Geotechnical Engineering Report

Cottonwood Residential Development
Walla Walla County Parcel: 360604120029
Walla Walla, Washington

Prepared for:
Hayden Homes LLC
2464 SW Glacier Place, Suite 110
Redmond, Oregon 97756

April 8, 2019
PBS Project HDJ4203.000

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1 INTRODUCTION

1.1 General

This report presents results of PBS Engineering and Environmental Inc. (PBS) geotechnical engineering services for the proposed residential infrastructure development located at Walla Walla County Parcel: 360604120029 in Walla Walla (site). The general site location is shown on the Vicinity Map, Figure 1. The locations of PBS' explorations in relation to existing and proposed site features are shown on the Site Plan, Figure 2.

1.2 Purpose and Scope

The purpose of PBS' services was to develop geotechnical design and construction recommendations in support of the planned new residential infrastructure development. This was accomplished by performing the following scope of services.

1.2.1 Literature and Records Review

PBS reviewed various published geologic maps of the area for information regarding geologic conditions and hazards at or near the site. PBS also reviewed previously completed reports for the project site and vicinity.

1.2.2 Subsurface Explorations

PBS excavated 30 test pits within the proposed residential development parcel to depths of up to 16.5 feet below the existing ground surface (bgs). The test pits were logged and representative soil samples collected by a member of the PBS geotechnical engineering staff. Interpreted test pit logs are included as Figures A1 through A30 in Appendix A, Field Explorations.

1.2.3 Field Infiltration Testing

Four open-hole, falling-head field infiltration tests were completed in test pits TP-2, TP-5, TP-23, and TP-28 within the proposed development at depths between 5 and 6 feet bgs. Infiltration testing was monitored by PBS geotechnical engineering staff.

1.2.4 Soils Testing

Soil samples were returned to our laboratory and classified in general accordance with the Unified Soil Classification System (ASTM D2487) and/or the Visual-Manual Procedure (ASTM D2488). Laboratory tests included natural moisture contents and grain-size analyses. Laboratory test results are included in the exploration logs in Appendix A, Field Explorations; and in Appendix B, Laboratory Testing.

1.2.5 Geotechnical Engineering Analysis

Data collected during the subsurface exploration, literature research, and testing were used to develop site-specific geotechnical design parameters and construction recommendations.

1.2.6 Report Preparation

This Geotechnical Engineering Report summarizes the results of our explorations, testing, and analyses, including information relating to the following:

- Field exploration logs and site plan showing approximate exploration locations
- Laboratory test results
- Infiltration test results
- Groundwater considerations
- Liquefaction potential
- Earthwork and grading, cut, and fill recommendations:

  - Structural fill materials and preparation, and reuse of on-site soils
  - Wet weather considerations
  - Utility trench excavation and backfill requirements
  - Temporary and permanent slope inclinations
- Seismic design criteria in accordance with the current International Building Code (IBC) with State of Washington amendments
- Pavement subgrade preparation recommendations
- Recommended asphalt concrete (AC) pavement sections

1.3 Project Understanding

PBS understands the client plans to develop the approximately 105-acre property for the purpose of subdividing the property and constructing single-family residential homes. Site improvements will consist of cuts of approximately 14 feet and fills of approximately 22 feet, stormwater infiltration facilities, asphalt concrete access roads, and underground utility lines. This investigation will not provide assessments of individual residential lots.

2 SITE CONDITIONS

2.1 Surface Description

The site can generally be described as a polygon. The longer, eastern margin is oriented north-south and is relatively straight, while the western margin is shorter, with concave sides. It is bordered to the east by Kendall Road, to the south by Cottonwood Road, to the southwest by Powerline Road, to the west by residential properties, and to the north by farmland and adjoining residential properties. The site is located on gently rolling hills and currently used for farming. Review of available topographic data indicate the site slopes down to the west, with ground surface elevations ranging from a maximum of approximately 1020 feet above mean sea level (amsl) at the eastern portion of the site to 970 feet amsl in the northern and western portions of the site (NAVD88; USGS, 2018). Outside of the site, the ground surface follows the same general rolling topography, with higher elevations to the east and lower elevations to the west before reaching shallow drainages near the city limits of Walla Walla, Washington.

2.2 Geologic Setting

The site is located along the southern margin of the Columbia Basin, a geologic province of Eastern Washington that is separated from the Deschutes-Columbia Plateau and Blue Mountains Provinces of Oregon. The province is composed primarily of volcanic basement rocks of the Columbia River Basalt Group (CRBG) subdivided into smaller recognizable flows and members that are overlain by Quaternary deposits (Derkey et al., 2006). The older basalt flows were generated by volcanic eruptions between 16.7 million years ago (Ma) and 5.5 Ma from fissures located in eastern Oregon, eastern Washington, and western Idaho.

The Pasco-Walla Walla (PWW) basin is structurally controlled by strike-slip faulting with relative down drop and upthrown blocks leading the basin to become one of the lowest points within the greater Columbia Basin (Derkey et al., 2006). Other structural features that influence the sedimentation in the PWW Basin include the Horse Heaven Anticline and the Wallula Fault Zone (Schuster, 1994). As Tertiary volcanic rocks of the CRBG were uplifted and deformed, near the present-day Washington-Oregon border, they produced Horse Heaven Hills that formed the southwestern margin of the PWW Basin. Incision of the ancestral Columbia River continued through this gradual uplift.

Horse Heaven Hills played a significant role in sediment deposition during the Late Pleistocene cataclysmic Missoula glacial outburst flooding events. Meltwater form Glacial Lake Missoula was released in the late Pleistocene and rushed across eastern Washington until reaching the water gap of Horse Heaven Hills. Here, floodwaters became backed up against the southwestern boundary of the PWW basin before draining into the Columbia River Gorge. Slack water deposits of fine-grained material are widespread in the PWW basin and greater Columbia Basin.

The site is underlain by windblown loess. These deposits are categorized as silt, fine-grained sand, and clay capable of being mobilized up eolian forces after deposition of fine-grained material within low-lying areas and after the draining of the PWW basin via the Columbia River Gorge. Other unconsolidated Quaternary alluvium of sand, silt, clay, and gravel can be encountered in small stream and creek channels on at the site. The site is underlain at depth by Miocene age Frenchman Springs Member of the Wanapum Basalt, a subdivided basalt flow of the CRBG. One Quaternary fault is identified approximately 4.5 kilometers east of the site as the northeast trending Buroker fault (USGS No. 578a).

2.3 Subsurface Conditions

The site was explored by excavating 30 test pits, designated TP-1 through TP-30, to depths of 11.5 to 16.5 feet bgs. The excavation was performed by Braden and Nelson, Inc., of Walla Walla, Washington, using a track-mounted Cat 314 excavator and 42-inch toothed bucket.

PBS has summarized the subsurface units as follows:

TILL ZONE (ML):	Dark brown silt with fine roots was encountered from the ground surface to between 1 and 3 feet bgs in all test pits.
SILT WITH SAND (ML):	Silt with sand was encountered in all test pits below the till zone. It was generally medium stiff to very stiff, dark brown to light brown, exhibited no to low plasticity, contained fine-grained sand and calcite stringers, and produced a vigorous chemical reaction when introduced to hydrochloric acid below approximately 4 feet bgs.
SILTY SAND (SM):	Silty sand was encountered in test pits TP-9 between 4 to 8 feet bgs, TP-16 between 9 to 12 feet bgs, and TP-20 between 10 to 11.5 feet bgs. This material was dark brown to light brown, non-plastic, fine- to medium-grained sand, with some calcite stringers in TP-16 and -20.
LEAN CLAY (CL):	Lean clay was encountered in TP-11 from a depth of 14 to 16 feet bgs. This material was brown to gray, moist, exhibited medium plasticity, and had oxidation features.
GRAVELLY SILT WITH SAND (ML):	Silt with varying amounts of sand and gravel was encountered in test pit TP-2 at 12 feet bgs, TP-8 at 16 feet bgs, TP-11 at 16 feet bgs, TP-14 at 8.5 feet bgs, and TP-21 at 9 feet bgs, to termination depth in these test pits. The material was light brown to dark brown, moist to wet, contained fine- to coarse-grained sand, and fine- to coarse-grained subrounded gravel, and low to medium plasticity fines.
ASH:	Ash was encountered in test pit TP-18 from 6.5 to 8 feet bgs and within limited lenses in other test pits throughout the site. It was white, dry to moist, exhibited no plasticity, and contained fine-grained sand.

2.4 Groundwater

Limited groundwater seepage was encountered during our explorations in TP-11 and TP-28 at approximately 12 and 11.5 feet bgs, respectively. Based on a review of regional groundwater logs available from the Washington State Department of Ecology, we anticipate that the static groundwater level is present at a depth greater than 50 feet bgs. Please note that groundwater levels can fluctuate during the year depending on climate, irrigation season, extended periods of precipitation, drought, and other factors.

2.5 Infiltration Testing

PBS completed four open-hole, falling head infiltration tests in test pits TP-2, TP-5, TP-23, and TP-28, at depths of approximately 5 feet bgs. The infiltration tests were conducted in general accordance with the Stormwater Management Manual for Eastern Washington procedures. The test pits were excavated and filled with approximately 2 to 3.5 feet of water. After a period of saturation, the water level was then measured initially and at regular, timed intervals. Results of our field infiltration testing are presented in Table 1.

Table 1. Infiltration Test Results

Test Location	Depth (feet bgs)	Field Measured Infiltration Rate (in/hr)	Soil Classification
TP-2	5.5	1	SILT with sand (ML)
TP-5	5.5	2	SILT with sand (ML)
TP-23	5.3	1.5	SILT with sand (ML)
TP-28	5	2.5	SILT with sand (ML)

The infiltration rates listed in Table 1 are not permeabilities/hydraulic conductivities, but field-measured rates, and do not include correction factors related to long-term infiltration rates. The design engineer should determine the appropriate correction factors to account for the planned level of pre-treatment, maintenance, vegetation, siltation, etc. Field-measured infiltration rates are typically reduced by a minimum factor of 2 to 4 for use in design.

Soil types can vary significantly over relatively short distances. The infiltration rates noted above are representative of one discrete location and depth. Installation of infiltration systems within the layer the field rate was measured is considered critical to proper performance of the systems.

3 CONCLUSIONS AND RECOMMENDATIONS

3.1 Geotechnical Design Considerations

This report was prepared to address design and construction for site grading and infrastructure and is not intended for use in development of individual lots or residential foundations.

Subsurface conditions at the site consist of silt with variable amounts of sand. Based on our observations and analyses, conventional foundation support on shallow spread footings is feasible for the proposed residential structures. Excavation with conventional equipment is feasible at the site.

Preliminary grading plans include cuts of up to approximately 14 feet and fills of up to approximately 22 feet. Once completed, proposed site grading should be reviewed for conformance with the geotechnical-related recommendations and updated recommendations provided, as necessary.

3.2 Seismic Design Considerations

3.2.1 Code-Based Seismic Design Parameters

According to the Site Class Map of Benton County, Washington (Palmer, 2004), the site is located within an area classified as Site Class D, characterizing the profile as stiff soil. Based on subsurface conditions encountered in our explorations combined with DCP blow counts, Site Class D is appropriate for use in design. The seismic design criteria, in accordance with the 2015 International Building Code IBC with state of Washington amendments, are summarized in Table 2.

Table 2. 2015 IBC Seismic Design Parameters

Parameter	Short Period	1 Second
Maximum Credible Earthquake Spectral Acceleration	S_s = 0.83 g	S_1 = 0.35 g
Site Class	D	
Site Coefficient	F_a = 1.17	F_v = 1.69
Adjusted Spectral Acceleration	S_{MS} = 0.97 g	S_{M1} = 0.60 g
Design Spectral Response Acceleration Parameters	S_{DS} = 0.65 g	S_{D1} = 0.40 g

g= Acceleration due to gravity

3.2.2 Liquefaction Potential

Liquefaction is defined as a decrease in the shear resistance of loose, saturated, cohesionless soil (e.g., sand) or low plasticity silt soils, due to the buildup of excess pore pressures generated during an earthquake. This results in a temporary transformation of the soil deposit into a viscous fluid. Liquefaction can result in ground settlement, foundation bearing capacity failure, and lateral spreading of ground.

Based on a review of the *Washington Division of Geology and Earth Resources website,* the site is shown as having a low to moderate liquefaction hazard. However, based on the soil types, relative density of site soils encountered in our explorations, and depth to groundwater, our current opinion is that the risk of structurally damaging liquefaction settlement at the site is low. Subsequently, the risk of structurally damaging lateral spreading is also low.

3.3 Ground Moisture

The perimeter ground surface and hard-scape should be sloped to drain away from all structures and away from adjacent slopes. Gutters should be tight-lined to a suitable discharge and maintained as free-flowing. All crawl spaces should be adequately ventilated and sloped to drain to a suitable, exterior discharge.

3.4 Recommended Pavement Sections

The provided pavement recommendations were developed based on our experience with similar developments and reference the associated Washington Department of Transportation (WSDOT) specifications for construction.

The minimum recommended pavement section thicknesses are provided in Table 3. Depending on weather conditions at the time of construction, a thicker aggregate base course section could be required to support construction traffic during preparation and placement of the pavement section.

Table 3. Minimum AC Pavement Sections

Traffic Loading	AC (inches)	Base Course (inches)	Subgrade
Drive Lanes and Access Roads	3	9	Stiff subgrade as verified by PBS personnel*

* Subgrade must pass proofroll

The asphalt cement binder should be selected following WSDOT SS 9-02.1(4) – Performance Graded Asphalt Binder. The AC should consist of ½-inch hot mix asphalt (HMA) with a maximum lift thickness of 3 inches. The AC should conform to WSDOT SS 5-04.3(7)A – Mix Design, WSDOT SS 9-03.8(2) – HMA Test Requirements, and WSDOT SS 9-03.8(6) – HMA Proportions of Materials. The AC should be compacted to 91 percent of the maximum theoretical density (Rice value) of the mix, as determined in accordance with ASTM D2041, following the guidelines set in WSDOT SS 5-04.3(10) – Compaction.

Heavy construction traffic on new pavements or partial pavement sections (such as base course over the prepared subgrade) will likely exceed the design loads and could potentially damage or shorten the pavement life; therefore, we recommend construction traffic not be allowed on new pavements, or that the contractor take appropriate precautions to protect the subgrade and pavement during construction.

If construction traffic is to be allowed on newly constructed road sections, an allowance for this additional traffic will need to be made in the design pavement section.

4 CONSTRUCTION RECOMMENDATIONS

4.1 Site Preparation

Construction of the proposed development will involve clearing and grubbing of the existing vegetation or demolition of possible existing structures. Underground utility lines or other abandoned structural elements should also be removed. The voids resulting from removal of foundations or loose soil in utility lines should be backfilled with compacted structural fill. The base of these excavations should be excavated to firm native subgrade before filling, with sides sloped at a minimum of 1H:1V (horizontal to vertical) to allow for uniform compaction. Materials generated during demolition should be transported off site or stockpiled in areas designated by the owner's representative. Till zone soils should be scarified and recompacted as structural fill or removed from beneath fill areas.

4.1.1 Proofrolling/Subgrade Verification

Following site preparation and prior to placing aggregate base over shallow foundation, floor slab, and pavement subgrades, the exposed subgrade should be evaluated either by proofrolling or another method of subgrade verification. The subgrade should be proofrolled with a fully loaded dump truck or similar heavy, rubber-tire construction equipment to identify unsuitable areas. If evaluation of the subgrades occurs during wet conditions, or if proofrolling the subgrades will result in disturbance, they should be evaluated by PBS using a steel foundation probe. We recommend that PBS be retained to observe the proofrolling and perform the subgrade verifications. Unsuitable areas identified during the field evaluation should be compacted to a firm condition or be excavated and replaced with structural fill.

4.1.2 Wet/Freezing Weather and Wet Soil Conditions

Due to the presence of fine-grained silt and sands in the near-surface materials at the site, construction equipment may have difficulty operating on the near-surface soils when the moisture content of the surface soil is more than a few percentage points above the optimum moisture required for compaction. Soils

disturbed during site preparation activities, or unsuitable areas identified during proofrolling or probing, should be removed and replaced with compacted structural fill.

Site earthwork and subgrade preparation should not be completed during freezing conditions, except for mass excavation to the subgrade design elevations. We recommend the earthwork construction at the site be performed during the dry season.

Protection of the subgrade is the responsibility of the contractor. Construction of granular haul roads to the project site entrance may help reduce further damage to the pavement and disturbance of site soils. The actual thickness of haul roads and staging areas should be based on the contractors' approach to site development, and the amount and type of construction traffic. The imported granular material should be placed in one lift over the prepared undisturbed subgrade and compacted using a smooth-drum, non-vibratory roller. A geotextile fabric should be used to separate the subgrade from the imported granular material in areas of repeated construction traffic. Depending on site conditions, the geotextile should meet Washington State Department of Transportation (WSDOT) SS 9-33.2 – Geosynthetic Properties for soil separation or stabilization. The geotextile should be installed in conformance with WSDOT SS 2-12.3 – Construction Geosynthetic (Construction Requirements) and, as applicable, WSDOT SS 2-12.3(2) – Separation or WSDOT SS 2-12.3(3) – Stabilization.

4.1.3 Erosion Protection

Site soils are easily eroded by wind and water. Therefore, erosion control measures should be planned and in place prior to construction, with native vegetation left in place outside the grading limits. Erosion protection should be provided in accordance with Walla Walla County standards. Erosion can be reduced with the use of silt fences, hay bales, and zones of natural growth. Additionally, cut and fill slopes should be protected immediately upon completion. All stormwater should be tight-lined to suitable discharges such as approved, protected outlets and infiltration systems.

4.1.4 Slopes

All temporary cut slopes should be excavated with a smooth bucket excavator with the surface repaired if disturbed. In addition, upslope surface runoff should be rerouted so that it does not run down the face of the slopes. Equipment should not be allowed to induce vibration or infiltrate water above the slopes, and no surcharges are allowed within 25 feet of the slope crest.

Permanent cut slopes up to 14 feet high can be inclined at 2H:1V in the medium stiff or better silt. The presence of slow seepage may require use of a rock blanket or a suitably revegetated reinforced erosion control blanket. Seepage may also require additional erosion control measures, such as additional drainage elements, and/or flatter slopes, and PBS should be consulted. Exposed soils that are soft or loose may also require such measures. Erosion control is critical to maintaining slopes.

Permanent fill slopes up to 22 feet high can be inclined at 2H:1V in on-site structural fill. The slope should be over-built, slightly steeper than the design slope inclination with the slope cut back into to compacted structural fill at the design slope inclination. Fill slopes should be protected as described for cut slopes

4.2 Excavation

The near-surface soils at the site can be excavated with conventional earthwork equipment. Sloughing and caving should be anticipated. All excavations should be made in accordance with applicable Occupational Safety and Health Administration (OSHA) and state regulations. The contractor is solely responsible for adherence to the OSHA requirements. Trench cuts should stand relatively vertical to a depth of approximately

4 feet bgs, provided no groundwater seepage is present in the trench walls. Open excavation techniques may be used provided the excavation is configured in accordance with the OSHA requirements, groundwater seepage is not present, and with the understanding that some sloughing may occur. Trenches/excavations should be flattened if sloughing occurs or seepage is present. Use of a trench shield or other approved temporary shoring is recommended if vertical walls are desired for cuts deeper than 4 feet bgs. If dewatering is used, we recommend that the type and design of the dewatering system be the responsibility of the contractor, who is in the best position to choose systems that fit the overall plan of operation.

4.3 Structural Fill

Currently proposed site grading may include cuts of up to 14 feet and fills of up to 22 feet within the proposed site. Structural fill should be placed over subgrade that has been prepared in conformance with the Site Preparation and Wet/Freezing Weather and Wet Soil Conditions sections of this report. Structural fill material should consist of relatively well-graded soil, or an approved rock product that is free of organic material and debris, and contains particles not greater than 4 inches nominal dimension.

The suitability of soil for use as compacted structural fill will depend on the gradation and moisture content of the soil when it is placed. As the amount of fines (material finer than the US Standard No. 200 Sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and compaction becomes more difficult to achieve. Soils containing more than about 5 percent fines cannot consistently be compacted to a dense, non-yielding condition when the water content is significantly greater (or significantly less) than optimum.

If fill and excavated material will be placed on slopes steeper than 5H:1V, these must be keyed/benched into the existing slopes and installed in horizontal lifts. Vertical steps between benches should be approximately 2 feet.

4.3.1 On-Site Soil

On-site soils encountered in our explorations are generally suitable for placement as structural fill during moderate, dry weather when moisture content can be maintained by air drying and/or addition of water. The fine-grained fraction of the site soils are moisture sensitive, and during wet weather, may become unworkable because of excess moisture content. In order to reduce moisture content, some aerating and drying of fine-grained soils may be required. The material should be placed in lifts with a maximum uncompacted thickness of approximately 8 inches and compacted to at least 92 percent of the maximum dry density, as determined by ASTM D1557 (modified proctor).

The till zone soils should be scarified and recompacted as required for structural fill.

4.3.2 Imported Granular Materials

Imported granular material used during periods of wet weather or for haul roads, building pad subgrades, staging areas, etc., should be pit or quarry run rock, crushed rock, or crushed gravel and sand, and should meet the specifications provided in WSDOT SS 9-03.14(2) – Select Borrow. In addition, the imported granular material should be fairly well graded between coarse and fine, and of the fraction passing the US Standard No. 4 Sieve, less than 5 percent by dry weight should pass the US Standard No. 200 Sieve.

Imported granular material should be placed in lifts with a maximum uncompacted thickness of 9 inches and be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557.

4.3.3 Base Aggregate

Base aggregate for floor slabs and beneath pavements should be clean crushed rock or crushed gravel. The base aggregate should contain no deleterious materials, meet specifications provided in WSDOT SS 9-03.9(3) – Crushed Surfacing Base Course, and have less than 5 percent (by dry weight) passing the US Standard No. 200 Sieve. The imported granular material should be placed in one lift and compacted to at least 95 percent of the maximum dry density, as determined by ASTM D1557.

4.3.4 Foundation Base Aggregate

Imported granular material placed at the base of excavations for spread footings, slabs-on-grade, and other below-grade structures should be clean, crushed rock or crushed gravel, and sand that is fairly well graded between coarse and fine. The granular materials should contain no deleterious materials, have a maximum particle size of 1½ inch, and meet WSDOT SS 9-03.12(1)A – Gravel Backfill for Foundations (Class A). The imported granular material should be placed in one lift and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557.

4.3.5 Trench Backfill

Trench backfill placed beneath, adjacent to, and for at least 2 feet above utility lines (i.e., the pipe zone) should consist of well-graded granular material with a maximum particle size of 1 inch and less than 10 percent by dry weight passing the US Standard No. 200 Sieve, and should meet the standards prescribed by WSDOT SS 9-03.12(3) – Gravel Backfill for Pipe Zone Bedding. The pipe zone backfill should be compacted to at least 90 percent of the maximum dry density as determined by ASTM D1557, or as required by the pipe manufacturer or local building department.

Within pavement areas or beneath building pads, the remainder of the trench backfill should consist of well-graded granular material with a maximum particle size of 1½ inches, less than 10 percent by dry weight passing the US Standard No. 200 Sieve, and should meet standards prescribed by WSDOT SS 9-03.19 – Bank Run Gravel for Trench Backfill. This material should be compacted to at least 92 percent of the maximum dry density, as determined by ASTM D1557, or as required by the pipe manufacturer or local building department. The upper 2 feet of the trench backfill should be compacted to at least 95 percent of the maximum dry density, as determined by ASTM D1557.

Outside of structural improvement areas (e.g., roadway alignments or building pads), trench backfill placed above the pipe zone should consist of excavated material free of wood waste, debris, clods, or rocks greater than 6 inches in diameter and meet WSDOT SS 9-03.14 – Borrow and WSDOT SS 9-03.15 – Native Material for Trench Backfill. This general trench backfill should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D1557, or as required by the pipe manufacturer or local building department.

4.3.6 Stabilization Material

Stabilization rock should consist of pit or quarry run rock that is well-graded, angular, crushed rock consisting of 4- or 6-inch-minus material with less than 5 percent passing the US Standard No. 4 Sieve. The material should be free of organic matter and other deleterious material. WSDOT SS 9-13.1(5) – Quarry Spalls can be used as a general specification for this material with the stipulation of limiting the maximum size to 6 inches.

5 ADDITIONAL SERVICES AND CONSTRUCTION OBSERVATIONS

In most cases, other services beyond completion of a final geotechnical engineering report are necessary or desirable to complete the project. Occasionally, conditions or circumstances arise that require additional work that was not anticipated when the geotechnical report was written. PBS offers a range of environmental, geological, geotechnical, and construction services to suit the varying needs of our clients.

PBS should be retained to review the plans and specifications for this project before they are finalized. Such a review allows us to verify that our recommendations and concerns have been adequately addressed in the design.

Satisfactory earthwork performance depends on the quality of construction. Sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. We recommend that PBS be retained to observe general excavation, stripping, fill placement, footing subgrades, and/or pile installation. Subsurface conditions observed during construction should be compared with those encountered during the subsurface explorations. Recognition of changed conditions requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those anticipated.

6 LIMITATIONS

This report has been prepared for the exclusive use of the addressee, and their architects and engineers, for aiding in the design and construction of the proposed development and is not to be relied upon by other parties. It is not to be photographed, photocopied, or similarly reproduced, in total or in part, without express written consent of the client and PBS. It is the addressee's responsibility to provide this report to the appropriate design professionals, building officials, and contractors to ensure correct implementation of the recommendations.

The opinions, comments, and conclusions presented in this report are based upon information derived from our literature review, field explorations, laboratory testing, and engineering analyses. It is possible that soil, rock, or groundwater conditions could vary between or beyond the points explored. If soil, rock, or groundwater conditions are encountered during construction that differ from those described herein, the client is responsible for ensuring that PBS is notified immediately so that we may reevaluate the recommendations of this report.

Unanticipated fill, soil and rock conditions, and seasonal soil moisture and groundwater variations are commonly encountered and cannot be fully determined by merely taking soil samples or completing explorations such as test pits. Such variations may result in changes to our recommendations and may require additional funds for expenses to attain a properly constructed project; therefore, we recommend a contingency fund to accommodate such potential extra costs.

The scope of work for this subsurface exploration and geotechnical report did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous substances in the soil, surface water, or groundwater at this site.

If there is a substantial lapse of time between the submission of this report and the start of work at the site, if conditions have changed due to natural causes or construction operations at or adjacent to the site, or if the basic project scheme is significantly modified from that assumed, this report should be reviewed to determine the applicability of the conclusions and recommendations presented herein. Land use, site conditions (both on and off site), or other factors may change over time and could materially affect our findings; therefore, this report should not be relied upon after three years from its issue, or in the event that the site conditions change.

7 REFERENCES

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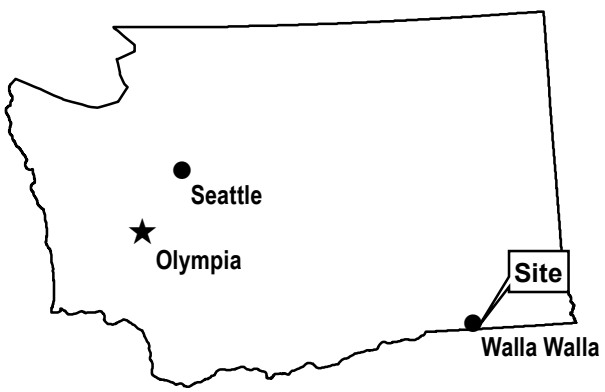
Figures



VICINITY MAP

COTTONWOOD RESIDENTIAL DEVELOPMENT
WALLA WALLA, WASHINGTON

DATE: APR 2019 · PROJECT: HDJ4203.000

PBS

FIGURE
1

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EXPLANATION

- TP-1 - Test pit name and approximate location
- TP-2 - Test pit name and approximate location with infiltration test
- Approximate property boundary

1 inch = 300 feet

0 150 300 Feet 600

SOURCES: ESRI World Imagery Basemap

SITE PLAN

COTTONWOOD RESIDENTIAL DEVELOPMENT
WALLA WALLA, WASHINGTON

DATE:APR 2019 · PROJECT: HDJ4203.000

PBS

FIGURE 2

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Appendix A
Field Explorations

Appendix A: Field Explorations

A1 GENERAL

PBS explored subsurface conditions at the project site by excavating 30 test pits to depths of up to approximately 16.5 feet bgs on February 25, 27, and March 1, 2019. The approximate locations of the explorations are shown on Figure 2, Site Plan. The procedures used to advance the test pits, collect samples, and other field techniques are described in detail in the following paragraphs. Unless otherwise noted, all soil sampling and classification procedures followed engineering practices in general accordance with relevant ASTM procedures. "General accordance" means that certain local drilling/excavation and descriptive practices and methodologies have been followed.

A2 TEST PITS

A2.1 Excavation

Test pits were excavated using a CAT 314 excavator equipped with a 42-inch toothed bucket provided and operated by Braden and Nelson, Inc., of Walla Walla, Washington. The test pits were observed by a member of the PBS geotechnical staff, who maintained a detailed log of the subsurface conditions and materials encountered during the course of the work.

A2.2 Sampling

Representative disturbed samples were taken at selected depths in the test pits. The disturbed soil samples were examined by a member of the PBS geotechnical staff and sealed in plastic bags for further examination.

A2.3 Test Pit Logs

The test pit logs show the various types of materials that were encountered in the excavations and the depths where the materials and/or characteristics of these materials changed, although the changes may be gradual. Where material types and descriptions changed between samples, the contacts were interpreted. The types of samples taken during excavation, along with their sample identification number, are shown to the right of the classification of materials. The natural water (moisture) contents are shown farther to the right. Measured seepage levels, if observed, are noted in the column to the right.

A3 MATERIAL DESCRIPTION

Initially, samples were classified visually in the field. Consistency, color, relative moisture, degree of plasticity, and other distinguishing characteristics of the soil samples were noted. Afterward, the samples were reexamined in the PBS laboratory, various standard classification tests were conducted, and the field classifications were modified where necessary. The terminology used in the soil classifications and other modifiers are defined in Table A-1, Terminology Used to Describe Soil.

Table A-1
Terminology Used to Describe Soil

Soil Descriptions

Soils exist in mixtures with varying proportions of components. The predominant soil, i.e., greater than 50 percent based on total dry weight, is the primary soil type and is capitalized in our log descriptions (SAND, GRAVEL, SILT, or CLAY). Smaller percentages of other constituents in the soil mixture are indicated by use of modifier words in general accordance with the ASTM D2488-06 Visual-Manual Procedure. "General Accordance" means that certain local and common descriptive practices may have been followed. In accordance with ASTM D2488-06, group symbols (such as GP or CH) are applied on the portion of soil passing the 3-inch (75mm) sieve based on visual examination. The following describes the use of soil names and modifying terms used to describe fine- and coarse-grained soils.

Fine-Grained Soils (50% or greater fines passing 0.075 mm, No. 200 sieve)
The primary soil type, i.e., SILT or CLAY is designated through visual-manual procedures to evaluate soil toughness, dilatency, dry strength, and plasticity. The following outlines the terminology used to describe fine-grained soils, and varies from ASTM D2488 terminology in the use of some common terms.

Primary soil NAME, Symbols, and Adjectives			Plasticity Description	Plasticity Index (PI)
SILT (ML & MH)	**CLAY (CL & CH)**	**ORGANIC SOIL (OL & OH)**		
SILT		Organic SILT	Non-plastic	0 – 3
SILT		Organic SILT	Low plasticity	4 – 10
SILT/Elastic SILT	Lean CLAY	Organic SILT/ Organic CLAY	Medium Plasticity	10 – 20
Elastic SILT	Lean/Fat CLAY	Organic CLAY	High Plasticity	20 – 40
Elastic SILT	Fat CLAY	Organic CLAY	Very Plastic	>40

Modifying terms describing secondary constituents, estimated to 5 percent increments, are applied as follows:

Description	% Composition	
With Sand	% Sand ≥ % Gravel	15% to 25% plus No. 200
With Gravel	% Sand < % Gravel	
Sandy	% Sand ≥ % Gravel	≤30% to 50% plus No. 200
Gravelly	% Sand < % Gravel	

Borderline Symbols, for example CH/MH, are used when soils are not distinctly in one category or when variable soil units contain more than one soil type. **Dual Symbols,** for example CL-ML, are used when two symbols are required in accordance with ASTM D2488.

Soil Consistency terms are applied to fine-grained, plastic soils (i.e., PI ≥ 7). Descriptive terms are based on direct measure or correlation to the Standard Penetration Test N-value as determined by ASTM D1586-84, as follows. SILT soils with low to non-plastic behavior (i.e., PI < 7) may be classified using relative density.

Consistency Term	SPT N-value	Unconfined Compressive Strength	
		tsf	kPa
Very soft	Less than 2	Less than 0.25	Less than 24
Soft	2 – 4	0.25 – 0.5	24 – 48
Medium stiff	5 – 8	0.5 – 1.0	48 – 96
Stiff	9 – 15	1.0 – 2.0	96 – 192
Very stiff	16 – 30	2.0 – 4.0	192 – 383
Hard	Over 30	Over 4.0	Over 383

Soil Descriptions

Coarse - Grained Soils (less than 50% fines)

Coarse-grained soil descriptions, i.e., SAND or GRAVEL, are based on the portion of materials passing a 3-inch (75mm) sieve. Coarse-grained soil group symbols are applied in accordance with ASTM D2488-06 based on the degree of grading, or distribution of grain sizes of the soil. For example, well-graded sand containing a wide range of grain sizes is designated SW; poorly graded gravel, GP, contains high percentages of only certain grain sizes. Terms applied to grain sizes follow.

Material NAME	Particle Diameter	
	Inches	Millimeters
SAND (SW or SP)	0.003 – 0.19	0.075 – 4.8
GRAVEL (GW or GP)	0.19 – 3	4.8 – 75
Additional Constituents:		
Cobble	3 – 12	75 – 300
Boulder	12 – 120	300 – 3050

The primary soil type is capitalized, and the fines content in the soil are described as indicated by the following examples. Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 percent. Other soil mixtures will have similar descriptive names.

Example: Coarse-Grained Soil Descriptions with Fines

>5% to < 15% fines (Dual Symbols)	≥15% to < 50% fines
Well graded GRAVEL with silt: GW-GM	Silty GRAVEL: GM
Poorly graded SAND with clay: SP-SC	Silty SAND: SM

Additional descriptive terminology applied to coarse-grained soils follow.

Example: Coarse-Grained Soil Descriptions with Other Coarse-Grained Constituents

Coarse-Grained Soil Containing Secondary Constituents	
With sand or with gravel	≥ 15% sand or gravel
With cobbles; with boulders	Any amount of cobbles or boulders.

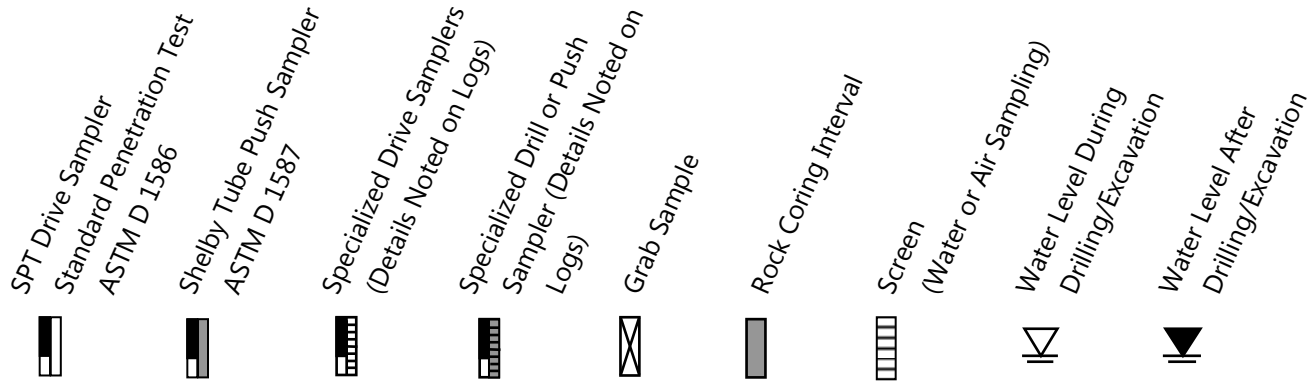
Cobble and boulder deposits may include a description of the matrix soils, as defined above.

Relative Density terms are applied to granular, non-plastic soils based on direct measure or correlation to the Standard Penetration Test N-value as determined by ASTM D1586-84.

Relative Density Term	SPT N-value
Very loose	0 – 4
Loose	5 – 10
Medium dense	11 – 30
Dense	31 – 50
Very dense	> 50

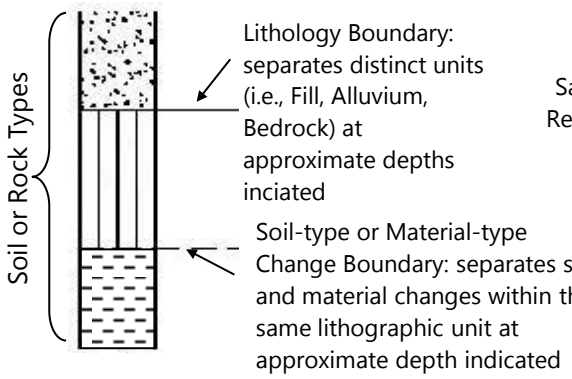
Table A-2
Key To Test Pit and Boring Log Symbols

SAMPLING DESCRIPTIONS

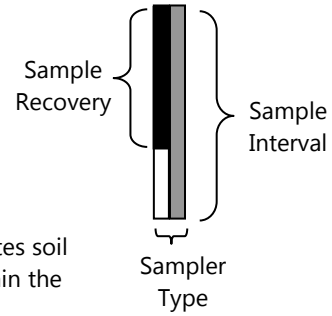


LOG GRAPHICS

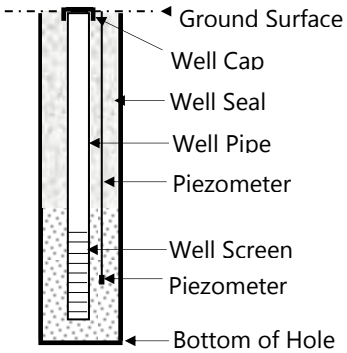
Soil and Rock



Sampling Symbols



Instrumentation Detail



Geotechnical Testing Acronym Explanations

PP	Pocket Penetrometer	HYD	Hydrometer Gradation
TOR	Torvane	SIEV	Sieve Gradation
DCP	Dynamic Cone Penetrometer	DS	Direct Shear
ATT	Atterberg Limits	DD	Dry Density
PL	Plasticity Limit	CBR	California Bearing Ratio
LL	Liquid Limit	RES	Resilient Modulus
PI	Plasticity Index	VS	Vane Shear
P200	Percent Passing US Standard No. 200 Sieve	bgs	Below ground surface
OC	Organic Content	MSL	Mean Sea Level
CON	Consolidation	HCL	Hydrochloric Acid
UC	Unconfined Compressive Strength		

Details of soil and rock classification systems are available on request.

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

PBS PROJECT NUMBER:
HDJ4203.000

TEST PIT TP-1

APPROX. TEST PIT TP-1 LOCATION:
(See Site Plan)

Lat: 46.026282 Long: -118.31048

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER / STATIC PENETROMETER / MOISTURE CONTENT % (0 50 100)	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
			1.5				
2.0		Stiff, dark brown SILT (ML) with sand; non-plastic; fine sand; dry		PP	S-1		PP = 1.25 tsf
4.0		becomes light brown; strong HCl reaction		PP	S-2		PP = 1.5 tsf
6.0							
8.0							
10.0							
		becomes olive-brown		PP	S-3		PP = 2 tsf
12.0		Final depth 12.0 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	12.0				
14.0							
16.0							
18.0							
20.0							

LOGGED BY: C. Grant
COMPLETED: 2/25/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A1
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-2

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-2 LOCATION:
(See Site Plan)

Lat: 46.026927 Long: -118.310178

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER / STATIC PENETROMETER / MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	0.0				Surface Conditions: Wheat Field
		TILL ZONE; dark brown SILT (ML) with roots and root fragments					
2.0				PP	S-1		PP = 1.25 tsf
		Stiff, dark brown SILT (ML) with sand ;low plasticity; fine sand; moist	2.5				
4.0		becomes very stiff, brown		P200 PP	S-2	●	P200 = 82% PP = 2.25 tsf Infiltration testing completed at 5.5 feet bgs
6.0		white disseminated ash to 12 feet bgs					
8.0							
10.0							
12.0		Brown, gravelly SILT (ML) with cobbles; low plasticity; coarse, subrounded gravel; trace limonite staining; dry	12.0		S-3		
14.0		Brown, poorly graded SAND (SP-SM) with silt, gravel, and cobbles; non-plastic; fine to medium sand; coarse, subrounded gravel; dry	14.0				
16.0		Final depth 16.0 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	16.0				
18.0							
20.0							

LOGGED BY: D. Ertel
COMPLETED: 2/25/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A2
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-3

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-3 LOCATION:
(See Site Plan)

Lat: 46.027131 Long: -118.310878

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER STATIC PENETROMETER MOISTURE CONTENT %	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
			1.5				
2.0		Stiff, dark brown SILT (ML) with sand; non-plastic; fine sand; dry		PP	S-1		PP = 1.5 tsf
4.0		becomes light brown		PP	S-2		PP = 1.5 tsf
6.0							
8.0							
10.0		thin (<1mm), interbedded ash lenses becomes pale brown; strong HCl reaction					
12.0			12.0		S-3		
		Final depth 12.0 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.					
14.0							
16.0							
18.0							
20.0						0 50 100	

LOGGED BY: C. Grant
COMPLETED: 2/25/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A3
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-4

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-4 LOCATION:
(See Site Plan)

Lat: 46.026864 Long: -118.31179

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER STATIC PENETROMETER MOISTURE CONTENT %	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
2.0		Stiff, dark brown SILT (ML) with sand; non-plastic; fine sand; dry	2.0	PP	S-1		PP = 1.75 tsf
4.0		becomes light brown		PP	S-2		PP = 1.5 tsf
6.0							
8.0							
10.0		thin (<1mm to 10mm), interbedded ash lenses becomes light olive brown; low plasticity; fine to medium sand			S-3		
12.0		Final depth 12.0 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	12.0				
14.0							
16.0							
18.0							
20.0							

0 50 100

LOGGED BY: C. Grant
COMPLETED: 2/25/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A4
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS DATATMPL GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-5

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-5 LOCATION:
(See Site Plan)

Lat: 46.026464 Long: -118.313295

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER STATIC PENETROMETER MOISTURE CONTENT % (0 50 100)	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
2.0		Very stiff, dark brown SILT (ML) with sand; non-plastic; fine sand; dry	2.3	PP	S-1		PP = 1.25 tsf
4.0		becomes light brown		P200 PP	S-2	●	P200 = 78% PP = 3.5 tsf Infiltration testing completed at 5.5 feet bgs
6.0							
8.0							
10.0							
11.5		Final depth 11.5 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.			S-3		
12.0							
14.0							
16.0							
18.0							
20.0							

LOGGED BY: C. Grant
COMPLETED: 2/25/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A5
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-6

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-6 LOCATION:
(See Site Plan)

Lat: 46.027315 Long: -118.313238

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER STATIC PENETROMETER MOISTURE CONTENT % (0 50 100)	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
2.0				PP	S-1		PP = 3.75 tsf
		Very stiff, dark brown SILT (ML) with sand; non-plastic; fine sand; dry	2.5				
4.0		becomes light brown, with thin (<1mm) ash lenses		PP	S-2		PP = 2.0 tsf
6.0					S-3		
8.0							
10.0		thin (<1mm), interbedded ash lenses					
12.0		becomes pale brown, with oxidized/stained pore spaces, calcareous veins			S-4		
					S-5		
		Final depth 13.0 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	13.0				Slight caving at 13 feet
14.0							
16.0							
18.0							
20.0							

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COMPLETED: 2/25/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A6
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL.GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-7

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-7 LOCATION:
(See Site Plan)

Lat: 46.027817 Long: -118.31448

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER STATIC PENETROMETER MOISTURE CONTENT % (0 50 100)	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
2.0				PP	S-1		PP = 3.0 tsf
		Very stiff, dark brown SILT (ML); non-plastic; dry	2.8				
4.0		becomes stiff, light brown		PP	S-2		PP = 2.0 tsf
		thin (<1mm), interbedded ash lenses to ~6 feet bgs					
6.0							
8.0							
10.0							
		becomes brown, with oxidation/staining; fine to medium sand					
12.0					S-3		
		Final depth 12.5 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	12.5				
14.0							
16.0							
18.0							
20.0							

LOGGED BY: C. Grant
COMPLETED: 2/27/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A7
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-8

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-8 LOCATION:
(See Site Plan)

Lat: 46.02854 Long: -118.315577

DEPTH FEET	MATERIAL DESCRIPTION	DEPTH	TESTING	SAMPLE TYPE / SAMPLE ID	COMMENTS
0.0	TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0			Surface Conditions: Wheat Field
2.0	Very stiff, dark brown SILT (ML) with sand; non-plastic; fine sand; dry	1.8	PP	S-1	PP = 3.0 tsf
4.0	becomes stiff, light brown to gray; with ash to 11 feet bgs		PP	S-2	PP = 1.25 tsf
6.0				S-3	
8.0					
10.0	becomes brown, with gray clay nodules; low plasticity; small (<1mm) vesicles			S-4	
12.0				S-5	
14.0	becomes dark brown, with oxidation/staining; moist			S-6	
16.0	Dark brown, gravelly SILT (ML) with sand; low to medium plasticity; fine to coarse sand; fine to coarse, subrounded gravel; moist	16.0		S-7	
18.0	Final depth 16.5 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	16.5			
20.0					

GRAPHIC LOG

DYNAMIC CONE PENETROMETER
STATIC PENETROMETER
MOISTURE CONTENT %
0 50 100

Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.

LOGGED BY: C. Grant
COMPLETED: 2/27/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A8
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

PBS PROJECT NUMBER:
HDJ4203.000

TEST PIT TP-9

APPROX. TEST PIT TP-9 LOCATION:
(See Site Plan)

Lat: 46.029152 Long: -118.316474

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER / STATIC PENETROMETER / MOISTURE CONTENT % (0 50 100)	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
			1.5	PP	S-1		PP = 3.0 tsf
2.0		Very stiff, dark brown SILT (ML) with sand; non-plastic; fine sand; dry					
4.0		Dark brown, silty SAND (SM) with ash; non-plastic; fine sand; calcite stringers; strong HCL reaction; dry	4.0		S-2		
6.0							
8.0		Dark brown, sandy SILT (ML); non-plastic; fine sand; dry	8.0				
10.0							
12.0		Dark brown SILT (ML); low plasticity; moist	12.0	P200	S-3	●	P200 = 92%
		Final depth 12.5 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	12.5				
14.0							
16.0							
18.0							
20.0							

LOGGED BY: C. Grant
COMPLETED: 2/27/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A9
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-10

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-10 LOCATION:
(See Site Plan)

Lat: 46.028714 Long: -118.317249

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER STATIC PENETROMETER MOISTURE CONTENT %	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
2.0				PP	S-1		PP = 1.75 tsf
		Stiff, dark brown SILT (ML) with sand; non-plastic; fine to medium sand; trace roots; dry	2.5				
4.0		becomes brown to light brown; one cobble encountered		PP	S-2		PP = 1.0 tsf
6.0							
8.0							
10.0							
		small (<1mm) vesicles; calcite stringers; strong HCL reaction					
12.0					S-3		
		Final depth 12.5 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	12.5				
14.0							
16.0							
18.0							
20.0							

0 50 100

LOGGED BY: C. Grant
COMPLETED: 2/27/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A10
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-11

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-11 LOCATION:
(See Site Plan)

Lat: 46.029653 Long: -118.317072

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER STATIC PENETROMETER MOISTURE CONTENT %	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
		Dark brown, silty SAND (SM); non-plastic; fine to medium sand; dry	1.5		S-1		
2.0							
4.0		Stiff, brown SILT (ML) with sand, ash, and gray clay nodules; non-plastic; fine sand; dry	4.0	PP	S-2		PP = 1.5 tsf
6.0							
8.0							
10.0		becomes dark brown; low plasticity; moist			S-3		
12.0							Caving from 12 to 16 feet bgs
14.0		Brown-gray, lean CLAY (CL) with oxidation/staining; medium plasticity; wet	14.0				∿ 02/27/19 Seepage at 14 to 16 feet bgs
16.0		Dark brown, gravelly SILT (ML) with sand; low to medium plasticity; fine to coarse sand; fine to coarse, subrounded gravel; moist	16.0 16.5		S-4		
18.0		Final depth 16.5 feet bgs; test pit backfilled with excavated material to existing ground surface.					
20.0							

LOGGED BY: C. Grant
COMPLETED: 2/27/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A11
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-12

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-12 LOCATION:
(See Site Plan)

Lat: 46.030026 Long: -118.315404

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER STATIC PENETROMETER MOISTURE CONTENT %	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
2.0				PP	S-1		PP = 1.5 tsf
		Stiff, brown to light brown SILT (ML) with sand; non-plastic; fine to medium sand; calcite stringers; strong HCL reaction; dry	3.0				
4.0				PP	S-2		PP = 1.5 tsf
6.0							
8.0							
10.0							
					S-3		
12.0		Final depth 12.0 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	12.0				
14.0							
16.0							
18.0							
20.0							

0 50 100

0 50 100

LOGGED BY: C. Grant
COMPLETED: 2/27/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A12
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-13

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-13 LOCATION:
(See Site Plan)

Lat: 46.02888 Long: -118.314192

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH	TESTING	SAMPLE TYPE / SAMPLE ID	DYNAMIC CONE PENETROMETER / STATIC PENETROMETER / MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	0.0				Surface Conditions: Wheat Field
		TILL ZONE; dark brown SILT (ML) with roots and root fragments					
2.0				PP	S-1		PP = 1.25 tsf
		Stiff, light brown SILT (ML) with sand; non-plastic; fine to medium sand; calcite stringers; strong HCL reaction; dry	2.5				
4.0				PP	S-2		PP = 1.75 tsf
6.0		calcite stringers					
8.0							
10.0							
12.0					S-3		
		Final depth 12.0 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	12.0				
14.0							
16.0							
18.0							
20.0							

LOGGED BY: C. Grant
COMPLETED: 2/27/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A13
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-14

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-14 LOCATION:
(See Site Plan)

Lat: 46.029218 Long: -118.313054

DEPTH FEET	MATERIAL DESCRIPTION	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	COMMENTS
0.0	TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0			Surface Conditions: Wheat Field
2.0			P200 PP	S-1	P200 = 79% PP = 1.25 tsf
	Stiff, brown SILT (ML) with sand; non-plastic; fine sand; dry	3.0			
4.0			PP	S-2	PP = 2.0 tsf
6.0	calcite stringers				
8.0		8.5			
10.0	Light brown SILT (ML) with sand, gravel, and cobbles; non-plastic; fine to medium sand; fine, subrounded gravel; calcite stringers; strong HCL reaction; dry			S-3	
12.0	Final depth 11.5 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	11.5			
14.0					
16.0					
18.0					
20.0					

GRAPHIC LOG

DYNAMIC CONE PENETROMETER
STATIC PENETROMETER
MOISTURE CONTENT %
0 50 100

Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.

LOGGED BY: C. Grant
COMPLETED: 2/27/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A14
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-15

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-15 LOCATION:
(See Site Plan)

Lat: 46.028088 Long: -118.311411

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE / SAMPLE ID	DYNAMIC CONE PENETROMETER / STATIC PENETROMETER / MOISTURE CONTENT % (0 50 100)	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
		Medium stiff, dark brown SILT (ML) with sand; low plasticity; fine sand; moist	1.0				
2.0				PP	S-1		PP = 0.75 tsf
4.0		becomes stiff, light brown; non-plastic; calcite stringers; dry		PP	S-2		PP = 1.5 tsf
6.0							
8.0							
10.0		becomes brown					
12.0		Final depth 12.0 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	12.0		S-3		
14.0							
16.0							
18.0							
20.0							

LOGGED BY: D. Ertel
COMPLETED: 2/25/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A15
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-16

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-16 LOCATION:
(See Site Plan)

Lat: 46.027876 Long: -118.309916

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER / STATIC PENETROMETER / MOISTURE CONTENT % (0 50 100)	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
2.0				PP	S-1		PP = 1.25 tsf
		Stiff, dark brown SILT (ML) with sand; non-plastic; fine sand; dry	3.0				
4.0		becomes brown		PP	S-2		PP = 1.25 tsf
6.0							
8.0							
		Yellow-brown with gray mottles, silty SAND (SM); non-plastic; fine to medium sand; calcite stringers; dry	9.0				
10.0							
12.0			12.0		S-3		
		Final depth 12.0 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.					
14.0							
16.0							
18.0							
20.0							

LOGGED BY: D. Ertel
COMPLETED: 2/25/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A16
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-17

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-17 LOCATION:
(See Site Plan)

Lat: 46.028948 Long: -118.310639

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH	TESTING	SAMPLE TYPE / SAMPLE ID	DYNAMIC CONE PENETROMETER / STATIC PENETROMETER / MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.					Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
2.0				PP	S-1		PP = 1.25 tsf
		Stiff, brown SILT (ML) with sand; non-plastic; fine to medium sand; calcite stringers; strong HCL reaction; dry	2.5				
4.0				PP	S-2		PP = 1.25 tsf
6.0							
8.0							
10.0							
		becomes light brown; with fine sand			S-3		
12.0			12.0				
		Final depth 12.0 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.					
14.0							
16.0							
18.0							
20.0							

LOGGED BY: C. Grant
COMPLETED: 2/27/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A17
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-18

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-18 LOCATION:
(See Site Plan)

Lat: 46.029663 Long: -118.310504

DEPTH FEET	MATERIAL DESCRIPTION (Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.)	DEPTH	TESTING	SAMPLE TYPE / SAMPLE ID	COMMENTS
0.0	TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0			Surface Conditions: Wheat Field
		1.5			
2.0	Stiff, light brown SILT (ML) with sand; non-plastic; fine sand; calcite stringers; vesicles; strong HCL reaction; dry		PP	S-1	PP = 2.0 tsf
4.0			PP	S-2	PP = 2.0 tsf
6.0		6.5			
	White ASH with sand; non-plastic; fine sand; dry			S-3	
8.0		8.0			
	Brown SILT (ML) with sand; non-plastic; fine sand; calcite stringers; vesicles; strong HCL reaction; dry			S-4	
10.0					
12.0					
14.0	with fine to medium sand			S-5	
16.0	Final depth 16.0 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	16.0			
18.0					
20.0					

GRAPHIC LOG

DYNAMIC CONE PENETROMETER
STATIC PENETROMETER
MOISTURE CONTENT %
0 50 100

LOGGED BY: C. Grant
COMPLETED: 3/01/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A18
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-19

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-19 LOCATION:
(See Site Plan)

Lat: 46.03054 Long: -118.311054

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER STATIC PENETROMETER MOISTURE CONTENT %	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0			0 50 100	
2.0				PP	S-1		PP = 1.25 tsf
		Stiff, brown SILT (ML) with sand; non-plastic; fine sand; dry	2.5				
4.0		with calcite stringers; vesicles		PP	S-2		PP = 1.75 tsf
6.0							
8.0		with fine to medium sand					
10.0							
12.0		Final depth 12.0 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	12.0		S-3		
14.0							
16.0							
18.0							
20.0						0 50 100	

LOGGED BY: C. Grant
COMPLETED: 3/01/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A19
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-20

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-20 LOCATION:
(See Site Plan)

Lat: 46.030802 Long: -118.312327

DEPTH FEET	MATERIAL DESCRIPTION	DEPTH	TESTING	SAMPLE TYPE / SAMPLE ID	COMMENTS
0.0	TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0			Surface Conditions: Wheat Field
2.0		2.5	PP	S-1	PP = 2.0 tsf
	Stiff to very stiff, brown SILT (ML) with sand; non-plastic; fine to medium sand; dry				
4.0			P200 PP	S-2	P200 = 72% PP = 2.25 tsf
6.0	with calcite stringers; vesicles				
8.0					
10.0	Light brown, silty SAND (SM); non-plastic; fine to medium sand; calcite stringers; vesicles; dry	10.0		S-3	
12.0	Final depth 11.5 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	11.5			
14.0					
16.0					
18.0					
20.0					

GRAPHIC LOG

DYNAMIC CONE PENETROMETER
STATIC PENETROMETER
MOISTURE CONTENT %
0 50 100

Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.

LOGGED BY: C. Grant
COMPLETED: 3/01/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A20
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-21

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-21 LOCATION:
(See Site Plan)

Lat: 46.030829 Long: -118.313863

DEPTH FEET	MATERIAL DESCRIPTION	DEPTH	TESTING	SAMPLE TYPE / SAMPLE ID	COMMENTS
0.0	TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0			Surface Conditions: Wheat Field
2.0		2.5	PP	S-1	PP = 1.25 tsf
	Stiff, dark brown SILT (ML) with sand; non-plastic; fine sand; dry				
4.0	becomes light brown; with calcite stringers		PP	S-2	PP = 1.25 tsf
6.0					
8.0					
	Light brown, sandy SILT (ML) with gravel and cobbles; non-plastic; fine to medium sand; fine, subrounded to rounded gravel; calcite stringers; strong HCl reaction; dry	9.0			
10.0				S-3	
	Final depth 11.5 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	11.5			
12.0					
14.0					
16.0					
18.0					
20.0					

GRAPHIC LOG

SAMPLE TYPE / SAMPLE ID

◆ DYNAMIC CONE PENETROMETER
⊠ STATIC PENETROMETER
● MOISTURE CONTENT %

0 50 100

LOGGED BY: C. Grant
COMPLETED: 2/27/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A21
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-22

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-22 LOCATION:
(See Site Plan)

Lat: 46.031265 Long: -118.310826

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER STATIC PENETROMETER MOISTURE CONTENT %	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
2.0				PP	S-1		PP = 1.0 tsf
		Very stiff, brown SILT (ML) with sand; non-plastic; fine to medium sand; calcite stringers; vesicles; strong HCL reaction; dry	3.0				
4.0				PP	S-2		PP = 2.5 tsf
6.0							
8.0							
10.0							
		increased sand			S-3		
		Final depth 11.5 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	11.5				
12.0							
14.0							
16.0							
18.0							
20.0							

0 50 100

LOGGED BY: C. Grant
COMPLETED: 3/01/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A22
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

PBS PROJECT NUMBER:
HDJ4203.000

TEST PIT TP-23

APPROX. TEST PIT TP-23 LOCATION:
(See Site Plan)

Lat: 46.031767 Long: -118.309887

DEPTH FEET	MATERIAL DESCRIPTION	DEPTH	TESTING	SAMPLE TYPE / SAMPLE ID	COMMENTS
0.0	TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0			Surface Conditions: Wheat Field
2.0	Stiff, brown SILT (ML); non-plastic; dry	1.5	PP	S-1	PP = 1.5 tsf
4.0	Stiff, light brown SILT (ML) with sand; non-plastic; fine to medium sand; calcite stringers; vesicles; strong HCL reaction; dry	4.0	P200 PP	S-2	P200 = 78% PP = 1.0 tsf Infiltration testing completed at 5.5 feet bgs
10.0				S-3	
12.0	Final depth 11.0 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	11.0			
20.0					

GRAPHIC LOG

DYNAMIC CONE PENETROMETER
STATIC PENETROMETER
MOISTURE CONTENT %
0 50 100

LOGGED BY: C. Grant
COMPLETED: 3/01/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A23
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-24

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-24 LOCATION:
(See Site Plan)

Lat: 46.033491 Long: -118.310195

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER STATIC PENETROMETER MOISTURE CONTENT %	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
2.0				PP	S-1		PP = 1.25 tsf
		Stiff, dark brown SILT (ML) with sand; non-plastic; fine sand; dry	2.5				
4.0		becomes light brown; with fine to medium sand		PP	S-2		PP = 1.75 tsf
6.0							
8.0		with calcite stringers; vesicles; strong HCL reaction					
10.0							
12.0		Final depth 12.0 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	12.0		S-3		
14.0							
16.0							
18.0							
20.0						0 50 100	

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EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A24
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TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-25

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-25 LOCATION:
(See Site Plan)

Lat: 46.034389 Long: -118.310209

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER / STATIC PENETROMETER / MOISTURE CONTENT % (0 50 100)	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
2.0				PP	S-1		PP = 1.25 tsf
		Stiff, dark brown SILT (ML) with sand; non-plastic; fine to medium sand; dry	2.5				
4.0				PP	S-2		PP = 1.5 tsf
		becomes light brown; with calcite stringers, vesicles					
6.0							
8.0							
10.0							
				P200	S-3		P200 = 87%
12.0		Final depth 11.5 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	11.5				
14.0							
16.0							
18.0							
20.0							

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COMPLETED: 3/01/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A25
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS DATATMPL GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-26

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-26 LOCATION:
(See Site Plan)

Lat: 46.034347 Long: -118.311362

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER STATIC PENETROMETER MOISTURE CONTENT %	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
2.0				PP	S-1		PP = 1.25 tsf
		Stiff, dark brown SILT (ML); non-plastic; dry	2.5				
4.0		Very stiff, light brown SILT (ML) with sand; non-plastic; fine to medium sand; calcite stringers; vesicles; strong HCL reaction; dry	4.0	PP	S-2		PP = 2.75 tsf
6.0							
8.0							
10.0							
					S-3		
		Final depth 11.5 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	11.5				
12.0							
14.0							
16.0							
18.0							
20.0						0 50 100	

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COMPLETED: 3/01/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A26
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TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

PBS PROJECT NUMBER:
HDJ4203.000

TEST PIT TP-27

APPROX. TEST PIT TP-27 LOCATION:
(See Site Plan)

Lat: 46.033895 Long: -118.312842

DEPTH FEET	MATERIAL DESCRIPTION	DEPTH	TESTING	SAMPLE TYPE / SAMPLE ID	COMMENTS
0.0	TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0			Surface Conditions: Wheat Field
2.0		2.5	PP	S-1	PP = 1.5 tsf
4.0	Hard, dark brown SILT (ML) with sand; non-plastic; fine sand; dry	4.5	PP	S-2	PP = 4.5 tsf
6.0	Light brown, sandy SILT (ML); non-plastic; fine to coarse sand; calcite stringers; vesicles; strong HCL reaction; dry			S-3	
8.0					
10.0					
12.0		12.5			
14.0	Final depth 12.5 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.				
16.0					
18.0					
20.0					

SAMPLE TYPE / SAMPLE ID: ◆ DYNAMIC CONE PENETROMETER; ⊠ STATIC PENETROMETER; ● MOISTURE CONTENT %

MOISTURE CONTENT % scale: 0 50 100

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COMPLETED: 3/01/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A27
Page 1 of 1

TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-28

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-28 LOCATION:
(See Site Plan)

Lat: 46.033719 Long: -118.315281

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER STATIC PENETROMETER MOISTURE CONTENT %	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
2.0					S-1		
		Stiff, dark brown SILT (ML) with sand; non-plastic; fine sand; dry	2.5				
4.0				P200 PP	S-2		P200 = 82% PP = 1.0 tsf Infiltration testing completed at 5 feet bgs
		becomes brown					
6.0							
		becomes gray			S-3		
8.0							
		becomes dark brown, with clay nodules; wet					
10.0							Seepage at 11.5 feet bgs; caving from 11 to 12 feet bgs
12.0		Final depth 12.0 feet bgs; test pit backfilled with excavated material to existing ground surface.	12.0		S-4		∿ 03/01/19
14.0							
16.0							
18.0							
20.0							

0 50 100

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EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A28
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TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-29

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-29 LOCATION:
(See Site Plan)

Lat: 46.033315 Long: -118.313575

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER STATIC PENETROMETER MOISTURE CONTENT %	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
2.0				PP	S-1		PP = 1.5 tsf
		Stiff, brown SILT (ML) with sand; non-plastic; fine to medium sand; dry	2.5				
4.0		becomes hard, light brown; with calcite stringers, vesicles, strong HCL reaction		PP	S-2		PP = 4.5 tsf
6.0							
8.0							
10.0							
12.0		Final depth 12.0 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.	12.0		S-3		
14.0							
16.0							
18.0							
20.0							

0 50 100

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COMPLETED: 3/01/19

EXCAVATED BY: Braden and Nelson, Inc.
EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A29
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TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

TEST PIT TP-30

PBS PROJECT NUMBER:
HDJ4203.000

APPROX. TEST PIT TP-30 LOCATION:
(See Site Plan)

Lat: 46.032942 Long: -118.312139

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.	DEPTH	TESTING	SAMPLE TYPE SAMPLE ID	DYNAMIC CONE PENETROMETER STATIC PENETROMETER MOISTURE CONTENT %	COMMENTS Surface Conditions: Wheat Field
0.0		TILL ZONE; dark brown SILT (ML) with roots and root fragments	0.0				
2.0				P200 PP	S-1	●	P200 = 78% PP = 1.5 tsf
		Stiff, light brown SILT (ML) with sand; non-plastic; fine sand; calcite stringers; vesicles; dry	2.5				
4.0				PP	S-2		PP = 3.0 tsf
6.0		becomes brown; fine to medium sand; strong HCL reaction clay nodules from 7 to 9 feet					
8.0							
10.0							
12.0			12.0		S-3		
		Final depth 12.0 feet bgs; test pit backfilled with excavated material to existing ground surface. Groundwater not encountered at time of exploration.					
14.0							
16.0							
18.0							
20.0						0 50 100	

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EXCAVATION METHOD: CAT 314 with 42" Bucket

FIGURE A30
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TEST PIT LOG - 1 PER PAGE HDJ4203.000 TP1-30 20190311.GPJ PBS_DATATMPL_GEO.GDT PRINT DATE: 3/28/19 RPG

Appendix B
Laboratory Testing

Appendix B: Laboratory Testing

B1 GENERAL

Samples obtained during the field explorations were examined in the PBS laboratory. The physical characteristics of the samples were noted and field classifications were modified where necessary. During the course of examination, representative samples were selected for further testing. The testing program for the soil samples included standard classification tests, which yield certain index properties of the soils important to an evaluation of soil behavior. The testing procedures are described in the following paragraphs. Unless noted otherwise, all test procedures are in general accordance with applicable ASTM standards. "General accordance" means that certain local and common descriptive practices and methodologies have been followed.

B2 CLASSIFICATION TESTS

B2.1 Visual Classification

The soils were classified in accordance with the Unified Soil Classification System with certain other terminology, such as the relative density or consistency of the soil deposits, in general accordance with engineering practice. In determining the soil type (that is, gravel, sand, silt, or clay) the term that best described the major portion of the sample is used. Modifying terminology to further describe the samples is defined in Table A-1, Terminology Used to Describe Soil, in Appendix A.

B2.2 Moisture (Water) Contents

Natural moisture content determinations were made on samples of the fine-grained soils (that is, silts, clays, and silty sands). The natural moisture content is defined as the ratio of the weight of water to dry weight of soil, expressed as a percentage. The results of the moisture content determinations are presented on the logs of the borings in Appendix A and on Figure B1, Summary of Laboratory Data, in Appendix B.

B2.3 Grain-Size Analyses (P200 Wash)

Washed sieve analyses (P200) were completed on samples to determine the portion of soil samples passing the No. 200 Sieve (i.e., silt and clay). The results of the P200 test results are presented on the exploration logs in Appendix A and on Figure B1, Summary of Laboratory Data, in Appendix B.

SUMMARY OF LABORATORY DATA

HAYDEN HOMES - COTTONWOOD
WALLA WALLA, WASHINGTON

PBS PROJECT NUMBER:
HDJ4203.000

SAMPLE INFORMATION				MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT (PERCENT)	PLASTIC LIMIT (PERCENT)	PLASTICITY INDEX (PERCENT)
TP-2	S-2	4.5		20.3				82			
TP-5	S-2	4.5		14.4				78			
TP-9	S-3	12		29.3				92			
TP-14	S-1	2		19.4				79			
TP-20	S-2	4.5		15.0				72			
TP-23	S-2	4		16.1				78			
TP-25	S-3	11		16.7				87			
TP-28	S-2	4		47.9				82			
TP-30	S-1	2		20.0				78			

FIGURE B1
Page 1 of 1