Northern, Inc.

Consulting Engineers Environmental Scientists Geologists
Construction Materials Testing Geophysical Services

GEOTECHNICAL SITE INVESTIGATION REPORT

ROAD & STORMWATER IMPROVEMENTS
PORT OF PASCO - BIG PASCO INDUSTRIAL CENTER
PASCO, WASHINGTON

PORT OF PASCO

GNN PROJECT NO. 219-1119

MAY 2020

Prepared for

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At GN Northern our mission is to serve our clients in the most efficient, cost effective way using the best resources and tools available while maintaining professionalism on every level. Our philosophy is to satisfy our clients through hard work, dedication and extraordinary efforts from all of our valued employees working as an extension of the design and construction team.

May 20, 2020

MacKay & Sposito, Inc.
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Attention: Paul Harmsen, PE, MacKay & Sposito, Inc.

Subject: Geotechnical Site Investigation Report
Road & Stormwater Improvements
Port of Pasco - Big Pasco Industrial Center
Pasco, Washington

GNN Project No. 219-1119

Gentlemen,

As requested, GN Northern (GNN) has completed a geotechnical site investigation for the proposed road and stormwater improvements to be constructed at the Port of Pasco's Big Pasco Industrial Center in the City of Pasco, Washington.

Based on the findings of our evaluation, we conclude that the site is suitable for the proposed improvements provided that the geotechnical recommendations presented in this report are followed during the design and construction phases of the project.

This report describes in detail the results of our investigation, summarizes our findings and presents our recommendations concerning the proposed improvements to the existing pavements and stormwater management facilities. It is important that GN Northern provide consultation during the design phase, as well as field compaction testing and geotechnical monitoring services during the construction phase, to review and monitor the implementation of the geotechnical recommendations.

If you have any questions regarding this report, please contact us at 509-734-9320.

Respectfully submitted,
GN Northern, Inc.

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1.0 PURPOSE AND SCOPE OF SERVICES

This geotechnical site investigation report has been prepared for the proposed roadway and stormwater disposal facility improvements to be constructed at the Port of Pasco's Big Pasco Industrial Center (BPIC) in the City of Pasco, Washington; site location is shown on the *Vicinity Map* (Figure 1, Appendix I). Our investigation was conducted to collect information regarding subsurface soil and groundwater conditions, and present findings and recommendations for suitability of the subsurface materials to support the planned site improvement, along with appropriate mitigation measures to address potential adverse geotechnical conditions.

GN Northern, Inc. has prepared this report for use by the client and their design consultants in the design of the proposed project site improvement. Do not use or rely upon this report for other locations or purposes without the written consent of GN Northern, Inc.

Our study was conducted in general accordance with the Section 6.0, *Geotechnical Engineering,* of the *Scope of Work* document (Exhibit A) of the Master Subcontract Agreement (MSI Project #17240 – Road and Storm at Big Pasco), prepared by MacKay Sposito. Our understanding of the proposed project was based on communication between our office, MacKay Sposito, and representatives of the Port of Pasco (Port); notice to proceed was provided in the form of a fully executed Master Subcontract Agreement (MSI Project #17240 – Road and Storm at Big Pasco) issued by MacKay Sposito on June 21, 2019. A copy of the *Grant Request Locational Drawings* (Sheets G-01 to G-02 & C-01 to C-23, dated August 22, 2018) prepared by the Port, showing areas of proposed improvements at the Big Pasco Industrial Center, was provided for our use by MacKay Sposito via email on March 22, 2019.

Field exploration, consisting of twenty-eight (28) pavement cores, fifteen (15) borings, five (5) test-pits, and eighteen (18) infiltration tests, along with the installation of three (3) groundwater monitoring wells within the boreholes, was completed at the project site between July 30th and August 5th, 2019. The exploration and testing locations are shown on Figures 2A-2C, 3A-3C & 4A-4N (Appendix I). Detailed boring, test-pit and infiltration test logs are presented in Appendix II, and results of our laboratory testing are presented in Appendix III. Photographs of the site and our exploration are presented in Appendix IV, along with photographs of the asphalt cores in Appendix V.

As part of this study, we performed a detailed desktop study to review available information related to the Big Pasco Industrial Center (BPIC). Results of the field exploration and laboratory testing were analyzed to develop recommendations for the proposed roadway pavement and stormwater management facilities improvements. To assess potential groundwater impacts as it relates to stormwater design, we have identified areas of the BPIC that may be impacted by relatively shallow groundwater conditions, as well as analyze the effects of groundwater mounding beneath proposed infiltration facilities. This report has been prepared to summarize the data obtained during this study and to present our recommendations based on the proposed improvements and the subsurface conditions encountered at the site to support the project civil design. Design parameters and a discussion of the geotechnical engineering considerations related to the proposed improvements are included.

2.0 PROPOSED IMPROVEMENTS

We understand that the Port was successful in obtaining a grant from the Economic Development Administration (EDA) to construct site improvements at the Big Pasco Industrial Center (BPIC) located in the City of Pasco, Washington. The primary components of the proposed improvements project will include repairing and reconstructing roadway pavement surfaces along with the construction of new stormwater management facilities throughout the BPIC site. Portions of roadways evaluated as part of this study included E. Warehouse Street, E. Ainsworth Avenue, E. Cargo Street, SE Road 18, SE Road 21, Avenue C, SE Road 33, SE Road 36, as shown in the following excerpt from the EDA Grant Drawings:

Design of proposed stormwater management facilities improvements for the project have not been finalized at the time of this report. We understand that initial conceptual plans generally call for dividing portions of the project site into various distinct drainage basins that would each drain into infiltration trenches of various lengths and widths.

3.0 FIELD EXPLORATION & LABORATORY TESTING

Prior to conducting field investigation activities, GNN personnel completed a project site walk-through with representatives of MacKay Sposito and the Port on July 23, 2019 to coordinate and pre-mark the proposed points of exploration. Our field exploration activities at the Big Pasco Industrial Center project site were completed between July 30th and August 5th, 2019. A local public utility clearance was obtained prior to the field exploration. Exploration and testing activities performed at the site included twenty-eight (28) pavement cores, fifteen (15) exploratory borings, five (5) exploratory test-pits, and eighteen (18) infiltration tests, along with the installation of three (3) groundwater monitoring wells within the boreholes.

The exploratory test-pits were excavated by Big D's Construction using a John Deere 50G Mini-excavator to depths ranging from approximately 7 to 10 feet below existing ground surface (BGS). Borings were drilled by Johnson Exploration Drilling using a Mobile B-53 drill rig utilizing 8-inch outside diameter hollow stem augers (HSA) to depths of approximately 6.5 to 16.5 feet. The exploratory test-pits and borings were logged by a GNN field engineer.

Following completion of three (3) selected exploratory borings (B-3, B-7 & B-12), groundwater monitoring wells were constructed in general accordance with WA DOE guidelines extending to depths of approximately 14 to 15 feet BGS with the intent of intercepting the anticipated range of fluctuating groundwater levels. Test-pit excavations were loosely backfilled with the excavated spoils upon completion. Locations of the pavement cores, test-pits, borings/monitoring wells, and infiltration tests are shown on Figures 2A-2C, 3A-3C & 4A-4N (Appendix I).

The soils observed during our field exploration were classified according to the Unified Soil Classification System (USCS), utilizing the field classification procedures as outlined in ASTM D2488. A copy of the USCS Classification Chart is included in Appendix II. Photographs of the site and exploration are presented in Appendix IV. Depths referred to in this report are relative to

the existing ground surface elevation at the time of our investigation. The surface and subsurface conditions described in this report are as observed at the time of our field investigation.

Representative samples of the subsurface soils obtained from the field exploration were selected for testing to determine the index properties of the soils in general accordance with ASTM procedures. The following laboratory tests were performed:

Table 1: Laboratory Tests Performed

Test	To determine
Particle Size Distribution (ASTM D6913)	Soil classification based on proportion of sand, silt, and clay-sized particles
Natural Moisture Content (ASTM D2216)	Soil moisture content indicative of in-situ condition at the time samples were taken
Cation Exchange Capacity (EPA 9081)	Relative ability of soils to store one particular group of nutrients, the cations

Results of the laboratory tests are included on the boring, test-pit and infiltration test logs and are also presented in graphic form in Appendix III.

4.0 SITE CONDITIONS

The approximate 400-acre Big Pasco Industrial Center (BPIC) project site is located along the northeast shoreline of the Lake Wallula reservoir on the Columbia River in the City of Pasco, Washington. The large site is situated in portions of Section 32, 33, & 34, Township 9 North and Range 30 East, as well as portions of Section 3 & 4, Township 8 North and Range 30 East, Willamette Meridian. The BPIC facility is generally bound to the east by Sacajawea State Park, to the south by Lake Wallula, to west by S. Oregon Avenue, and to the north by the Burlington Northern railroad tracks.

We understand that the facility was originally developed by the US Army Corps of Engineers during World War II and was later purchased by the Port in 1958. Existing facilities at the BPIC include eight (8) 160,000 square foot warehouses, each separated into three or four bays. The facility includes four primary northwest-southeast aligned parallel roads, including E. Warehouse Street, E. Ainsworth Avenue, E. Cargo Street, and E. Dock Street, from north to south. Cross streets include SE Road 18, SE Road 21, Avenue C, SE Road 27, SE Road 30, SE Road 33, and SE Road 36 from west to east.

The BPIC site has been historically graded with cuts and fills. It is presumed that cuts from the northern portion, particularly across the BNSF rail yard, were likely placed as fill in the southern portions. Based on a review of Google Earth topography that uses USGS elevation data, it appears that surface grades are typically higher in the north/northwestern potion at elevation ±366', generally descending toward the east t elevation ±347'. Google Earth elevations appear to be higher than the local vertical elevation data on the order of approximately 4 feet.

5.0 EXISTING PAVEMENT SECTIONS & SURFACE CONDITIONS

Existing pavement conditions and structural sections were observed to vary significantly throughout the BPIC facility. While some selected areas were noted to have recently been paved with new asphalt, several areas revealed significant degradation, cracking and surface weathering. Our exploration of existing pavements included twenty-eight (28) 6-inch diameter core holes. Thickness of the asphaltic concrete section, as well as the crushed rock base course, was observed and recorded at each location. The AC core samples obtained were secured and returned to our laboratory for additional review and documentation. The thickness of the as-built asphalt layers was noted to vary significantly from approximately 1 to 6 inches. Thickness of the base course layers commonly ranged from 1 to 3 inches, with some selected areas noted with up to approximately 6 inches. The locations of the exploratory test cores are shown on Figures 2A-2C & 4A-4N (Appendix I). The core holes were backfilled and restored with a quick-setting concrete mix. The following table provides core hole locations along with the existing pavement section data acquired at each location:

Table 2: Pavement Sections & Subgrade

Core#	Road	Pavement Section		Subbase Material
		Asphalt	Base Course	
1	E Ainsworth St.	5.3"	2"	Silty Sand with Gravel (SM)
2	SE Road 18	5.8"	2"	Silty Sand with Gravel (SM)
3	SE Road 18	4.5" (*)	3"	Sand with Gravel (SP)
4	SE Road 18	2"	3"	Silty Sand with Gravel (SM)
5	E Warehouse St.	3.5"	3"	Silty Sand with Gravel (SM)
6	E Cargo St.	3.5"	3"	Sand with Gravel (SP)
7	E Ainsworth St.	3"	6"	Silty Sand with Gravel (SM)
8	E Warehouse St.	3.25"	2"	Silty Sand (SM)
9	SE Road 21	2"	3"	Silty Sand (SM)
10	SE Road 21	3.75"	4"	Silty Sand (SM)
11	E Cargo St.	4"	2"	Sand with Gravel (SP)

12	E Cargo St.	3.4"	2"	Sand with Gravel (SP)
13	Avenue C	3"	2"	Sand with Gravel (SP)
14	Avenue C	3.75"	2"	Sand with Gravel (SP)
15	E Ainsworth St.	3"	2"	Sand with Gravel (SP)
16	Avenue C	3.5"	(**)	Sand with Gravel (SP)
17	E Warehouse St.	3.5"	1"	Silt with Gravel (ML)
18	E Cargo St.	1.25"	2"	Sand with Gravel (SP)
19	E Ainsworth St.	4.9"	1"	Sand with Gravel (SP)
20	E Warehouse St.	2.2"	1"	Silt with Gravel (ML)
21	E Warehouse St.	3.25"	1"	Sand (SP)
22	E Warehouse St.	3"	6"	Silty Sand with Gravel (SM)
23	E Warehouse St.	3.4"	1"	Sand with Silt (SP-SM)
24	E Warehouse St.	2"	3"	Silty Sand with Gravel (SM)
25	E Warehouse St.	3.8"	3"	Sand with Silt (SP-SM)
26	SE Road 36	5"	3"	Silty Sand with Gravel (SM)
27	SE Road 36	1"	3"	Sand with Gravel (SP)
28	SE Road 36	2.2"	3"	Silty Sand with Gravel (SM)

(*) Combined thickness of upper and lower layers of asphalt; (**) No base course material encountered

6.0 REGIONAL & LOCAL GEOLOGIC CONDITIONS

The City of Pasco lies in the Yakima Fold Belt region of the Columbia Plateau, a broad plain situated between the Cascade Range to the west and the Rocky Mountains to the east. The Columbia Plateau was formed by a thick sequence of Miocene-Age Tholeiitic basalt flows, called the Columbia River Basalt Group (CRBG) that erupted from fissures in north-central and northeastern Oregon, eastern Washington, and western Idaho. The Columbia Plateau is often called the Columbia Basin because it forms a broad lowland surrounded by mountains. The Columbia River Basalt Group is underlain by continental sedimentary rocks from earlier in the Tertiary Period. In the project area, the uppermost layers of the CRBG are fractured bedrock of the Saddle Mountain Basalt formation. The Pliocene-Age lower Ringold formation sediments, primarily composed of silt and clay, are known to locally overlie the Saddle Mountain Basalt.

Overlying sediments in the project site area consist of localized areas of Quaternary alluvium and a sequence of Pleistocene-age flood deposits, locally identified as Pasco Gravels. These deposits generally consist of boulder and cobble to granule-sized basaltic gravel, with lesser deposits of sand, silt, and non-basaltic gravel. Surficial deposits consist of Plio-Pleistocene loess, silt and fine-grained sand. Based on the *Geologic Map of the Richland 1:100,000 Quadrangle, Washington* (Reidel, 1994), surface geology is mapped as Quaternary alluvium [Qa] deposited by the Columbia

River across the majority of the site, with Quaternary outburst flood deposits, gravel [Qfg(4)] of glacial Lake Missoula (a.k.a. Pasco Gravels of the Hanford Formation) along the northern end.

7.0 SUBSURFACE SOIL CONDITIONS

Our understanding of the subsurface soil conditions is based on the results of our site-specific exploration through borings and test-pits, along with a review of selected geotechnical investigations previously completed by others. In general, subsurface soils across the BPIC consist of near-surface fine-grained alluvial sand and silt typically underlain by flood-gravels and sands locally known as Pasco Gravels.

Due to historic grading and previous development across the BPIC, majority of the site is mantled with a relatively thin layer of artificial fill soils. In general, fill soils consisted of a mix of onsite silty sands and gravels that appear to have been locally derived from the cut areas across the north side of the BPIC, as well as imported crushed aggregate beneath existing pavements and as surfacing gravel. Some evidence of miscellaneous wood and metal debris was noted in isolated areas. Depth of these fill soils typically ranged from less than 6 inches to approximately 2 feet BGS. Slightly deeper fills, to approximately 3 to 3.5 feet BGS, were noted in test-pit TP-4 where an abandoned buried storm drain was encountered.

Native near-surface soils predominantly consisted of fine-grained Silty Sand (SM) across the majority of the western three-quarters of the project area. Test-pit TP-1 near the northwest corner of the project did not encounter these near-surface sands, likely due to historic cut grading in this area. These silty sand soils were typically noted to exhibit ‘loose’ to ‘medium dense’ relative in-place density based on SPT blow-counts. These sands were also noted to grade to a cleaner sand (SP-SM & SP) with depth, especially when mixed with gravels. Layers of predominantly sandy and predominantly gravelly soil were commonly noted to be interbedded within the borings.

Sandy Gravels with cobbles (GP) and some silt (GP-GM) are present across most of the project site at depths as shallow as approximately 2 feet BGS in the western portion, to approximately 6 to 10 feet BGS or greater across the central portion, roughly between Avenue C & Road 33. The gravels/cobbles were primarily rounded to subrounded, and typically included a fine- to coarse-grained sand matrix. Infiltration test-pit P-16 along the south side of Warehouse No. 7 encountered

Silty Gravel with Sand (GM). Slight cementation was observed near the top of the gravel unit in the exposed profile within a few test-pits in the western portion. While artificially elevated due to the presence of oversized gravels and cobbles, SPT blow-count data suggests 'medium dense' to 'very dense' in-place relative density for these gravel soils.

Silty soils, generally classified as Sandy Silt (ML) and Silt with Sand (ML), were primarily encountered in the eastern portion of the project area, typically east of Road 27. Near-surface silts were observed in the eastern/northeastern-most portion around Warehouse No. 1 & 2, while silt layers underlying silty sands were encountered at approximately 3 to 7 feet BGS in the east-central portion in the vicinity of Warehouse No. 3. Evidence of ferrous staining was also noted within the deeper silty soils in borings B-4 & B-5 near the groundwater table. Based on the SPT blow-counts, the silt soils generally exhibited 'loose' to 'medium dense' relative in-place density.

Deeper borings completed for the Big Pasco Business Park located southwest of BPIC further confirm that these predominantly sandy/gravelly soils (Pasco Gravels) extend to approximately 50 feet BGS, underlain by a hard silt unit likely associated with the lower Ringold Formation (Landau Associates, 2009).

7.1 NRCS Soil Survey

While known to have been significantly altered by historic grading and development activities, the soil survey map of the site prepared by the Natural Resources Conservation Service (NRCS) identifies the near surface site soils across the BPIC project site as *Urban land-Torripsamments complex.* The parent material of the *Torripsamments* soils are described as *mixed eolian sands* with a typical soil profile of *loamy fine sand* over *fine sand* (see Appendix VI).

8.0 GROUNDWATER CONDITIONS

Based on our subsurface exploration, groundwater was encountered at depths ranging from approximately 3.5 to 14 feet BGS. The shallowest groundwater was noted in the eastern/northeastern-most portion at depths of approximately 3.5 to 4.5 feet BGS, generally coinciding with the relatively low surface elevations of the project area, within exploration completed along the north and east sides of Warehouse No. 6. Groundwater was measured at depths of approximately 5 to 10 feet BGS within exploration completed around Warehouse No. 3,

4 & 5 and the eastern portion of Warehouse No. 2. Depth to groundwater is generally greater than 10 feet BGS in the western/southwestern portion of the project area. These depths roughly correlate to groundwater elevations ranging from ±341' to ±338.5', with the higher elevation contour typically along Warehouse Street and the lower elevation contour generally along Cargo Street. The following tables provide depths to un-stabilized groundwater readings measured within the borings and test-pits at time of exploration (Table 3a), as well as stabilized groundwater depths and elevations recorded within the monitoring wells (Table 3b):

Table 3a: Summary of Groundwater Depths

Boring/ Test-Pit	Depth to Groundwater at time of Exploration
B-1	4.5'
B-2	5'
B-3 (MW-1)	9.25'
B-4	6.5'
B-5	8.75'
B-7 (MW-2)	12.25'
B-9	14.25'
B-10	13'
B-12 (MW-3)	12.75'
B-13	7.8'
B-14	8.4'
B-15	12.4'
P-6	6'
P-8	3.5'
TP-2	8'
TP-3	4.25'
TP-4	8.5'

Table 3b: Stabilized Groundwater Depths & Elevations

Monitoring Well	Aug 5, 2019		Aug 19, 2019		Aug 26, 2019		Sep 3, 2019	
	Depth	Elev.	Depth	Elev.	Depth	Elev.	Depth	Elev.
B-3 (MW-1)	9.27'	338.62'	9.37'	338.52'	9.39'	338.50'	9.34'	338.55'
B-7 (MW-2)	11.74'	340.65'	11.86'	340.53'	12.24'	340.15'	11.90'	340.49'
B-12 (MW-3)	12.47'	339.83'	12.81'	339.49'	13.92'	338.38'	12.57'	339.73'

Geotechnical investigation conducted for the Big Pasco Industrial office building, located southwest of Ainsworth Street & Road 30, did not encounter groundwater to depths of approximately 8 feet BGS in early May (Shannon & Wilson, 2007). Another geotechnical investigation completed for the Big Pasco Business Park located southwest of BPIC, which

includes the existing Port of Pasco office building, measured groundwater levels ranging from approximately 8 to 16.5 feet BGS in January and July (Landau Associates, 2009).

Groundwater in this area of Pasco is known to discharge into the Columbia River and the groundwater table slopes directly towards the river (Drost et al., 1997). This condition was further confirmed through stabilized groundwater measurements recorded in the three monitoring wells, yielding a groundwater flow direction of approximately 192° to 205°. Hydraulic gradients (i) of approximately 0.001 to 0.005 were calculated based on these available data points. Therefore, while we believe that the groundwater table is influenced by the river stages in the adjacent Columbia River (Lake Wallula), local variation in the groundwater elevations will likely be controlled by recharge from upgradient sources including the applied irrigation across the center-pivot crop fields located north of the BPIC. Groundwater fluctuation of up to approximately 1.5 feet has been observed over a period of about four weeks of groundwater measurements within the monitoring wells. While not anticipated to be significant, a full understanding of the seasonal groundwater fluctuation across the BPIC will require collecting groundwater depth data within the monitoring wells over a 1-year period.

9.0 SOIL INFILTRATION TESTING

Infiltration testing was completed using a small-scale Pilot Infiltration Test (PIT) in test-pits P-1, P-13 & P-16. To the degree possible, care was exercised during excavation to attempt to maintain relatively uniform side walls, and the resulting size and geometry of the finished test-pit was carefully recorded in the field. The infiltration test-pit was filled with water from a nearby hydrant. The excavation was continuously filled at a measured constant inflow rate until the water head within the test-pit was observed to be relatively stable. Water flow into the test-pit at the noted rate was continued for a sufficient period to flood the pit and fully saturate the surrounding soils.

Soil infiltration testing utilizing the single ring infiltrometer method was conducted at all infiltration locations except for test-pits P-1, P-13 & P-16. The single ring infiltrometer consists of a 10-inch diameter steel pipe driven into the ground at the test depth. After an initial pre-soak period, a constant water level was maintained in the ring with the use of a float valve and timed intervals of the water demand volumes were recorded. Continuous readings of the infiltration rates

of water volumes required to maintain the constant head were recorded until a relatively constant rate was achieved and the average infiltration rate was determined.

Based on the gravelly nature of the soils encountered within test-pit P-17, a falling head infiltration method was performed by placing a 12-inch diameter steel pipe into the ground at the test depth. The pipe was filled with water and timed readings of the measured falling water level within the ring were taken and the procedure was repeated until the timed intervals generally yielded a constant rate.

The test results are indicative of the infiltration characteristics of the subsurface soils encountered at the test location/depth using the specific test method. The following table presents the results of the infiltration tests:

Table 4: Infiltration Test Results

Test ID	Test Method		Test Depth	Soil Tested	CEC (meq/100g)	% Fines from #200 Wash	Field Infiltration Rate
P-1	PIT		4	Gravel with Sand (GP)	-	-	**>20 in./hr.**
P-2	SRI	CH	3	Silty Sand (SM)	4.3	20%	**2.3 in./hr.**
P-3	SRI	CH	3	Silty Sand (SM)	-	25%	**1.2 in./hr.**
P-4	SRI	CH	3	Silty Sand (SM)	-	28%	**2.2 in./hr.**
P-5	SRI	CH	3	Silty Sand (SM)	5.5	38%	**2.1 in./hr.**
P-6	SRI	CH	3	Silty Sand (SM) [1]	-	33%	**0.1 in./hr.**
P-7	SRI	CH	3	Sandy Silt (ML) [2]	6.4	54%	**0.76 in./hr.**
P-8	*no testing conducted due to groundwater at ~3.5 feet BGS*						
P-9	SRI	CH	3	Gravel with Sand (GP) [2]	4.2	1%	**7.6 in./hr.**
P-10	SRI	CH	3	Silty Sand (SM)	-	26%	**1.7 in./hr.**
P-11	SRI	CH	3	Sand with Silt (SP-SM)	2.7	11%	**9.0 in./hr.**
P-12	SRI	CH	3	Silty Sand (SM)	-	13%	**6.4 in./hr.**
P-13	PIT		5	Gravel with Sand (GP)	-	-	**>20 in./hr.**
P-14	SRI	CH	3	Silty Sand (SM)	-	34%	**0.7 in./hr.**
P-15	SRI	CH	3	Silty Sand w/ Gravel (SM)	5.1	13%	**1.0 in./hr.**
P-16	PIT		4.5	Silty Gravel with Sand (GM)	-	29%	**3.8 in./hr.**
P-17	SRI	FH	3	Gravel w/ Silt and Sand (GP-GM)	-	-	**>20 in./hr.**
P-18	SRI	CH	4	Silty Sand (SM)	-	34%	**8.5 in./hr.**

Notes: SRI = Single ring infiltrometer; PIT = Small-scale Pilot Infiltration Test; CH = Constant head; FH = Falling head
[1] Groundwater encountered at 6 feet BGS, ~3 feet below test depth
[2] Moist to wet soil at test depth, with groundwater anticipated to be less 5 feet below test depth

The native onsite silty sands typically yielded a field infiltration rate on the order of 1 to 2 inches/hour, while the relatively cleaner sands yielded field rates of 6 to 9 inches/hour. The predominantly gravelly soils typically resulted in infiltration rates in excess of 20 inches/hour, with the siltier gravels yielding a relatively slower rate. However, notably slower infiltration rates were recorded where shallow groundwater conditions were noted; i.e. separation to the groundwater table anticipated to be less than 5 feet. Therefore, tests performed in areas of relatively shallow groundwater (P-6 through P-9) yielded field infiltration rates that were generally lower by an order of magnitude.

The infiltration rates presented herein represent the un-factored field soil infiltration rate. An appropriate factor of safety should be applied to the field infiltration rate to determine long-term design infiltration rate. Determination of safety factors for long-term design infiltration should consider the following: pretreatment, potential for biofouling, system maintainability, horizontal and vertical variability of soils, and type of infiltration testing. Typical factors of safety for these soils generally range from 2 to 3.

Furthermore, we used the soil grain size analysis method outlined in Section 6, Appendix 6.B.4, of the 2019 Eastern Washington Stormwater Manual (EWSWM). This method is a laboratory test-based method that estimates saturated hydraulic conductivity (K_{sat}) using empirical relationships to grain size, including the fines content and various other grain-size characteristics (d_{10}, d_{60} & d_{90}). Based on the results of this empirical correlation, using appropriate correction factors as outlined in section 6.3.3 of the 2019 EWSWM, we have estimated a design infiltration rate of **0.6 inches/hour** for the native onsite silty sands, considering no reduction due to minimal separation from groundwater.

10.0 PRELIMINARY GROUNDWATER MOUNDING ANALYSIS

A preliminary groundwater mounding analysis was performed as part of this geotechnical site investigation to simulate the mound of groundwater beneath proposed stormwater infiltration facilities. The mounding analysis was performed using a spreadsheet developed by the USGS that numerically integrates the Hantush (1967) equation for groundwater mounding beneath an infiltration facility. Hantush's equations define the shape of groundwater mounds beneath the infiltration facilities, and are based on several simplifying assumptions, including that the aquifer

is homogeneous and isotropic, flow is strictly horizontal, the change in aquifer saturated thickness relative to original saturated thickness is trivial, and the infiltration rate is constant.

Using the Hantush method, several input parameters are required in order to compute the groundwater mound height. All input parameters used have been derived using standard practices and readily available information from site-specific subsurface soil exploration and infiltration testing. The design storm at the site is 1.6 inches based on a 25-year return period 24-hour storm event. We also considered a 24-hour design storm event and a 48-hour period for the basin to fully drain, resulting in 3 days of total duration of infiltration period. Onsite infiltration tests yielded field infiltration rates ranging from approximately 0.1 to 9 inches/hour. Based on the field readings, our analyses assumed a vertical hydraulic conductivity (K_v) of 1.5 inches/hour to estimate a horizontal hydraulic conductivity (K_h) of 30 feet/day (assuming $K_h \approx 10 \cdot K_v$). Specific yield of the unsaturated zone was estimated to be 20% from values provided within the *Specific Yield- Compilation of Specific Yields for Various Materials* publication (Johnson, 1967). Based on our site-specific subsurface exploration and review other available data (Appendix VII), we have estimated a conservative initial thickness of the saturated zone to be 40 feet.

We understand that infiltration trenches constructed in accordance with City of Pasco Public Works Department standard details for single-outlet 4-feet wide or multiple-outlet 6-feet wide designs (see Appendix VIII) will be employed for onsite disposal of stormwater at the BPIC site. However, the final design inputs with regard to the number, length, and location of infiltrations trenches and associated impervious surface areas conveyed to the various infiltration trenches is currently undetermined.

To assist with the final design of the onsite stormwater facilities, we have performed the mounding analyses using a range of surface areas to be drained and conveyed into standard infiltration trenches constructed in 50-foot lengths. Logically the resulting height of the groundwater mound beneath a given infiltration trench increases as the volume of recharge increases. The following charts provide the results of the mounding analyses expressed as a linear graph of the anticipated mound height resulting from increased impervious surface area conveyed to each 50-feet long, 4-feet or 6-feet wide infiltration trenches:

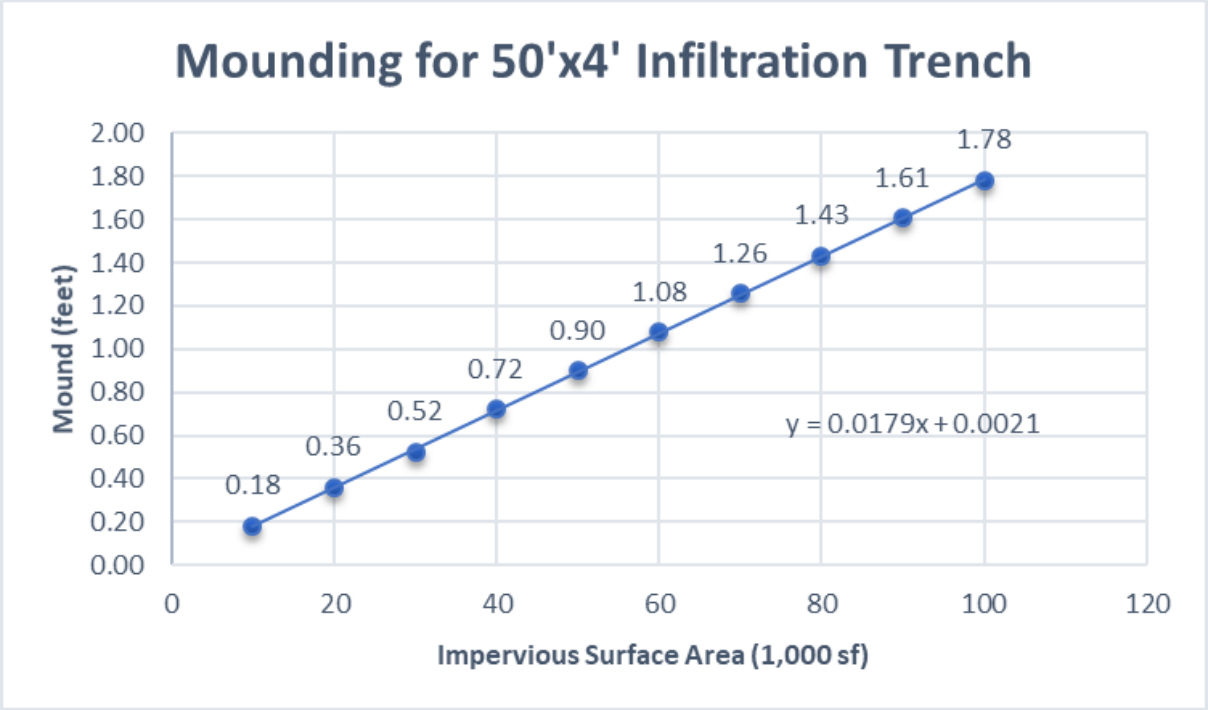

Chart 1a: Mound Height vs. Impervious Surface Area (50'x4' Infiltration Trench)

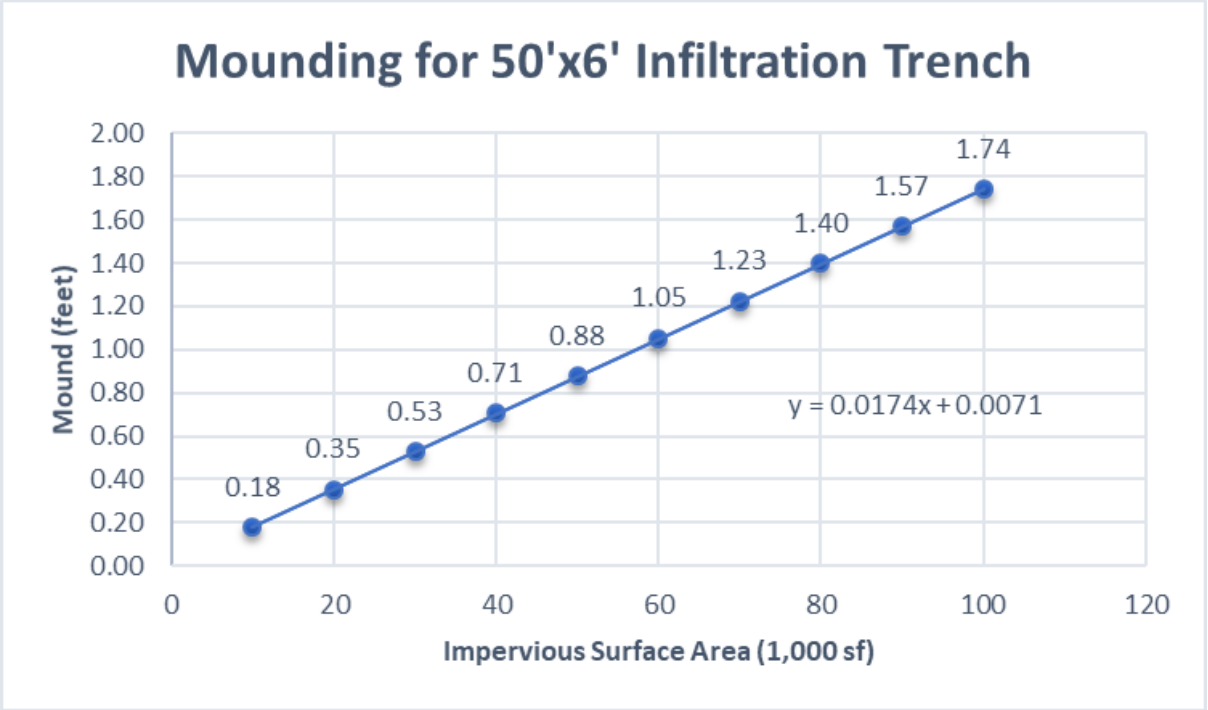

Chart 1b: Mound Height vs. Impervious Surface Area (50'x6' Infiltration Trench)

We understand that final stormwater management design at the project site will also include various sized swales throughout the development. Based on the information provided we have performed additional mounding analyses for the various infiltration facility scenarios being considered for the project. The resulting calculated groundwater mound heights beneath the center of the various swales proposed for the project using Hantush method are presented in the table below:

Table 5: Mounding Analyses for Various Stormwater Facilities

Swale Dimensions	Tributary Area (sq-ft)	Mound Height (inches)
8' x 260'	42,000	4.3
8' x 260'	130,000	7.3
8' x 174'	20,000	2.7
8' x 290'	91,000	8.7
8' x 80'	71,000	8.9
15' x 75'	59,000	10.5
15' x 75' overflowing to 3 x 100'	46,580 (79% of 59,000)	8.3
	12,390 (21% of 59,000)	2.1

Design of the new stormwater management facilities for the BPIC facility, including design criteria for appropriate biofiltration and separation, are under the purview of the project civil engineer. Based on our analyses, short-term groundwater mounding from the design storm event can be limited beneath the proposed infiltration trenches. Final design of stormwater facilities at the site should allow for appropriate separations with regard to the anticipated short-term mounding conditions and seasonal high groundwater levels.

11.0 PAVEMENT ANALYSIS

Various pavement structural sections for the proposed roadway improvements were calculated using the 1993 AASHTO pavement design method. The 1993 AASHTO pavement design method calculates a relative strength of the pavement section referred to as the Structural Number [SN]. Determination of the Structural Number is based on several factors including the design reliability, initial and terminal serviceability, subgrade strength and anticipated traffic loads of the proposed

roadway. Subgrade strength in terms of the M_R and anticipated traffic loading in terms of predicted 18,000 lb. equivalent single axle loads (ESALs) over the design life of the roadway are key parameters in the design. The analyses of the strength of various pavement sections further assumes construction over competent subgrade soils prepared in accordance with the recommendations of Section 12.4 of this report. The total strength of the pavement section is then determined by summing the various relative strengths of each layer incorporating layer strength and drainage characteristic coefficients.

A CBR value of 6% was estimated for the project based on our field exploration (SPT blow-counts), laboratory testing, and our experience with similar soils in the site vicinity. Using a common empirical correlation, we estimated a resilient modulus of subgrade (M_r) of ~9,000 psi ($M_r \approx 1{,}500 \times CBR$). Our calculations of SN for the asphalt pavements used the following input parameters:

Design life (years)	20
Reliability (R%)	80%
Combined Standard Error (S_0)	0.50
Initial Serviceability (P_0)	4.5
Terminal Serviceability (P_t)	1.7

While a traffic count study of BPIC roadways has not been conducted, it is well understood that Port roadways experience a significant number of ESALs from daily operations. Since actual traffic loading conditions and traffic count were unavailable, our analyses consisted of back-calculating allowable design ESALs that each of the various pavement section options can support.

We understand that the EDA Grant for the project includes a proposed section for Port roadway improvements to consist of 4-inches of HMA, over 2-inches of CSTC, over 6-inches of CSBC, constructed atop the prepared compacted subgrade. The following table presents various options of pavement sections for the project, presenting the Structural Number (relative strength) and associated allowable ESAL traffic volumes:

Table 6: Recommended Pavement Section Design Options

Pavement Design	Section	S_n	Allowable ESAL
EDA Grant Section	4" HMA/2" CSTC/6" CSBC	2.78	800,000
Alternate Conventional Sections	4" HMA/2" CSTC/7" CSBC	2.81	1,000,000
	5" HMA/2" CSTC/4" CSBC	2.97	
	4" HMA/2" CSTC/9" CSBC	3.16	1,500,000
	5" HMA/2" CSTC/5" CSBC	3.10	

Notes:
CSTC = Crushed Surfacing Top Course; CSBC = Crushed Surfacing Base Course;
Assumed Drainage Coefficients: HMA-1.0, CSTC-0.95, CSBC-0.90

The selection of the appropriate recommended pavement section shall be based on budgetary constraints, actual traffic loading conditions for a given roadway, and the owner's acceptance of future maintenance and repair demands.

It shall be noted that pavement design recommendations assume proper and positive drainage and construction monitoring. Asphalt pavements tend to develop thermal and fatigue cracking over time from environmental factors and traffic loads. Asphalt, being a viscoelastic material, weakens from temperature influx. Timely preventative measures for continual flexible maintenance such as crack filling and seal coating at 8-10 year intervals to control the progression of surface cracking and distress to prevent water from infiltrating into the base course and subgrade shall be considered. Performing this intermediate level of maintenance will net at least a 20-year service life/performance life.

12.0 GEOTECHNICAL RECOMMENDATIONS

The following geotechnical recommendations are based on our current understanding of the proposed project as depicted on the Port of Pasco Grant Request Locational Drawings, dated 8/22/2018. We recommend that we be engaged to review project plans in order to provide revised, augmented, and/or additional geotechnical recommendations as required.

12.1 Site Development – Grading

A representative of the GER should observe site clearing, grading, and the bottoms of excavations before placing fills. Local variations in soil conditions may warrant increasing the depth of over-excavation and recompaction. Seasonal weather conditions may adversely affect grading

operations. To improve compaction efforts and prevent potential pumping and unstable ground conditions, we suggest performing site grading during dryer periods of the year.

Soil conditions shall be evaluated by in-place density testing, visual evaluation, probing, and proof-rolling of the imported fill and re-compacted on-site soil as it is prepared to check for compliance with recommendations of this report. A moisture-density curve shall be established in accordance with the ASTM D1557 method for all onsite soils and imported fill materials used as structural fill.

Clearing and Grubbing: At the start of site grading, areas of proposed improvements should be cleared of existing vegetation, large roots, non-engineered fill, any construction debris, trash, and abandoned underground utilities. The surface should be stripped of organic growth and removed from the construction area. The actual depth of stripping may be reduced through real-time observation during clearing activities. Areas disturbed during clearing should be properly backfilled and compacted as described below.

Re-Use of Onsite Soils as Engineered Fill: The onsite soils are generally suitable for use as engineered fill and utility trench backfill, provided it is free of significant organic or deleterious matter, and rocks greater than 3 inches. Fill soils should be placed in maximum 8-inch lifts (loose) and compacted to at least 95% relative compaction (ASTM D1557) near its optimum moisture content. The fine-grained silty soils are moisture-sensitive, and will therefore require compaction to be performed within a strict range of ±2% of optimum moisture to achieve the proper degree of compaction. Compaction should be verified by testing.

Use of Imported Soils as Engineered Fill: If needed, imported fill soils should be non-expansive, granular soils meeting the USCS classifications of SM, SP-SM, or SW-SM with a maximum rock size of 3 inches, minimum 70% passing the No. 4 sieve, and 5 to 25% passing the No. 200 sieve. The GER should evaluate the import fill soils before hauling to the site. However, because of the potential variations within the borrow source, import soil will not be prequalified by GNN. The imported fill should be placed in lifts no greater than 8 inches in loose thickness and compacted to at least 95% of the maximum dry density (ASTM D1557) near optimum moisture content.

12.2 Temporary Excavation

It shall be the responsibility of the contractor to maintain safe temporary slope configurations since the contractor is at the job site, able to observe the nature and conditions of the slopes and be able to monitor the subsurface conditions encountered. Unsupported vertical cuts deeper than 4 feet are not recommended if worker access is necessary. The cuts shall be adequately sloped, shored or supported to prevent injury to personnel from caving and sloughing. The contractor and subcontractors shall be aware of and familiar with applicable local, state and federal safety regulation including the current OSHA Excavation and Trench Safety Standards, and OSHA Health and Safety Standards for Excavations, 29 CFR Part 1929, or successor regulations.

According to chapter 296-155 of the Washington Administrative Code (WAC), it is our opinion that the near-surface soil encountered at the site is classified as Type C soils. We recommend that temporary, unsupported, open cut slopes shall be no steeper than 1.5 feet horizontal to 1.0 feet vertical (1.5H:1V) in Type C soils. No heavy equipment should be allowed near the top of temporary cut slopes unless the cut slopes are adequately braced. Where unstable soils are encountered, flatter slopes may be required.

The native sandy/gravelly soil will be prone to caving and sloughing in open excavations. We anticipate excavation bank stability problems will be encountered due to the non-cohesive granular nature of the on-site soils. Excavation stability may be achieved by sloping excavation banks or widening shallow excavations in the anticipation of caving. Deeper excavations may require external support such as shoring or bracing to provide excavation bank stability.

12.3 Utility Excavation, Pipe Bedding and Trench Backfill

To provide suitable support and bedding for the pipe, we recommend the utilities be founded on suitable bedding material consisting of clean sand and/or sand & gravel mixture. To minimize trench subgrade disturbance during excavation, the excavator should use a smooth-edged bucket rather than a toothed bucket.

Pipe bedding and pipe zone materials shall conform to Section 9-03.12(3) of the Washington State Department of Transportation (WSDOT) 2018 Standard Specifications. Pipe bedding should provide a firm uniform cradle for support of the pipes. A minimum 4-inch thickness of bedding material beneath the pipe should be provided. Prior to installation of the pipe, the pipe bedding

should be shaped to fit the lower part of the pipe exterior with reasonable closeness to provide uniform support along the pipe. Pipe bedding material should be used as pipe zone backfill and placed in layers and tamped around the pipes to obtain complete contact. To protect the pipe, bedding material should extend at least 6 inches above the top of the pipe.

Placement of bedding material is particularly critical where maintenance of precise grades is essential. Backfill placed within the first 12 inches above utility lines should be compacted to at least 90% of the maximum dry density (ASTM D1557), such that the utility lines are not damaged during backfill placement and compaction. In addition, rock fragments greater than 1 inch in maximum dimension should be excluded from this first lift. The remainder of the utility excavations should be backfilled and compacted to 95% of the maximum dry density as determined by ASTM D1557.

Onsite soils are considered suitable for utility trench backfill provided they are free of oversize material and can be adequately compacted. All excavations should be wide enough to allow for compaction around the haunches of pipes and underground tanks. We recommend that utility trenching, installation, and backfilling conform to all applicable federal, state, and local regulations such as OSHA and WISHA for open excavations.

Compaction of backfill material should be accomplished with soils within ±2% of their optimum moisture content in order to achieve the minimum specified compaction levels recommended in this report. However, initial lift thickness could be increased to levels recommended by the manufacturer to protect utilities from damage by compacting equipment.

12.4 Flexible Pavement Construction

Proposed pavement areas shall be cleared of all soils containing roots or organic materials and any unsuitable artificial fill soils prior to subgrade construction. The upper 12 inches of subgrade soils beneath the pavement section shall be scarified, moisture conditioned and re-compacted to at least 95% of the maximum dry density as determined by ASTM D1557. Where predominantly gravelly subgrade conditions are exposed, we recommend moisture-conditioning and proof-compaction of the subgrade. All fills used to raise low areas must be compacted onsite soils or structural gravel fill and shall be placed under engineering control conditions. The finished surface shall be smooth, uniform and free of localized weak/soft spots. All subgrade deficiency corrections and drainage

provisions shall be made prior to placing the aggregate base course. All underground utilities shall be protected prior to grading.

Imported crushed surfacing top course (CSTC) shall be ¾" minus and crushed surfacing base course (CSBC) shall be 1¼" minus aggregate meeting the requirements of Section 9-03.9(3) of the 2018 WSDOT Standard Specifications (see Table 6 below) . The crushed surfacing rock shall be placed in uniform lifts not exceeding 8 inches in loose thickness and each lift compacted to at least 95% of the maximum dry density as determined by ASTM D1557 method. Aggregate base or pavement materials should not be placed when the surface is wet.

Table 7: WSDOT Standard Spec. 9-03.9(3)

Sieve Size	Percent Passing (by Weight)	
	CSTC	CSBC
1¼"		99 - 100
1"		80 - 100
¾"	99 - 100	
⅝"		50 – 80
½"	80 - 100	
No. 4	46 - 66	25 - 45
No. 40	8 – 24	3 – 18
No. 200	10.0 max.	7.5 max.
Sand Equivalent	40 min.	40 min.

If required, granular subbase material placed under the required crushed surfacing gravel sections shall consist of 2- to 4-inch minus granular material meeting the grading and quality requirements of WSDOT Standard Specification Section 9-03.14(1), Gravel Borrow, as presented below:

Table 8: WSDOT Standard Spec. 9-03.14(1)

Sieve Size	Percent Passing (by Weight)
4"	99 - 100
2"	75 – 100
U.S. No. 4	50 - 80
U.S. No. 40	30 max.
U.S. No. 200	7.0 max.
Sand Equivalent	50 min.

A fifty (50) pound sample of each imported fill material shall be collected by GNN personnel prior to placement to ensure proper gradation and establish the moisture-density relationship (proctor curve).

Cement-treated base (CTB) shall consist of a mixture of Portland cement and CSBC, and shall be placed in max. 8-inch thick loose lifts and each lift shall be compacted to 95% of ASTM D1557. We estimate 6% cement content (percent dry weight) will be required for the CTB using the recommended CSBC. Minimum unconfined compressive strength in 7-days for CTB section shall be 700 psi. Construction of the CTB section, i.e. placement, spreading, mixing, blending, processing, and compaction and quality control testing shall be in general accordance with the methods and procedures outlined in Soil Cement Construction Handbook (Portland Cement Association, 1995) and Soil Stabilization for Pavements (Unified Facilities Criteria, 2004).

In accordance with Section 9-03.21(1)E of the 2018 WSDOT Standard Specs, recycled asphalt subbase shall consist of a blend of crushed surfacing base course (CSBC) with no more than 25% pulverized asphalt (by weight).

The Hot Mix Asphalt (HMA) utilized for this project should be designed and produced in accordance with Section 5-04 Hot Mix Asphalt of the 2018 WSDOT Standard Specifications. GNN recommends that HMA should be placed two uniform lifts and shall be constructed using a Superpave asphalt binder PG 64-28. The contractor shall submit an HMA Mix Design to the Engineer for review and approval. The asphalt paving materials shall be compacted to minimum 92% (but not to exceed 95%) of the maximum theoretical specific gravity ASTM D2041 (Rice's density). The gradation of the HMA aggregate shall conform to the gradation control points for ½-inch mixes as presented in Section 9-03.8(6), HMA Proportions of Materials, of the 2018 WSDOT Standard Specifications. The HMA shall be compacted in accordance with the requirements of Section 5-04.3(10), Compaction, of the 2018 WSDOT Standard Specifications.

12.5 Mitigation of Unsuitable Subgrade Soils

The degree to which construction grading problems develop is expected to be dependent, in part, on the time of year that construction proceeds and the precautions which are taken by the contractor to protect the subgrade. Proceeding with site earthwork operations using these soils during wet weather could add project costs and/or delays. The stability of exposed soils may rapidly deteriorate due to a change in moisture content. Onsite silty soils, especially in the eastern/northeastern portion of the BPIC site, are considered moisture and disturbance sensitive due to their fines content and may become unstable (pumping) if allowed to increase in moisture content and are disturbed (rutted) by construction traffic if wet.

The site shall be graded to prevent water from ponding within construction areas and/or flowing into excavations. Accumulated water must be removed immediately along with any unstable soil. It may be necessary to amend the on-site soils or import granular materials for use as structural fill. If soils become unstable, the following actions may be required for mitigation:

- Pumping soils shall be removed and replaced with structural compacted gravel fill, or mechanically stabilized with a coarse crushed aggregate (Quarry Spalls, per WSDOT 9-13.1(5)) punched into the subgrade;
- A stabilization geotextile fabric, such as Mirafi 600X, may be placed atop the pumping subgrade to provide for favorable working conditions;
- To prevent soil disturbance, the size or type of equipment may have to be limited;
- Excavation and fill placement should be observed on a full-time basis by a representative of GER to determine that unsuitable materials are removed and that suitable compaction and site drainage is achieved.

13.0 REFERENCES

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Johnson, A.I., 1967. Specific Yield- Compilation of Specific Yields for Various Materials: U.S. Geologic Survey Water-Supply Paper 1662-D.

Landau Associates, November 3, 2009. Geotechnical Report, Big Pasco Business Park, Pasco, Washington.

MacKay Sposito, Inc., August 22, 2019. *17240_TP1_082119.dwg*, CAD file providing survey elevations for monitoring wells.

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Reidel, S.P., and Fecht, K.R., June 1994. Geologic Map of the Richland 1:100,000 Quadrangle, Washington: Washington State Department of Natural Resources, Open File Report 94-8.

Shannon & Wilson, Inc., June 1, 2007. Geotechnical Engineering Study; Big Pasco Industrial Office Building, Pasco, Washington, S&W Project No.: 22-1-02472-001.

Unified Facilities Criteria, January 16, 2004. Soil Stabilization for Pavements (UFC 3-250-11).

14.0 ADDITIONAL SERVICES

The Client should maintain an adequate program of geotechnical consultation, construction monitoring, and soils testing during the final design and construction phases to ensure compliance with GNN's geotechnical recommendations. For this purpose, GNN, the Geotechnical Engineer-of-Record, shall be retained as the geotechnical consultant from beginning to end of the project to maintain continuity of services.

GNN can provide construction monitoring and testing as additional services. The costs of these services are not included in our present fee arrangement, but can be obtained from our office. The recommended construction monitoring and testing includes, but is not necessarily limited to, the following:

- Consultation during the design stages of the project.
- Review of the grading and drainage plans to monitor compliance and proper implementation of the recommendations in GNN's Report.
- Observation and quality control testing during site preparation, grading, and placement of engineered fill as required by the local building ordinances.
- Geotechnical engineering consultation as needed during construction

15.0 LIMITATIONS OF THE GEOTECHNICAL SITE INVESTIGATION REPORT

This GEOTECHNICAL SITE INVESTIGATION REPORT ("Report") was prepared for the exclusive use of the Client. GN Northern, Inc.'s (GNN) findings, conclusions and recommendations in this Report are based on selected points of field exploration, laboratory testing, and GNN's understanding of the proposed project at the time the Report is prepared. Furthermore, GNN's findings and recommendations are based on the assumption that soil, rock and/or groundwater conditions do not vary significantly from those found at specific exploratory locations. Variations in soil, bedrock and/or groundwater conditions could exist between and beyond the exploration points. The nature and extent of these variations may not become evident until during or after construction. Variations in soil, bedrock and groundwater may require additional studies, consultation, and revisions to GNN's recommendations in the Report.

In many cases the scope of geotechnical exploration and the test locations are selected by others without consultation from the geotechnical engineer/consultant. GNN assumes no responsibility and, by preparing this Report, does not impliedly or expressly validate the scope of exploration and the test locations selected by others.

This Report's findings are valid as of the issued date of this Report. However, changes in conditions of the subject property or adjoining properties can occur due to passage of time, natural processes, or works of man. In addition, applicable building standards/codes may change over time. Accordingly, findings, conclusions, and recommendations of this Report may be invalidated, wholly or partially, by changes outside of GNN's control. Therefore, this Report is subject to review and shall not be relied upon after a period of **one (1) year** from the issued date of the Report.

In the event that any changes in the nature, design, or location of structures are planned, the findings, conclusions and recommendations contained in this Report shall not be considered valid unless the changes are reviewed by GNN and the findings, conclusions, and recommendations of this Report are modified or verified in writing.

This Report is issued with the understanding that the owner or the owner's representative has the responsibility to bring the findings, conclusions, and recommendations contained herein to the attention of the architect and design professional(s) for the project so that they are incorporated

into the plans and construction specifications, and any follow-up addendum for the project. The owner or the owner's representative also has the responsibility to verify that the general contractor and all subcontractors follow such recommendations during construction. It is further understood that the owner or the owner's representative is responsible for submittal of this Report to the appropriate governing agencies. The foregoing notwithstanding, no party other than the Client shall have any right to rely on this Report and GNN shall have no liability to any third party who claims injury due to reliance upon this Report, which is prepared exclusively for Client's use and reliance.

GNN has provided geotechnical services in accordance with generally accepted geotechnical engineering practices in this locality at this time. GNN expressly disclaims all warranties and guarantees, express or implied.

Client shall provide GNN an opportunity to review the final design and specifications so that earthwork, drainage and foundation recommendations may be properly interpreted and implemented in the design and specifications. If GNN is not accorded the review opportunity, GNN shall have no responsibility for misinterpretation of GNN's recommendations.

Although GNN can provide environmental assessment and investigation services for an additional cost, the current scope of GNN's services does not include an environmental assessment or an investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater, or air on, below, or adjacent to the subject property.

APPENDICES

Appendix I

Vicinity Map (Figure 1)

Site Exploration Maps (Figures 2A-2C)

Points of Exploration Overlayed on EDA Drawings (Figures 3A-3C)

***Pavement** Core Location Maps (Figures 4A-4N)*

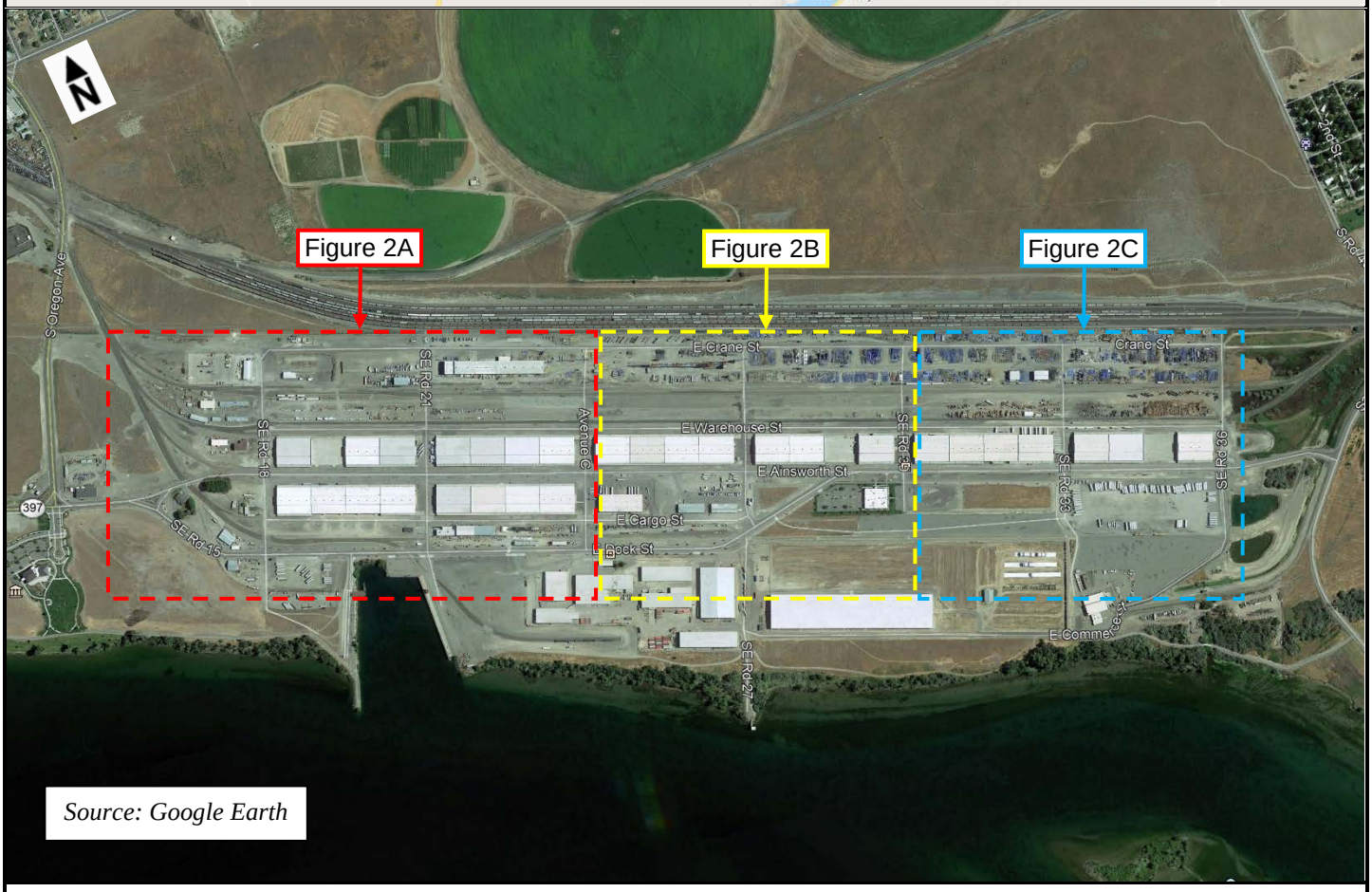


FIGURE 1: VICINITY MAP **PROJECT NO. 219-1119**

FIGURE 2A: SITE EXPLORATION MAP **PROJECT NO. 219-1119**

FIGURE 2B: SITE EXPLORATION MAP **PROJECT NO. 219-1119**

FIGURE 2C: SITE EXPLORATION MAP **PROJECT NO. 219-1119**

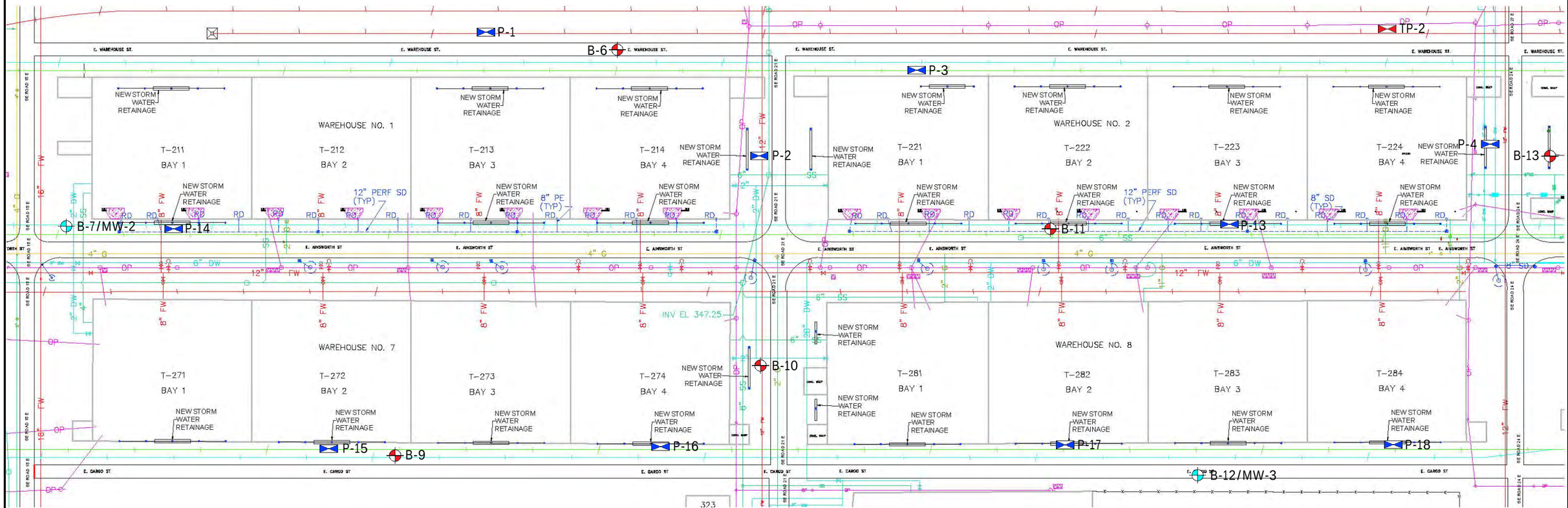
LEGEND

= Exploratory test-pit

= Infiltration test

= Exploratory borehole

= Monitoring well



NOTE

Base aerial image from *Google Earth*; overlayed *Storm Retention Locations* (Sheet C-21) dated August 22, 2018 prepared by Port of Pasco

FIGURE 3A: POINTS OF EXPLORATION OVERLAYED ON EDA DRAWINGS

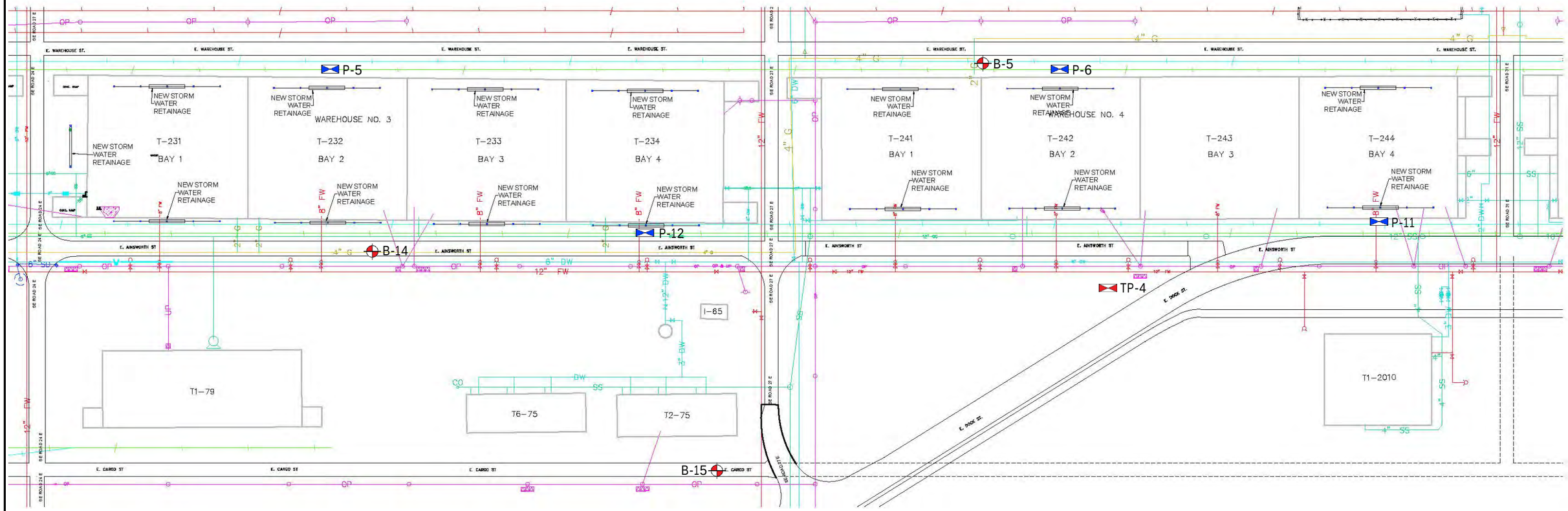
PROJECT NO. 219-1119

LEGEND

= Exploratory test-pit

= Infiltration test

= Exploratory borehole



NOTE

Base aerial image from *Google Earth*; overlayed *Storm Retention Locations* (Sheet C-22) dated August 22, 2018 prepared by Port of Pasco

FIGURE 3B: POINTS OF EXPLORATION OVERLAYED ON EDA DRAWINGS

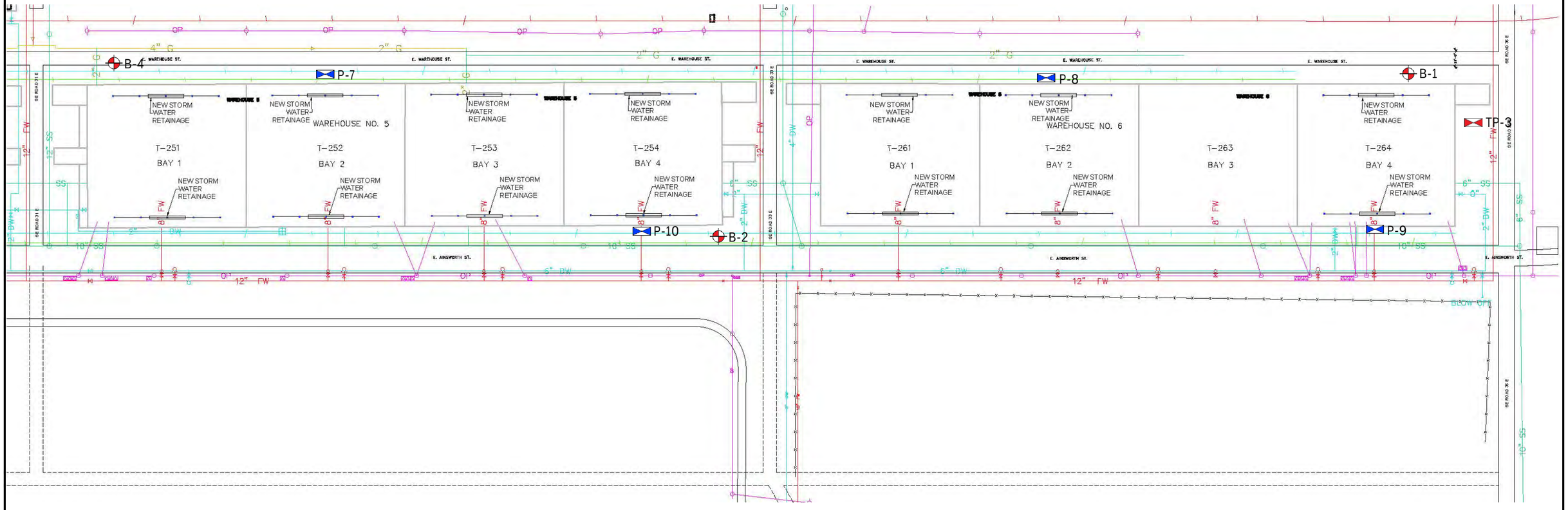
PROJECT NO. 219-1119

LEGEND

= Exploratory test-pit

= Infiltration test

= Exploratory borehole

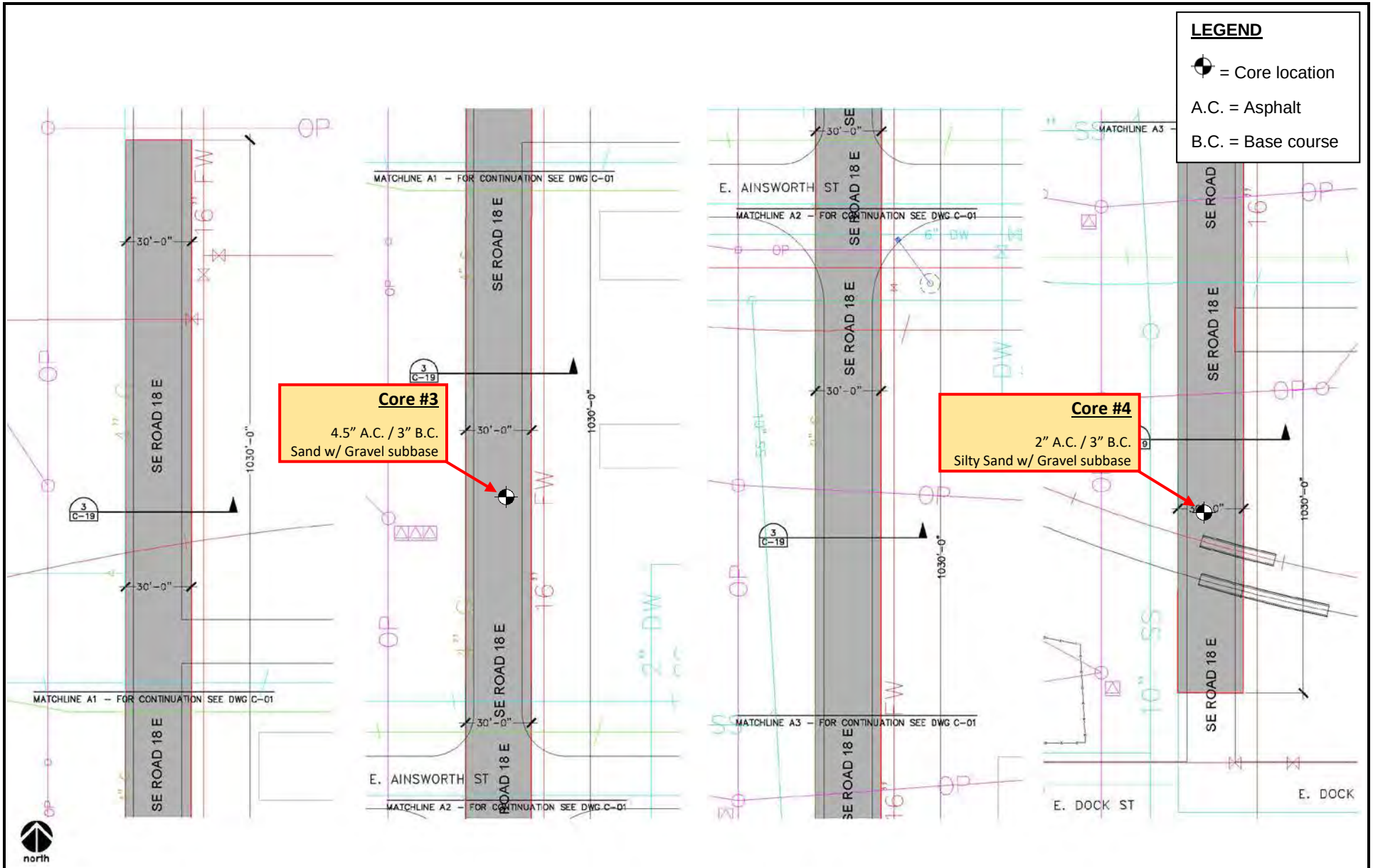


NOTE

Base aerial image from *Google Earth*; overlayed *Storm Retention Locations* (Sheet C-23) dated August 22, 2018 prepared by Port of Pasco

FIGURE 3C: POINTS OF EXPLORATION OVERLAYED ON EDA DRAWINGS

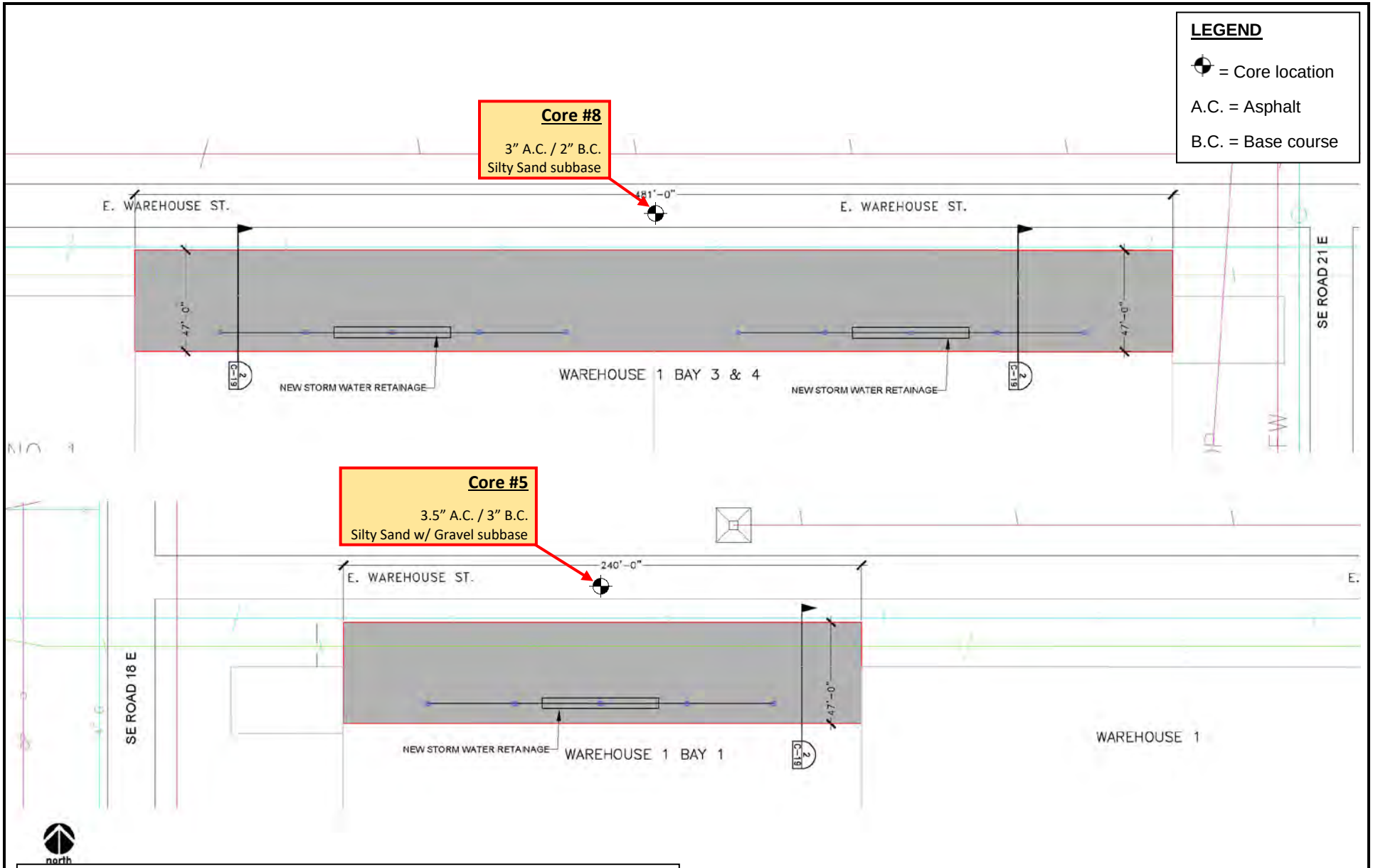
PROJECT NO. 219-1119



NOTE

Paving Road 18 (Sheet C-01) dated August 22, 2018 prepared by Port of Pasco

FIGURE 4A: CORE LOCATION MAP **PROJECT NO. 219-1119**



NOTE

Paving from Building Face on North Side of Warehouse 1 to E. Warehouse St., Storm Water Retention (Sheet C-02) dated August 22, 2018 prepared by Port of Pasco

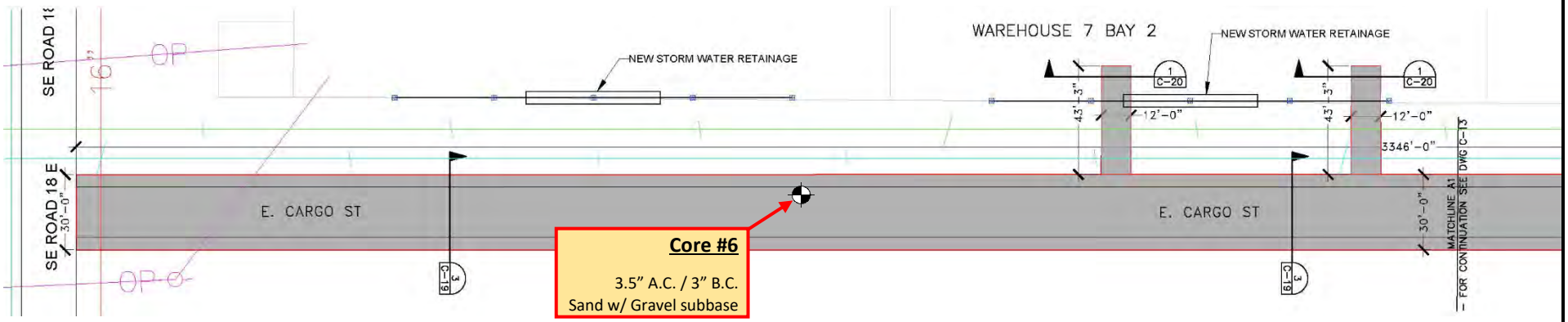
FIGURE 4B: CORE LOCATION MAP **PROJECT NO. 219-1119**

LEGEND

= Core location

A.C. = Asphalt

B.C. = Base course

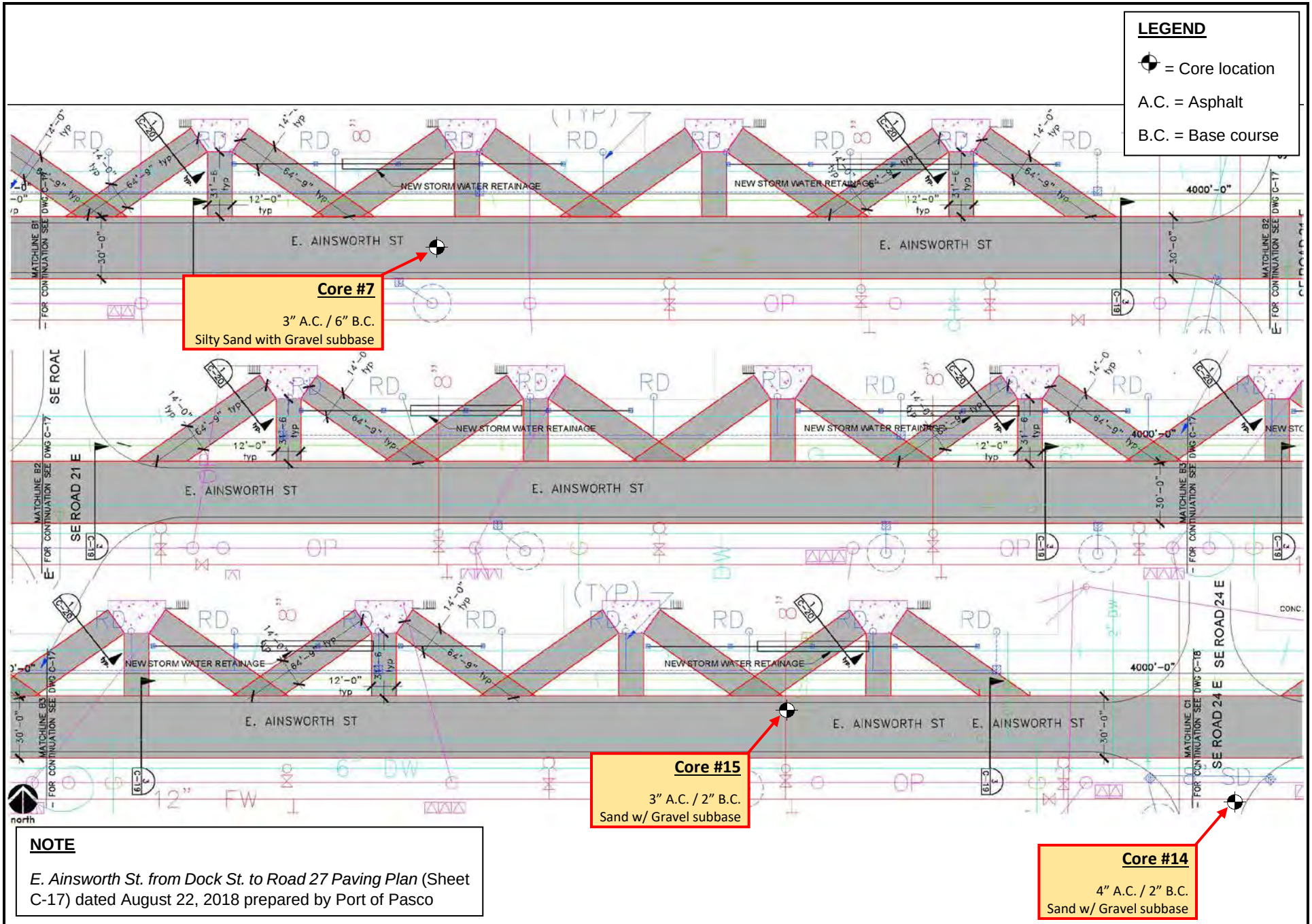


NOTE

E. Cargo St. from Road 18 to Road 27 Paving Plan, Asphalt Approaches to Warehouse 7 (Sheet C-13) dated August 22, 2018 prepared by Port of Pasco

FIGURE 4C: CORE LOCATION MAP

PROJECT NO. 219-1119



NOTE

E. Ainsworth St. from Dock St. to Road 27 Paving Plan (Sheet C-17) dated August 22, 2018 prepared by Port of Pasco

FIGURE 4D: CORE LOCATION MAP

PROJECT NO. 219-1119

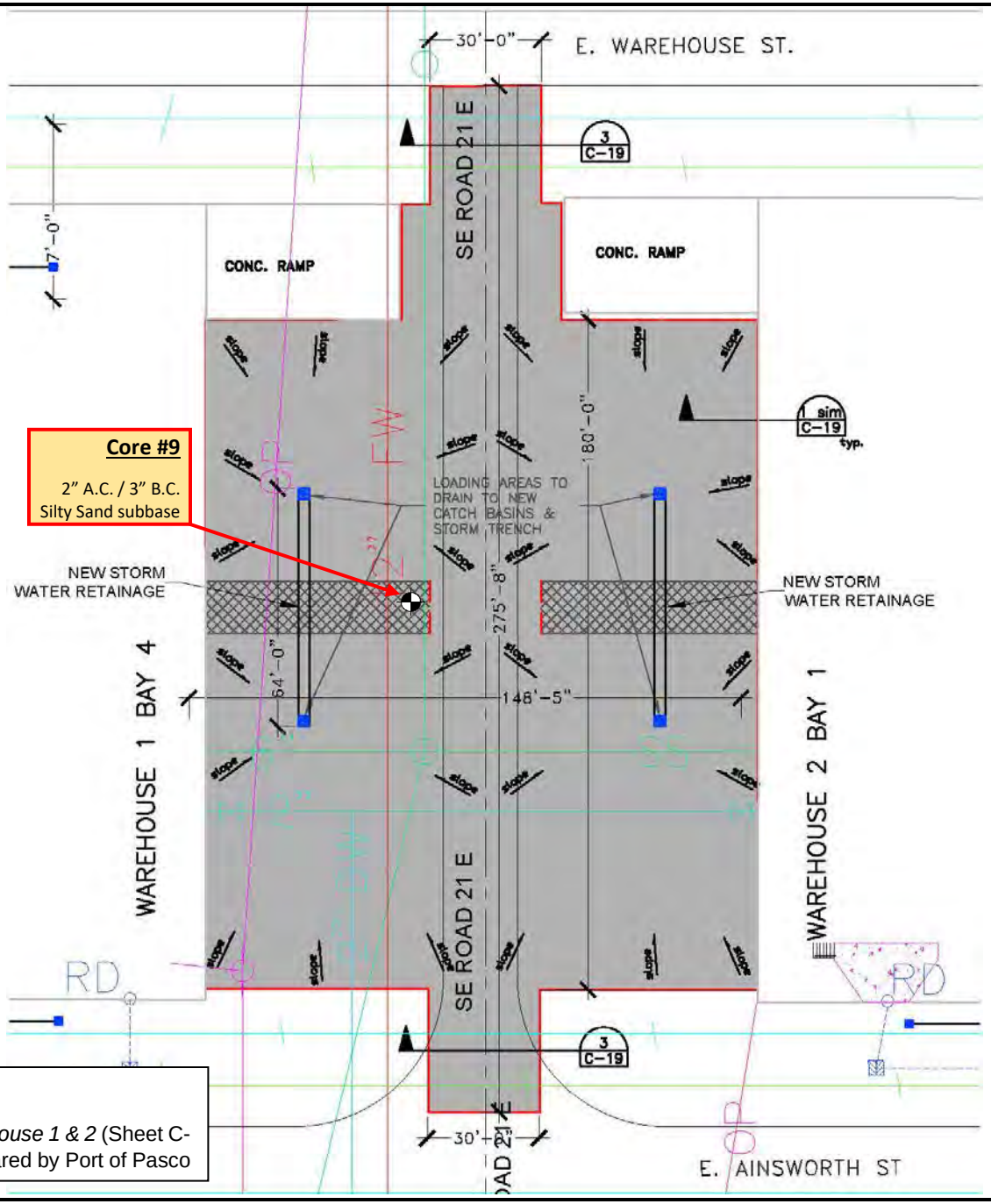
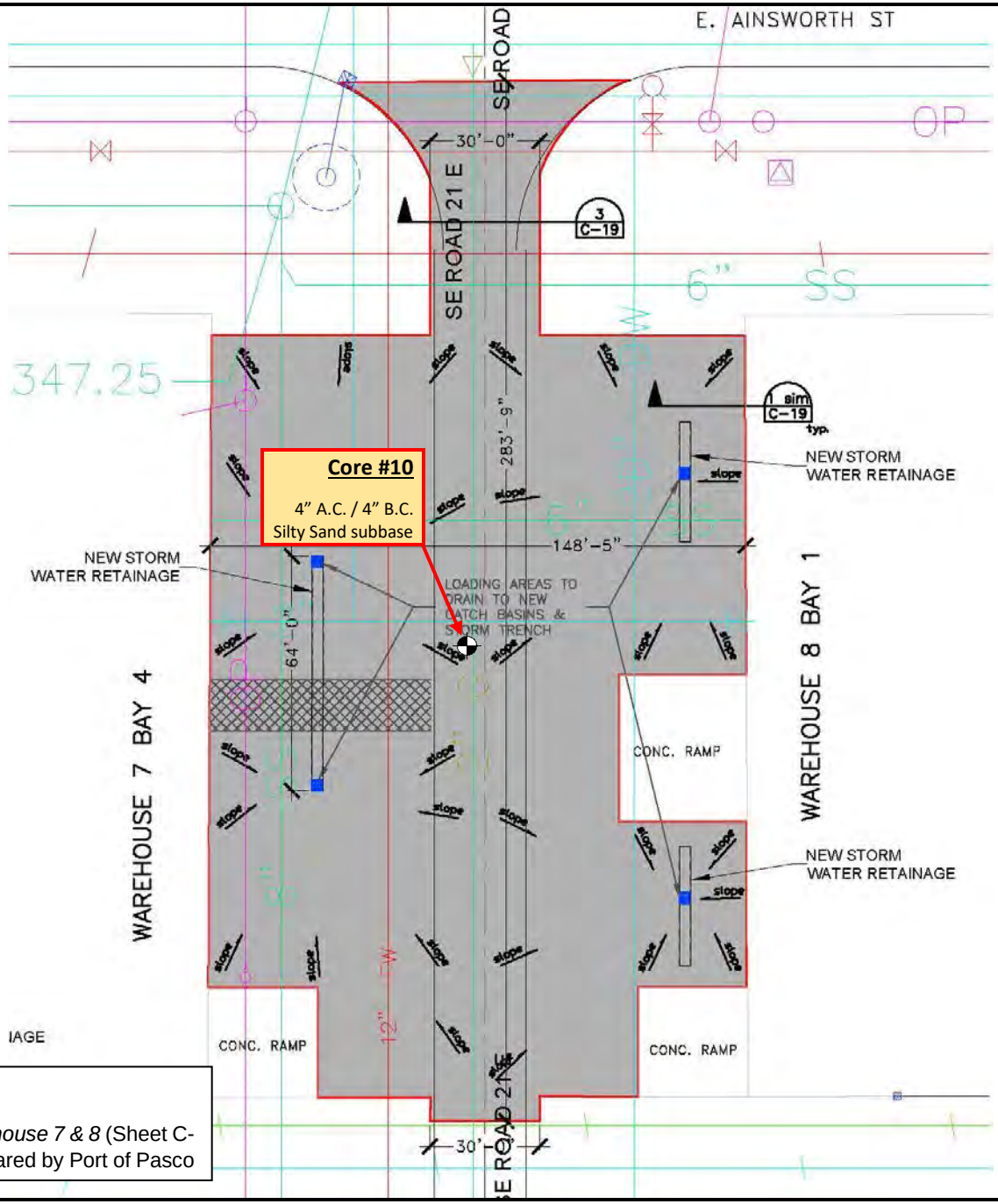


FIGURE 4E: CORE LOCATION MAP

PROJECT NO. 219-1119



LEGEND

= Core location

A.C. = Asphalt

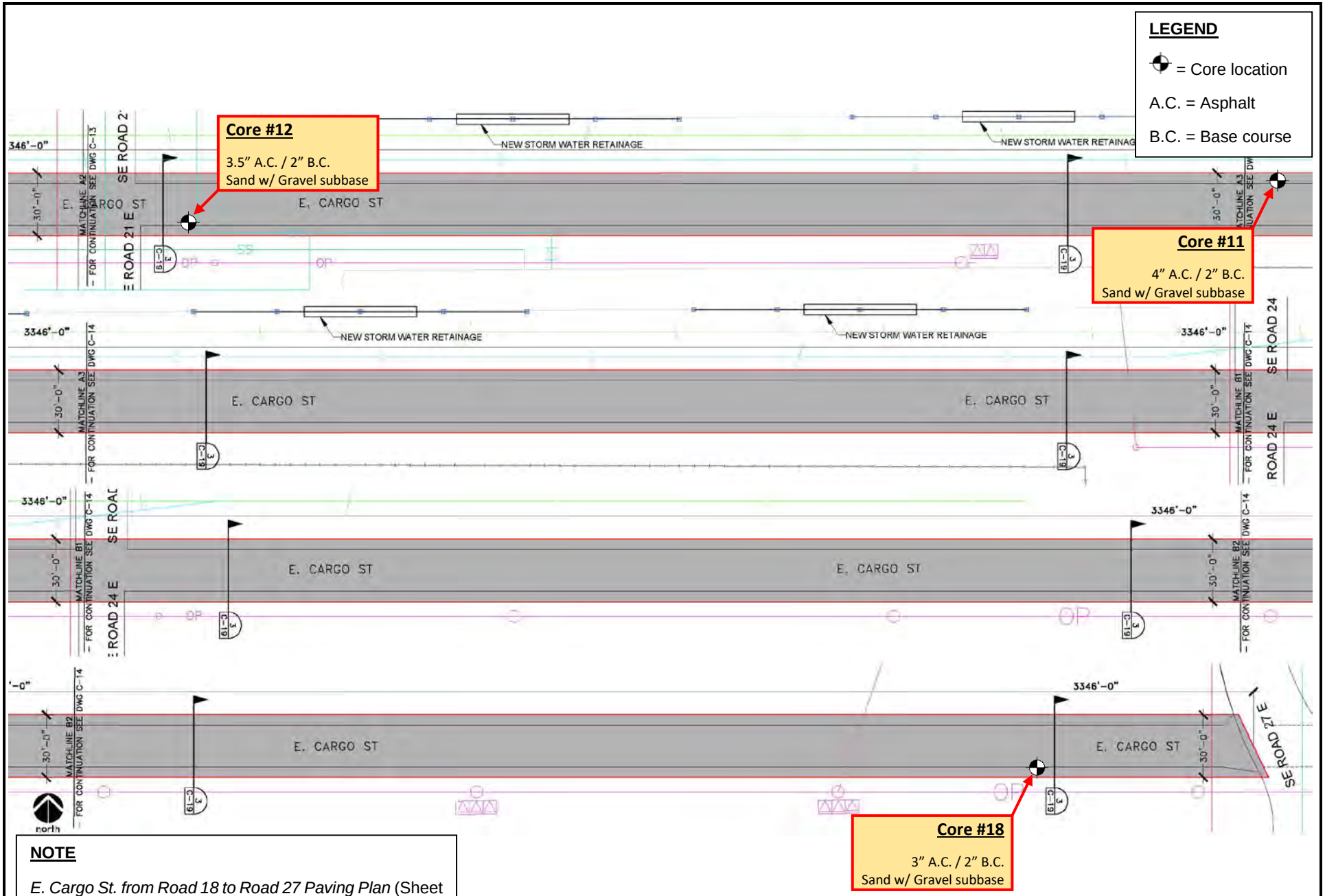
B.C. = Base course

NOTE

Paving Road 21 Between Warehouse 7 & 8 (Sheet C-15) dated August 22, 2018 prepared by Port of Pasco

FIGURE 4F: CORE LOCATION MAP

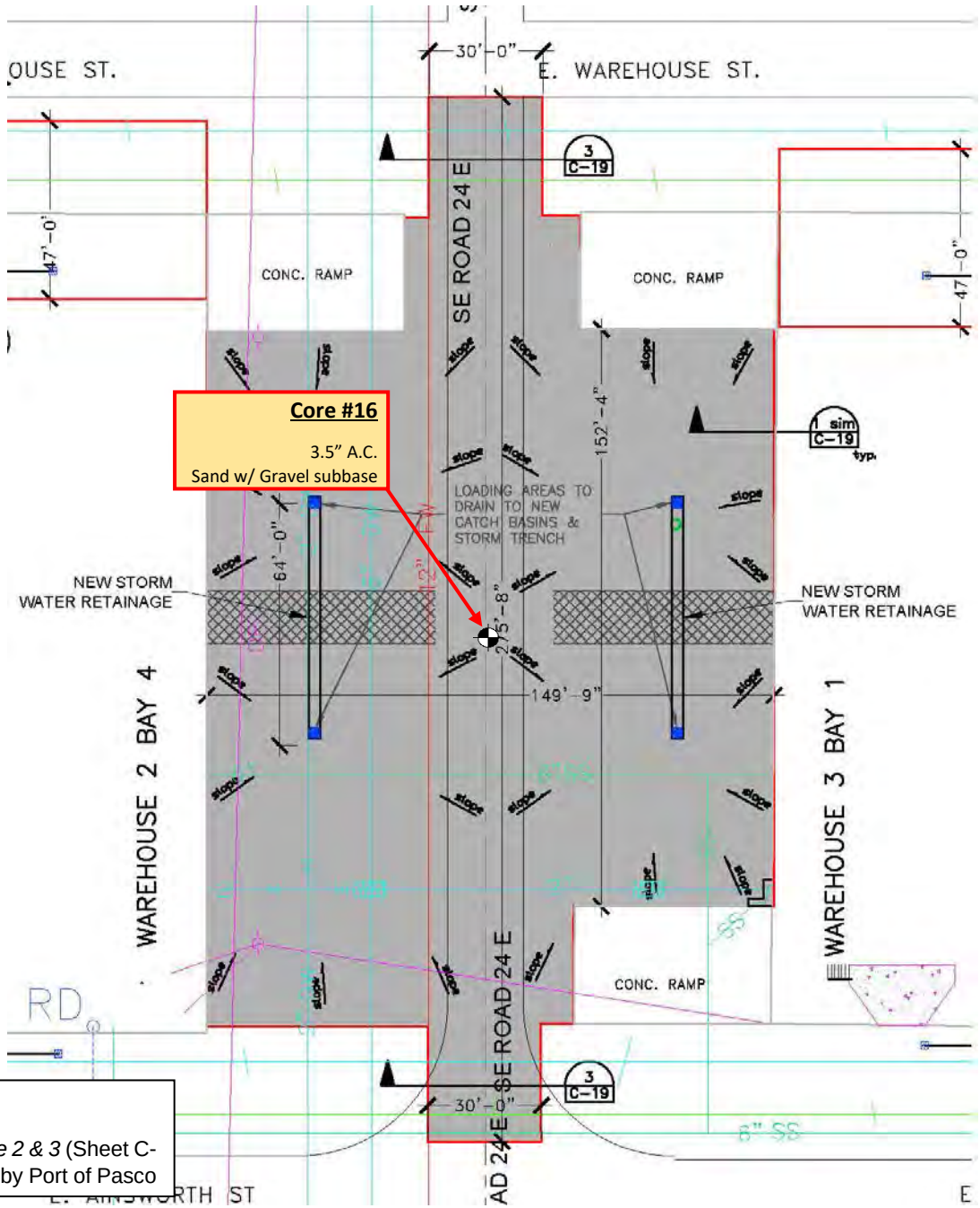
PROJECT NO. 219-1119



NOTE

E. Cargo St. from Road 18 to Road 27 Paving Plan (Sheet C-14) dated August 22, 2018 prepared by Port of Pasco

FIGURE 4G: CORE LOCATION MAP **PROJECT NO. 219-1119**



LEGEND

= Core location

A.C. = Asphalt

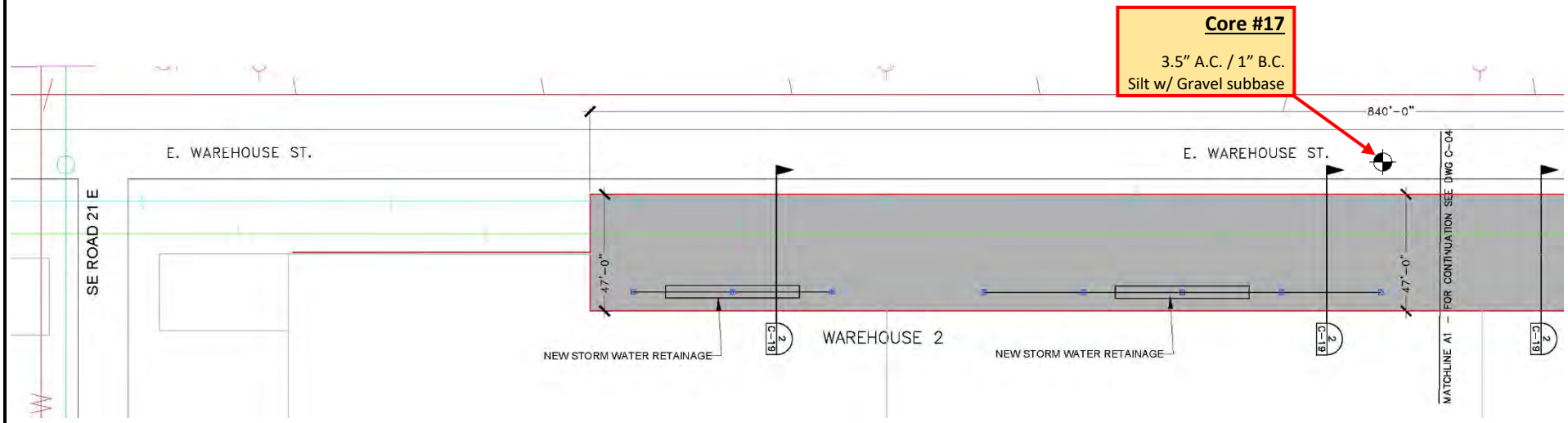
B.C. = Base course

NOTE

Paving Road 24 Between Warehouse 2 & 3 (Sheet C-05) dated August 22, 2018 prepared by Port of Pasco

FIGURE 4H: CORE LOCATION MAP

PROJECT NO. 219-1119



NOTE

Paving Road 21 Between Warehouse 1 & 2 (Sheet C-04) dated August 22, 2018 prepared by Port of Pasco

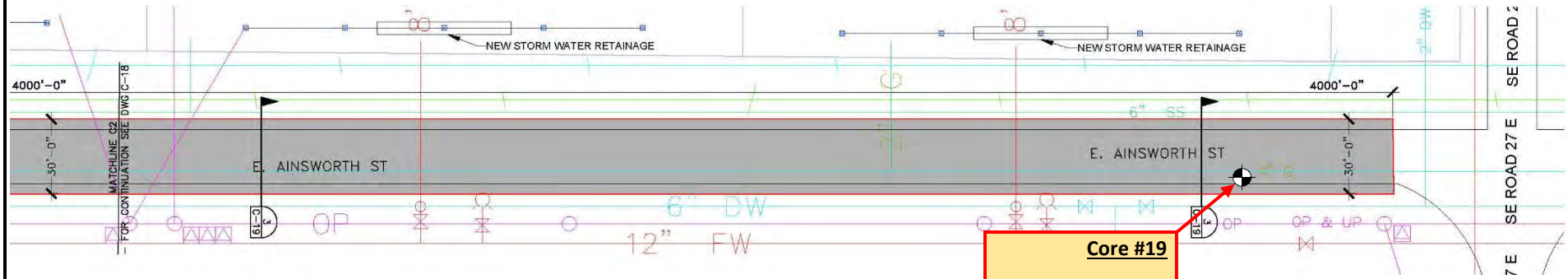
FIGURE 4I: CORE LOCATION MAP **PROJECT NO. 219-1119**

LEGEND

= Core location

A.C. = Asphalt

B.C. = Base course



Core #19

5" A.C. / 1" B.C.
Sand w/ Gravel subbase

NOTE

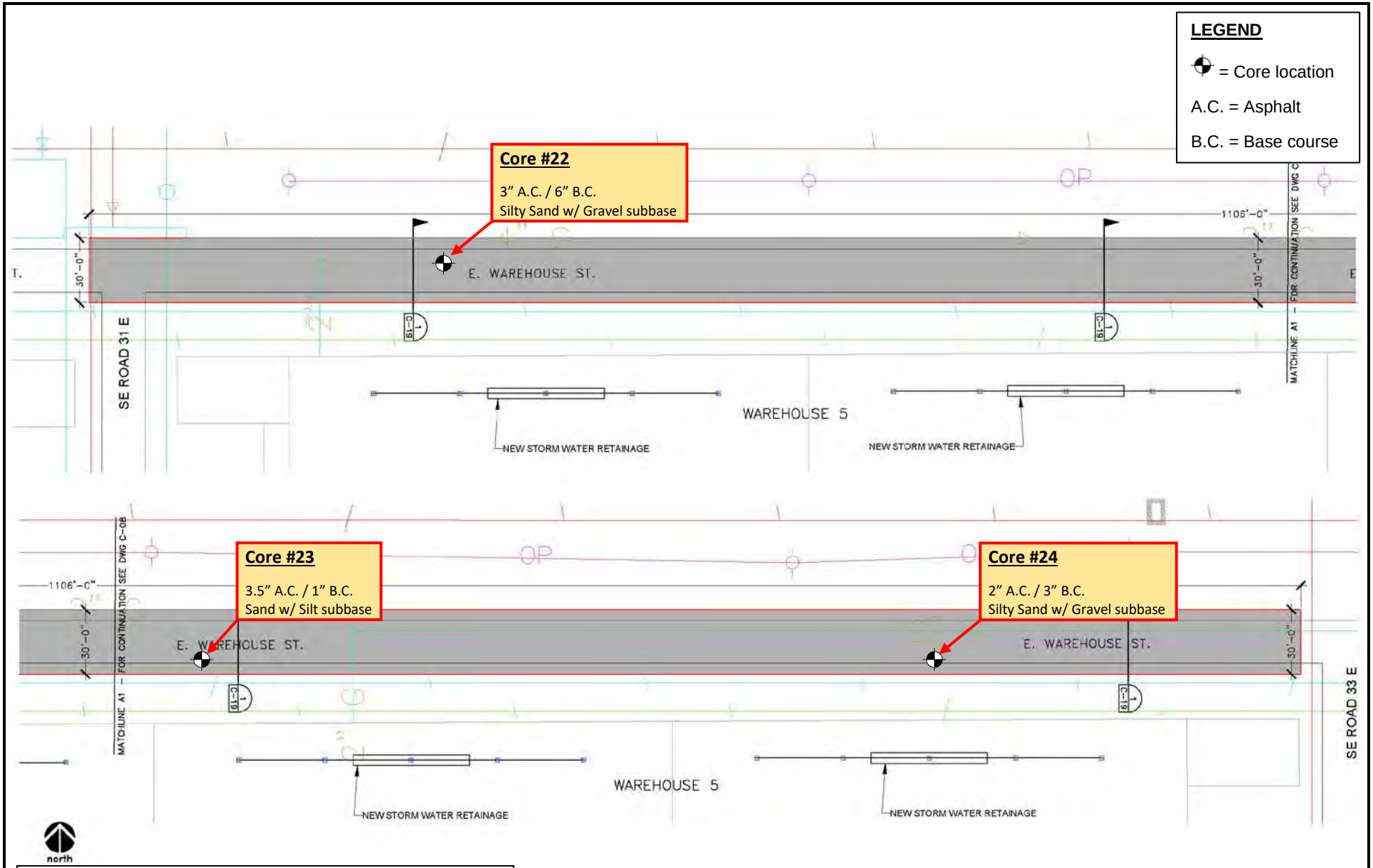
E. Ainsworth St. from Dock St. to Road 27 Paving Plan (Sheet C-18) dated August 22, 2018 prepared by Port of Pasco

FIGURE 4J: CORE LOCATION MAP **PROJECT NO. 219-1119**

NOTE

Paving from Building Face on North Side Warehouse 4 Bays 1, 2 & 4 to E. Warehouse St., Storm Water Retention (Sheet C-07) dated August 22, 2018 prepared by Port of Pasco

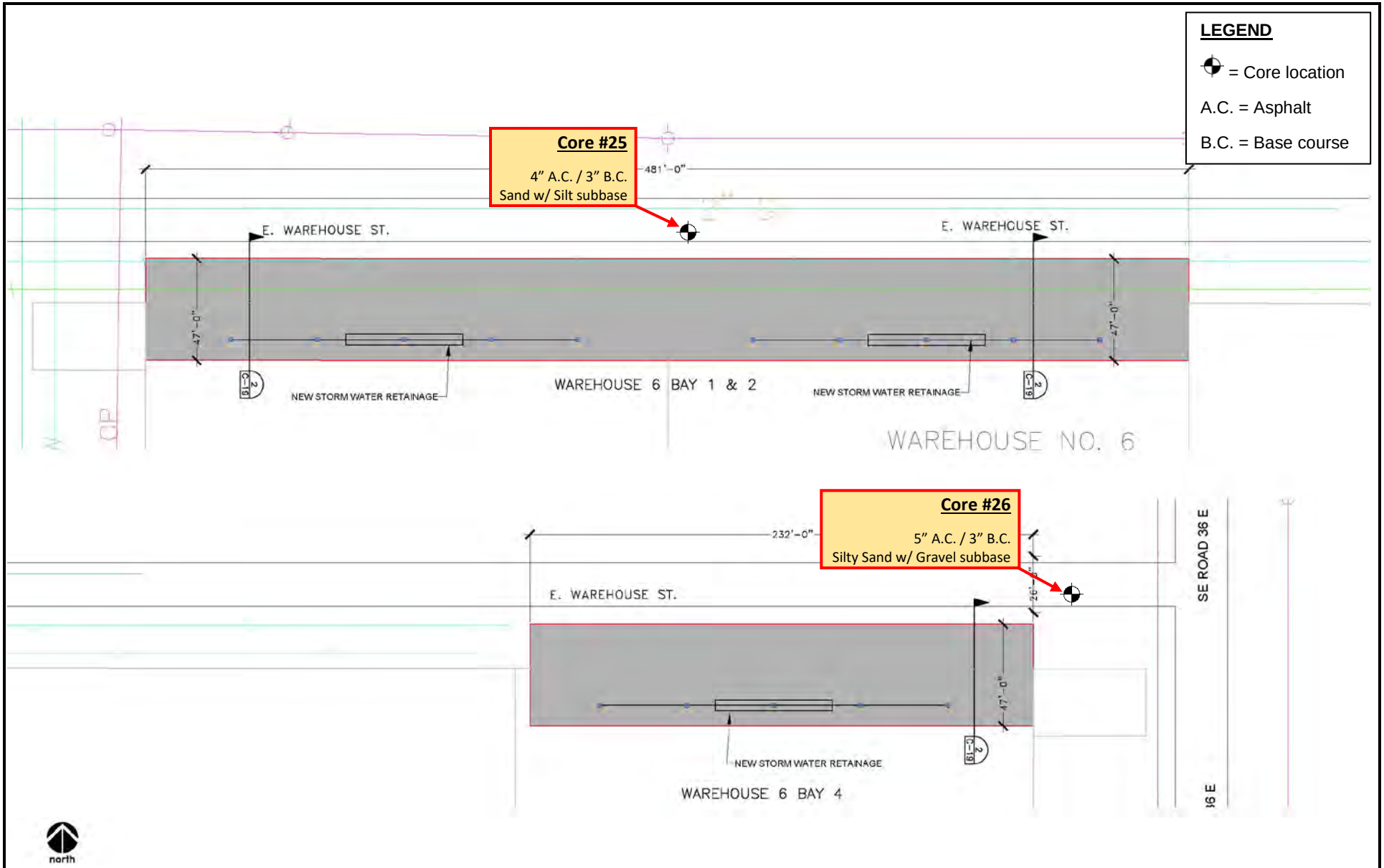
FIGURE 4K: CORE LOCATION MAP **PROJECT NO. 219-1119**



NOTE

E. Warehouse St. from Road 31 to Road 33 Paving Plan (Sheet C-08) dated August 22, 2018 prepared by Port of Pasco

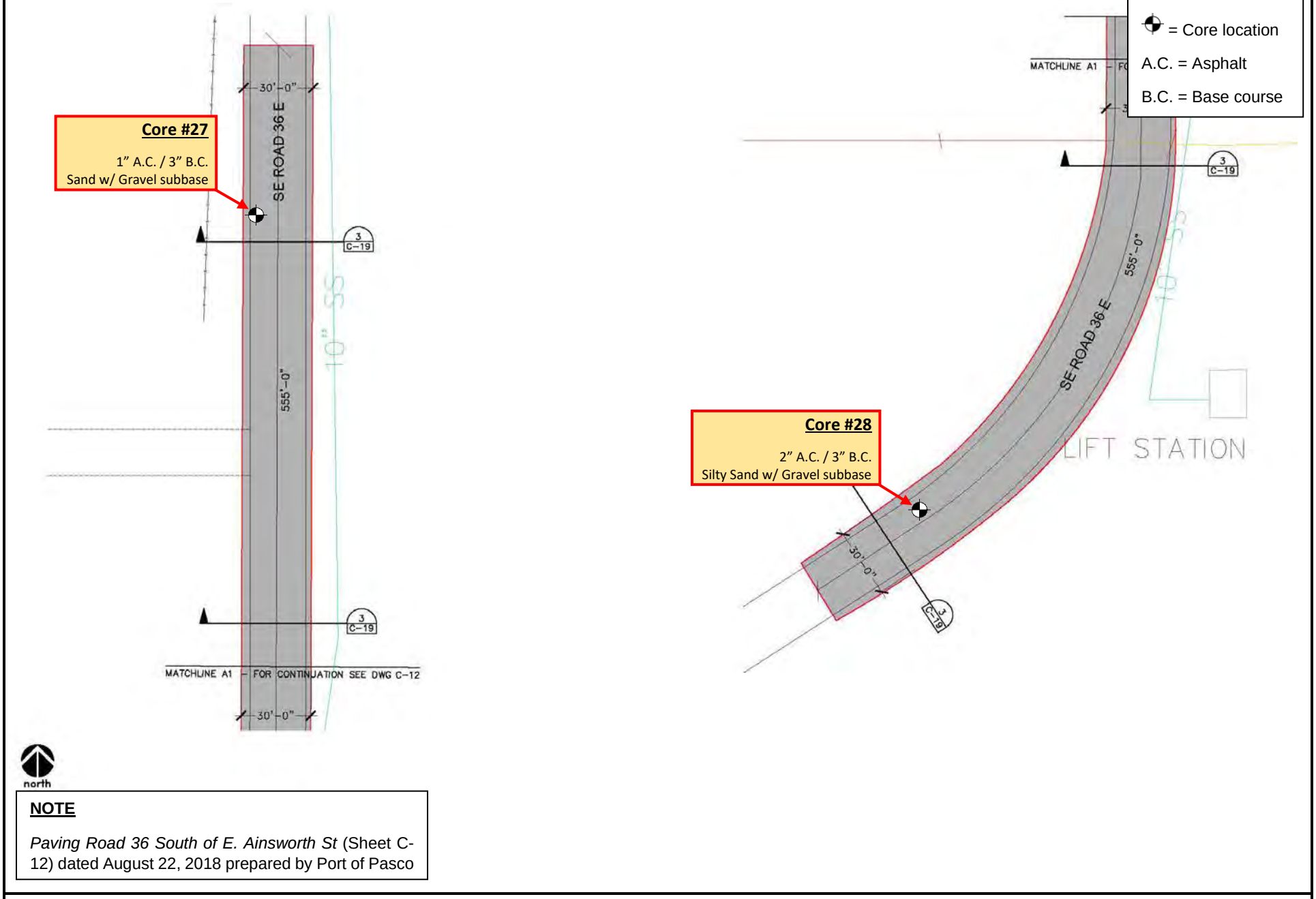
FIGURE 4L: CORE LOCATION MAP **PROJECT NO. 219-1119**



NOTE

Paving from Building Face on North Side Warehouse 6 Bays 1, 2 & 4 to E. Warehouse St., Storm Water Retention (Sheet C-10) dated August 22, 2018 prepared by Port of Pasco

FIGURE 4M: CORE LOCATION MAP **PROJECT NO. 219-1119**



NOTE

Paving Road 36 South of E. Ainsworth St (Sheet C-12) dated August 22, 2018 prepared by Port of Pasco

FIGURE 4N: CORE LOCATION MAP **PROJECT NO. 219-1119**

Appendix II

Boring, Test-Pit & Infiltration Test Logs, Key Chart (for Soil Classification)

GN Northern Inc.
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BORING NUMBER B-1

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/31/19 **COMPLETED** 7/31/19
GROUND ELEVATION 344 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Johnson Exploration Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-53 w/ HSA and Rope & Cathead
▽ **AT TIME OF DRILLING** 4.50 ft / Elev 339.50 ft
LOGGED BY KAH **CHECKED BY** MYM
AT END OF DRILLING ---
NOTES Approx. GPS Coords.: 46°12'39.04"N, 119° 3'2.15"W
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0					0.3	~3" ASPHALT	343.8
				GM		FILL: SILTY GRAVEL WITH SAND, (GM) gray, subrounded to subangular, damp, with woody debris	
					1.5		342.5
	SPT	6-6-6 (12)	MC = 21% Fines = 63%	ML		SANDY SILT, (ML) olive brown, moist to wet, medium dense	
						- becomes wet	
					4.5 ▽		339.5
5	SPT	3-7-10 (17)		SP-SM		POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) gray, fine grained, medium dense, with gravel	
					7.0		337.0
	SPT	10-7-7 (14)		SP		POORLY GRADED SAND WITH GRAVEL, (SP) dark gray, fine to medium grained, medium dense	
10	SPT	13-8-10 (18)			11.5		332.5
				GP		POORLY GRADED GRAVEL, (GP) gray, rounded, medium dense, with cobbles	
15	SPT	8-16-12 (28)			16.5		327.5

- Groundwater encountered at ~4.5' BGS at time of drilling
- Referenced elevations are approximate and based on Google Earth topography

Bottom of borehole at 16.5 feet.

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BORING NUMBER B-2

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/31/19 **COMPLETED** 7/31/19
GROUND ELEVATION 345 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Johnson Exploration Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-53 w/ HSA and Rope & Cathead
▽ **AT TIME OF DRILLING** 5.00 ft / Elev 340.00 ft
LOGGED BY KAH **CHECKED BY** MYM
AT END OF DRILLING ---
NOTES Approx. GPS Coords.: 46°12'41.15"N, 119° 3'17.03"W
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0					0.3	CRUSHED GRAVEL	344.8
				SM		SILTY SAND, (SM) brown, fine grained, damp, medium dense	
	SPT	8-10-9 (19)					
					4.5		340.5
5						▽ POORLY GRADED SAND, (SP) gray, fine grained, loose	
	SPT	7-4-5 (9)	MC = 10% Fines = 3%	SP			
					7.0		338.0
	SPT	16-11-12 (23)				POORLY GRADED GRAVEL WITH SAND, (GP) gray, rounded, medium dense	
10							
	SPT	7-11-9 (20)		GP			
15						- becomes dense	
	SPT	15-20-15 (35)					
					16.5		328.5

- Groundwater encountered at ~5' BGS at time of drilling
- Referenced elevations are approximate and based on Google Earth topography

Bottom of borehole at 16.5 feet.

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BORING NUMBER B-3

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/31/19 **COMPLETED** 7/31/19
GROUND ELEVATION 348 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR Johnson Exploration Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-53 w/ HSA and Rope & Cathead
▽ **AT TIME OF DRILLING** 9.25 ft / Elev 338.75 ft
LOGGED BY KAH **CHECKED BY** MYM
AT END OF DRILLING ---
NOTES Approx. GPS Coords.: 46°12'31.36"N, 119° 3'4.71"W
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					0.3	~3" CRUSHED GRAVEL — 347.8
				ML		SILT WITH SAND, (ML) olive, moist to wet, medium dense
	SPT	8-6-8 (14)	MC = 17% Fines = 66%			
					4.0	344.0
5						POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) brown, rounded, moist to wet, very dense
	SPT	28-19-49 (68)				
10				GP-GM		▽
	SPT	10-9-15 (24)				- becomes medium dense
					14.5	333.5

- Groundwater encountered at ~9.25' BGS at time of drilling
Referenced elevations are based on topography provided by MacKay Sposito
Bottom of borehole at 14.5 feet.

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BORING NUMBER B-4

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/1/19 **COMPLETED** 8/1/19
GROUND ELEVATION 346 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Johnson Exploration Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-53 w/ HSA and Rope & Cathead
AT TIME OF DRILLING ---
LOGGED BY KS **CHECKED BY** MYM
AT END OF DRILLING 6.50 ft / Elev 339.50 ft
NOTES Approx. GPS Coords.: 46°12'46.99"N, 119° 3'26.63"W
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					0.3	~3" ASPHALT — 345.8
						SILTY SAND, (SM) brown, fine grained, moist, medium dense
	SPT	7-6-5 (11)	MC = 3% Fines = 14%	SM		
5	SPT	3-1-1 (2)				- becomes brown to gray, wet, very loose
					7.0	339.0
	SPT	5-4-7 (11)		ML		SANDY SILT, (ML) brown, medium dense, some ferrous staining
10	SPT	4-10-13 (23)				- becomes SILT (ML), with interbedded lenses of SILTY SAND (SM)
					11.5	334.5

- Groundwater encountered at ~6.5' BGS at end of drilling
- Referenced elevations are approximate and based on Google Earth topography

Bottom of borehole at 11.5 feet.

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BORING NUMBER B-5

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/1/19 **COMPLETED** 8/1/19
GROUND ELEVATION 347 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Johnson Exploration Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-53 w/ HSA and Rope & Cathead
AT TIME OF DRILLING ---
LOGGED BY MYM **CHECKED BY** KAH
AT END OF DRILLING 8.75 ft / Elev 338.25 ft
NOTES Approx. GPS Coords.: 46°12'50.66"N, 119° 3'39.84"W
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					0.2	CRUSHED GRAVEL ~346.8
						SILTY SAND, (SM) brown, fine grained, moist, loose
	SPT	5-3-4 (7)	MC = 16% Fines = 33%	SM		
5						
	SPT	7-5-5 (10)				- becomes loose to medium dense (no sample recovery)
					7.0	340.0
	SPT	3-3-4 (7)				SANDY SILT, (ML) brown, wet, loose, ferrous staining, some SILT (ML) and SILTY SAND (SM)
10				ML		
	SPT	4-3-4 (7)			13.0	- becomes SILT WITH SAND (ML), light brown 334.0
				SP	14.0	POORLY GRADED SAND WITH GRAVEL, (SP) gray to black, fine to coarse grained, loose, rounded gravel 333.0

- Groundwater encountered at ~8'9" BGS
- Referenced elevations are approximate and based on Google Earth topography

Bottom of borehole at 14.0 feet.

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BORING NUMBER B-6

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/1/19 **COMPLETED** 8/1/19
GROUND ELEVATION 341 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Johnson Exploration Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-53 w/ HSA and Rope & Cathead
AT TIME OF DRILLING ---
LOGGED BY MYM **CHECKED BY** KAH
AT END OF DRILLING ---
NOTES Approx. GPS Coords.: 46°13'1.69"N, 119° 4'15.76"W
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				GM		FILL: SILTY GRAVEL WITH SAND, (GM) grayish brown, subrounded to subangular, dry to damp — 340.3
				SM		0.8 SILTY SAND, (SM) brown, fine grained, moist, loose to medium dense — 338.5
	SPT	24-27-25 (52)	MC = 3% Fines = 5%	GP		2.5 POORLY GRADED GRAVEL WITH SAND, (GP) gray, rounded, damp to moist, very dense, with cobbles
5						
	SPT	19-25-22 (47)				- becomes dense
						6.5 — 334.5

- Borehole terminated at ~5' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on Google Earth topography

Bottom of borehole at 6.5 feet.

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BORING NUMBER B-7

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/2/19 **COMPLETED** 8/2/19
GROUND ELEVATION 352.5 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR Johnson Exploration Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-53 w/ HSA and Rope & Cathead
▽ **AT TIME OF DRILLING** 12.25 ft / Elev 340.25 ft
LOGGED BY MBB **CHECKED BY** KAH
AT END OF DRILLING ---
NOTES Approx. GPS Coords.: 46°13'3.42"N, 119° 4'28.28"W
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					~6" CRUSHED GRAVEL — 0.5 — 352.0
			SM		SILTY SAND, (SM) brown, fine grained, moist — 4.5 — 348.0
5			GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) brown
10					— 11.5 — 341.0
			SP		POORLY GRADED SAND, (SP) black, medium grained, medium dense, trace gravel ▽
15	SPT	5-6-9 (15)			— 16.5 — 336.0

- Groundwater encountered at ~12'3" BGS at time of drilling
Referenced elevations are based on topography provided by MacKay Sposito
Bottom of borehole at 16.5 feet.

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BORING NUMBER B-8

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/2/19 **COMPLETED** 8/2/19
GROUND ELEVATION 355 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Johnson Exploration Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-53 w/ HSA and Rope & Cathead
AT TIME OF DRILLING ---
LOGGED BY MBB **CHECKED BY** KAH
AT END OF DRILLING ---
NOTES Approx. GPS Coords.: 46°13'4.74"N, 119° 4'40.33"W
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				GP		FILL: POORLY GRADED GRAVEL WITH SAND, (GP) gray, subrounded to subangular, damp
0.8						354.2
				SM		SILTY SAND, (SM) brown, fine grained, moist, medium dense
	SPT	11-9-13 (22)	MC = 8% Fines = 23%			
5						- with gravel
	SPT	12-11-9 (20)				
8.5						346.5
				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) grayish brown to gray, subrounded, moist, dense
10	SPT	32-21-16 (37)				
11.1						343.9
						- Borehole terminated at ~9.5' BGS due to auger refusal - Groundwater not encountered at time of drilling - Referenced elevations are approximate and based on Google Earth topography Bottom of borehole at 11.1 feet.

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BORING NUMBER B-9

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/2/19 **COMPLETED** 8/2/19
GROUND ELEVATION 353 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Johnson Exploration Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-53 w/ HSA and Rope & Cathead
▽ **AT TIME OF DRILLING** 14.25 ft / Elev 338.75 ft
LOGGED BY MBB **CHECKED BY** KAH
AT END OF DRILLING ---
NOTES Approx. GPS Coords.: 46°12'57.77"N, 119° 4'23.49"W
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0				GP		FILL: POORLY GRADED GRAVEL WITH SAND, (GP) gray, subrounded to subangular, damp	352.5
				ML		0.5 APPARENT FILL: SANDY SILT, (ML) brown, moist	352.0
						1.0 SANDY SILT, (ML) brown, moist, dense, (APPARENT NATIVE)	
				ML			
	SPT	5-31-50/5"	MC = 18% Fines = 51%			3.5	349.5
5						POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, subrounded, moist, very dense	
	SPT	21-31-43 (74)					
				GP-GM			
10						- becomes medium dense	
	SPT	25-15-11 (26)					
						13.5	339.5
						POORLY GRADED SAND WITH GRAVEL, (SP) fine to coarse grained, loose	
15						▽	
	SPT	3-3-4 (7)		SP			
						16.5	336.5

- Groundwater encountered at ~16.5' BGS at time of drilling
- Referenced elevations are approximate and based on Google Earth topography

Bottom of borehole at 16.5 feet.

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BORING NUMBER B-10

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/5/19 **COMPLETED** 8/5/19
GROUND ELEVATION 353 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Johnson Exploration Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-53 w/ HSA and Rope & Cathead
▽ **AT TIME OF DRILLING** 13.00 ft / Elev 340.00 ft
LOGGED BY KS **CHECKED BY** KAH
AT END OF DRILLING ---
NOTES Approx. GPS Coords.: 46°12'56.95"N, 119° 4'15.46"W
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					0.3	~3" ASPHALT 352.8
					0.5	~3" CRUSHED GRAVEL 352.5
				SM		SILTY SAND, (SM) brown, fine grained
					2.0	351.0
	SPT	18-36-25 (61)	MC = 4% Fines = 8%	GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) brown to gray, subrounded, damp, very dense
5	SPT	35-16-20 (36)				- becomes dense
10	SPT	50/4"				- becomes very dense
					▽	
15	SPT	32-22-24 (46)				- becomes dense
					16.5	336.5

- Groundwater encountered at ~13' BGS at time of drilling
- Referenced elevations are approximate and based on Google Earth topography

Bottom of borehole at 16.5 feet.

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BORING NUMBER B-11

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/5/19 **COMPLETED** 8/5/19
GROUND ELEVATION 350 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Johnson Exploration Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-53 w/ HSA and Rope & Cathead
AT TIME OF DRILLING ---
LOGGED BY KS **CHECKED BY** KAH
AT END OF DRILLING ---
NOTES Approx. GPS Coords.: 46°12'56.80"N, 119° 4'8.67"W
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				GP-GM		FILL: POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) light brown, subrounded, damp
					1.0	349.0
				SM		SILTY SAND, (SM) brown, fine grained, moist, (APPARENT NATIVE)
					2.0	348.0
	SPT	24-37-50/5"	MC = 3% Fines = 5%	GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) brown to gray, subangular, dry, very dense
5						
	SPT	17-42-46 (88)				- becomes dry to damp
					6.5	343.5

- Borehole terminated at ~5.5' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on Google Earth topography

Bottom of borehole at 6.5 feet.

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BORING NUMBER B-12

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/2/19 **COMPLETED** 8/2/19
GROUND ELEVATION 352.5 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR Johnson Exploration Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-53 w/ HSA and Rope & Cathead
AT TIME OF DRILLING ---
LOGGED BY MBB **CHECKED BY** KAH
AT END OF DRILLING ---
NOTES Approx. GPS Coords.: 46°12'52.94"N, 119° 4'7.90"W
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					0.3 ~3" ASPHALT 352.3
					0.5 ~3" CRUSHED GRAVEL 352.0
			SM		SILTY SAND, (SM) brown, fine grained, damp
					1.5 351.0
					POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, subrounded, medium dense
	SPT	7-12-11 (23)			
5					
			GP-GM		
10					
	SPT	10-12-18 (30)			- becomes medium dense to dense
					14.0 338.5

- Groundwater encountered at ~12'9" at time of drilling
Referenced elevations are based on topography provided by MacKay Sposito
Bottom of borehole at 14.0 feet.

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BORING NUMBER B-13

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/5/19 **COMPLETED** 8/5/19
GROUND ELEVATION 348 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Johnson Exploration Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-53 w/ HSA and Rope & Cathead
▽ **AT TIME OF DRILLING** 7.80 ft / Elev 340.20 ft
LOGGED BY KS **CHECKED BY** KAH
AT END OF DRILLING ---
NOTES Approx. GPS Coords.: 46°12'55.00"N, 119° 3'58.11"W
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						0.3 ~3" ASPHALT 347.8
						0.6 ~4" CRUSHED GRAVEL 347.4
						SILTY SAND, (SM) brown, fine grained, damp, medium dense, trace gravel
	SPT	5-6-5 (11)	MC = 8% Fines = 21%	SM		
5						- becomes loose to medium dense
	SPT	7-6-4 (10)				
						7.5 340.5
						▽ POORLY GRADED GRAVEL WITH SAND, (GP) gray, subrounded, very dense
10	SPT	10-26-36 (62)		GP		
15						- becomes medium dense to dense
	SPT	22-16-14 (30)				16.5 331.5

- Groundwater encountered at ~7.8' BGS at time of drilling
- Referenced elevations are approximate and based on Google Earth topography

Bottom of borehole at 16.5 feet.

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BORING NUMBER B-14

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/5/19 **COMPLETED** 8/5/19
GROUND ELEVATION 348 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Johnson Exploration Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-53 w/ HSA and Rope & Cathead
▽ **AT TIME OF DRILLING** 8.40 ft / Elev 339.60 ft
LOGGED BY KS **CHECKED BY** KAH
AT END OF DRILLING ---
NOTES Approx. GPS Coords.: 46°12'51.77"N, 119° 3'52.38"W
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0				GM		FILL: SILTY GRAVEL, (GM) gray, angular	347.5
						0.5	
						SILTY SAND, (SM) brown, fine grained, damp, medium dense	
				SM			
	SPT	10-10-14 (24)	MC = 13% Fines = 33%				
						4.0	344.0
5						POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, damp, medium dense, trace gravel	
	SPT	18-15-14 (29)					
						▽	
10				SP-SM			
	SPT	19-12-13 (25)				- some gravel	
						14.5	333.5
15						POORLY GRADED SAND, (SP) gray to black, fine to medium grained, dense	
	SPT	12-13-20 (33)		SP			
						16.5	331.5

- Groundwater encountered at ~8'5" BGS
- Referenced elevations are approximate and based on Google Earth topography

Bottom of borehole at 16.5 feet.

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BORING NUMBER B-15

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/5/19 **COMPLETED** 8/5/19
GROUND ELEVATION 351 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Johnson Exploration Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-53 w/ HSA and Rope & Cathead
▽ **AT TIME OF DRILLING** 12.40 ft / Elev 338.60 ft
LOGGED BY KS **CHECKED BY** KAH
AT END OF DRILLING ---
NOTES Approx. GPS Coords.: 46°12'46.80"N, 119° 3'48.28"W
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						0.2 ~2" ASPHALT 350.8
						0.5 ~3" CRUSHED GRAVELS 350.5
				SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) gray, fine to medium grained, some gravel
						2.0 349.0
	SPT	17-16-13 (29)	MC = 3% Fines = 4%	SP		POORLY GRADED SAND, (SP) gray, fine to medium grained, dry to damp, medium dense
5						- with gravel
	SPT	12-10-10 (20)				
						9.5 341.5
10						POORLY GRADED GRAVEL WITH SAND, (GP) gray, subrounded, damp to moist, medium dense
	SPT	5-7-7 (14)		GP		▽
						14.5 336.5
15						POORLY GRADED SAND, (SP) gray to black, fine to medium grained, medium dense, trace gravel
	SPT	13-12-7 (19)		SP		
						16.5 334.5

- Groundwater encountered at ~12'5" BGS at time of drilling
- Referenced elevations are approximate and based on Google Earth topography

Bottom of borehole at 16.5 feet.

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TEST PIT NUMBER TP-1

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/30/19 **COMPLETED** 7/30/19
GROUND ELEVATION 360 ft **TEST PIT SIZE** 24 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY KAH **CHECKED BY** MYM
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°13'8.60"N, 119° 4'24.60"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0		GM		FILL: SILTY GRAVEL, (GM) brown to gray, damp, appears medium dense	
				0.8	359.2
		GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) brown, subrounded, damp to moist, appears medium dense, with cobbles (APPARENT NATIVE)	
				1.5	358.5
		GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, subrounded, damp, appears dense, with cobbles, fine to coarse grained sand	
5				- no cobbles	
10				10.0	350.0

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 10.0 feet.

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TEST PIT NUMBER TP-2

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/30/19 **COMPLETED** 7/30/19
GROUND ELEVATION 351 ft **TEST PIT SIZE** 24 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY KAH **CHECKED BY** MYM
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'57.60"N, 119° 4'0.18"W
AFTER EXCAVATION 8.00 ft / Elev 343.00 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0				~6" CRUSHED GRAVEL	
0.5					350.5
		GM		SILTY GRAVEL, (GM) dark grayish brown, damp to moist, appears dense, trace trash/debris (wood, rebar)	
1.7					349.3
		SM		SILTY SAND, (SM) brown, fine grained, moist, appears medium dense, trace gravel (APPARENT NATIVE)	
2.3					348.8
		GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, rounded, damp, appears medium dense to dense, slightly cemented in upper portion, interbedded fine to coarse grained gravel	
5					
8.3					342.8

- Groundwater encountered at ~8' BGS after excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 8.3 feet.

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TEST PIT NUMBER TP-3

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/30/19 **COMPLETED** 7/30/19
GROUND ELEVATION 344 ft **TEST PIT SIZE** 24 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
▽ **AT TIME OF EXCAVATION** 4.25 ft / Elev 339.75 ft
LOGGED BY KAH **CHECKED BY** MYM
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'38.00"N, 119° 3'1.30"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0					
				0.2 ~2.5" ASPHALT/CHIP SEAL	343.8
				0.5 ~4" CRUSHED GRAVEL	343.5
				SILT WITH SAND, (ML) olive brown, moist, appears medium dense, (APPARENT NATIVE)	
		ML		- 3" lense of SILTY SAND (SM)	
				3.0	341.0
				POORLY GRADED GRAVEL WITH SAND, (GP) gray, subrounded, moist to wet, appears medium dense to dense, trace cobbles, slightly cemented at top of layer	
				▽	
5		GP		- becomes POORLY GRADED SAND WITH GRAVEL (SP), fine to coarse grained	
				7.0	337.0

- Groundwater encountered at ~4'3" BGS at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 7.0 feet.

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TEST PIT NUMBER TP-4

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/30/19 **COMPLETED** 7/30/19
GROUND ELEVATION 348 ft **TEST PIT SIZE** 24 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY KAH **CHECKED BY** MYM
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'46.96"N, 119° 3'38.85"W
AFTER EXCAVATION 8.50 ft / Elev 339.50 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0		GP-GM		FILL: POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, subrounded to subangular	347.6
0.4				FILL: SILTY SAND, (SM) brown, fine grained, damp to moist, appears medium dense, abandoned storm drain encountered at ~2.5' BGS	
		SM			
3.3					344.7
		ML		SILT WITH SAND, (ML) olive brown, moist, appears medium dense, slightly cemented (APPARENT NATIVE)	
4.5					343.5
5				SILTY SAND, (SM) brown, fine grained, damp to moist, appears medium dense	
		SM		- becomes moist to wet	
10					
10.0					338.0

- Groundwater encountered at ~8.5' BGS after excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 10.0 feet.

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TEST PIT NUMBER TP-5

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/30/19 **COMPLETED** 7/30/19
GROUND ELEVATION 357 ft **TEST PIT SIZE** 24 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY KAH **CHECKED BY** MYM
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'56.22"N, 119° 4'21.68"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0					
				0.3 ~3" CRUSHED GRAVEL	356.8
		SM		FILL: SILTY SAND WITH GRAVEL, (SM) brown, fine grained, damp, appears loose to medium dense, with wood debris	
				1.8	355.3
		SM		2.0 SILTY SAND, (SM) brown, fine grained, damp, appears medium dense, (APPARENT NATIVE)	355.0
				POORLY GRADED GRAVEL WITH SAND, (GP) gray, rounded, damp to moist, appears medium dense to dense, slightly cemented at top of layer	
5		GP			
				8.5	348.5

- Test-pit terminated at ~8.5' BGS due to caving of excavation
- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 8.5 feet.

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TEST PIT NUMBER P-1

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/30/19 **COMPLETED** 7/30/19
GROUND ELEVATION 352 ft **TEST PIT SIZE** 27 x 78 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY MBB **CHECKED BY** KAH
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°13'2.94"N, 119° 4'17.78"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0		GM		FILL: SILTY GRAVEL, (GM) grayish brown, subrounded to subangular, dry to damp, appears loose to medium dense	351.3
0.8		SM		SILTY SAND, (SM) brown, fine grained, moist, appears loose to medium dense, (APPARENT NATIVE)	350.0
2.0		GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, subrounded, damp to moist, appears medium dense, with cobbles	348.0
4.0					

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 4.0 feet.

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TEST PIT NUMBER P-2

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/30/19 **COMPLETED** 7/30/19
GROUND ELEVATION 351 ft **TEST PIT SIZE** 30 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY MBB **CHECKED BY** KAH
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°13'0.27"N, 119° 4'13.24"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					~6" CRUSHED GRAVEL 350.5
0.5			SM		APPARENT FILL: SILTY SAND, (SM) light brown, fine grained, moist, appears medium dense 350.2
0.8			SM		SILTY SAND, (SM) brown, fine grained, moist, appears medium dense, (APPARENT NATIVE)
	GB	MC = 5% Fines = 20%			
3.0					348.0

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 3.0 feet.

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TEST PIT NUMBER P-3

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/30/19 **COMPLETED** 7/30/19
GROUND ELEVATION 350 ft **TEST PIT SIZE** 30 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY MBB **CHECKED BY** KAH
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'59.84"N, 119° 4'9.88"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			GM		FILL: SILTY GRAVEL WITH SAND, (GM) grayish brown, subrounded, dry to damp, appears loose to medium dense
1.0					349.0
			SM		SILTY SAND, (SM) brown, fine grained, moist, appears medium dense, (APPARENT NATIVE)
	GB	MC = 10% Fines = 25%			
3.0					347.0

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 3.0 feet.

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TEST PIT NUMBER P-4

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/30/19 **COMPLETED** 7/30/19
GROUND ELEVATION 349 ft **TEST PIT SIZE** 30 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY MBB **CHECKED BY** KAH
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'55.48"N, 119° 3'59.41"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					0.3 ~3" ASPHALT 348.8
					0.7 ~5" CRUSHED GRAVEL 348.3
			SM		SILTY SAND, (SM) brown, fine grained, moist, appears medium dense, (APPARENT NATIVE)
	GB	MC = 10% Fines = 28%			3.0 346.0

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 3.0 feet.

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TEST PIT NUMBER P-5

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/30/19 **COMPLETED** 7/30/19
GROUND ELEVATION 348 ft **TEST PIT SIZE** 30 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY MBB **CHECKED BY** KAH
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'54.24"N, 119° 3'52.24"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			GP-GM		FILL: POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) grayish brown, subrounded, damp, appears loose to medium dense
1.0					347.0
			SM		SILTY SAND, (SM) brown, fine grained, moist, appears medium dense, (APPARENT NATIVE)
	GB	MC = 17% Fines = 38%			
3.0					345.0

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 3.0 feet.

GN Northern Inc.
11115 E. Montgomery, Suite C
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Fax: (509) 248-4220

TEST PIT NUMBER P-6

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/30/19 **COMPLETED** 7/31/19
GROUND ELEVATION 348 ft **TEST PIT SIZE** 30 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
▽ **AT TIME OF EXCAVATION** 6.00 ft / Elev 342.00 ft
LOGGED BY MBB **CHECKED BY** KAH
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'49.95"N, 119° 3'37.99"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					~6" CRUSHED GRAVEL — 0.5 — 347.5
	GB	MC = 16% Fines = 33%	SM		SILTY SAND, (SM) brown, fine grained, moist, appears medium dense, (APPARENT NATIVE)
					4.5 — 343.5
5	GB	MC = 25% Fines = 76%	ML		SILT WITH SAND, (ML) brown, moist, appears medium dense ▽
					8.0 — 340.0

- Groundwater encountered at ~6' BGS at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 8.0 feet.

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TEST PIT NUMBER P-7

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/31/19 **COMPLETED** 7/31/19
GROUND ELEVATION 346 ft **TEST PIT SIZE** 30 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY MBB **CHECKED BY** KAH
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'45.50"N, 119° 3'23.54"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			GP-GM		FILL: POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) grayish brown, subrounded, damp, appears loose to medium dense
1.8					344.2
			ML		SANDY SILT, (ML) brown, moist, appears medium dense, (APPARENT NATIVE)
	GB	MC = 24% Fines = 54%			- becomes moist to wet
3.0					343.0

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 3.0 feet.

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TEST PIT NUMBER P-8

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/31/19 **COMPLETED** 7/31/19
GROUND ELEVATION 344 ft **TEST PIT SIZE** 30 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
▽ **AT TIME OF EXCAVATION** 3.50 ft / Elev 340.50 ft
LOGGED BY KAH **CHECKED BY** MYM
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'41.06"N, 119° 3'9.07"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			GP-GM		FILL: POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) grayish brown, subrounded, damp, appears loose to medium dense	
1.5						342.5
	GB	MC = 17% Fines = 55%	ML		SANDY SILT, (ML) brown, moist, appears medium dense, (APPARENT NATIVE)	
2.0						342.0
			GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, subrounded, appears medium dense	
3.5 ▽						340.5

- Groundwater encountered at ~3.5' BGS at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 3.5 feet.

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TEST PIT NUMBER P-9

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/31/19 **COMPLETED** 7/31/19
GROUND ELEVATION 344 ft **TEST PIT SIZE** 30 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY MBB **CHECKED BY** KAH
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'37.29"N, 119° 3'4.01"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0						
			GM		FILL: SILTY GRAVEL WITH SAND, (GM) grayish brown, subrounded, damp, appears loose to medium dense	343.0
1.0						
			SM		SILTY SAND WITH GRAVEL, (SM) brown, fine grained, moist, appears medium dense, (APPARENT NATIVE)	342.0
2.0						
	GB	MC = 3% Fines = 1%	GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, subrounded, moist, appears medium dense, fine to coarse grained sand - becomes moist to wet	341.0
3.0						

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 3.0 feet.

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TEST PIT NUMBER P-10

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/31/19 **COMPLETED** 7/31/19
GROUND ELEVATION 346 ft **TEST PIT SIZE** 30 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY KS **CHECKED BY** KAH
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'41.75"N, 119° 3'18.73"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			GP-GM		FILL: POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) grayish brown, subrounded, damp, appears loose to medium dense
2.0					344.0
	GB	MC = 12% Fines = 26%	SM		SILTY SAND, (SM) brown, fine to medium grained, moist, appears medium dense, (APPARENT NATIVE)
3.0					343.0

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 3.0 feet.

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TEST PIT NUMBER P-11

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/31/19 **COMPLETED** 7/31/19
GROUND ELEVATION 348 ft **TEST PIT SIZE** 30 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY KS **CHECKED BY** KAH
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'46.13"N, 119° 3'32.84"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					~6" CRUSHED GRAVEL — 347.5
0.5			GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, subrounded, damp, appears medium dense, (APPARENT NATIVE) — 346.5
1.5			SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to medium grained, moist, appears medium dense
	GB	MC = 8% Fines = 11%			345.0
3.0					

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 3.0 feet.

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TEST PIT NUMBER P-12

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 7/31/19 **COMPLETED** 7/31/19
GROUND ELEVATION 348 ft **TEST PIT SIZE** 30 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY MBB **CHECKED BY** KAH
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'50.62"N, 119° 3'47.40"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			SM		FILL: SILTY SAND WITH GRAVEL, (SM) brownish gray, fine grained, damp, appears medium dense — 347.3
0.7					
			SM		SILTY SAND, (SM) brown, fine grained, moist, appears medium dense, (APPARENT NATIVE)
	GB	MC = 7% Fines = 13%			- becomes moist to wet — 345.0
3.0					

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 3.0 feet.

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TEST PIT NUMBER P-13

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/1/19 **COMPLETED** 8/1/19
GROUND ELEVATION 352 ft **TEST PIT SIZE** 30 x 48 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY MBB **CHECKED BY** KAH
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'56.01"N, 119° 4'4.93"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0		GP-GM		FILL: POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) light brown, subrounded, damp, appears loose to medium dense	
1.0					351.0
		SM		SILTY SAND, (SM) brown, fine grained, moist, appears medium dense, (APPARENT NATIVE)	
2.5					349.5
		GM		SILTY GRAVEL, (GM) brown, subrounded, moist, appears medium dense	
3.0					349.0
		GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, subrounded, moist, appears medium dense, with medium to coarse grained sand	
5					
5.0					347.0

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 5.0 feet.

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TEST PIT NUMBER P-14

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/1/19 **COMPLETED** 8/1/19
GROUND ELEVATION 352 ft **TEST PIT SIZE** 30 x 84 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY KS **CHECKED BY** KAH
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°13'2.50"N, 119° 4'25.59"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			GP-GM		FILL: POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) light brown, subrounded, damp, appears loose to medium dense
1.0					351.0
			SM		SILTY SAND, (SM) brown, fine grained, moist, appears medium dense, (APPARENT NATIVE)
	GB	MC = 13% Fines = 34%			
3.0					349.0

- Groundwater encountered at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 3.0 feet.

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TEST PIT NUMBER P-15

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/1/19 **COMPLETED** 8/1/19
GROUND ELEVATION 353 ft **TEST PIT SIZE** 30 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY KS **CHECKED BY** KAH
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'58.46"N, 119° 4'24.45"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			GP-GM		FILL: POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) light brown, subrounded, damp, appears loose to medium dense
1.0					352.0
			SM		SILTY SAND WITH GRAVEL, (SM) brown, fine grained, moist, appears medium dense, (APPARENT NATIVE)
	GB	MC = 5% Fines = 13%			
3.0					350.0

- Groundwater encountered at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 3.0 feet.

GN Northern Inc.
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TEST PIT NUMBER P-16

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/1/19 **COMPLETED** 8/1/19
GROUND ELEVATION 352 ft **TEST PIT SIZE** 30 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY MBB **CHECKED BY** KAH
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'56.42"N, 119° 4'18.14"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			GM		FILL: SILTY GRAVEL, (GM) light brown, subrounded, damp, appears loose to medium dense	
1.5						350.5
			SM		SILTY SAND, (SM) brown, fine grained, moist, appears medium dense, (APPARENT NATIVE)	
3.0						349.0
			GM		SILTY GRAVEL WITH SAND, (GM) brown, subrounded, moist, appears medium dense	
	GB	MC = 18% Fines = 29%				
4.5						347.5

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 4.5 feet.

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TEST PIT NUMBER P-17

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/1/19 **COMPLETED** 8/1/19
GROUND ELEVATION 352 ft **TEST PIT SIZE** 30 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY MBB **CHECKED BY** KAH
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'54.00"N, 119° 4'10.30"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0		GM		FILL: SILTY GRAVEL WITH SAND, (GM) light brown, subrounded, dry to damp	
1.0					351.0
		GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, subrounded, damp to moist, (APPARENT NATIVE)	
3.0					349.0

- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 3.0 feet.

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TEST PIT NUMBER P-18

CLIENT MacKay Sposito, Inc.
PROJECT NAME Road and Storm at Big Pasco Industrial Center
PROJECT NUMBER 219-1119
PROJECT LOCATION Port of Pasco, Pasco, WA
DATE STARTED 8/1/19 **COMPLETED** 8/1/19
GROUND ELEVATION 352 ft **TEST PIT SIZE** 30 x 60 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD John Deere 50G Mini Excavator
AT TIME OF EXCAVATION ---
LOGGED BY KS **CHECKED BY** KAH
AT END OF EXCAVATION ---
NOTES Approx. GPS Coords.: 46°12'51.95"N, 119° 4'3.63"W
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			GM		FILL: SILTY GRAVEL WITH SAND, (GM) light brown, subrounded, dry to damp, appears medium dense
1.0					351.0
			SM		SILTY SAND, (SM) brown, fine grained, moist, appears medium dense, (APPARENT NATIVE)
					- thin layer of POORLY GRADED SAND WITH SILT (SP-SM)
	GB	MC = 17% Fines = 34%			
4.0					348.0

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on Google Earth topography

Bottom of test pit at 4.0 feet.

Northern, Inc.
Kennewick, Yakima, Spokane, Hermiston (OR)

KEY CHART

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N-VALUE

COARSE-GRAINED SOILS			FINE-GRAINED SOILS		
DENSITY	N (BLOWS/FT)	FIELD TEST	CONSISTENCY	N (BLOWS/FT)	FIELD TEST
Very Loose	0 – 4	Easily penetrated with ½-inch reinforcing rod pushed by hand	Very Soft	0 – 2	Easily penetrated several inches by thumb
Loose	4 – 10	Difficult to penetrate with ½-inch reinforcing rod pushed by hand	Soft	2 – 4	Easily penetrated one inch by thumb
Medium -Dense	10 – 30	Easily penetrated with ½-inch rod driven with a 5-lb hammer	Medium-Stiff	4 – 8	Penetrated over ½-inch by thumb with moderate effort
Dense	30 – 50	Difficult to penetrate with ½-inch rod driven with a 5-lb hammer	Stiff	8 – 15	Indented about ½-inch by thumb but penetrated with great effort
Very Dense	> 50	penetrated only a few inches with ½-inch rod driven with a 5-lb hammer	Very Stiff	15 – 30	Readily indented by thumb
			Hard	> 30	Indented with difficulty by thumbnail

USCS SOIL CLASSIFICATION

MAJOR DIVISIONS				GROUP DESCRIPTION
Coarse-Grained Soils <50% passes #200 sieve	**Gravel** and **Gravelly Soils** <50% coarse fraction passes #4 sieve	**Gravel** (with little or no fines)	GW	Well-graded **Gravel**
			GP	Poorly Graded **Gravel**
		Gravel (with >12% fines)	GM	Silty **Gravel**
			GC	Clayey **Gravel**
	Sand and **Sandy Soils** >50% coarse fraction passes #4 sieve	**Sand** (with little or no fines)	SW	Well-graded **Sand**
			SP	Poorly graded **Sand**
		Sand (with >12% fines)	SM	Silty **Sand**
			SC	Clayey **Sand**
Fine-Grained Soils >50% passes #200 sieve	**Silt** and **Clay** Liquid Limit < 50		ML	**Silt**
			CL	Lean **Clay**
			OL	Organic **Silt** and C**lay** (low plasticity)
	Silt and **Clay** Liquid Limit > 50		MH	Inorganic **Silt**
			CH	Inorganic **Clay**
			OH	Organic **Clay** and **Silt** (med. to high plasticity)
Highly Organic Soils			PT	**Peat**
				Top Soil

LOG SYMBOLS

	2S	2" OD Split Spoon (SPT)
	3S	3" OD Split Spoon
	NS	Non-Standard Split Spoon
	ST	Shelby Tube
	CR	Core Run
	BG	Bag Sample
	TV	Torvane Reading
	PP	Penetrometer Reading
	NR	No Recovery
	GW	Groundwater Table

MODIFIERS

DESCRIPTION	RANGE
Trace	<5%
Little	5% – 12%
Some	>12%

MOISTURE CONTENT

DESCRIPTION	FIELD OBSERVATION
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but not visible water
Wet	Visible free water

SOIL CLASSIFICATION INCLUDES

1. Group Name
2. Group Symbol
3. Color
4. Moisture content
5. Density / consistency
6. Cementation
7. Particle size (if applicable)
8. Odor (if present)
9. Comments

MAJOR DIVISIONS WITH GRAIN SIZE

SIEVE SIZE						
12"	3"	3/4"	4	10	40	200
GRAIN SIZE (INCHES)						
12	3	0.75	0.19	0.079	0.0171	0.0029

Boulders	Cobbles	Gravel		Sand			Silt and Clay
		Coarse	Fine	Coarse	Medium	Fine	

Conditions shown on boring and testpit logs represent our observations at the time and location of the fieldwork, modifications based on lab test, analysis, and geological and engineering judgment. These conditions may not exist at other times and locations, even in close proximity thereof. This information was gathered as part of our investigation, and we are not responsible for any use or interpretation of the information by others.

Appendix III

Laboratory Testing Results

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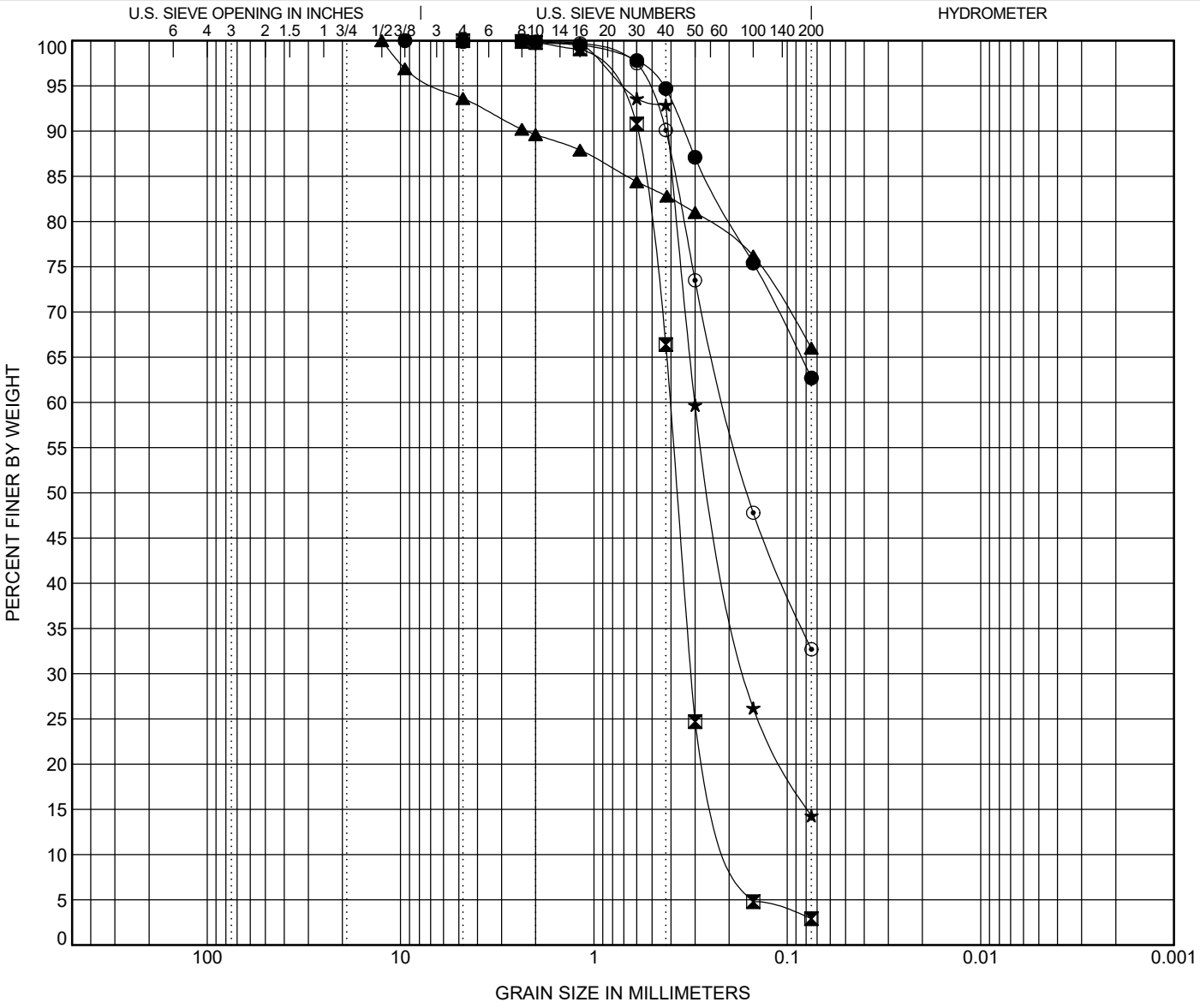
GRAIN SIZE DISTRIBUTION

CLIENT MacKay Sposito, Inc.

PROJECT NAME Road and Storm at Big Pasco Industrial Center

PROJECT NUMBER 219-1119

PROJECT LOCATION Port of Pasco, Pasco, WA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	B-1	2.0	SANDY SILT (ML)					
⊠	B-2	5.0	POORLY GRADED SAND (SP)				1.36	2.24
▲	B-3	2.5	SANDY SILT (ML)					
★	B-4	2.5	SILTY SAND (SM)					
⊙	B-5	2.5	SILTY SAND (SM)					

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-1	2.0	9.5				0.1	37.2	62.7	
⊠	B-2	5.0	4.75	0.403	0.314	0.18	0.0	97.1	2.9	
▲	B-3	2.5	12.5				6.4	27.6	66.0	
★	B-4	2.5	2.36	0.301	0.162		0.0	85.7	14.3	
⊙	B-5	2.5	2.36	0.208			0.0	67.3	32.7	

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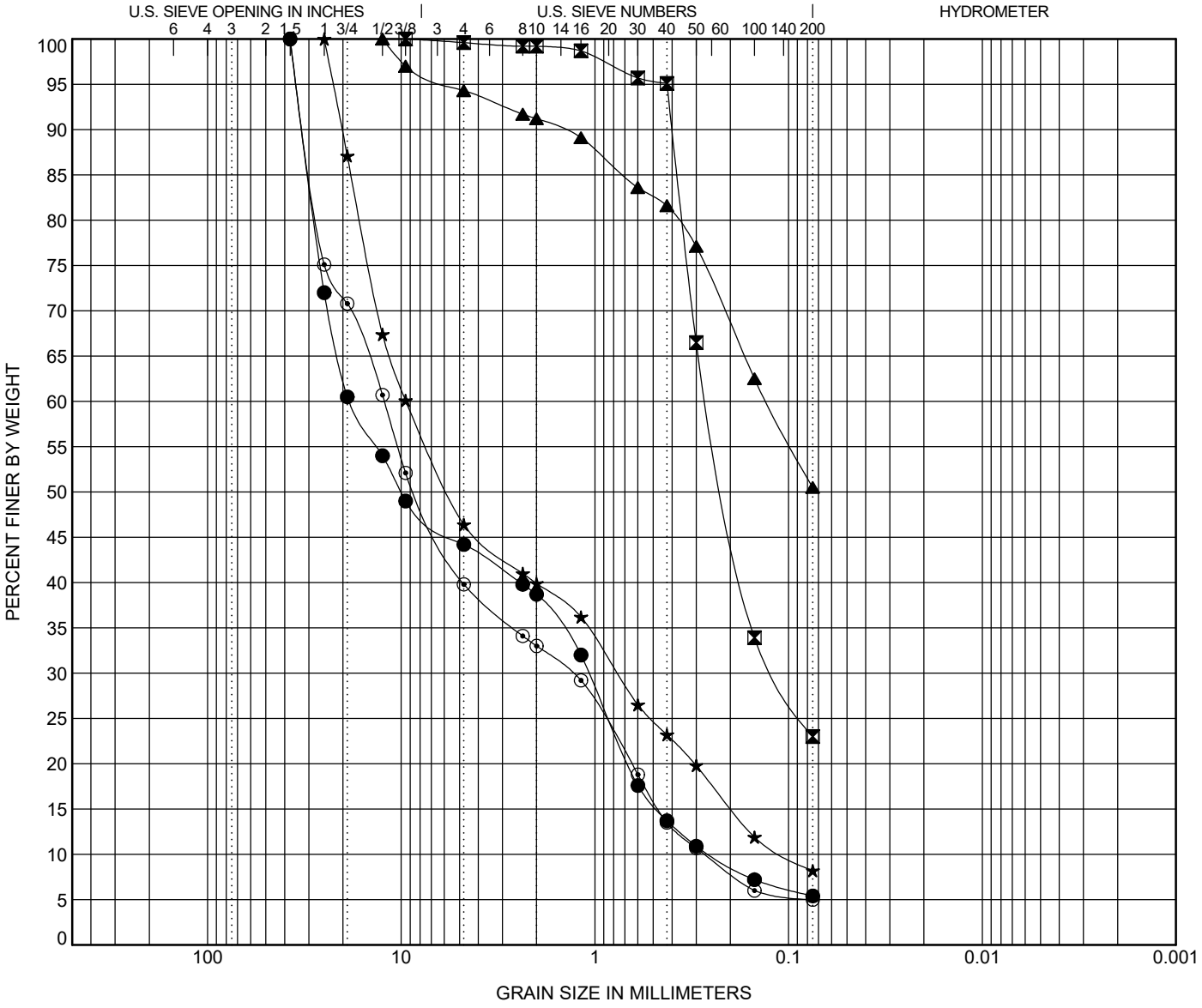
GRAIN SIZE DISTRIBUTION

CLIENT MacKay Sposito, Inc.

PROJECT NAME Road and Storm at Big Pasco Industrial Center

PROJECT NUMBER 219-1119

PROJECT LOCATION Port of Pasco, Pasco, WA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	B-6	2.5	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)				0.25	72.59
⊠	B-8	2.5	SILTY SAND (SM)					
▲	B-9	2.5	SANDY SILT (ML)					
★	B-10	2.5	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)				0.59	89.95
⊙	B-11	2.5	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)				0.53	45.18

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-6	2.5	37.5	18.398	1.074	0.253	55.8	38.8	5.4	
⊠	B-8	2.5	9.5	0.261	0.117		0.4	76.6	23.0	
▲	B-9	2.5	12.5	0.13			5.7	43.8	50.5	
★	B-10	2.5	25	9.452	0.766	0.105	53.6	38.2	8.2	
⊙	B-11	2.5	37.5	12.224	1.319	0.271	60.2	34.8	5.0	

GN Northern Inc.
11115 E. Montgomery, Suite C
Spokane Valley, WA, 99206
Telephone: (509) 248-9798
Fax: (509) 248-4220

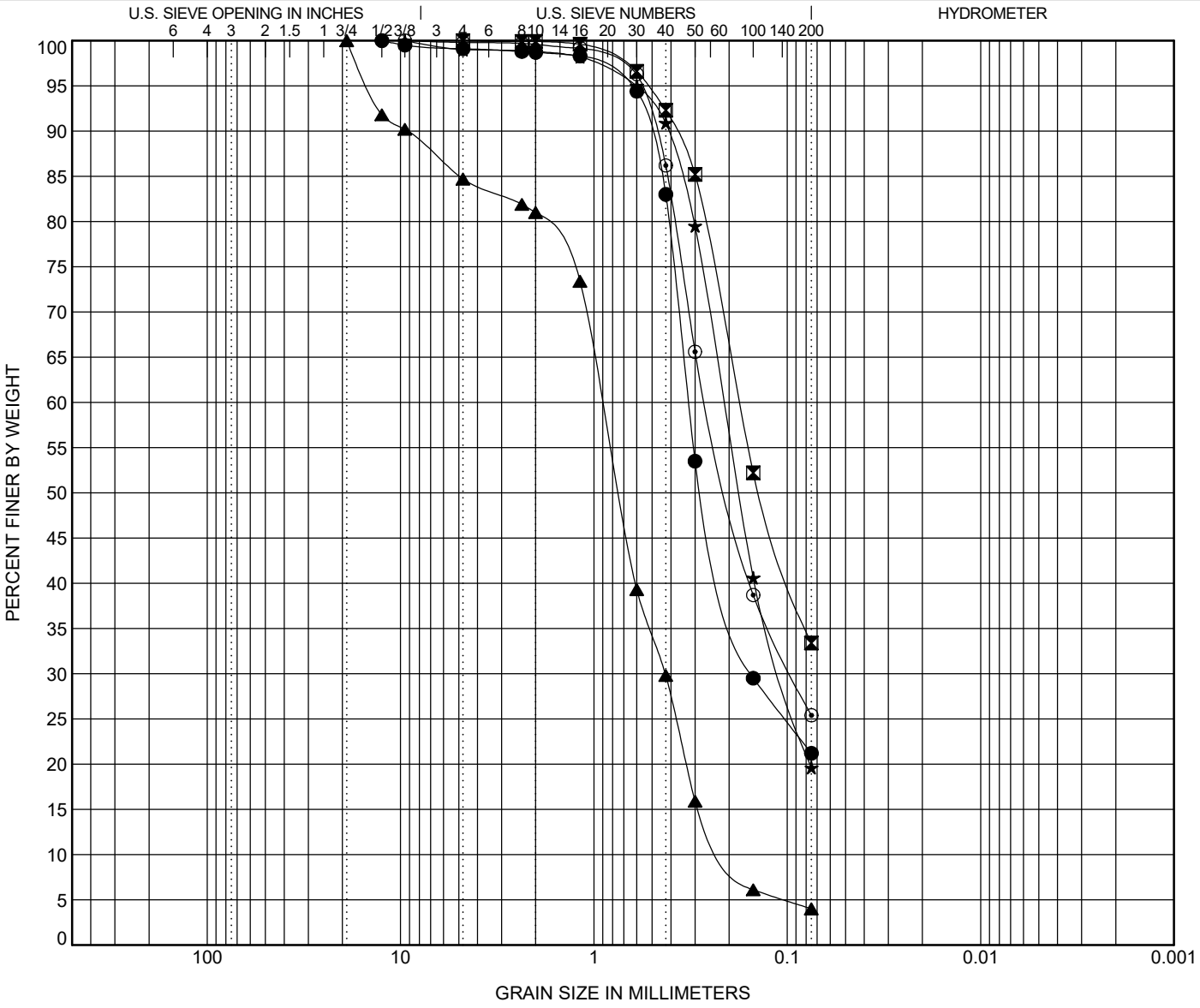
GRAIN SIZE DISTRIBUTION

CLIENT MacKay Sposito, Inc.

PROJECT NAME Road and Storm at Big Pasco Industrial Center

PROJECT NUMBER 219-1119

PROJECT LOCATION Port of Pasco, Pasco, WA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**B-13**	**2.5**	**SILTY SAND (SM)**					
⊠	**B-14**	**2.5**	**SILTY SAND (SM)**					
▲	**B-15**	**2.5**	**POORLY GRADED SAND WITH GRAVEL (SP)**				**1.03**	**4.58**
★	**P-2**	**2.5**	**SILTY SAND (SM)**					
⊙	**P-3**	**2.5**	**SILTY SAND (SM)**					

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-13**	**2.5**	**12.5**	**0.324**	**0.152**		**0.9**	**77.9**	**21.2**	
⊠	**B-14**	**2.5**	**4.75**	**0.177**			**0.0**	**66.6**	**33.4**	
▲	**B-15**	**2.5**	**19**	**0.905**	**0.428**	**0.198**	**15.3**	**80.7**	**4.0**	
★	**P-2**	**2.5**	**9.5**	**0.212**	**0.106**		**1.0**	**79.4**	**19.6**	
⊙	**P-3**	**2.5**	**9.5**	**0.26**	**0.095**		**0.2**	**74.4**	**25.4**	

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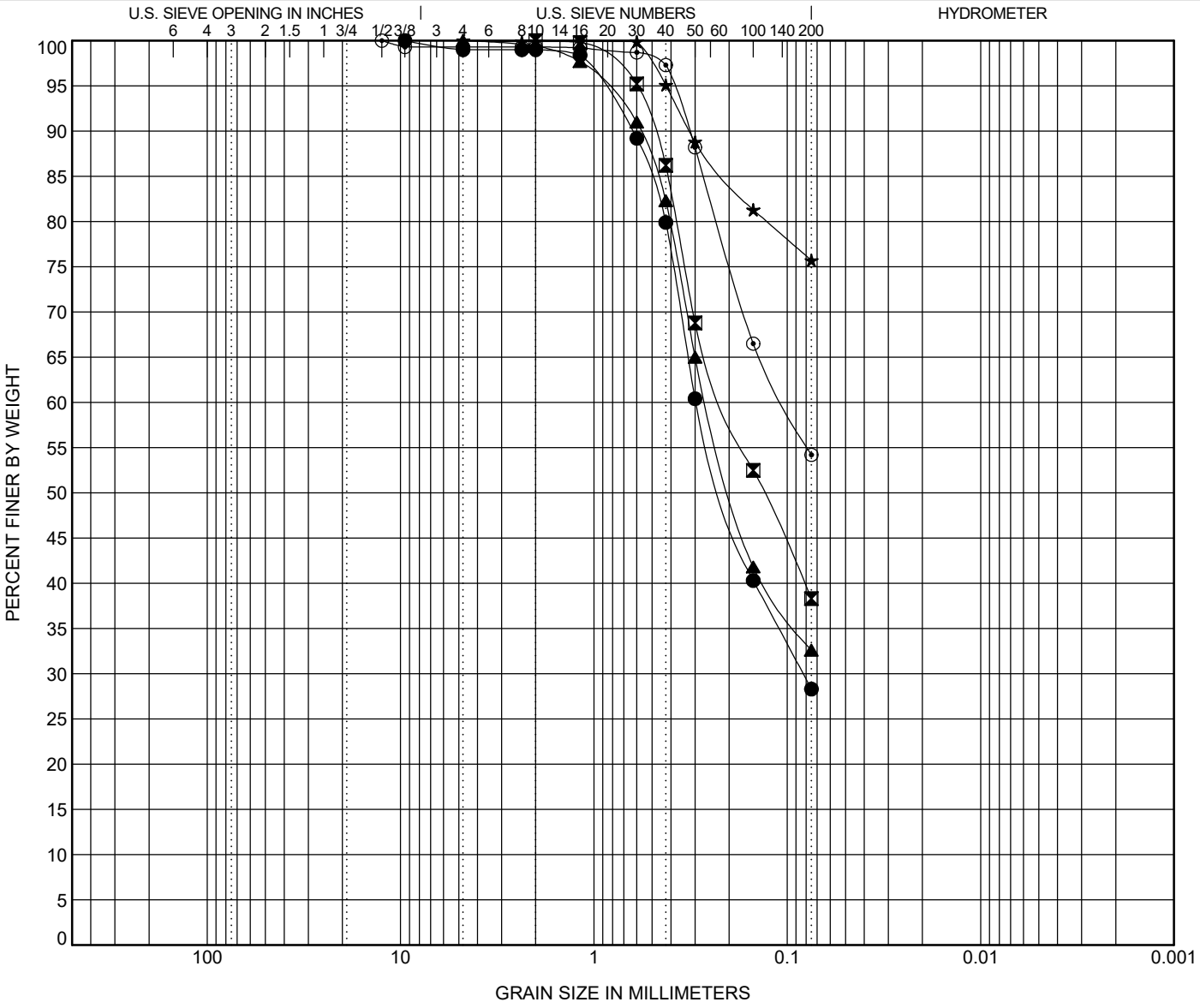

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	P-4	2.5	SILTY SAND (SM)					
⊠	P-5	2.5	SILTY SAND (SM)					
▲	P-6	2.5	SILTY SAND (SM)					
★	P-6	5.0	SILT WITH SAND (ML)					
⊙	P-7	2.5	SANDY SILT (ML)					

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	P-4	2.5	9.5	0.296	0.083		1.0	70.7	28.3	
⊠	P-5	2.5	2	0.206			0.0	61.7	38.3	
▲	P-6	2.5	4.75	0.258			0.0	67.4	32.6	
★	P-6	5.0	4.75				0.0	24.3	75.7	
⊙	P-7	2.5	12.5	0.104			0.7	45.1	54.2	

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PROJECT NAME Road and Storm at Big Pasco Industrial Center

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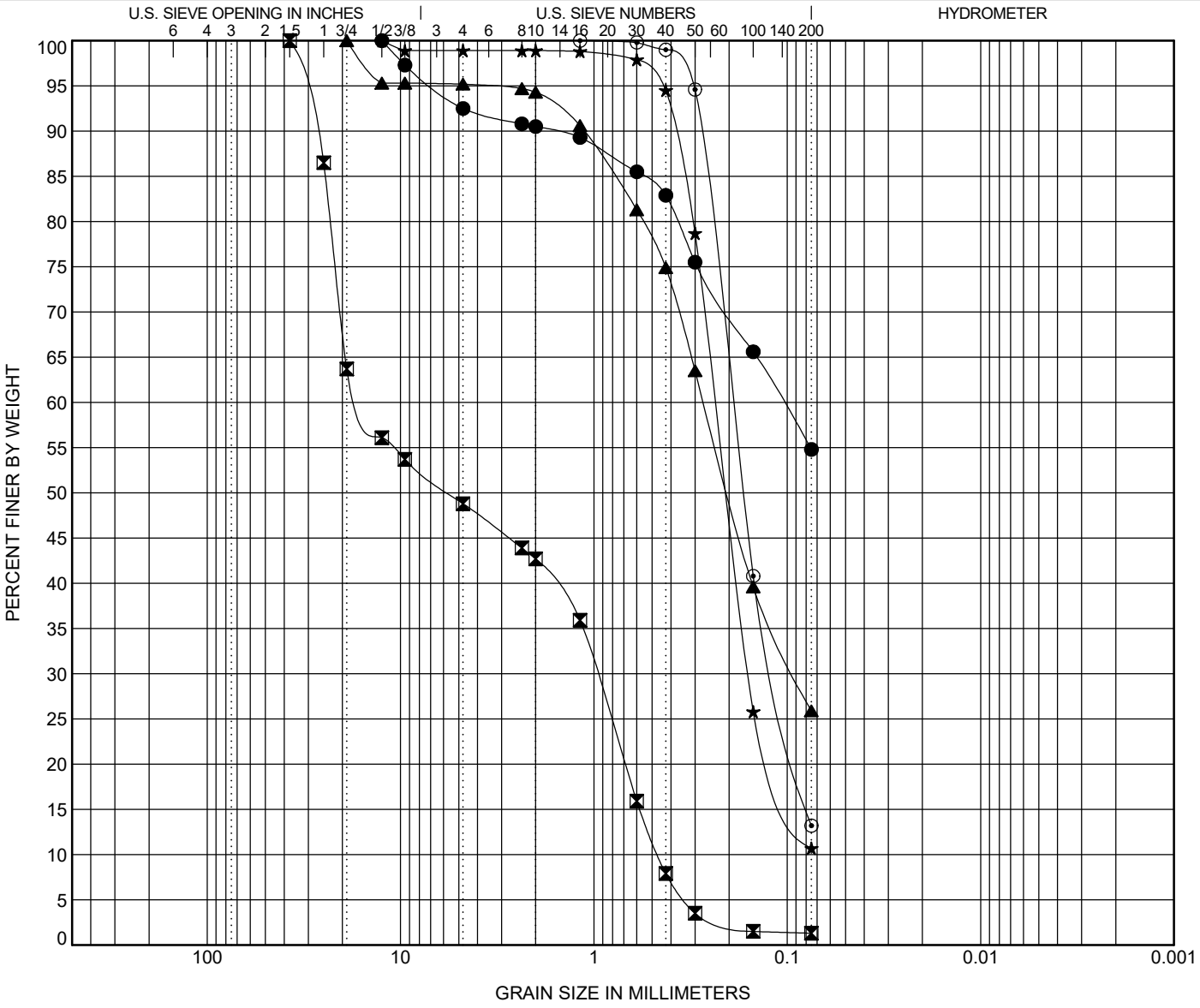

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	P-8	1.5	SANDY SILT (ML)					
⊠	P-9	2.5	POORLY GRADED GRAVEL WITH SAND (GP)				0.13	33.31
▲	P-10	2.5	SILTY SAND (SM)					
★	P-11	2.5	POORLY GRADED GRAVEL WITH SILT AND SAND (SP-SM)				1.47	3.23
⊙	P-12	2.5	SILTY SAND (SM)					

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	P-8	1.5	12.5	0.105			7.5	37.7	54.8	
⊠	P-9	2.5	37.5	15.496	0.967	0.465	51.2	47.5	1.3	
▲	P-10	2.5	19	0.271	0.092		4.8	69.3	25.9	
★	P-11	2.5	12.5	0.235	0.158		1.1	88.2	10.7	
⊙	P-12	2.5	1.18	0.192	0.114		0.0	86.8	13.2	

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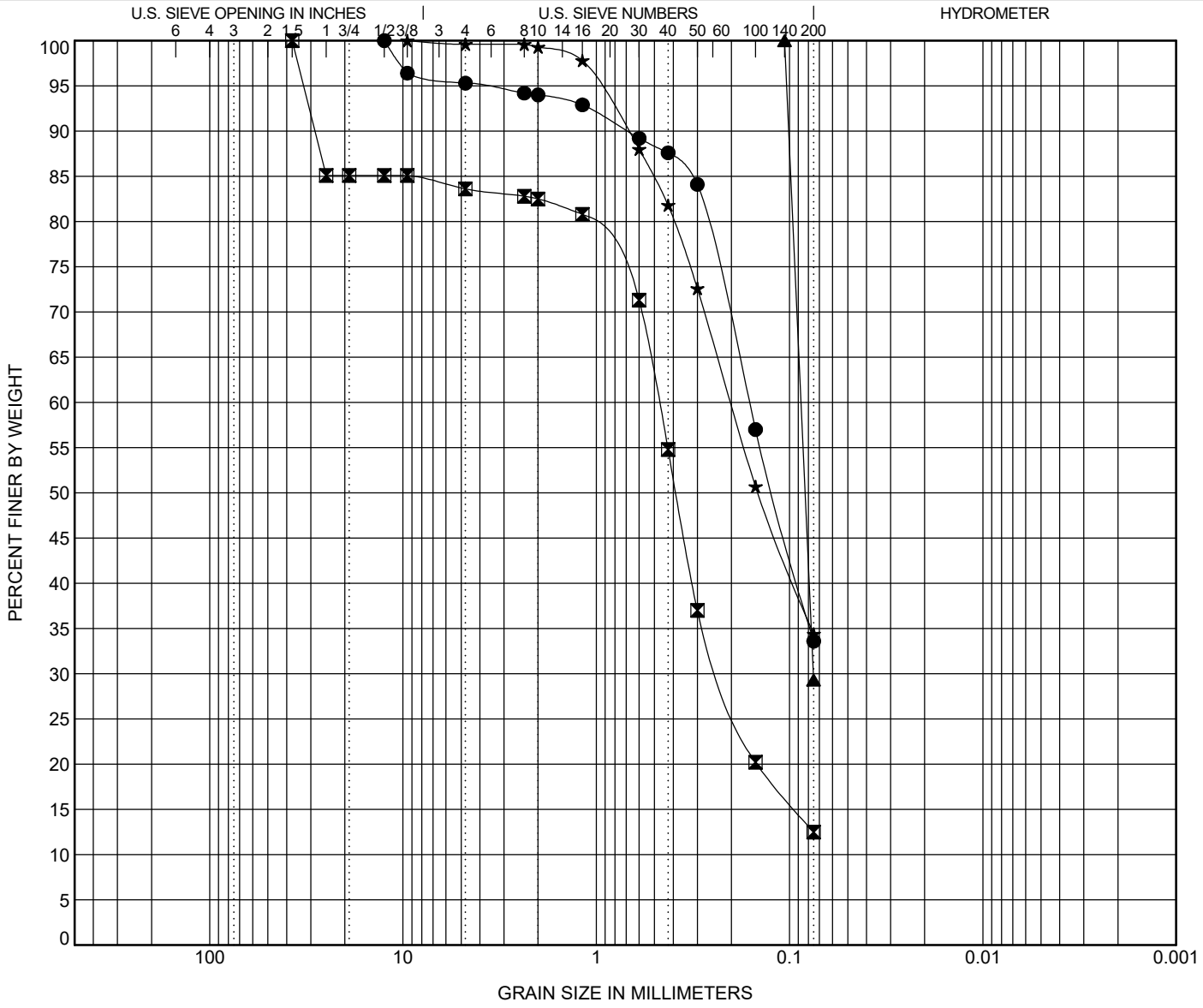


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	P-14	2.5	SILTY SAND (SM)					
⊠	P-15	2.5	SILTY SAND WITH GRAVEL (SM)					
▲	P-16	4.0	SILTY SAND (SM)					
★	P-18	3.5	SILTY SAND (SM)					

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	P-14	2.5	12.5	0.162			4.7	61.7	33.6	
⊠	P-15	2.5	37.5	0.474	0.225		16.4	71.1	12.5	
▲	P-16	4.0	0.106	0.087	0.075		0.0	70.7	29.3	
★	P-18	3.5	9.5	0.201			0.4	65.2	34.4	

Northwest Agricultural Consultants

2545 W Falls Avenue
Kennewick, WA 99336
509.783.7450
www.nwag.com
lab@nwag.com

PAP-Accredited
NAPT

GN NORTHERN INC
722 N. 16TH AVE #31
YAKIMA, WA 98902

Report: 48636-1-1
Date: August 8, 2019
Project No: 219-1119
Project Name:

Sample ID	Cation Exchange Capacity
P-2 @ 3.0’	4.3 meq/100g
P-5 @ TD	5.5 meq/100g
P-7 @ TD	6.4 meq/100g
P-9 @ 3.0’	4.2 meq/100g
P-11 @ 3.0’	2.7 meq/100g
P-15 @ 3.0’	5.1 meq/100g
Method	**EPA 9081**

Appendix IV

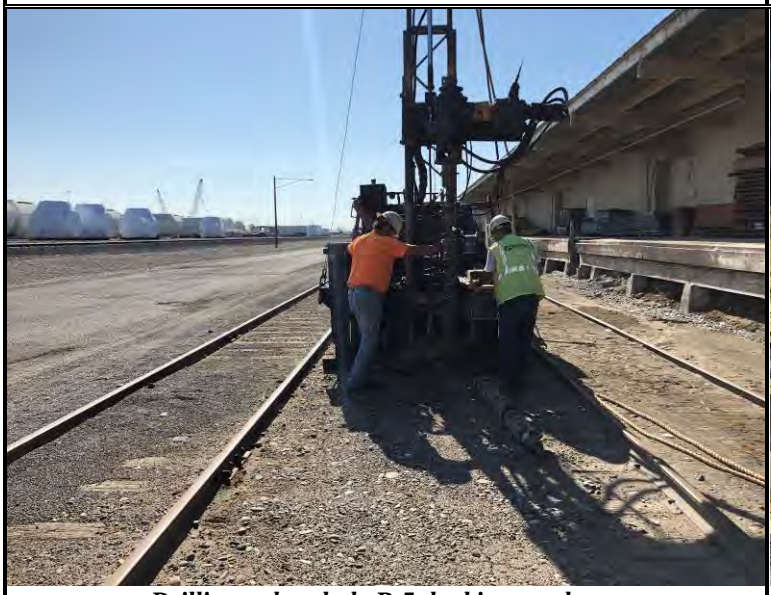
Site & Exploration Photographs

Drilling at borehole B-1, looking west

Split-spoon sample obtained from borehole B-1 @ 15' BGS

Drilling at borehole B-4, looking south

Split-spoon sample obtained from borehole B-4 @ 10' BGS



Drilling at borehole B-5, looking southeast

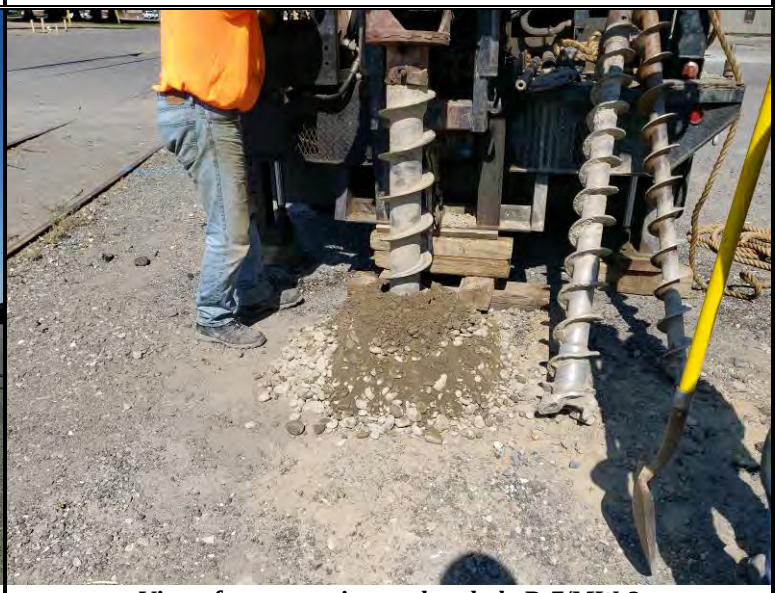
Split-spoon sample obtained from borehole B-5 @ 12.5' BGS

PLATE 1: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 219-1119**

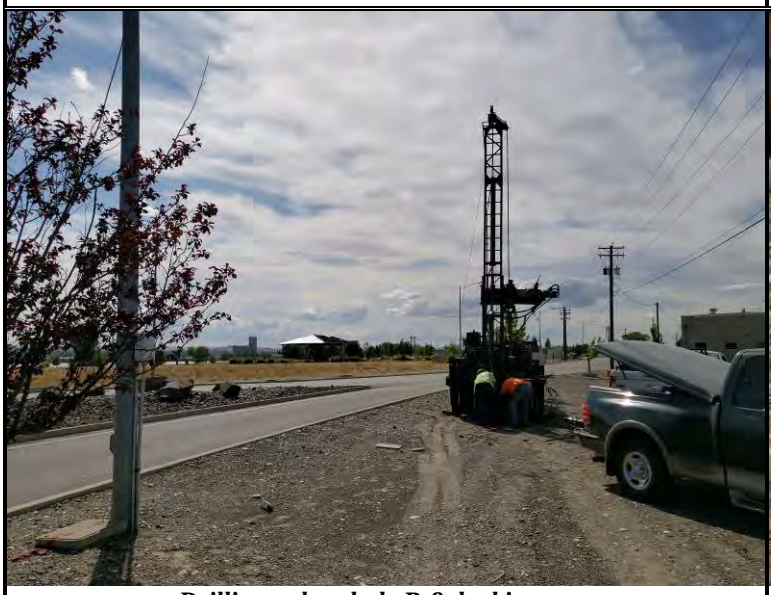
Drilling at borehole B-6, looking south/southeast

Split-spoon sample obtained from borehole B-6 @ 5' BGS

Drilling at borehole B-7/MW-2, looking east



View of auger cuttings at borehole B-7/MW-2



Drilling at borehole B-8, looking west

Split-spoon sample obtained from borehole B-8 @ 10' BGS

PLATE 2: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 219-1119**

Drilling at borehole B-9, looking northeast

Split-spoon sample obtained from borehole B-9 @ 2.5' BGS

Split-spoon sample obtained from borehole B-9 @ 5' BGS

Drilling at borehole B-10, looking north

Split-spoon sample obtained from borehole B-10 @ 5' BGS

Drilling at borehole B-11, looking southeast

PLATE 3: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 219-1119**

Drilling at borehole B-12/MW-3, looking south

Drilling at borehole B-13

Split-spoon sample obtained from borehole B-13 @ 10' BGS

Drilling at borehole B-14, looking west

Split-spoon sample obtained from borehole B-14 @ 5' BGS

Split-spoon sample obtained from borehole B-15 @ 10' BGS

PLATE 4: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 219-1119**

Excavation of test-pit TP-1, looking west

View of exposed soil profile within test-pit TP-1

Excavation of test-pit TP-2, looking southeast

View of exposed soil profile within test-pit TP-2

Excavation of test-pit TP-3, looking south

View of exposed soil profile within test-pit TP-3

PLATE 5: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 219-1119**

Excavation of test-pit TP-4, looking west

View of exposed soil profile within test-pit TP-4

Excavation of test-pit TP-5, looking north

View of exposed soil profile within test-pit TP-5

Infiltration test setup at P-1

Infiltration test setup at P-2

PLATE 6: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 219-1119**

Infiltration test setup at P-3

Infiltration test setup at P-4

Infiltration test setup at P-5

Infiltration test setup at P-7

Test-pit P-8 after excavation

View of exposed soil profile within test-pit P-8

PLATE 7: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 219-1119**

Infiltration test setup at P-9

Infiltration test setup at P-11

Infiltration test setup at P-12

Infiltration test setup at P-13

Infiltration test setup at P-16

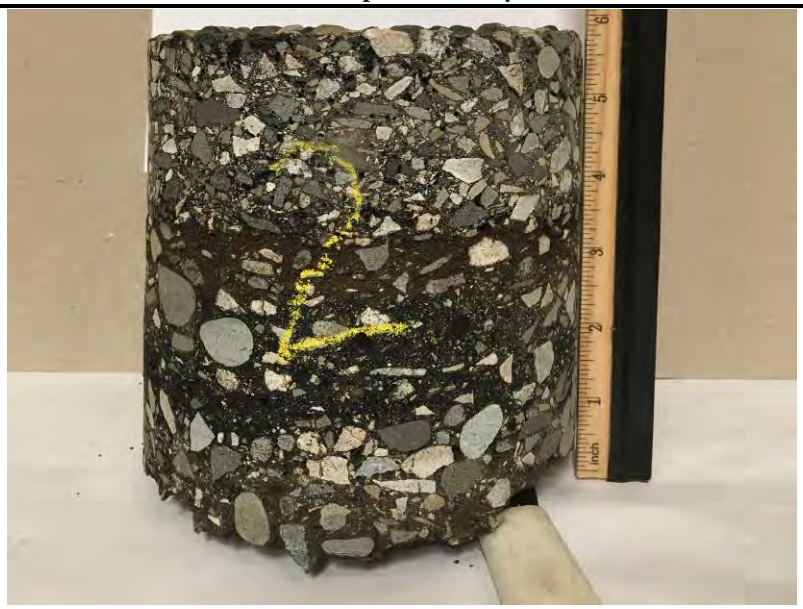
Infiltration test setup at P-17

PLATE 8: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 219-1119**

Appendix V

Pavment Core Photographs

Pavement core sample obtained from Core #1



Pavement core sample obtained from Core #2

Pavement core sample obtained from Core #3

PLATE 1: CORE PHOTOGRAPHS **PROJECT NO. 219-1119**

Pavement core sample obtained from Core #4

Pavement core sample obtained from Core #5

Pavement core sample obtained from Core #6

PLATE 2: CORE PHOTOGRAPHS **PROJECT NO. 219-1119**

Pavement core sample obtained from Core #7

Pavement core sample obtained from Core #8

Pavement core sample obtained from Core #9

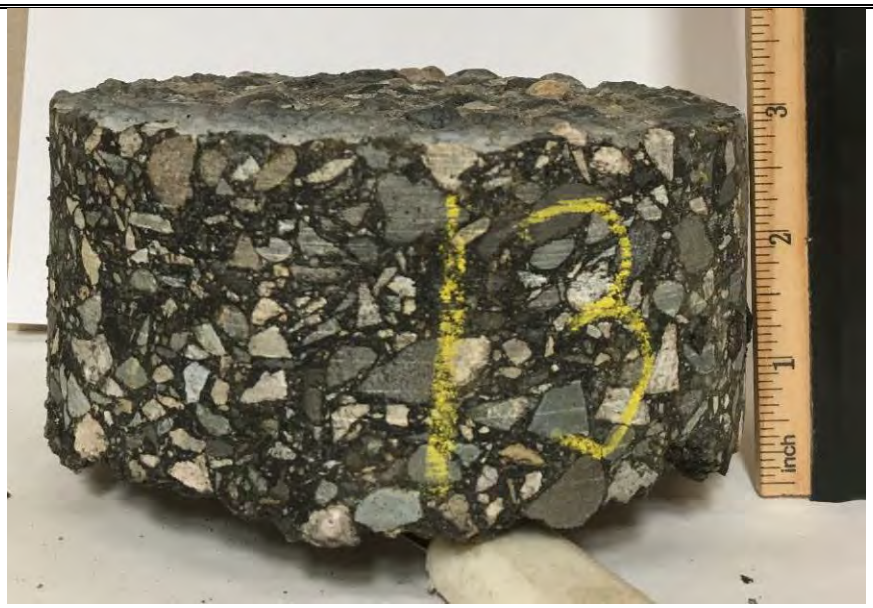
PLATE 3: CORE PHOTOGRAPHS **PROJECT NO. 219-1119**

Pavement core sample obtained from Core #10

Pavement core sample obtained from Core #11

Pavement core sample obtained from Core #12

PLATE 4: CORE PHOTOGRAPHS **PROJECT NO. 219-1119**



Pavement core sample obtained from Core #13

Pavement core sample obtained from Core #14

Pavement core sample obtained from Core #15

PLATE 5: CORE PHOTOGRAPHS **PROJECT NO. 219-1119**

Pavement core sample obtained from Core #16

Pavement core sample obtained from Core #17

Pavement core sample obtained from Core #18

PLATE 6: CORE PHOTOGRAPHS **PROJECT NO. 219-1119**

Pavement core sample obtained from Core #19

Pavement core sample obtained from Core #20

Pavement core sample obtained from Core #21

PLATE 7: CORE PHOTOGRAPHS **PROJECT NO. 219-1119**

Pavement core sample obtained from Core #22

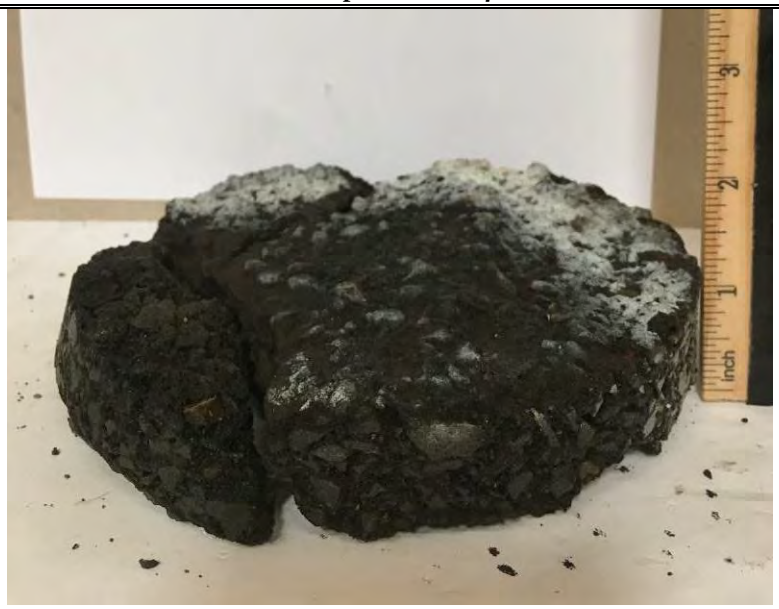
Pavement core sample obtained from Core #23

Pavement core sample obtained from Core #24

PLATE 8: CORE PHOTOGRAPHS **PROJECT NO. 219-1119**

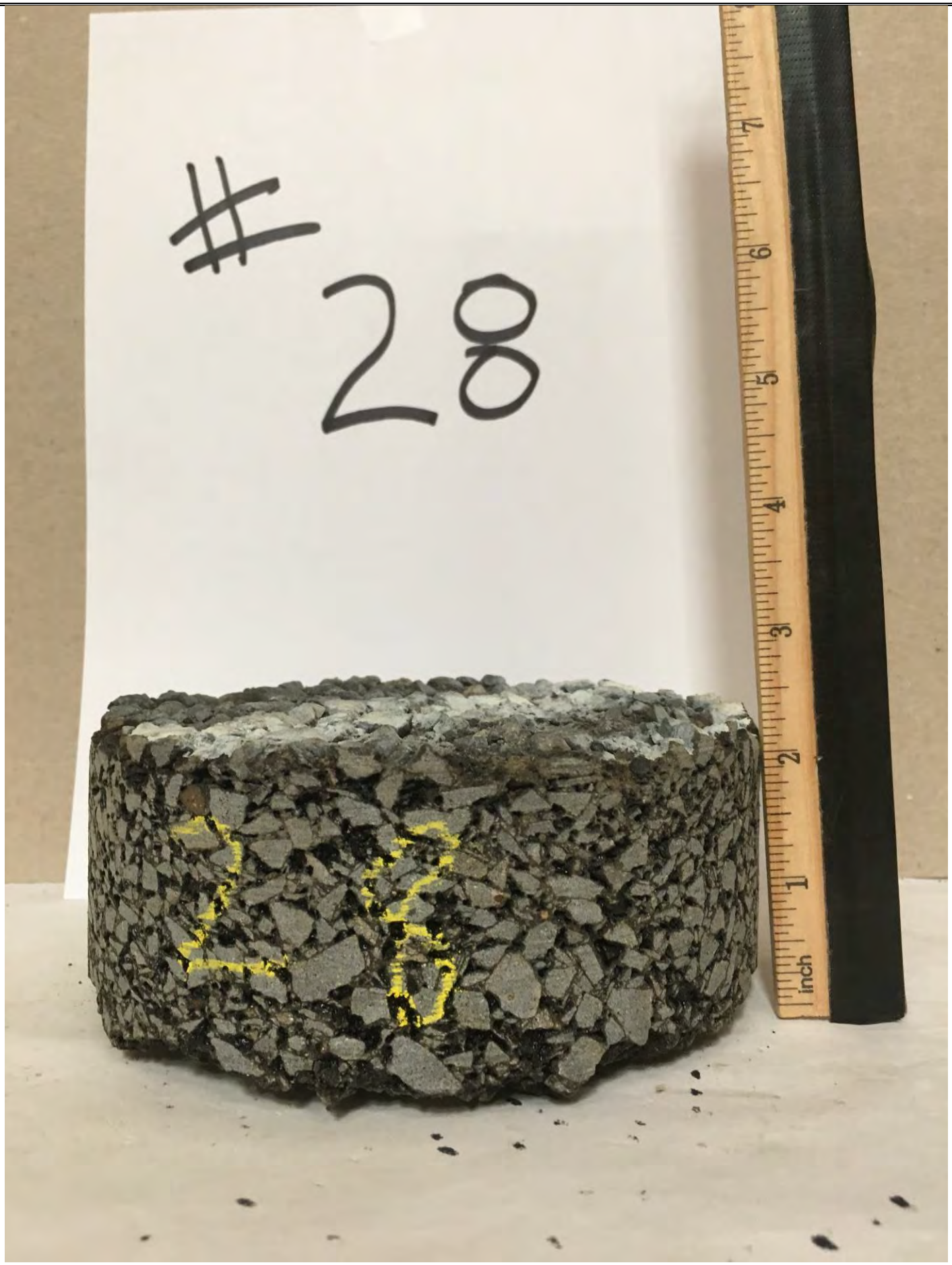
Pavement core sample obtained from Core #25

Pavement core sample obtained from Core #26



Pavement core sample obtained from Core #27

PLATE 9: CORE PHOTOGRAPHS **PROJECT NO. 219-1119**



Pavement core sample obtained from Core #28

PLATE 10: CORE PHOTOGRAPHS **PROJECT NO. 219-1119**

Appendix VI

NRCS Soil Survey

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Franklin County, Washington

Big Pasco Industrial Center

August 29, 2019

Custom Soil Resource Report
Soil Map

Franklin County, Washington

89—Quincy loamy fine sand, 0 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2dtt
Elevation: 350 to 1,200 feet
Mean annual precipitation: 6 to 12 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Quincy

Setting

Landform: Terraces
Parent material: Mixed eolian sands

Typical profile

H1 - 0 to 4 inches: loamy fine sand
H2 - 4 to 60 inches: fine sand

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 3 percent
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: SANDS 6-10 PZ (R007XY502WA)
Hydric soil rating: No

Minor Components

Sagehill

Percent of map unit: 15 percent
Landform: Dunes, terraces
Hydric soil rating: No

90—Quincy loamy fine sand, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2dv0
Elevation: 350 to 1,200 feet
Mean annual precipitation: 6 to 12 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Quincy

Setting

Landform: Terraces
Parent material: Mixed eolian sands

Typical profile

H1 - 0 to 4 inches: loamy fine sand
H2 - 4 to 60 inches: fine sand

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 3 percent
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: SANDS 6-10 PZ (R007XY502WA)
Hydric soil rating: No

Minor Components

Sagehill

Percent of map unit: 10 percent
Landform: Terraces, dunes
Hydric soil rating: No

Royal

Percent of map unit: 5 percent
Landform: Dunes, terraces
Hydric soil rating: No

186—Urban land-Torripsamments complex, gently rolling

Map Unit Setting

National map unit symbol: 2djv
Elevation: 300 to 500 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 180 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 65 percent
Torripsamments and similar soils: 25 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform: Terraces

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Description of Torripsamments

Setting

Landform: Terraces
Parent material: Mixed eolian sands

Typical profile

H1 - 0 to 8 inches: loamy fine sand
H2 - 8 to 31 inches: loamy fine sand
H3 - 31 to 60 inches: fine sand

Properties and qualities

Slope: 0 to 10 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: SANDY 6-10 PZ (R007XY501WA)
Hydric soil rating: No

Minor Components

Royal

Percent of map unit: 5 percent
Landform: Terraces
Hydric soil rating: No

Sagehill

Percent of map unit: 5 percent
Landform: Terraces
Hydric soil rating: No

220—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water

Setting

Landform: Alluvial cones

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Unranked

Appendix VII

WA DOE Well Logs

480165

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE46697

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in box)*

☒ Construction
☐ Decommission

ORIGINAL INSTALLATION Notice of Intent Number:

Consulting Firm SHANNON & WILSON

Unique Ecology Well IDTag 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 Last, First Name) ADAMS , JASON
Driller/Engineer /Trainee Signature Jason Adams
Driller or Trainee License No. 3075

If trainee, licensed driller's Signature and License Number:

Type of Well *("x in box)*

☐ Resource Protection
☒ Geotech Soil Boring

Property Owner BNSF RAILROAD COMPANY
Site Address SACAJUWEA PARK RD.
City BURBANK County FRANKLIN -11

Location NW1/4-1/4 WE1/4 Sec 2 Twn 8 R 30
EWM ☒ or WWM ☐

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

Tax Parcel No. 113010036
Cased or Uncased Diameter 4.5" Static Level 72.3
Work/Decommission Start Date 11-13-12
Work/Decommission Completed Date 11-16-12

Construction Design	Well Data	Formation Description
CASING ADVANCE. TO A DEPTH OF 70' BGS. THEN HQ CORE TO A DEPTH OF 140' BGS.	HOLE #1	0-40' BROWN SAND 40'-93' BROWN SAND/ GRAVEL 93,-103.5 GRAY CONGLOMERET 103.5-140' BLUE GRAY BASALT

RECEIVED
JAN 04 2013
DEPARTMENT OF ECOLOGY
EASTERN REGIONAL OFFICE

SCALE: 1"= _____ PAGE _____ OF _____

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

DEPARTMENT OF ECOLOGY State of Washington

Construction/Decommission *("x" in circle)*

■ Construction

☐ Decommission *ORIGINAL INSTALLATION*

Notice of Intent Number _____

PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ■ Other Cathodic

TYPE OF WORK: Owner's number of well (if more than one) _____

■ New well ☐ Reconditioned *Method :* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ■ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 300 ft.
Depth of completed well 300 ft.

CONSTRUCTION DETAILS

Casing ■ Welded 8 " Diam. from 20 ft. to 74 ft.
Installed: ☐ Liner installed _____ " Diam. from _____ ft. to _____ ft.
☐ Threaded _____ " Diam. From _____ ft. to _____ ft.

Perforations: ☐ Yes ■ No
Type of perforator used _____
SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☐ Yes ■ No ☐ K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ■ No Size of gravel/sand _____
Materials placed from _____ ft. to _____ ft.

Surface Seal: ■ Yes ☐ No To what depth? 120 ft.
Material used in seal Bentonite Grout
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP: Manufacturer's Name N/A
Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level N/A ft.
Static level _____ ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ■ No If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test N/A
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☐ No

CURRENT

Notice of Intent No. GE00630
Unique Ecology Well ID Tag No. BJK 842
Water Right Permit No. N/A
Property Owner Name Cascade Natural Gas
Well Street Address S. 4th St. & E. Washington
City Pasco County Franklin
Location NW/4-1/4 SE 1/4 Sec 32 Twn 9 R 30 E EWM ■ Or WWM ■
(s, t, r Still REQUIRED)

Lat/Long
Lat Deg _____ Lat Min/Sec _____
Long Deg _____ Long Min/Sec _____

Tax parcel No. (Required) N/A

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL		FROM	TO
Gravels and Cobbles w/Sand	Tan	0	35
Sand w/Gravels & Cobbles	Black	35	64
Sandy Siltstone	Br/Tan	64	81
Sandy Siltstone w/ some Clay	Gr/Br	81	152
Basalt - Pourous/Vesicular	Bl	152	174
Baslt - Very Hard	Bl	174	300
Cathodic Protection Well			
20 Anodes were installed every 3'			
starting from bottom of hole @ 300'			
Coke Breeze was placed from 120'-300'			
Bentonite Grout was placed from 4'-120'			

RECEIVED
JAN 28 2016
Department of Ecology
Eastern Washington Office

Start Date 12/2/15 Completed Date 12/4/15

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 Chad N. Gregory
Driller/Engineer/Trainee Signature
Driller or trainee License No. 2369
IF TRAINEE: Driller's License No:
Driller's Signature:

Drilling Company Gregory Drilling Inc
Address 17609 NE 70th St
City, State, Zip Redmond, WA 98052
Contractor's Registration No. GREGOCN247MN Date 1/6/16

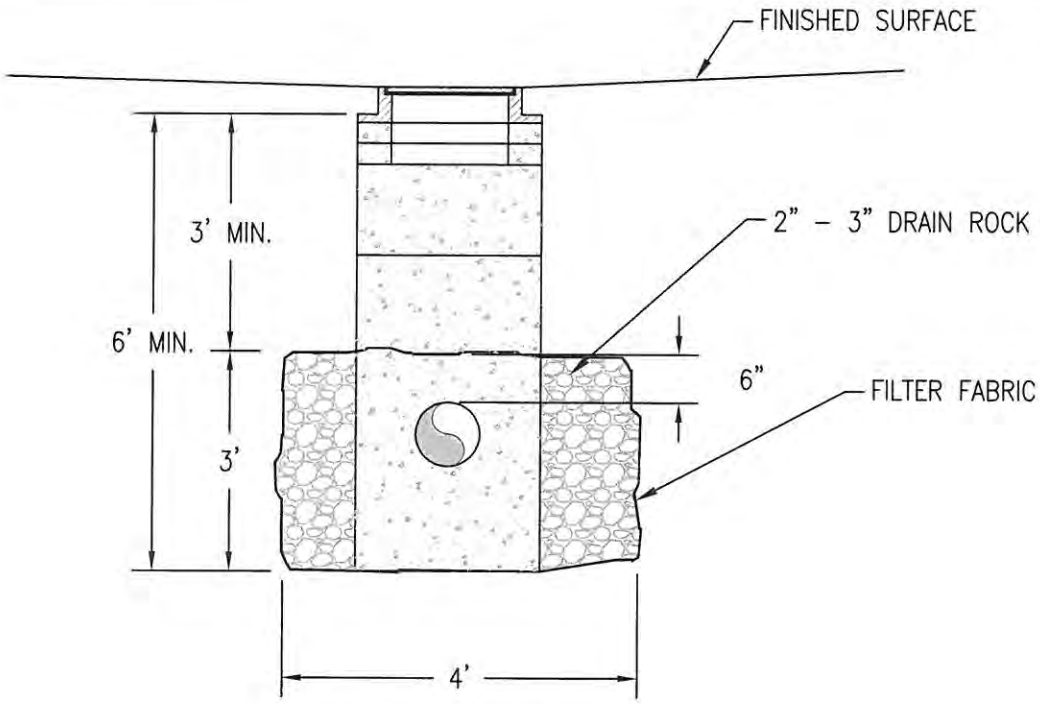
ECY 050-1-20 (Rev 02-2010) To request ADA accommodation including materials in a format for the visually impaired, call Ecology Water Resources Program at 360-407-6872. Persons with impaired hearing may call Washington Relay Service at 711. Persons with speech disability may call TTY at 877-833-6341.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report

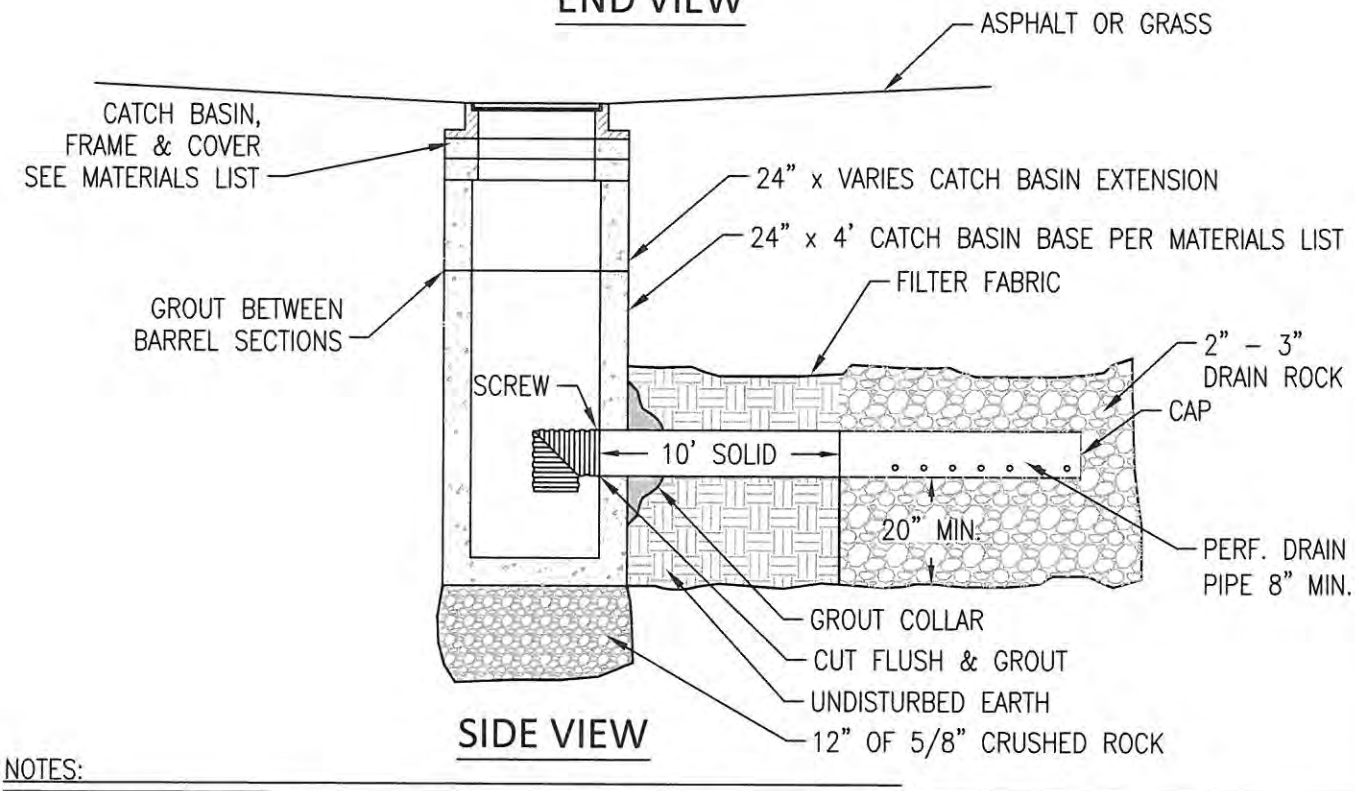
Northern, Inc.

Appendix VIII

City of Pasco Typical Details



END VIEW



SIDE VIEW

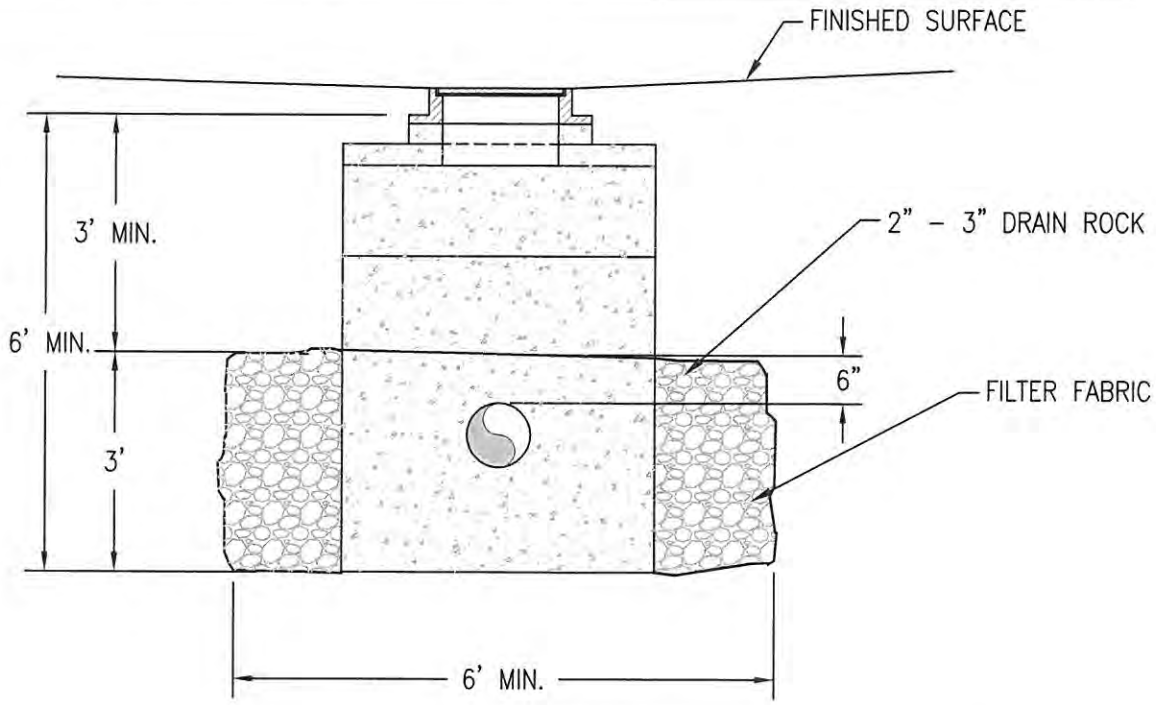
NOTES:

1. FILTER FABRIC TO ENTIRELY ENVELOP THE DRAIN ROCK WITH 1' OVERLAP MIN.
2. INFILTRATION TRENCHES SHALL MEET ALL DEPARTMENT OF ECOLOGY REQUIREMENTS AND BMP'S
3. INFILTRATION TRENCH MAY ONLY BE USED WITH APPROVAL OF THE CITY ENGINEER.
4. ALL CATCH BASINS CONNECTED TO INFILTRATION TRENCHES MUST HAVE AN OIL/WATER SEPARATOR, SEE MATERIALS LIST.
5. INLET PIPE TO INFILTRATION TRENCH MUST BE PRECEDED BY A PRETREATMENT B.M.P.
6. UIC REGISTRATION: FILL OUT FORM (TO BE SUPPLIED BY COP) AND COORDINATE WITH COP FOR SUBMITTAL REQUIREMENTS.

7

REV. 7
6/20/14

PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION CITY OF PASCO, WASHINGTON	INFILTRATION TRENCH (SINGLE OUTLET)		
		STD. SPEC. 7-05	
	APPROVED: Brent McKee	DATE: 5/15/15 3-6-15	DWG. NO. 4-4



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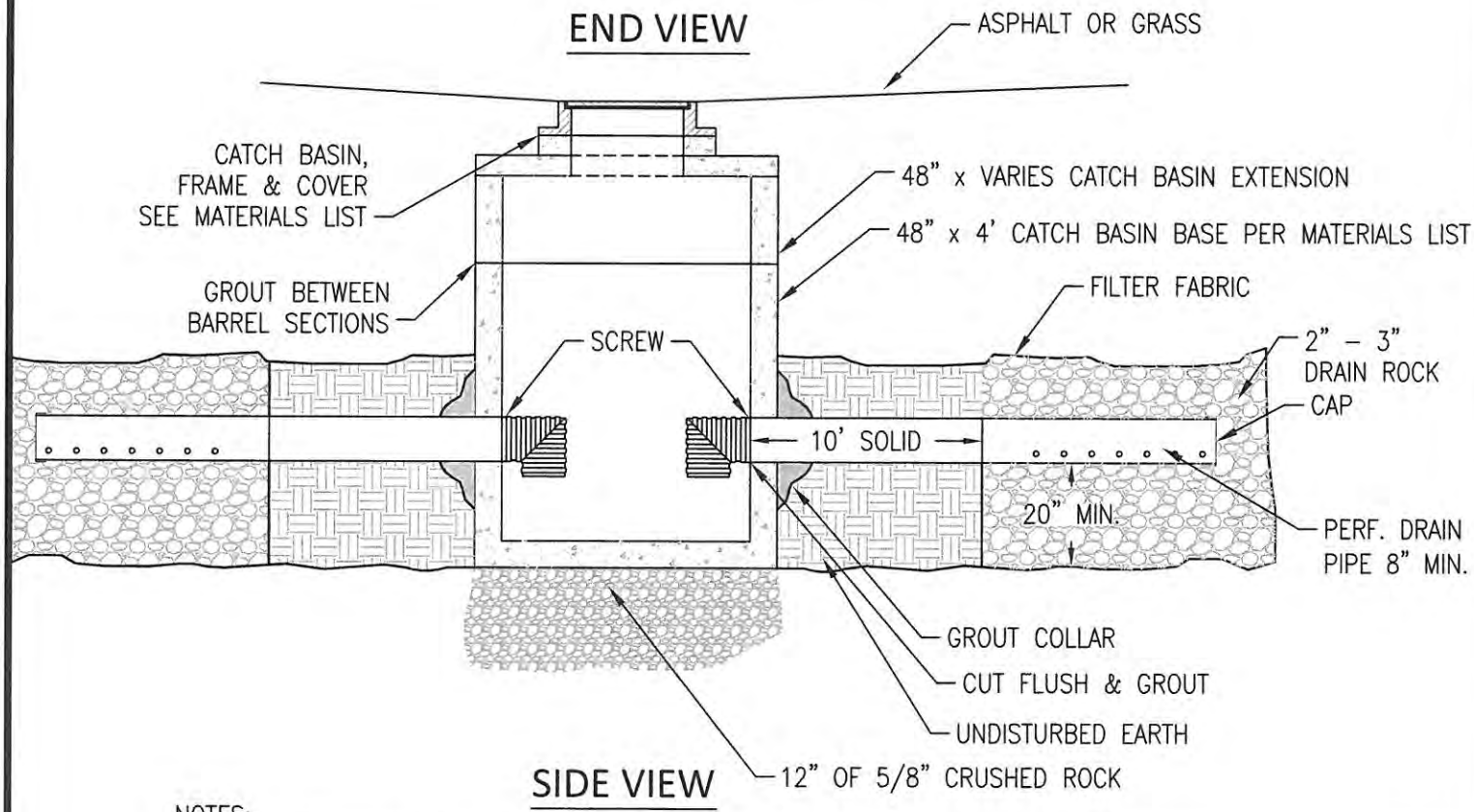

SIDE VIEW

NOTES:

1. FILTER FABRIC TO ENTIRELY ENVELOP THE DRAIN ROCK WITH 1' OVERLAP MIN.
2. INFILTRATION TRENCHES SHALL MEET ALL DEPARTMENT OF ECOLOGY REQUIREMENTS AND BMP'S
3. INFILTRATION TRENCH MAY ONLY BE USED WITH APPROVAL OF THE CITY ENGINEER.
4. ALL CATCH BASINS CONNECTED TO INFILTRATION TRENCHES MUST HAVE AN OIL/WATER SEPARATOR, SEE MATERIALS LIST.
5. UIC REGISTRATION: FILL OUT FORM (TO BE SUPPLIED BY COP) AND COORDINATE WITH COP FOR SUBMITTAL REQUIREMENTS.

REV. 0
3/2/15

PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION CITY OF PASCO, WASHINGTON	INFILTRATION TRENCH (MULTIPLE OUTLET)			
		STD. SPEC. 7-05		
	APPROVED:	DATE:	5/15/15 3-6-15	DWG. NO. 4-4A

APPENDIX B

STORMWATER QUALITY – MEDIA CARTRIDGE FILTRATION SYSTEM STANDARD SPECIFICATION

1. GENERAL

1.1. The Contractor shall furnish and install the Stormwater filtration system, complete and operable as shown and as specified herein, in accordance with the requirements of the plans and contract documents. The water quality treatment flow shall be as determined and approved by the Engineer of Record.

1.2. The Stormwater filtration system shall consist of an aboveground or underground precast concrete, steel or plastic structure that houses passive, radial flow, siphon-actuated, and rechargeable media filled filtration cartridge(s). The rechargeable media-filled filter cartridges shall incorporate a protective hood over the media cartridge and a siphon-actuated surface self-cleaning mechanism to increase the effective life of the filter media and to reduce the accumulation of material on the cartridge/media interface. Each radial-flow filter cartridge shall operate at a predetermined flow rate through the use of an integrated flow control orifice located within each filter cartridge outlet manifold. The media-filled cartridges shall trap particulates (TSS) and have the ability to adsorb pollutants such as dissolved metals, nutrients and hydrocarbons. The media cartridge filtration system shall consist of no less than 0.12 cubic feet of filter media for each 1-gallon per minute of water quality treatment flow.

1.3. The Stormwater filtration system shall be of a type that has been installed and in use for a minimum of five (5) consecutive years preceding the date of installation of the system. The manufacturer shall have been, during the same consecutive five (5) year period, engaged in the engineering design and production of systems deployed for the treatment of storm water runoff and which have a history of successful production, acceptable to the Engineer of Record and/or the approving Jurisdiction.

1.4. Submittals:

1.4.1. Manufacturer or supplier shall submit to the Contractor shop drawings for the Stormwater filtration system structure, filter cartridges and accessory equipment. Drawings shall include principal dimensions, filter placement, location of piping and unit foundation.

1.4.2. Manufacturer or supplier shall submit Installation Instructions to the Contractor.

1.4.3. Manufacturer or supplier shall submit an Operation and Maintenance Manual to the Contractor.

1.5. Substitution: Any proposed equal alternative product substitution to this specification must be submitted for review and approved by the Engineer of Record 10 days prior to bid opening. Review package should include third party reviewed performance data for both flow rate and pollutant removal. Pollutant data should follow TAPE protocols. The system must have a GULD approval for Basic treatment through the department of Ecology.

1.6. American Society for Testing and Materials (ASTM) Reference Specifications

1.6.1. ASTM C857: Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

1.6.2. ASTM C858: Standard Specification of Underground Precast Concrete Utility Structures

1.6.3. ASTM C478: Standard Specification for Circular Precast Reinforced Concrete Manhole Sections

1.6.4. ASTM C497: Standard Test Methods for Concrete Pipe, Manhole Sections or Tile

1.6.5. ASTM C109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars

1.6.6. ASTM A615/A615M: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

1.6.7. ASTM D698: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort

1.6.8. ASTM F628: Standard Specification for ABS Schedule 40 Plastic Drain, Waste and Vent Pipe with a Cellular Core

1.6.9. ASTM D1785: Standard Specification for PVC Plastic Pipe, Schedules 40, 80 & 120

1.6.10. ASTM D2466: Standard Specification for PVC Plastic Pipe Fittings, Schedule 40

1.6.11. ASTM A36: Standard Specification for Carbon Structural Steel

1.6.12. ASTM A48: Standard Specification for Gray Iron Castings

1.6.13. ASTM D4101: Standard Specification for Polypropylene Injection and Extrusion Materials

1.7. American Association of State Highway and Transportation Officials (AASHTO) Reference Specifications

1.7.1. AASHTO M199: Standard Specification for Precast Reinforced Concrete Manhole Sections

2. MATERIALS

2.1. Internal Components:

2.1.1. All internal components including ABS and PVC manifold piping, filter cartridge(s), filter media (as specified on the plans in the Stormwater filtration system data block or by the Engineer of Record) shall be provided by the manufacturer. This includes sump covers, flow spreaders, energy dissipaters and outlet risers with scum baffles where appropriate.

2.1.2. ABS manifold pipe shall meet ASTM F628. PVC manifold pipe shall meet ASTM D1785 and PVC fittings shall meet ASTM D2466.

2.1.3. Filter cartridge bottom pan, inner ring, and hood shall be constructed from linear low-density polyethylene (LLDPE) or ABS. Filter cartridge screen shall consist of 1" x ½" welded wire fabric (16 gauge minimum) with a bonded PVC coating. Internal parts shall consist of ABS or PVC material. Siphon-priming float shall be constructed from high-density polyethylene (HDPE). All miscellaneous nuts, bolts, screws, and other fasteners shall be stainless steel or aluminum.

2.1.4. An orifice plate shall be supplied with each cartridge to restrict flow rate to a maximum of 22.5 gpm at system design head or as specified on drawings.

2.1.5. If a sump cover/overflow, baffle/inlet, sump/outlet, sump/inlet, tower/outlet overflow is provided, they shall be constructed of ABS and sealed to the interior vault walls and floor with a polyurethane construction sealant rated for use below the waterline, SikaFlex 1a or equal. Contractor to provide sealant material and installation unless completed prior to shipment.

2.1.6. Where an Underdrain Design is provided, the size of the underdrain will provide a minimum of 0.067 in^2 of underdrain cross sectional area per 1 gpm of design flow rate. (example: 105 gpm maximum design flow rate will require an underdrain with 7.035 in^2 of cross sectional area, which is equal to one 3" diameter pipe).

2.1.7. Filter media shall be provided by the same manufacturer as the Stormwater filtration system or an approved alternate source. Filter media shall consist of one or more of the following, as specified in the Stormwater filtration system data block, or by the Engineer:

2.1.7.1. Perlite Media: Perlite media shall be made of natural siliceous volcanic rock free of any debris or foreign matter. The perlite media shall have a bulk density ranging from 6.5 to 8.5 lb/ft^3 and particle sizes ranging from that passing through a 0.50 inch screen and retained on a U.S. Standard #8 sieve.

2.1.7.2. CSF Media: CSF media shall be made exclusively of composted fallen deciduous leaves. Filter media shall be granular. Media shall be dry at the time of installation. The CSF leaf media shall have a bulk density ranging from 40 to 50 lb/ft^3 and particle sizes ranging from that passing through a 0.50 inch screen to that retained on a U.S. Standard #8 sieve.

2.1.7.3. Metal Rx Media: Metal Rx media shall be made exclusively of composted fallen deciduous leaves. Filter media shall be granular. Media shall be dry at the time of installation. The Metal Rx media shall have a bulk density ranging from 40 to 50 lb/ft^3 and particle sizes ranging from that passing through a U.S. Standard #8 sieve to that retained on a U.S. Standard #14 sieve.

2.1.7.4. Zeolite Media: Zeolite media shall be made of naturally occurring clinoptilolite, which has a geological structure of potassium-calcium-sodium aluminosilicate. The zeolite media shall have a bulk density ranging from 44 to 48 lb/ft^3, particle sizes ranging from that passing through a U.S. Standard #4 sieve to that retained on a U.S. Standard #6 sieve, and a cation exchange capacity ranging from 1.0 to 2.2 meq/g.

2.1.7.5. Granular Activated Carbon: Granular activated carbon (GAC) shall be made of lignite coal that has been steam activated. The GAC media shall have a bulk density ranging from 28 to 31 lb/ft^3 and particle sizes ranging from that passing through a U.S. Standard #4 sieve to that retained on a U.S. Standard #8 sieve.

2.1.7.6. Zeolite-Perlite-Granular Activated Carbon (ZPG): ZPG is a mixed media that shall be composed of a 1.3 ft^3 outer layer of 100% Perlite (see above) and a 1.3 ft^3 inner layer consisting of a mixture of 90% Zeolite (see above) and 10% Granular Activated Carbon (see above).

2.1.7.7. Zeolite-Perlite (Zeo/Perl): Zeo/Perl is a mixed media that shall be composed of a 1.3 ft^3 outer layer of 100% Perlite (see above) and a 1.3 ft^3 inner layer consisting of 100% Zeolite.

2.1.7.8. CSF Leaf Media – Granular Activated Carbon (CSF/GAC): CSF/GAC is a mixed media that shall be composed of a 1.3 ft^3 outer layer of 100% CSF media (see above) and a 1.3 ft^3 inner layer consisting of 100% Granular Activated Carbon (see above).

2.1.7.9. Perlite – Metal Rx : Perlite/Metal Rx is a mixed media that shall be composed of a 1.3 ft^3 outer layer of 100% Perlite (see above) and a 1.3 ft^3 inner layer consisting of 100% Metal Rx (see above).

2.1.7.10. PhosphoSorb: PhosphoSorb media shall be made from Perlite pellets with activated alumina bound to the surface. The PhosphoSorb media pellets shall be granular and have a bulk density from 18 to 25 lb/ft^3. The pellet size should range from that passing through a U.S. Standard ¼ inch sieve and retained on a #8 sieve.

2.1.8. Overflow Assembly (Where Provided):

2.1.8.1. Flow spreader shall be constructed of Linear Low-Density Polyethylene (LLDPE). Contractor to provide sealant material and installation unless completed prior to shipment.

2.1.8.2. Energy dissipater shall be constructed of polyolefins. Contractor to provide sealant material and installation unless completed prior to shipment.

2.1.8.3. Outlet riser with scum baffle shall be constructed of HDPE. Outlet riser shall have an outlet stub outside dimension (O.D.) of 12-inch diameter PVC, SDR 26 and a secondary outlet stub O.D. of 8-inch diameter PVC, SDR 26.

2.2. Steel Catch Basin & Roof Drain Components:

2.2.1. Basin shall be all welded steel construction, fabricated from ASTM A36 ¼-inch steel and shall be designed to withstand AASHTO H-20 wheel loads when placed below ground in a location that could receive direct loading.

2.2.2. Basin Grate: Grating shall be ductile iron construction and shall meet AASHTO H-20 loading requirements, and shall be provided according to ASTM A48.

2.2.3. Basin Solid Lid (below ground system design): Solid lid shall be gray cast iron, treated with non-slip surfacing, and shall meet AASHTO H-20 loading requirements, and shall be provided according to ASTM A48.

2.2.4. Basin Solid Lid (above ground system design): Solid lids shall be PVC plate with pick holes. Covers to be cut as required for top inlet roof drain pipes.

2.3. Precast Concrete Structure Components:

2.3.1. Precast concrete vault shall be provided according to ASTM C857 and C858. Precast concrete manhole shall be provided according to ASTM C478.

2.3.2. Vault and manhole joint sealant shall be Conseal CS-101 or approved equal.

2.3.3. If interior concrete baffle walls are provided, baffle walls shall be sealed to the interior vault walls and floor with a polyurethane construction sealant rated for use below the waterline, SikaFlex 1a or equal. Contractor to provide sealant material and installation unless completed prior to shipment.

2.3.4. Frames and covers shall be gray cast iron and shall meet AASHTO H-20 loading requirements, and shall be provided according to ASTM A48.

2.3.5. Doors shall have hot-dipped galvanized frame and covers. Covers shall have diamond plate finish. Each door to be equipped with a recessed lift handle. Doors shall meet H-20 loading requirements for incidental traffic, at a minimum, or per project specific traffic loading requirements.

2.3.6. Steps shall be constructed of copolymer polypropylene conforming to ASTM D4101. Steps shall be driven into preformed or drilled holes once concrete is cured. Steps shall meet the requirements of ASTM C478 and AASHTO M199. The ½" Grade 60 deformed reinforcing bar shall meet ASTM A615, where required.

2.3.7. Ladders shall be constructed of aluminum and steel reinforced copolymer polypropylene conforming to ASTM D4101. Ladder shall bolt in place. Ladder shall meet all ASTM C497 load requirements. Ladders provided upon request or where required, and shall not conflict with the operation and accessibility to perform maintenance of the Stormwater filtration system.

2.4. Contractor Provided Components (below ground installation):

2.4.1. All contractor-provided components shall meet the requirements of this section, the plans specifications and contract documents. In the case of conflict, the more stringent specification shall apply.

2.4.2. Sub-base: Crushed rock base material shall be six-inch minimum layer of ¾-inch minus rock. Compact undisturbed sub-grade materials to 95% of maximum density at +/-2% of optimum moisture content. Unsuitable material below sub-grade shall be replaced to engineer's approval.

2.4.3. In-situ concrete, if required, shall have an unconfined compressive strength at 28 days of at least 3000 psi, with ¾-inch round rock, a 4-inch slump maximum, and shall be placed within 90 minutes of initial mixing.

2.4.4. Silicone Sealant shall be pure RTV silicone conforming to Federal Specification Number TT S001543A or TT S00230C or Engineer approved.

2.4.5. Grout shall be non-shrink grout meeting the requirements of Corps of Engineers CRD-C588. Specimens molded, cured and tested in accordance with ASTM C109 shall have minimum compressive strength of 6,200 psi. Grout shall not exhibit visible bleeding.

2.4.6. For manhole systems, Contractor shall connect to 12-inch or 8-inch diameter outlet riser with Fernco flexible coupling, or approved equal.

2.4.7. Rebar used on applicable Catch Basin & Roof Drain systems shall meet ASTM A615M Grade 420 (60 ksi) or as otherwise specified in the general technical specifications.

2.4.8. Backfill material shall be ¾-inch minus crushed rock, or approved equal.

3. PERFORMANCE

3.1. Cartridge Operation: Each Stormwater filtration system shall contain one or more siphon actuated media filter cartridges that maintain a uniform pressure profile across the face of the filter during operation. At the design flow rate the maximum filter hydraulic loading rate is not to exceed 2.1 gallons per minute per square foot of filter surface area. Stormwater shall enter the filter cartridges through sides and shall flow through the filter media radially from the outer perimeter to the inner cartridge lumen and shall have an average contact time no less than 38 seconds. These media filter cartridges will incorporate a self-cleaning mechanism to remove accumulated material from the cartridge media surface that is activated when the siphon breaks.

3.2. Documentation of Sediment Removal: The Filtration system shall have the State of Washington Department of Ecology, General Use Level Designation (GULD) Certification and current approval status from the New Jersey Department of Environmental Protection (NJDEP).

3.3. Cartridge Sediment Loading: Filter cartridges shall be of a design that has demonstrated a minimum sediment retention capacity of 22 pounds of silty loam per cartridge in laboratory tests without a reduction in hydraulic capacity. Laboratory data shall be corroborated with field observations/data demonstrating equivalent or improved longevity without impacting normal hydraulic performance of the Stormwater filtration system. All laboratory and field tests submitted in support of this specification must have undergone peer review by outside entity other than the manufacturer of the Stormwater filtration system.

3.4. Overflow:

3.4.1. Vault Configuration: Stormwater filtration system shall have a baffled, non-siphoning internal overflow with a minimum capacity of 1.8 cfs.

3.4.2. Manhole Configuration: The filter system will have a baffled, non-siphoning internal overflow with a minimum of 1.0 cfs capacity.

3.4.3. Peak Diversion Configuration: Each Stormwater filtration system shall include an internal, offline overflow bypass. Water first enters an inlet bay that is separate from the cartridge bay and separate from the outlet bay. Low flows travel from the inlet bay, through a transfer opening and into the cartridge bay. High flows enter the outlet bay by topping a weir separating the inlet and outlet bay. Flow rates beyond the treatment design flow shall bypass, and not enter the cartridge bay.

3.4.4. Catch Basin Configuration: Each Stormwater filtration system shall include an internal, offline overflow bypass. Water enters through the grate into the inlet bay that is separate from the cartridge bay and separate from the outlet bay. Low flows travel from the inlet bay, through a transfer opening and into the cartridge bay. High flows enter the outlet bay by topping the baffled weir separating the inlet and outlet bay. Flow rates beyond the design flow (overflow)

will not enter the cartridge bay. Minimum of 0.5 cfs overflow capacity.

3.4.5. Roof Drain Configuration: Minimum of 1 cfs overflow capacity.

3.4.6. Infiltration Manhole Configuration: The filter system will have a baffled, non-siphoning internal overflow with a minimum of 1.0 cfs capacity.

3.5. Linear Grate Configuration Vault Access: All portions of the vault, inlet bay, outlet bay and filtration bay shall be directly accessible from the surface through removable grated openings or solid covers.

4. EXECUTION

4.1. Precast Concrete Structure:

4.1.1. Set precast structure on crushed rock base material that has been placed in maximum 6-inch lifts, loose thickness, and compacted to at least 95-percent of the maximum dry density as determined by the standard Proctor compaction test, ASTM D698, at moisture content of +/-2% of optimum water content.

4.1.2. Structure floor shall slope 1/4 inch maximum across the width and slope downstream 1 inch per 12 foot of length. For manholes "Length" is defined by a line running from the invert of the outlet through the center of the manhole and "width" is the perpendicular to the "length". Structure top finish grade shall be even with surrounding finish grade surface unless otherwise noted on plans.

4.1.3. Inlet and outlet pipes shall be stubbed in and connected to precast concrete structure according to Engineer's requirements and specifications. All connections to be water tight. If grout is used, Contractor to grout all inlet and outlet pipes flush with or protruding up to 2 inches into interior of structure.

4.1.4. When required, ballast shall be placed to the dimensions specified by the engineer and noted on the data block. Ballast shall not encase the inlet and/or outlet piping. Provide 12" clearance from outside diameter of pipes.

4.2. Steel Catch Basin:

4.2.1. Catch basin floor shall slope 1/4 inch maximum across the width and slope downstream 1 inch per 12 foot of length. Catch basin top finish grade shall be even with surrounding finish grade surface unless otherwise noted on plans.

4.2.2. Contractor shall prevent sediment and debris from entering the filter unit during construction.

4.2.3. If necessary, the inlet chamber may be filled with clean water to assist in preventing flotation during construction until the structure is backfilled and the concrete collar is poured.

4.2.4. Catch basin outlet shall be connected to downstream (and upstream, if applicable) piping using a flexible-type coupling.

4.2.5. Concrete perimeter slab shall be constructed 1 foot wide and 6 inches thick. Slab shall include

two #4 rebar hoops with minimum 6-inch overlap at closure. Allow 2-inch vertical spacing between hoops and minimum 2-inch clearance from concrete surfaces, or as directed by the engineer.

4.3. Clean Up:

4.3.1. Remove all excess materials, rocks, roots, or foreign material, leaving the site in a clean, complete condition approved by the engineer. The project site shall be clean and free of dirt and debris and the inlet/outlet chamber(s) and filter chamber(s) shall be free of construction debris and sediment before the allowing runoff to enter and place the system in operation. All filter components shall be free of any foreign materials including concrete and excess sealant.

4.3.2. Where applicable, Contractor shall remove the temporary filter fabric around the inlet grate to place the system in operation.

4.3.3. Where required, the 4-inch cleanout plug in the overflow weir wall shall remain in place for proper operation of the system.

4.4. Filter Cartridges:

4.4.1. Filter cartridges shall be delivered installed in the structure, unless otherwise agreed upon with the manufacturer. Contractor shall take appropriate action to protect the cartridges from sediment and other debris during construction. The method ultimately selected shall be at Contractor's discretion and Contractor's risk. Some methods for protecting the cartridges include, but are not limited to:

4.4.1.1. Remove cartridges from the structure and store appropriately. Cartridges shall be reinstalled to operate according to 4.4.2 (see below).

4.4.1.2. If structure is equipped with underdrain bypass piping, Contractor may leave cartridges in the vault and allow stormwater entering collection system to bypass filter bay through underdrain bypass piping.

4.4.1.3. Leave cartridges in the structure and plug inlet and outlet pipe to prevent stormwater from entering the vault, and provide means for stormwater to bypass the Stormwater filtration system.

4.4.2. Filter cartridges shall not be placed in operation until the structure is clean and the project site is clean and stabilized (construction erosion control measures no longer required). The project site includes any surface that contributes storm drainage to the Stormwater filtration system. All impermeable surfaces shall be clean and free of dirt and debris. All catch basins, manholes and pipes shall be free of dirt and sediments. Contact the manufacturer to assist with system activation and/or inspect the system for proper installation once site is clean and stabilized.

4.5. Contractor to install filter cartridges. Specifications for alternate cartridge installation methods available by contacting the manufacturer directly.

4.5.1. *Filter Cartridges with ¼-Turn Connector Fittings:* Tape shall be cleanly and completely removed from manifold fitting openings. ¼-turn connects shall be glued and inserted into all manifold fittings to be equipped with a filter cartridge. Filter cartridges shall be turned onto the connector until they reach the hard stop on the connector – approximately ¼ revolution, with care to not

"over turn" the cartridge, or turn with such force to damage the hard stop mechanism. Plugs shall be inserted without glue in all manifold fittings not equipped with a filter cartridge.

5. INSPECTION AND MAINTENANCE

5.1. Maintenance and Inspection shall be in performed in accordance with the manufacturer's recommendations for maintenance and inspection.

5.2. Maintenance and inspection intervals shall be per the manufacturer's recommendations, or per the approving/local jurisdiction/agency requirements; whichever is more frequent.

5.3. Surface access for personnel and equipment for inspection and maintenance activities shall be provided.

END OF SECTION