Method:	None
Mesh Element Type:	3 noded triangles
Number of Elements:	568
Number of Nodes:	338

Static - 2.2H:1V Cut Slope

Groundwater Method:	Steady State FEA
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Tolerance:	0.001
Maximum number of iterations:	500
Use negative pore pressure cutoff:	No
Advanced Groundwater Method:	None
Mesh Element Type:	3 noded triangles
Number of Elements:	561
Number of Nodes:	334

Seismic - 2.2H:1V Cut Slope

Groundwater Method:	Steady State FEA
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Tolerance:	0.001
Maximum number of iterations:	500
Use negative pore pressure cutoff:	No
Advanced Groundwater Method:	None
Mesh Element Type:	3 noded triangles
Number of Elements:	561
Number of Nodes:	334

Static - 2H:1V Cut Slope - High GWT

Groundwater Method:	Steady State FEA
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Tolerance:	0.001
Maximum number of iterations:	500
Use negative pore pressure cutoff:	No
Advanced Groundwater Method:	None
Mesh Element Type:	3 noded triangles
Number of Elements:	568
Number of Nodes:	338

Seismic - 2H:1V Cut slope - High GWT

Groundwater Method:	Steady State FEA
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Tolerance:	0.001
Maximum number of iterations:	500
Use negative pore pressure cutoff:	No
Advanced Groundwater Method:	None
Mesh Element Type:	3 noded triangles
Number of Elements:	568
Number of Nodes:	338

2H:1V Cut Slope - High GWT Solution

Groundwater Method:	Steady State FEA
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Tolerance:	0.001
Maximum number of iterations:	500
Use negative pore pressure cutoff:	No
Advanced Groundwater Method:	None
Mesh Element Type:	3 noded triangles
Number of Elements:	620
Number of Nodes:	366

2.2H:1V Cut Slope - Very High GWT Solution

Groundwater Method:	Steady State FEA
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Tolerance:	0.001
Maximum number of iterations:	500
Use negative pore pressure cutoff:	No
Advanced Groundwater Method:	None
Mesh Element Type:	3 noded triangles
Number of Elements:	645
Number of Nodes:	380

Surface Options

All Open Scenarios

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Static - 2H:1V Fill Slope

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Seismic - 2H:1V Fill Slope

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.131
Seismic Load Coefficient (Vertical):	0.052

Static - 2H:1V Cut Slope

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Seismic - 2H:1V Cut Slope

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.131
Seismic Load Coefficient (Vertical):	0.052

Static - 2.2H:1V Cut Slope

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Seismic - 2.2H:1V Cut Slope

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.131
Seismic Load Coefficient (Vertical):	0.052

Static - 2H:1V Cut Slope - High GWT

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Seismic - 2H:1V Cut slope - High GWT

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.131
Seismic Load Coefficient (Vertical):	0.052

2H:1V Cut Slope - High GWT Solution

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.131
Seismic Load Coefficient (Vertical):	0.052

2.2H:1V Cut Slope - Very High GWT Solution

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.131
Seismic Load Coefficient (Vertical):	0.052

Loading

Static - 2H:1V Fill Slope

Distribution:	Constant
Magnitude [psf]:	240
Orientation:	Normal to boundary

Seismic - 2H:1V Fill Slope

Distribution:	Constant
Magnitude [psf]:	240
Orientation:	Normal to boundary

Materials

Fill	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	34
Unsaturated Shear Strength Angle [deg]	0
Air Entry Value [psf]	0
Ks [feet/day]	10
K2/K1	1
K Angle [deg]	0
Groundwater Model	Simple
GW Model Properties	Soil Type: General
Unsat. Shear Strength Phi b [deg]	0
Unsat. Shear Strength Air Entry Value [psf]	0
Native Sand	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	105
Cohesion [psf]	0
Friction Angle [deg]	32
Unsaturated Shear Strength Angle [deg]	0
Air Entry Value [psf]	0
Ks [feet/day]	15
K2/K1	1
K Angle [deg]	0
Groundwater Model	Simple
GW Model Properties	Soil Type: General
Unsat. Shear Strength Phi b [deg]	0
Unsat. Shear Strength Air Entry Value [psf]	0
Gravel	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	135
Cohesion [psf]	0
Friction Angle [deg]	35
Unsaturated Shear Strength Angle [deg]	0
Air Entry Value [psf]	0
Ks [feet/day]	75
K2/K1	1
K Angle [deg]	0
Groundwater Model	Simple
GW Model Properties	Soil Type: General
Unsat. Shear Strength Phi b [deg]	0
Unsat. Shear Strength Air Entry Value [psf]	0

Materials In Use

Material	Static - 2H:1V Fill Slope	Seismic - 2H:1V Fill Slope	Static - 2H:1V Cut Slope	Seismic - 2H:1V Cut Slope	Static - 2.2H:1V Cut Slope	Seismic - 2.2H:1V Cut Slope	Static - 2H:1V Cut Slope - High GWT	Seismic - 2H:1V Cut slope - High GWT	2H:1V Cut Slope - High GWT Solution	2.2H:1V Cut Slope - Very High GWT Solution
Fill	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗
Native Sa	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Gravel	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓

Global Minimums

Static - 2H:1V Fill Slope

Method: bishop simplified

FS	1.349310
Center:	71.860, 163.788
Radius:	114.363
Left Slip Surface Endpoint:	122.297, 61.149
Right Slip Surface Endpoint:	123.709, 61.854
Resisting Moment:	23.7087 lb-ft
Driving Moment:	17.571 lb-ft
Total Slice Area:	0.002863 ft2
Surface Horizontal Width:	1.41155 ft
Surface Average Height:	0.00202826 ft

Method: janbu simplified

FS	1.349030
Center:	71.860, 163.788
Radius:	114.363
Left Slip Surface Endpoint:	122.297, 61.149
Right Slip Surface Endpoint:	123.709, 61.854
Resisting Horizontal Force:	0.185388 lb
Driving Horizontal Force:	0.137423 lb
Total Slice Area:	0.002863 ft2
Surface Horizontal Width:	1.41155 ft
Surface Average Height:	0.00202826 ft

Seismic - 2H:1V Fill Slope

Method: bishop simplified

FS	1.012010
Center:	71.860, 163.788
Radius:	114.363
Left Slip Surface Endpoint:	122.297, 61.149
Right Slip Surface Endpoint:	123.709, 61.854
Resisting Moment:	23.3655 lb-ft
Driving Moment:	23.0882 lb-ft
Total Slice Area:	0.002863 ft2
Surface Horizontal Width:	1.41155 ft
Surface Average Height:	0.00202826 ft

Method: janbu simplified

FS	1.012750
Center:	71.860, 163.788
Radius:	114.363
Left Slip Surface Endpoint:	122.297, 61.149
Right Slip Surface Endpoint:	123.709, 61.854
Resisting Horizontal Force:	0.182849 lb
Driving Horizontal Force:	0.180547 lb
Total Slice Area:	0.002863 ft2
Surface Horizontal Width:	1.41155 ft
Surface Average Height:	0.00202826 ft

Static - 2H:1V Cut Slope

Method: bishop simplified

FS	1.250390
Center:	71.509, 165.229
Radius:	115.809
Left Slip Surface Endpoint:	122.598, 61.299
Right Slip Surface Endpoint:	124.000, 62.000
Resisting Moment:	18.782 lb-ft
Driving Moment:	15.0209 lb-ft
Total Slice Area:	0.00276221 ft2
Surface Horizontal Width:	1.4018 ft
Surface Average Height:	0.00197047 ft

Method: janbu simplified

FS	1.249750
Center:	71.509, 165.229
Radius:	115.809
Left Slip Surface Endpoint:	122.598, 61.299
Right Slip Surface Endpoint:	124.000, 62.000
Resisting Horizontal Force:	0.144986 lb
Driving Horizontal Force:	0.116012 lb
Total Slice Area:	0.00276221 ft2
Surface Horizontal Width:	1.4018 ft
Surface Average Height:	0.00197047 ft

Seismic - 2H:1V Cut Slope

Method: bishop simplified

FS	0.938334
Center:	71.509, 165.229
Radius:	115.809
Left Slip Surface Endpoint:	122.598, 61.299
Right Slip Surface Endpoint:	124.000, 62.000
Resisting Moment:	18.5203 lb-ft
Driving Moment:	19.7374 lb-ft
Total Slice Area:	0.00276221 ft2
Surface Horizontal Width:	1.4018 ft
Surface Average Height:	0.00197047 ft

Method: janbu simplified

FS	0.938491
Center:	71.509, 165.229
Radius:	115.809
Left Slip Surface Endpoint:	122.598, 61.299
Right Slip Surface Endpoint:	124.000, 62.000
Resisting Horizontal Force:	0.143167 lb
Driving Horizontal Force:	0.15255 lb
Total Slice Area:	0.00276221 ft2
Surface Horizontal Width:	1.4018 ft
Surface Average Height:	0.00197047 ft

Static - 2.2H:1V Cut Slope

Method: bishop simplified

FS	1.375700
Center:	66.215, 191.039
Radius:	142.380
Left Slip Surface Endpoint:	124.430, 61.104
Right Slip Surface Endpoint:	125.832, 61.742
Resisting Moment:	18.2118 lb-ft
Driving Moment:	13.2382 lb-ft
Total Slice Area:	0.00213994 ft2
Surface Horizontal Width:	1.40265 ft
Surface Average Height:	0.00152564 ft

Method: janbu simplified

FS	1.374720
Center:	66.168, 191.362
Radius:	142.694
Left Slip Surface Endpoint:	124.457, 61.117
Right Slip Surface Endpoint:	125.972, 61.805
Resisting Horizontal Force:	0.146435 lb
Driving Horizontal Force:	0.106519 lb
Total Slice Area:	0.00269297 ft2
Surface Horizontal Width:	1.51546 ft
Surface Average Height:	0.001777 ft

Seismic - 2.2H:1V Cut Slope

Method: bishop simplified

FS	1.017160
Center:	66.215, 191.039
Radius:	142.380
Left Slip Surface Endpoint:	124.430, 61.104
Right Slip Surface Endpoint:	125.832, 61.742
Resisting Moment:	18.0462 lb-ft
Driving Moment:	17.7418 lb-ft
Total Slice Area:	0.00213994 ft2
Surface Horizontal Width:	1.40265 ft
Surface Average Height:	0.00152564 ft

Method: janbu simplified

FS	1.017960
Center:	66.215, 191.039
Radius:	142.380
Left Slip Surface Endpoint:	124.430, 61.104
Right Slip Surface Endpoint:	125.832, 61.742
Resisting Horizontal Force:	0.115459 lb
Driving Horizontal Force:	0.113422 lb
Total Slice Area:	0.00213994 ft2
Surface Horizontal Width:	1.40265 ft
Surface Average Height:	0.00152564 ft

Static - 2H:1V Cut Slope - High GWT

Method: bishop simplified

FS	1.192890
Center:	100.525, 56.775
Radius:	7.199
Left Slip Surface Endpoint:	98.090, 50.000
Right Slip Surface Endpoint:	106.914, 53.457
Resisting Moment:	2765.51 lb-ft
Driving Moment:	2318.33 lb-ft
Total Slice Area:	8.2456 ft2
Surface Horizontal Width:	8.824 ft
Surface Average Height:	0.934451 ft

Method: janbu simplified

FS	1.067370
Center:	101.359, 54.735
Radius:	5.622
Left Slip Surface Endpoint:	98.329, 50.000
Right Slip Surface Endpoint:	106.822, 53.411
Resisting Horizontal Force:	428.083 lb
Driving Horizontal Force:	401.064 lb
Total Slice Area:	12.2555 ft2
Surface Horizontal Width:	8.49357 ft
Surface Average Height:	1.44292 ft

Seismic - 2H:1V Cut slope - High GWT

Method: bishop simplified

FS	0.893788
Center:	100.308, 56.729
Radius:	7.230
Left Slip Surface Endpoint:	97.663, 50.000
Right Slip Surface Endpoint:	106.700, 53.350
Resisting Moment:	2704.66 lb-ft
Driving Moment:	3026.07 lb-ft
Total Slice Area:	8.23989 ft2
Surface Horizontal Width:	9.0369 ft
Surface Average Height:	0.911805 ft

Method: janbu simplified

FS	0.799098
Center:	100.932, 56.174
Radius:	6.950
Left Slip Surface Endpoint:	97.740, 50.000
Right Slip Surface Endpoint:	107.433, 53.716
Resisting Horizontal Force:	458.536 lb
Driving Horizontal Force:	573.817 lb
Total Slice Area:	12.5327 ft2
Surface Horizontal Width:	9.69264 ft
Surface Average Height:	1.29301 ft

2H:1V Cut Slope - High GWT Solution

Method: bishop simplified

FS	0.938334
Center:	71.509, 165.229
Radius:	115.809
Left Slip Surface Endpoint:	122.598, 61.299
Right Slip Surface Endpoint:	124.000, 62.000
Resisting Moment:	18.5203 lb-ft
Driving Moment:	19.7374 lb-ft
Total Slice Area:	0.00276221 ft2
Surface Horizontal Width:	1.4018 ft
Surface Average Height:	0.00197047 ft

Method: janbu simplified

FS	0.938491
Center:	71.509, 165.229
Radius:	115.809
Left Slip Surface Endpoint:	122.598, 61.299
Right Slip Surface Endpoint:	124.000, 62.000
Resisting Horizontal Force:	0.143167 lb
Driving Horizontal Force:	0.15255 lb
Total Slice Area:	0.00276221 ft2
Surface Horizontal Width:	1.4018 ft
Surface Average Height:	0.00197047 ft

2.2H:1V Cut Slope - Very High GWT Solution

Method: bishop simplified

FS	1.017160
Center:	66.215, 191.039
Radius:	142.380
Left Slip Surface Endpoint:	124.430, 61.104
Right Slip Surface Endpoint:	125.832, 61.742
Resisting Moment:	18.0462 lb-ft
Driving Moment:	17.7418 lb-ft
Total Slice Area:	0.00213994 ft2
Surface Horizontal Width:	1.40265 ft
Surface Average Height:	0.00152564 ft

Method: janbu simplified

FS	0.947840
Center:	107.134, 68.855
Radius:	20.369
Left Slip Surface Endpoint:	99.427, 50.000
Right Slip Surface Endpoint:	126.298, 61.954
Resisting Horizontal Force:	5526.95 lb
Driving Horizontal Force:	5831.1 lb
Total Slice Area:	123.88 ft2
Surface Horizontal Width:	26.8707 ft
Surface Average Height:	4.61022 ft

APPENDIX D
Liquefaction Assessment

LIQUEFACTION ASSESSMENT

PROJECT : Wallula Gap Business Park Roads 2023
LOCATION: Walla Walla County, WA

Site Paramaters

Type:	PGA
Shear Wave Velocity, V_s^{30} (ft/s):	1,200

Subsurface Conditions

GWT Depth (Analysis):	**15**
GWT Depth (Field):	**15**
Depth Interval (feet):	**1**

Design Earthquake

Probability of Exceedance	Return Period (yrs)	a_{max} (g)	M_W
10% in 50 years	475 yrs	**0.101**	**6.34**
5% in 50 years	975 yrs	**0.156**	**6.47**
2% in 50 years	2,475 yrs	**0.262**	**6.70**

SPT Correction Factors

C_E =	1.24	(Automatic Hammer E=84%)
C_B =	1.15	(<5-inch Diameter Boring)
C_S =	1.00	(Standard Sampling)

anderson perry & associates, inc.

Total Estimated Liquefaction Induced Settlement

475-year event	975-year event	2,475-year event
Settlement (inches)	Settlement (inches)	Settlement (inches)
0.0	0.0	0.0

Top Depth of Layer (feet)	Bottom Depth of Layer (feet)	Soil Classification (USCS)	γ (pcf)	u (psf)	σ_v (psf)	σ'_v (psf)	u_0 (psf)	σ'_{v0} (psf)	SPT	C_R	N_{60}	Fines (%)	$\Delta(N_1)_{60}$	m	C_N	$(N_1)_{60}$	$(N_1)_{60CS}$	C_σ	K_σ	K_σ	α_{MSF}	β_{MSF}	MSF_{max}	MSF 475 yrs	MSF 975 yrs	MSF 2,475 yrs	α_{rd}	β_{rd}	r_d 475 yrs	r_d 975 yrs	r_d 2,475 yrs	CSR 475 yrs	CSR 975 yrs	CSR 2,475 yrs	CRR M=7.5	CRR 475 yrs	CRR 975 yrs	CRR 2,475 yrs	FS 475 yrs	FS 975 yrs	FS 2,475 yrs
0	1	SP-SM	110	0	55	55	0	55	**12**	0.75	13.0	**10**	1.15	0.43	1.60	20.87	22.02	0.14	1.53	1.10	0.87	1.0	1.58	1.26	1.23	1.17	0.010	-0.001	1.01	1.01	1.01	0.066	0.102	0.171	0.23	0.32	0.31	0.30	4.9	3.1	1.8
1	2	SP-SM	110	0	165	165	0	165	**12**	0.75	13.0	**10**	1.15	0.43	1.60	20.90	22.05	0.14	1.37	1.10	0.87	1.0	1.58	1.26	1.23	1.17	-0.003	0.001	1.00	1.00	1.00	0.066	0.101	0.171	0.23	0.32	0.32	0.30	4.9	3.1	1.8
2	3	SP-SM	110	0	275	275	0	275	**12**	0.75	13.2	**10**	1.15	0.42	1.60	21.13	22.27	0.15	1.30	1.10	0.87	1.0	1.59	1.26	1.23	1.17	-0.016	0.002	1.00	1.00	1.00	0.065	0.101	0.170	0.24	0.33	0.32	0.31	5.0	3.2	1.8
3	4	SP-SM	110	0	385	385	0	385	**13**	0.75	13.4	**10**	1.15	0.42	1.60	21.42	22.57	0.15	1.25	1.10	0.87	1.0	1.60	1.27	1.23	1.18	-0.030	0.004	0.99	0.99	1.00	0.065	0.101	0.170	0.24	0.34	0.33	0.31	5.2	3.3	1.8
4	5	SP-SM	110	0	495	495	0	495	**13**	0.75	13.7	**10**	1.15	0.42	1.59	21.75	22.90	0.15	1.22	1.10	0.87	1.0	1.62	1.28	1.24	1.18	-0.045	0.005	0.99	0.99	0.99	0.065	0.100	0.169	0.25	0.35	0.34	0.32	5.4	3.4	1.9
5	6	SP-SM	110	0	605	605	0	605	**13**	0.75	13.9	**10**	1.15	0.42	1.59	22.10	23.25	0.15	1.19	1.10	0.87	1.0	1.63	1.28	1.25	1.19	-0.060	0.007	0.99	0.99	0.99	0.064	0.100	0.168	0.25	0.36	0.35	0.33	5.6	3.5	2.0
6	7	SP-SM	115	0	718	718	0	718	**13**	0.75	14.4	**10**	1.15	0.41	1.57	22.51	23.66	0.15	1.17	1.10	0.87	1.0	1.65	1.29	1.25	1.19	-0.076	0.009	0.98	0.98	0.98	0.064	0.099	0.168	0.26	0.37	0.36	0.34	5.8	3.6	2.0
7	8	SP-SM	115	0	833	833	0	833	**15**	0.75	15.8	**10**	1.15	0.41	1.46	23.13	24.28	0.16	1.15	1.10	0.87	1.0	1.68	1.30	1.27	1.20	-0.093	0.011	0.98	0.98	0.98	0.064	0.099	0.167	0.27	0.39	0.38	0.36	6.2	3.9	2.2
8	9	SP-SM	115	0	948	948	0	948	**16**	0.75	17.2	**10**	1.15	0.40	1.38	23.77	24.92	0.16	1.13	1.10	0.87	1.0	1.72	1.32	1.28	1.21	-0.110	0.013	0.97	0.97	0.98	0.064	0.098	0.166	0.29	0.42	0.41	0.38	6.6	4.1	2.3
9	10	SP-SM	115	0	1,063	1,063	0	1,063	**17**	0.75	18.6	**10**	1.15	0.40	1.32	24.43	25.58	0.17	1.11	1.10	0.87	1.0	1.75	1.33	1.29	1.22	-0.128	0.015	0.97	0.97	0.97	0.063	0.098	0.165	0.30	0.45	0.43	0.41	7.1	4.4	2.5
10	11	SP-SM	115	0	1,178	1,178	0	1,178	**17**	0.80	20.0	**10**	1.15	0.39	1.26	25.10	26.25	0.17	1.10	1.10	0.87	1.0	1.78	1.35	1.31	1.23	-0.146	0.017	0.96	0.96	0.97	0.063	0.097	0.165	0.32	0.48	0.46	0.44	7.6	4.8	2.7
11	12	SP-SM	115	0	1,293	1,293	0	1,293	**19**	0.80	21.3	**10**	1.15	0.39	1.21	25.80	26.95	0.18	1.09	1.09	0.87	1.0	1.82	1.37	1.32	1.24	-0.165	0.019	0.96	0.96	0.96	0.063	0.097	0.164	0.34	0.51	0.49	0.47	8.2	5.1	2.8
12	13	SP-SM	115	0	1,408	1,408	0	1,408	**20**	0.80	22.7	**10**	1.15	0.38	1.17	26.52	27.67	0.18	1.07	1.07	0.87	1.0	1.86	1.38	1.34	1.25	-0.185	0.021	0.95	0.95	0.96	0.062	0.096	0.163	0.37	0.55	0.53	0.50	8.9	5.5	3.1
13	14	SP-SM	115	0	1,523	1,523	0	1,523	**20**	0.85	24.1	**10**	1.15	0.38	1.13	27.26	28.40	0.19	1.06	1.06	0.87	1.0	1.90	1.40	1.35	1.26	-0.205	0.023	0.94	0.95	0.95	0.062	0.096	0.162	0.40	0.60	0.58	0.54	9.7	6.0	3.3
14	15	SP-SM	115	0	1,638	1,638	0	1,638	**21**	0.85	25.5	**10**	1.15	0.37	1.10	28.01	29.16	0.19	1.05	1.05	0.87	1.0	1.95	1.42	1.37	1.28	-0.225	0.026	0.94	0.94	0.95	0.061	0.095	0.161	0.44	0.65	0.63	0.59	10.6	6.6	3.6
15	16	SP-SM	125	31	1,758	1,726	31	1,726	**22**	0.85	26.7	**10**	1.15	0.36	1.08	28.74	29.89	0.20	1.04	1.04	0.87	1.0	1.99	1.44	1.39	1.29	-0.247	0.028	0.93	0.94	0.94	0.062	0.096	0.163	0.48	0.72	0.69	0.64	11.5	7.2	3.9
16	17	SP-SM	125	94	1,883	1,789	94	1,789	**23**	0.85	27.7	**10**	1.15	0.36	1.06	29.42	30.57	0.21	1.03	1.03	0.87	1.0	2.03	1.46	1.40	1.30	-0.268	0.030	0.93	0.93	0.94	0.064	0.099	0.168	0.48	0.73	0.70	0.65	11.5	7.1	3.9
17	18	SP-SM	125	156	2,008	1,852	156	1,852	**24**	0.85	28.7	**10**	1.15	0.35	1.05	30.12	31.27	0.22	1.03	1.03	0.87	1.0	2.08	1.48	1.42	1.32	-0.291	0.033	0.92	0.93	0.93	0.065	0.101	0.172	0.48	0.74	0.71	0.66	11.3	7.0	3.8
18	19	SP-SM	125	218	2,133	1,914	218	1,914	**25**	0.85	29.8	**10**	1.15	0.35	1.04	30.84	31.99	0.22	1.02	1.02	0.87	1.0	2.12	1.50	1.44	1.33	-0.313	0.035	0.92	0.92	0.93	0.067	0.104	0.176	0.48	0.74	0.71	0.66	11.2	6.9	3.7
19	20	SP-SM	125	281	2,258	1,977	281	1,977	**25**	0.85	30.8	**10**	1.15	0.34	1.02	31.58	32.73	0.23	1.02	1.02	0.87	1.0	2.17	1.52	1.46	1.34	-0.336	0.038	0.91	0.91	0.92	0.068	0.105	0.179	0.48	0.75	0.72	0.66	11.0	6.8	3.7
20	21	SP-SM	125	343	2,383	2,039	343	2,039	**24**	0.95	31.9	**10**	1.15	0.34	1.01	32.34	33.48	0.24	1.01	1.01	0.87	1.0	2.20	1.54	1.47	1.35	-0.360	0.041	0.90	0.91	0.92	0.069	0.107	0.182	0.48	0.75	0.72	0.66	10.9	6.7	3.6
21	22	SP-SM	125	406	2,508	2,102	406	2,102	**24**	0.95	33.0	**10**	1.15	0.33	1.00	33.11	34.26	0.25	1.00	1.00	0.87	1.0	2.20	1.54	1.47	1.35	-0.384	0.043	0.90	0.90	0.91	0.070	0.109	0.185	0.48	0.75	0.71	0.66	10.7	6.6	3.6
22	23	SP-SM	125	468	2,633	2,165	468	2,165	**25**	0.95	34.2	**10**	1.15	0.33	0.99	33.90	35.05	0.26	0.99	0.99	0.87	1.0	2.20	1.54	1.47	1.35	-0.409	0.046	0.89	0.90	0.90	0.071	0.110	0.187	0.48	0.74	0.71	0.65	10.5	6.4	3.5
23	24	SP-SM	125	530	2,758	2,227	530	2,227	**26**	0.95	35.3	**10**	1.15	0.32	0.98	34.71	35.86	0.28	0.99	0.99	0.87	1.0	2.20	1.54	1.47	1.35	-0.434	0.049	0.88	0.89	0.90	0.072	0.111	0.190	0.48	0.73	0.70	0.65	10.3	6.3	3.4
24	25	SP-SM	125	593	2,883	2,290	593	2,290	**27**	0.95	36.4	**10**	1.15	0.32	0.98	35.54	36.69	0.29	0.98	0.98	0.87	1.0	2.20	1.54	1.47	1.35	-0.459	0.052	0.88	0.88	0.89	0.072	0.112	0.191	0.48	0.73	0.70	0.64	10.1	6.2	3.3
25	26	SP-SM	125	655	3,008	2,352	655	2,352	**28**	0.95	37.6	**10**	1.15	0.31	0.97	36.39	37.54	0.30	0.97	0.97	0.87	1.0	2.20	1.54	1.47	1.35	-0.484	0.054	0.87	0.88	0.89	0.073	0.113	0.193	0.48	0.72	0.69	0.64	9.9	6.1	3.3
26	27	SP-SM	125	718	3,133	2,415	718	2,415	**29**	0.95	38.8	**10**	1.15	0.31	0.96	37.26	38.41	0.30	0.96	0.96	0.87	1.0	2.20	1.54	1.47	1.35	-0.511	0.057	0.86	0.87	0.88	0.073	0.114	0.195	0.48	0.72	0.68	0.63	9.8	6.0	3.2
27	28	SP-SM	125	780	3,258	2,478	780	2,478	**30**	0.95	40.0	**10**	1.15	0.30	0.95	38.15	39.30	0.30	0.95	0.95	0.87	1.0	2.20	1.54	1.47	1.35	-0.537	0.060	0.86	0.86	0.88	0.074	0.115	0.196	0.48	0.71	0.68	0.63	9.6	5.9	3.2
28	29	SP-SM	125	842	3,383	2,540	842	2,540	**30**	0.95	41.2	**10**	1.15	0.30	0.95	39.06	40.21	0.30	0.95	0.95	0.87	1.0	2.20	1.54	1.47	1.35	-0.564	0.063	0.85	0.86	0.87	0.074	0.115	0.197	0.48	0.70	0.67	0.62	9.5	5.8	3.1
29	30	SP-SM	125	905	3,508	2,603	905	2,603	**31**	0.95	42.5	**10**	1.15	0.29	0.94	39.99	41.14	0.30	0.94	0.94	0.87	1.0	2.20	1.54	1.47	1.35	-0.591	0.066	0.84	0.85	0.86	0.074	0.116	0.198	0.48	0.70	0.67	0.62	9.4	5.8	3.1
30	31	SP-SM	125	967	3,633	2,665	967	2,665	**32**	0.95	43.7	**10**	1.15	0.29	0.94	40.95	42.10	0.30	0.93	0.93	0.87	1.0	2.20	1.54	1.47	1.35	-0.618	0.069	0.84	0.84	0.86	0.075	0.116	0.199	0.48	0.69	0.66	0.61	9.3	5.7	3.1
31	32	SP-SM	125	1,030	3,758	2,728	1,030	2,728	**33**	0.95	45.0	**10**	1.15	0.28	0.93	41.93	43.08	0.30	0.93	0.93	0.87	1.0	2.20	1.54	1.47	1.35	-0.645	0.072	0.83	0.84	0.85	0.075	0.117	0.200	0.48	0.69	0.66	0.61	9.2	5.6	3.0
32	33	SP-SM	125	1,092	3,883	2,791	1,092	2,791	**34**	0.95	46.3	**10**	1.15	0.28	0.93	42.93	44.08	0.30	0.92	0.92	0.87	1.0	2.20	1.54	1.47	1.35	-0.673	0.075	0.82	0.83	0.84	0.075	0.117	0.200	0.48	0.68	0.65	0.60	9.1	5.6	3.0
33	34	SP-SM	125	1,154	4,008	2,853	1,154	2,853	**33**	1.00	47.6	**10**	1.15	0.27	0.92	43.96	45.11	0.30	0.91	0.91	0.87	1.0	2.20	1.54	1.47	1.35	-0.701	0.078	0.82	0.82	0.84	0.075	0.117	0.201	0.48	0.68	0.65	0.60	9.1	5.5	3.0
34	35	SP-SM	125	1,217	4,133	2,916	1,217	2,916	**34**	1.00	49.0	**10**	1.15	0.26	0.92	45.01	46.16	0.30	0.91	0.91	0.87	1.0	2.20	1.54	1.47	1.35	-0.729	0.082	0.81	0.82	0.83	0.075	0.117	0.201	0.48	0.67	0.64	0.59	9.0	5.5	3.0
35	36	SP-SM	125	1,279	4,258	2,978	1,279	2,978	**35**	1.00	50.3	**10**	1.15	0.26	0.92	46.08	47.23	0.30	0.90	0.90	0.87	1.0	2.20	1.54	1.47	1.35	-0.758	0.085	0.80	0.81	0.83	0.075	0.117	0.201	0.48	0.67	0.64	0.59	8.9	5.5	2.9
36	37	SP-SM	125	1,342	4,383	3,041	1,342	3,041	**36**	1.00	51.7	**10**	1.15	0.25	0.91	47.19	48.34	0.30	0.89	0.89	0.87	1.0	2.20	1.54	1.47	1.35	-0.786	0.088	0.79	0.80	0.82	0.075	0.117	0.201	0.48	0.66	0.64	0.59	8.9	5.4	2.9
37	38	SP-SM	130	1,404	4,510	3,106	1,404	3,106	**37**	1.00	53.1	**10**	1.15	0.25	0.91	48.33	49.48	0.30	0.89	0.89	0.87	1.0	2.20	1.54	1.47	1.35	-0.815	0.091	0.79	0.80	0.81	0.075	0.117	0.201	0.48	0.66	0.63	0.58	8.8	5.4	2.9
38	39	SP-SM	130	1,466	4,640	3,174	1,466	3,174	**38**	1.00	54.6	**10**	1.15	0.24	0.91	49.51	50.66	0.30	0.88	0.88	0.87	1.0	2.20	1.54	1.47	1.35	-0.844	0.094	0.78	0.79	0.81	0.075	0.117	0.201	0.48	0.66	0.63	0.58	8.8	5.4	2.9
39	40	SP-SM	130	1,529	4,770	3,241	1,529	3,241	**39**	1.00	56.0	**10**	1.15	0.23	0.91	50.72	51.87	0.30	0.87	0.87	0.87	1.0	2.20	1.54	1.47	1.35	-0.873	0.097	0.77	0.78	0.80	0.075	0.117	0.201	0.48	0.65	0.62	0.57	8.7	5.3	2.9
40	41	SP-SM	130	1,591	4,900	3,309	1,591	3,309	**40**	1.00	57.5	**10**	1.15	0.23	0.90	51.96	53.11	0.30	0.87	0.87	0.87	1.0	2.20	1.54	1.47	1.35	-0.902	0.100	0.77	0.78	0.80	0.074	0.116	0.201	0.48	0.65	0.62	0.57	8.7	5.3	2.8
41	42	SP-SM	130	1,654	5,030	3,376	1,654	3,376	**41**	1.00	59.0	**10**	1.15	0.22	0.90	53.23	54.38	0.30	0.86	0.86	0.87	1.0	2.20	1.54	1.47	1.35	-0.931	0.104	0.76	0.77	0.79	0.074	0.116	0.200	0.48	0.64	0.61	0.57	8.7	5.3	2.8
42	43	SP-SM	130	1,716	5,160	3,444	1,716	3,444	**42**	1.00	60.6	**10**	1.15	0.22	0.90	54.53	55.68	0.30	0.86	0.86	0.87	1.0	2.20	1.54	1.47	1.35	-0.960	0.107	0.75	0.76	0.78	0.074	0.116	0.200	0.48	0.64	0.61	0.56	8.6	5.3	2.8
43	44	SP-SM	130	1,778	5,290	3,512	1,778	3,512	**44**	1.00	62.1	**10**	1.15	0.21	0.90	55.87	57.02	0.30	0.85	0.85	0.87	1.0	2.20	1.54	1.47	1.35	-0.990	0.110	0.75	0.76	0.78	0.074	0.115	0.199	0.48	0.63	0.61	0.56	8.6	5.2	2.8
44	45	SP-SM	130	1,841	5,420	3,579	1,841	3,579	**45**	1.00	63.7	**10**	1.15	0.20	0.90	57.25	58.39	0.30	0.84	0.84	0.87	1.0	2.20	1.54	1.47	1.35	-1.019	0.113	0.74	0.75	0.77	0.073	0.115	0.199	0.48	0.63	0.60	0.55	8.6	5.2	2.8
45	46	SP-SM	130	1,903	5,550	3,647	1,903	3,647	**46**	1.00	65.3	**10**	1.15	0.20	0.90	58.65	59.80	0.30	0.84	0.84	0.87	1.0	2.20	1.54	1.47	1.35	-1.048	0.116	0.73	0.74	0.76	0.073	0.115	0.198	0.48	0.62	0.60	0.55	8.6	5.2	2.8
46	47	SP-SM	130	1,966	5,680	3,714	1,966	3,714	**47**	1.00	66.9	**10**	1.15	0.19	0.90	60.10	61.25	0.30	0.83	0.83	0.87	1.0	2.20	1.54	1.47	1.35	-1.077	0.120	0.73	0.74	0.76	0.073	0.114	0.198	0.48	0.62	0.59	0.55	8.5	5.2	2.8
47	48	SP-SM	130	2,028	5,810	3,782	2,028	3,782	**48**	1.00	68.5	**10**	1.15	0.18	0.90	61.58	62.73	0.30	0.83	0.83	0.87	1.0	2.20	1.54	1.47	1.35	-1.107	0.123	0.72	0.73	0.75	0.072	0.114	0.197	0.48	0.62	0.59	0.54	8.5	5.2	2.8
48	49	SP-SM	130	2,090	5,940	3,850	2,090	3,850	**49**	1.00	70.1	**10**	1.15	0.18	0.90	63.10	64.25	0.30	0.82	0.82	0.87	1.0	2.20	1.54	1.47	1.35	-1.136	0.126	0.71	0.73	0.75	0.072	0.113	0.196	0.48	0.61	0.59	0.54	8.5	5.2	2.8
49	50	SP-SM	130	2,153	6,070	3,917	2,153	3,917	**50**	1.00	71.8	**10**	1.15	0.17	0.90	64.66	65.81	0.30	0.82	0.82	0.87	1.0	2.20	1.54	1.47	1.35	-1.165	0.129	0.71	0.72	0.74	0.072	0.113	0.195	0.48	0.61	0.58	0.54	8.5	5.2	2.7