GEODESIGN INC

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Harper Houf Peterson Righellis, Inc.
205 SE Spokane Street, Suite 200
Portland, OR 97202

Attention: Mr. Ben Austin

Report of Geotechnical Engineering Services
Reynolds School District Bus Facility
20311 NE Glisan Street
Fairview, Oregon
GeoDesign Project: ReynoldsSD-1-01

INTRODUCTION

GeoDesign, Inc. is pleased to submit our report OF geotechnical engineering services associated with the proposed pavement improvements at the Reynolds School District bus facility. The site is located at 20311 NE Glisan Street in Fairview, Oregon. The site is shown relative to surrounding physical features on Figure 1. The site layout and locations of our explorations for this project are shown on Figures 2

We understand that the school district periodically places additional gravel to maintain operations at the facility and is evaluating options for paving their bus facility. We also understand that stormwater management will be a significant consideration to paving the bus facility and that the option for infiltration will need to be evaluated.

PURPOSE AND SCOPE

The purpose of our geotechnical engineering services was to complete a geotechnical investigation to support design and construction of the proposed project. Our specific scope of our services is summarized as follows:

- Coordinated and managed the field investigation, including security badging, private and public utility locates, and scheduling of contractors and GeoDesign staff.
- Completed the following explorations:
    - Twelve test pits to depths of 2.0 to 5.5 feet below ground surface (BGS).
    - Infiltration test at test pits TP-1 through TP-5.
    - Spoils from the test pit explorations were placed back in the excavation and compacted using the bucket of the excavator.

- Maintained continuous logs of the test pits, collected samples at representative intervals, and observed groundwater conditions.
- Performed a laboratory testing program. The specific laboratory tests performed on selected soil samples were as follows:
  - Eight moisture content determinations
  - Four percent fines determinations
- Provided recommendations for site preparation, grading and drainage, stripping depths, fill type for imported material, compaction criteria, trench excavation and backfill, use of on-site soil, and wet/dry weather earthwork.
- Provided the results of field infiltration testing to be incorporated into the design of the infiltration system.
- Provided recommendations for the management of identified groundwater conditions that may affect the performance of pavements.
- Provided recommendations for construction of asphalt pavements for on-site access roads and parking areas, including subbase, base course, and asphalt paving thickness.
- Provided this geotechnical engineering report summarizing the results of our geotechnical evaluation.
- Provide earthwork and pavement specifications in the Harper Houf Peterson Righellis' selected format.

SITE CONDITIONS

GEOLOGIC SETTING

The site is located in the east-central part of the Portland Basin physiographic province, which is bound by the Tualatin Mountains to the west and south and the Cascade Range to the east and north. The near-surface geologic unit is mapped as Quaternary (10,000 years to present) alluvium (Gannett and Caldwell, 1998; Hartford and McFarland, 1989) related to the Columbia River. The unit consists of unconsolidated sand, silt, and gravel deposited within the floodplain of the Columbia River. A portion of the alluvium may have been deposited by multiple catastrophic glacial floods associated with the late Pleistocene (15,500 to 13,000 years before present) Missoula Floods (Gannett and Caldwell, 1998; Hartford and McFarland, 1989).

Underlying the alluvium deposits is the Pliocene to Pleistocene Age (5 million to 1.5 million years before present) Troutdale Formation that consists of poorly to moderately consolidated, poorly graded, subrounded to rounded sand and gravel layers that are interbedded with poorly to moderately consolidated clay and silt lacustrine deposits. Thickness of the Troutdale Formation in the site vicinity is approximately 150 to 170 feet (Gannett and Caldwell, 1998; Hartford and McFarland, 1989).

Underlying the Troutdale Formation is the late Miocene to Pliocene Age (6 million to 1.5 million years before present) Troutdale Formation "lower member" that consists of laminated silty clay and micaceous sand. Thickness of the fine-grained member in the site vicinity is approximately 1,000 feet (Gannett and Caldwell, 1998).

The Troutdale Formation is underlain by the Miocene Age (20 million to 10 million years before present) Columbia River Basalt Group, which is a series of basalt flows that originated from southeastern Washington and northeastern Oregon. The Columbia River Basalt Group is considered the geologic basement unit for this report.

SURFACE CONDITIONS

With the exception of concrete and asphalt pavement around the maintenance and fueling facilities (shown shaded on Figure 2), the majority of the bus facility is covered with gravel. We have briefly reviewed historical aerial photographs dating back to 1990. The site has been expanded at the northeast corner and along NE Gilsan Street since 1990 to the current configuration.

Several potholes are present; however, we observed only a few areas where more extensive rutting was present. As stated above, the school district periodically places additional gravel to maintain operations at the facility

SUBSURFACE CONDITIONS

Background

We reviewed the work we have completed in the vicinity, and variable thickness of surface silt underlain by gravel with variable amounts of silt, cobbles, and boulders is typically present in the area. Groundwater is also shallow, with our prior project indicating groundwater as shallow as 7 feet BGS.

General

We excavated 12 test pits (TP-1 through TP-12) to depths of 2.0 to 5.5 feet BGS. Test pits TP-1 through TP-5 were extended to the depth of the native gravel for the purpose of infiltration testing; the remaining test pits were extended to sufficient depth to evaluate the thickness of the surface gravel and subgrade material. The approximate locations of the explorations are shown on Figure 2. A description of our explorations, logs of the test pits, and laboratory test results are presented in the Attachment. In general, the subsurface conditions consist of fill underlain by native silt and gravel.

Fill

The fill varies from gravel to silt material. The gravel includes base aggregate, likely from school district maintenance operations, underlain by general gravel fill. The thickness of the base aggregate varies between 0.3 foot and 1.2 feet (see Table 1). The silt content of the existing base aggregate varies between with silt to silty.

The underlying general gravel fill is medium dense, subangular, and contains variable amounts of debris (concrete, wood, glass, rubber, asphalt), as well as variable amounts of sand and silt. In addition, the gravel fill contains cobbles at several of the explorations (TP-4, TP-6, TP-7, TP-8, TP-9, and TP-12). Where present, the base of the gravel fill extends to depths of 1.0 foot to greater than 3.0 feet BGS (see Table 1).

Table 1. Summary of Surface Aggregate

Location	Depth to Base (feet BGS)	
	Base Aggregate	General Granular Fill
TP-1	1.0	NA[1,2]
TP-2	1.0	NA[1]
TP-3	1.2	NA[1]
TP-4	0.3	2.0
TP-5	0.6	NA[1]
TP-6	0.4	1.0
TP-7	0.4	2.0
TP-8	0.5	>2.5
TP-9	0.5	>3.0
TP-10	0.4	NA[1]
TP-11	0.7	NA[1]
TP-12	0.3	1.5

1. General granular fill not present and base aggregate underlain by silt (either fill or native).
2. Gravel fill encountered below 6 inches of silt fill

Silt fill, where encountered (TP-1, TP-2, TP-5, TP-6, TP-10, and TP-11), is medium stiff to stiff and generally contains variable amounts of sand and gravel. Cobbles and/or boulders were also observed in the silt fill at TP-10 and TP-11. The silt fill at TP-5 also contains debris (glass).

Native Soil

The native soil encountered consists of silt (where encountered) and gravel. The native silt was encountered below fill materials at test pits TP-2, TP-3, TP-5, TP-6, TP-7, and TP-10 through TP-12. The silt is medium stiff and contains variable amounts of sand, gravel, and cobbles.

The native gravel is medium dense and fine to coarse with silt, sand, and varying amounts of cobbles and boulders. The gravel (and cobbles and boulders) are subrounded. The depth of the native gravel was established with the infiltration test pits (TP-1 through T-5) at between 2.0 and 4.0 feet, but was not encountered in the remaining test pits to the depths explored (2.0 to 3.0 feet).

Groundwater

We did not observe groundwater seepage during our explorations. Based on our experience in the area, groundwater is anticipated to be shallow, with our prior projects indicating groundwater as shallow as 7 feet BGS. he depth to groundwater may fluctuate in response to seasonal changes, prolonged rainfall, changes in surface topography, and other factors not observed in this study.

INFILTRATION TESTING

Infiltration tests were conducted in test pits TP-1 through TP-5 at depths of 4.0 to 5.0 feet BGS. The infiltration testing locations and depths were based on correspondence with the project team. The infiltration testing procedures are described in the Attachment. The results of our field infiltration testing and laboratory testing are presented in Table 2.

Table 2. Infiltration and Laboratory Testing Summary

Location	Depth (feet BGS)	Observed Infiltration Rate[1] (inches per hour)	Fines Content[2] (percent)
TP-1	4.5	7	14
TP-2	5.0	7	NA[3]
TP-3	4.5	10	29
TP-4	4.5	10	11
TP-5	4.0	15	15

1. In situ infiltration rate observed in the field.
2. Fines content - material passing the U.S. Standard No. 200 Sieve.
3. not analyzed

The infiltration rates shown in Table 2 are short-term field rates and factors of safety have not been applied. Based on the site-specific testing and soil classifications, we recommend that an average in situ unfactored infiltration rate of 7 inches per hour be used for the native gravel encountered at between 2.0 and 4.0 feet BGS at the site. The infiltration rates of the overlying fill or silt were not tested; however, based on the soil encountered, we anticipate minimal infiltration capacity.

The infiltration rates are field rates and proper correction factors should be applied to determine long-term infiltration parameters. The design engineer should determine the appropriate remaining correction factor values to account for maintenance, vegetation, siltation, and other factors. Also, care should be taken to allow for adequate separation between the base of the infiltration system and the water table.

The actual depths and estimated infiltration rates can vary significantly from the values presented above. We recommend that the design infiltration values for the stormwater systems be confirmed by field testing completed during installation of the systems. The results of this field testing might necessitate that the stormwater system be enlarged to achieve the design infiltration rate. Also, we recommend subsequent infiltration testing be completed when development plans and stormwater management plans are developed.

CONCLUSIONS

GENERAL

Based on our review of the proposed preliminary development plan and the results of our explorations, laboratory testing, and analyses, it is our opinion that the proposed improvements can be constructed at the site. The primary geotechnical considerations for the project are summarized as follows:

- Infiltration rates were measured at between 7 and 15 inches per hour. As discussed in the "Infiltration Testing" section of this report, we recommend using an unfactored rate of 7 inches per hour in conjunction with the appropriate correction factors for long-term performance.
- Pavement options are discussed below. The most important consideration to the pavement options will be site grading. The options include the following:
  - Grade the site and pave over the existing and, as needed, additional base aggregate
  - Cement amend the existing base aggregate and pave over the amended material

Our specific recommendations are provided in the following sections of this report.

DESIGN

PAVEMENTS

General

Pavement options are discussed below. The options include the following:

- Grade the site and pave over the existing and, as needed, additional base aggregate
- Cement amend the existing base aggregate and pave over the amended material.

Design Requirements

Pavements should be installed on existing or new fills prepared in conformance with the "Site Preparation" and "Structural Fill" sections of this report. Our pavement recommendations are based on the following assumptions:

- Existing or new base aggregate is present below the asphalt. The existing or new base aggregate is compacted to at least 95 percent of its maximum dry density, as determined by ASTM D 1557.
- A resilient modulus of 3,500 pounds per square inch (psi) was assumed for the subgrade below the base aggregate.
- A resilient modulus of 20,000 psi was estimated for the existing or new base aggregate.
- A pavement design life of 20 years.
- Initial and terminal serviceability indices of 4.2 and 2.5, respectively.
- Reliability and standard deviations of 85 percent and 0.4, respectively.

If any of these assumptions is incorrect, our office should be contacted with the appropriate information so that the pavement designs can be revised.

We do not have specific information on the frequency of bus and other vehicles expected at the site. We have made the assumptions described below:

- **Main Access Drive:** Currently paved and not part of this evaluation
- **Bus Access Drives:** Assumed daily bus traffic varies between 20 and 40 busses per day
- **Bus Parking Stalls:** Assumed daily bus traffic varies between two and four busses per day

The pavement sections corresponding to the traffic assumptions above are summarized in Table 3.

Table 3. Standard Pavement Sections

Traffic Levels	Trucks per Day	ESALs	AC (inches)	Base Aggregate (inches)
Bus Access Drives	20	98,000	4.0	15.0
	30	148,000	4.5	15.0
	40	197,000	4.5	16.0
Bus Parking Stalls	4	20,000	3.0	12.0
	6	30,000	3.0	13.0

AC: asphalt concrete
ESAL: equivalent single-axle load

Pave over Existing Base Aggregate

With the exception of locations with potholes and rutting, and the understanding that the school district periodically places additional gravel to maintain operations, the majority of the bus parking area is supporting bus traffic. With this in mind, one option is to grade the site and pave over the existing base aggregate. As discussed in the "Design Requirements" section above, the amount of base aggregate needed to achieve the 20-year design criteria (see Table 3) exceeds the amount of existing base aggregate unless additional material is added. The site grading plan may not accommodate the grade increase.

As shown in Table 1, the explorations completed at the site indicate existing base aggregate and gravel fill extends at least 1 foot BGS with the exception of TP-5 (0.6 foot), TP-10 (0.4 foot), and TP-11 (0.7 foot). The recommendations above can be modified to a 12-inch thickness of base aggregate by increasing the AC thickness as shown in Table 4.

Table 4. Thickened AC Pavement Sections

Traffic Levels	Trucks per Day	ESALs	AC (inches)	Base Aggregate (inches)
Bus Access Drives	20	98,000	4.5	12.0
	30	148,000	5.5	11.0
	40	197,000	5.5	12.0
Bus Parking Stalls	4	20,000	3.0	12.0
	6	30,000	3.5	11.0

With either approach we recommend that areas with existing rutting or potholes be excavated to the depth required to reach firm material and backfilled with base aggregate.

Pave over Cement-Amended Material

Alternative pavement sections may be possible using cement-amended subgrade. However, cobbles and boulders were encountered in the gravel and silt fill, so removal of this oversized material (relative to damage to the tiller) will likely be required if cement amendment is attempted.

If the subgrade is cement amended to the thicknesses indicated below and the amended soil achieves a seven-day unconfined compressive strength of at least 150 psi, then the pavements can be constructed as recommended in Table 5.

Table 5. Pavement Sections with Cement Amendment

Traffic Levels	Trucks per Day	ESALs	AC (inches)	Cement Amendment Depth (inches)[1]
Bus Access Drives	20	98,000	4.0	16.0
	30	148,000	4.5	16.0
	40	197,000	4.5	16.0
Bus Parking Stalls	4	20,000	3.0	16.0
	6	30,000	3.0	16.0

1. Assumes a minimum seven-day unconfined compressive strength of 150 psi. For preliminary purposes, we recommend a cement ratio of 6 percent by dry unit weight

To prevent strength loss during curing, cement-amended soil should be allowed to cure for at least four days prior to construction traffic or placing the base aggregate or AC. Alternatively, pavement can be constructed over the amended soil on the same day of treatment. In addition, cement-amended soil is susceptible to damage by construction traffic (lower abrasion resistance). Accordingly, we recommend minimizing construction traffic on the cement-amended material, or placing 2 to 3 inches of base aggregate prior to construction traffic access.

Additional Considerations

All thicknesses are intended to be the minimum acceptable. The design of the recommended pavement section is based on the assumption that construction will be completed during an extended period of dry weather. Wet weather construction could require an increased thickness of base aggregate. The AC, base aggregate, and cement amendment should meet the requirements outlined in the “Materials” section of this report.

Construction traffic should be limited to unpaved portions of the site or haul roads. Construction traffic should not be allowed on new pavements. If construction traffic is to be allowed on newly constructed road sections, an allowance for this additional traffic will need to be made in the design pavement section.

CONSTRUCTION

SITE PREPARATION

Grubbing and Stripping

Trees and shrubs should be removed from fill areas. In addition, root balls should be grubbed out to the depth of the roots, which could exceed 3 feet BGS. Depending on the methods used to remove the root balls, considerable disturbance and loosening of the subgrade could occur during site grubbing. We recommend that soil disturbed during grubbing operations be removed to expose firm, undisturbed subgrade. The resulting excavations should be backfilled with structural fill.

The existing topsoil zone should be stripped and removed from all fill areas. Based on our explorations, the depth of stripping will be minimal, likely less than 1 inch, although greater stripping depths may be required to remove localized zones of loose or organic soil. Greater stripping depths (approaching 12 inches) may be anticipated in areas with thicker vegetation and shrubs. The actual stripping depth should be based on field observations at the time of construction. Stripped material should be transported off site for disposal or used in landscaped areas.

Subgrade Evaluation

Upon completion of stripping and subgrade stabilization, and prior to the placement of fill or pavement improvements, the exposed subgrade should be evaluated by proof rolling. The subgrade should be proof rolled with a fully loaded dump truck or similarly heavy, rubber-tired construction equipment to identify soft, loose, or unsuitable areas. A member of our geotechnical staff should observe the proof rolling to evaluate yielding of the ground surface. During wet weather, subgrade evaluation should be performed by probing with a foundation probe rather than proof rolling. Areas that appear soft or loose should be improved in accordance with subsequent sections of this report.

CONSTRUCTION CONSIDERATIONS

The fine-grained soil underlying the existing base aggregate and granular fill is easily disturbed. If not carefully executed, site preparation, utility trench work, and roadway excavation can create extensive soft areas and significant repair costs can result. Earthwork planning, regardless of the time of year, should include considerations for minimizing subgrade disturbance.

If construction occurs during or extends into the wet season, or if the moisture content of the surficial soil is more than a couple percentage points above optimum, site stripping and cutting may need to be accomplished using track-mounted equipment. Likewise, the use of granular haul roads and staging areas will be necessary for support of construction traffic during the rainy season or when the moisture content of the surficial soil is more than a few percentage points above optimum. The base rock thickness for pavement areas is intended to support post-construction design traffic loads. This design base rock thickness may not support construction traffic or pavement construction when the subgrade soil is wet. Accordingly, if construction is planned for periods when the subgrade soil is wet, staging and haul roads with increased thicknesses of base rock will be required. The amount of staging and haul road areas, as well as the required thickness of granular material, will vary with the contractor's sequencing of a project and type/frequency of construction equipment. Based on our experience, between 12 and 18 inches of imported granular material is generally required in staging areas and between 18 and 24 inches in haul roads areas. Stabilization material may be used as a substitute, provided the top 4 inches of material consists of imported granular material. The actual thickness will depend on the contractor's means and methods and, accordingly, should be the contractor's responsibility. In addition, a geotextile fabric should be placed as a barrier between the subgrade and imported granular material in areas of repeated construction traffic. The imported granular material, stabilization material, and geotextile fabric should meet the specifications in the "Materials" section of this report.

EXCAVATION

General

Dense gravel with cobbles and boulders is present at relatively shallow depths across the site. Construction considerations associated with the presence of shallow gravel with cobbles and boulders include the following:

- Excavations can become difficult, if not impossible, with conventional equipment.
- Excavation volumes for utility trenches may be greater than anticipated due to sloughing and the need to remove oversized material.
- Boulders will likely be encountered during excavations, and we recommend that project bid documents include a contingency for boulder removal, as well as the associated increased trench volumes for backfilling.

Trench Cuts and Trench Shoring

Trench cuts should stand near vertical to a depth of at least 4 feet. Open excavation techniques may be used to excavate trenches with depths between 4 and 8 feet, provided the walls of the excavation are cut at a slope of 1 horizontal to 1 vertical (H:V), groundwater seepage is not present, and with the understanding that some sloughing may occur. The trenches should be flattened to 1½H:1V if excessive sloughing occurs. Excavations that extend into the very dense gravel unit will likely encounter difficult excavation as well as cobbles and boulders.

If box shoring is used, it should be understood that box shoring is a safety feature used to protect workers and does not prevent caving. If the excavations are left open for extended periods of time, then caving of the sidewalls may occur. The presence of caved material will limit the ability to properly backfill and compact the trenches. The contractor should be prepared to fill voids between the box shoring and the sidewalls of the trenches with sand or gravel before caving occurs.

If shoring is used, we recommend that the type and design of the shoring system be the responsibility of the contractor, who is in the best position to choose a system that fits the overall plan of operation. All excavations should be made in accordance with applicable Occupational Safety and Health Administration (OSHA) and state regulations.

Safety

All excavations should be made in accordance with applicable OSHA requirements and regulations of the state, county, and local jurisdiction. While this report describes certain approaches to excavation and dewatering, the contract documents should specify that the contractor is responsible for selecting excavation and dewatering methods, monitoring the excavations for safety, and providing shoring (as required) to protect personnel and adjacent structural elements.

MATERIALS

Structural Fill

General

A variety of material may be used as structural fill at the site. Fill should only be placed over subgrade that has been prepared in conformance with the "Site Preparation" section of this report. Structural fill should meet the specifications provided in Oregon Standard Specifications for Construction – 2015 (OSSC) 00330 - Earthwork, OSSC 00400 - Drainage and Sewers, and OSSC 02600 - Aggregates, depending on the application. A brief characterization of some of the acceptable materials and our recommendations for their use as structural fill is provided below.

A submittal should be made for each material prior to the start of construction. Each submittal should include the test information necessary to evaluate the degree to which the properties of the material comply with the properties that were recommended or specified. The geotechnical engineer and other appropriate members of the design team should review each submittal.

On-Site Fine-Grained Soil

The on-site silt soil is suitable for use as structural fill, provided it meets the specifications provided in OSSC 00330.12 - Borrow Material. Based on laboratory test results, the moisture content of the on-site silt was between 17 and 58 percent at the time of exploration. Based on our experience, we estimate the optimum moisture content for compaction to be approximately 14 to 17 percent for the on-site silty soil; therefore, significant moisture conditioning (drying) will be required to use on-site silty soil for structural fill. Accordingly, extended dry weather and sufficient area to dry the soil will be required to adequately condition the soil for use as structural fill.

When used as structural fill, the on-site silty soil should be placed in lifts with a maximum uncompacted thickness of 8 inches and compacted to not less than 92 percent of the maximum dry density, as determined by ASTM D 1557.

On-Site Gravelly Soil

The on-site gravelly soil is suitable for use as structural fill, provided it is free of organic material or other unsuitable material, has particles less than 4 inches in diameter, and meets the specifications provided in OSSC 00330.12 - Borrow Material. Occasional cobbles greater than 4 inches may be acceptable if they can be properly mixed into the fill matrix. Fine grading of gravelly soil may result in segregating boulders, cobbles, or coarse gravel from the soil matrix, resulting in unsatisfactory (poorly graded or "bony") fill. The material may also include a silt or clay matrix that will render the material moisture-sensitive and require moisture conditioning as described above for "on-site fine-grained soil." Fill material should be maintained as well graded with gravel, sand, and silt material for proper compaction during fill placement and mass grading. A qualified geotechnical engineer should observe fill material prior to placement.

When used as structural fill, the on-site gravelly soil should be placed in lifts with a maximum uncompacted thickness of 8 to 12 inches and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D 1557.

Imported Granular Material

Imported granular material used as structural fill should be pit- or quarry-run rock, crushed rock, or crushed gravel and sand and should meet the specifications provided in OSSC 00330.14 - Selected Granular Backfill or OSSC 00330.15 - Selected Stone Backfill. The imported granular material should also be angular, fairly well graded between coarse and fine material, have less than 5 percent by dry weight passing the U.S. Standard No. 200 Sieve, and have at least two mechanically fractured faces.

Imported granular material should be placed in lifts with a maximum uncompacted thickness of 12 inches and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D 1557. During the wet season or when wet subgrade conditions exists, the initial lift should be approximately 18 inches in uncompacted thickness and should be compacted by rolling with a smooth-drum roller without using vibratory action.

Stabilization Material

Stabilization material should consist of pit- or quarry-run rock, crushed rock, or crushed gravel and should meet the specifications provided in OSSC 00330.16 - Stone Embankment Material. In addition, the material should have a maximum particle size of 6 inches, have less than 5 percent by dry weight passing the U.S. Standard No. 4 Sieve, and have at least two mechanically fractured faces. The material should be free of organic matter and other deleterious material. Stabilization material should be placed in lifts between 12 and 18 inches thick and compacted to a firm condition.

Where the stabilization material is used to stabilize soft subgrade beneath pavements or construction haul roads, a geotextile should be placed as a barrier between the soil subgrade and the imported granular material. The placement of the imported granular fill should be done in conformance with the specifications provided in OSSC 00331 - Subgrade Stabilization. The geotextile fabric should meet the specifications provided below for subgrade geotextiles. Geotextile is not required where stabilization material is used at the base of utility trenches.

Trench Backfill

Trench backfill placed beneath, adjacent to, and for at least 12 inches above utility lines (i.e., the pipe zone) should consist of well-graded granular material with a maximum particle size of 1½ inches and less than 7 percent by dry weight passing the U.S. Standard No. 200 Sieve and should meet the specifications provided in OSSC 00405.13 - Pipe Zone Material. The pipe zone backfill should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D 1557, or as required by the pipe manufacturer or local building department.
Within roadway alignments, the remainder of the trench backfill up to the subgrade elevation should consist of well-graded granular material with a maximum particle size of 2½ inches and less than 7 percent by dry weight passing the U.S. Standard No. 200 Sieve and should meet the specifications provided in OSSC 00405.14 - Trench Backfill; Class B, C, or D. This material should be compacted to at least 92 percent of the maximum dry density, as determined by

ASTM D 1557, or as required by the pipe manufacturer or local building department. The upper 3 feet of the trench backfill should be compacted to at least 95 percent of the maximum dry density, as determined by ASTM D 1557.

Outside of structural improvement areas (e.g., roadway alignments or building pads), trench backfill placed above the pipe zone may consist of general fill material that is free of organics and material over 6 inches in diameter and meets the specifications provided in OSSC 00405.14 - Trench Backfill; Class A, B, C, or D. This general trench backfill should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D 1557, or as required by the pipe manufacturer or local building department.

Aggregate Base Rock

Imported granular material used as base rock for building floor slabs and pavements should consist of ¾- or 1½-inch-minus material (depending on the application) and meet the requirements in OSSC 00641 - Aggregate Subbase, Base, and Shoulders. In addition, the aggregate should have less than 5 percent by dry weight passing the U.S. Standard No. 200 Sieve. The base aggregate should be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D 1557.

Drain Rock Material

Drain rock should consist of angular, granular material that meets the specifications provided in OSSC 00430.11 - Granular Drain Backfill Material. The drain rock should be wrapped in a drainage geotextile that meets the specifications provided below for drainage geotextiles.

Soil Amendment with Cement

General

As an alternative to the use of imported granular material for wet weather structural fill, or for pavement subbase an experienced contractor may be able to amend the on-site soil with portland cement to obtain suitable support properties. Successful use of soil amendment depends on the use of correct mixing techniques, soil moisture content, and amendment quantities. Soil amending should be conducted in accordance with the specifications provided in OSSC 00344 - Treated Subgrade. The amount of cement used during treatment should be based on an assumed soil dry unit weight of 110 pounds per cubic foot. As noted above, cobbles and boulders were encountered in the gravel and silt fill, so removal of this oversized material (relative to damage to the tiller) will likely be required if cement amendment is attempted.

Pavement Subbase

Specific recommendations based on exposed site conditions for soil amending can be provided if necessary. However, for preliminary design purposes, we recommend a target strength of 150 psi for cement-amended soil below pavements. The amount of cement used to achieve this target generally varies with moisture content and soil type (specifically, the amount of soil and gravel). It is difficult to predict field performance of soil to cement amendment due to variability in soil response, and we recommend laboratory testing to confirm expectations. Assuming a mixture of primarily silty gravel, 5 percent cement by weight of dry soil can be used when the soil moisture content does not exceed approximately 20 percent. If the soil moisture content is in the range of 25 to 35 percent, 6 to 8 percent by weight of dry soil is recommended. The amount of cement added to the soil may need to be adjusted based on field observations and performance. Moreover, depending on the time of year and moisture content levels during amendment, water may need to be applied during tilling to appropriately condition the soil moisture content.

We recommend a minimum cement ratio of 6 percent (by dry weight). The amended material should be compacted to at least 92 percent of the achievable dry density at the moisture content of the material, as defined in ASTM D 1557.

A minimum curing of four days is required between treatment and construction traffic access. Construction traffic should not be allowed on unprotected, cement-amended subgrade. To protect the cement-treated surfaces from abrasion or damage, the finished surface should be covered with 4 to 6 inches of imported granular material.

Treatment depths for building/pavement, haul roads, and staging areas are typically on the order of 12, 16, and 12 inches, respectively. The crushed rock typically becomes contaminated with soil during construction. Contaminated base rock should be removed and replaced with clean rock in pavement areas. The actual thickness of the amended material and imported granular material for haul roads and staging areas will depend on the anticipated traffic, as well as the contractor’s means and methods and, accordingly, should be the contractor’s responsibility.

Cement amending should not be attempted when air temperature is below 40 degrees Fahrenheit or during moderate to heavy precipitation. Cement should not be placed when the ground surface is saturated or standing water exists.

Other Considerations

Portland cement-amended soil is hard and has low permeability. This soil does not drain well, nor is it suitable for planting. Future planted areas should not be cement amended, if practical, or accommodations should be made for drainage and planting. Moreover, cement amending soil within building areas must be done carefully to avoid trapping water under floor slabs. We should be contacted if this approach is considered. Cement amendment should not be used if runoff during construction cannot be directed away from adjacent wetlands (if any).

AC

The AC should be Level 3, ½-inch, dense asphalt concrete pavement (ACP) according to OSSC 00744 - Asphalt Concrete Pavement and compacted to 91 percent of the theoretical maximum density of the mix, as determined by AASHTO T 209. The minimum and maximum lift thickness is 2.0 and 3.0 inches, respectively, for ½-inch ACP. Asphalt binder should be performance graded and conform to
PG 64-22 or better.

OBSERVATION OF CONSTRUCTION

Satisfactory foundation and earthwork performance depends to a large degree on quality of construction. Sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications.

Subsurface conditions observed during construction should be compared with those encountered during the subsurface exploration. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect if subsurface conditions change significantly from those anticipated.

We recommend that GeoDesign be retained to observe earthwork activities, including stripping, proof rolling of the subgrade and repair of soft areas, footing subgrade preparation, performing laboratory compaction and field moisture-density tests, observing final proof rolling of the pavement subgrade and base rock, and asphalt placement and compaction.

LIMITATIONS

We have prepared this report for use by Harper Houf Peterson Righellis, Inc., Reynolds School District, and the design and construction team for the proposed project. The data and report can be used for bidding or estimating purposes, but our report, conclusions, and interpretations should not be construed as warranty of the subsurface conditions and are not applicable to other sites.

Exploration observations indicate soil conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect soil strata or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, re-evaluation will be necessary.

The site development plans and design details were preliminary at the time this report was prepared. When the design has been finalized and if there are changes in stormwater disposal plans, the conclusions and recommendations presented may not be applicable. If design changes are made, we request that we be retained to review our conclusions and recommendations and to provide a written modification or verification.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in this area at the time the report was prepared. No warranty, express or implied, should be understood.

◆ ◆ ◆

We appreciate the opportunity to be of continued service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,

GeoDesign, Inc.

George Saunders, P.E., G.E.
Principal Engineer

REGISTERED PROFESSIONAL
ENGINEER
15025
OREGON
July 25, 1990
GEORGE P. SAUNDERS
EXPIRES: 6/30/16

GPS:kt

Attachments

One copy submitted (via email only)

Document ID: ReynoldsSD-1-01-103015-geolr.docx

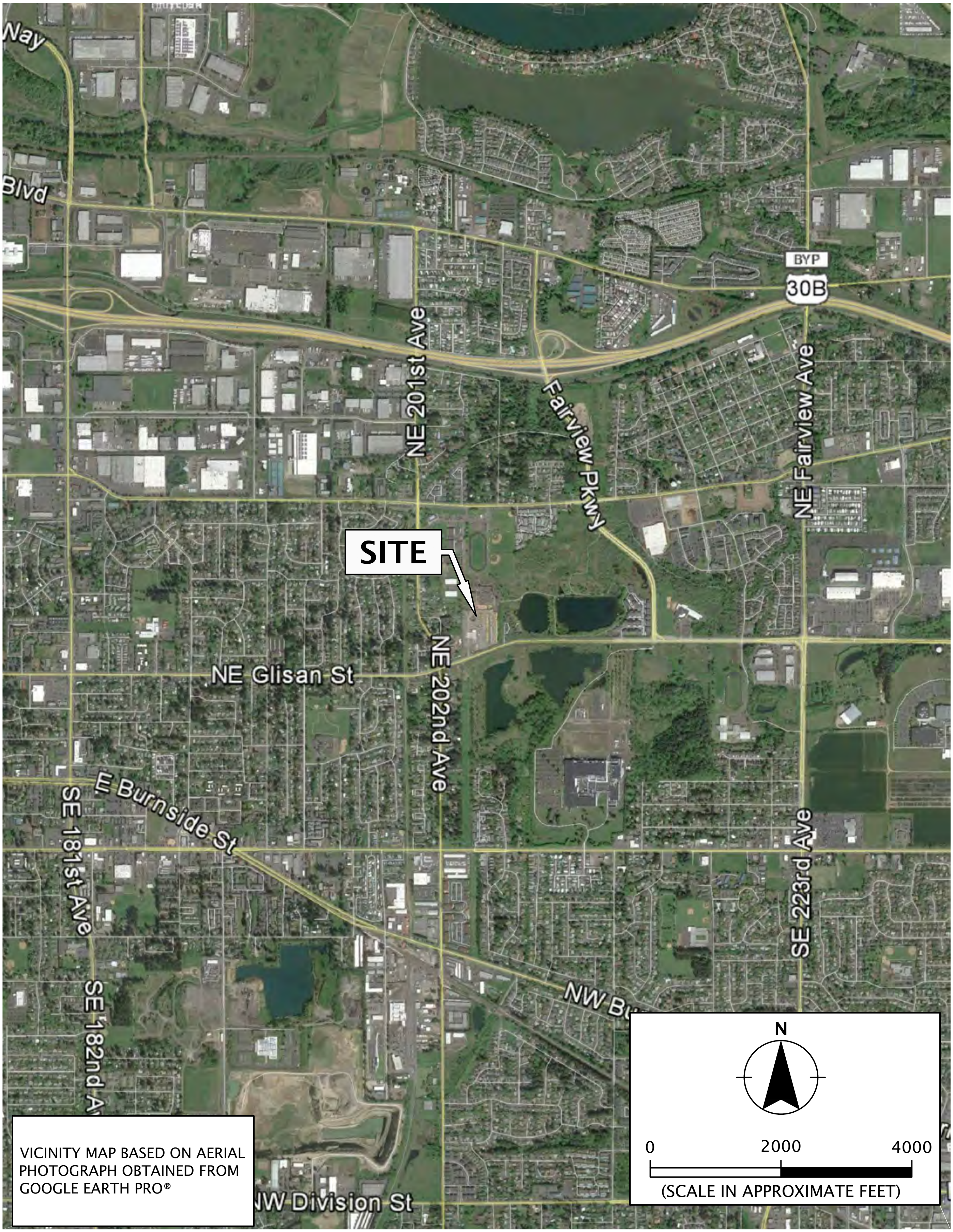
REFERENCES

Gannett, Marshall W., and Caldwell, Rodney R., 1998, Geologic Framework of the Willamette Lowland Aquifer System, Oregon and Washington: U. S. Geological Survey Professional Paper 1424-A, 32p, 8 plates.

Hartford, Susan V., and McFarland, William D., 1989, Lithology, Thickness, and Extent of Hydrogeologic Units Underlying the East Portland Area, Oregon, U. S. Geological Survey Water-Investigation Report 88-4110, 23 p., 6 plates.

ODOT, 2015. *Oregon Standard Specifications for Construction,* Oregon Department of Transportation, 2015 Edition.

FIGURES



VICINITY MAP BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO®

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VICINITY MAP

REYNOLDS SCHOOL DISTRICT BUS FACILITY
FAIRVIEW, OR

FIGURE 1

Printed By: aday | Print Date: 10/6/2015 3:07:35 PM
File Name: J:\M-R\ReynoldsSD\ReynoldsSD-1\ReynoldsSD-1-01\Figures\CAD\ReynoldsSD-1-01-VM01.dwg | Layout: FIGURE 1

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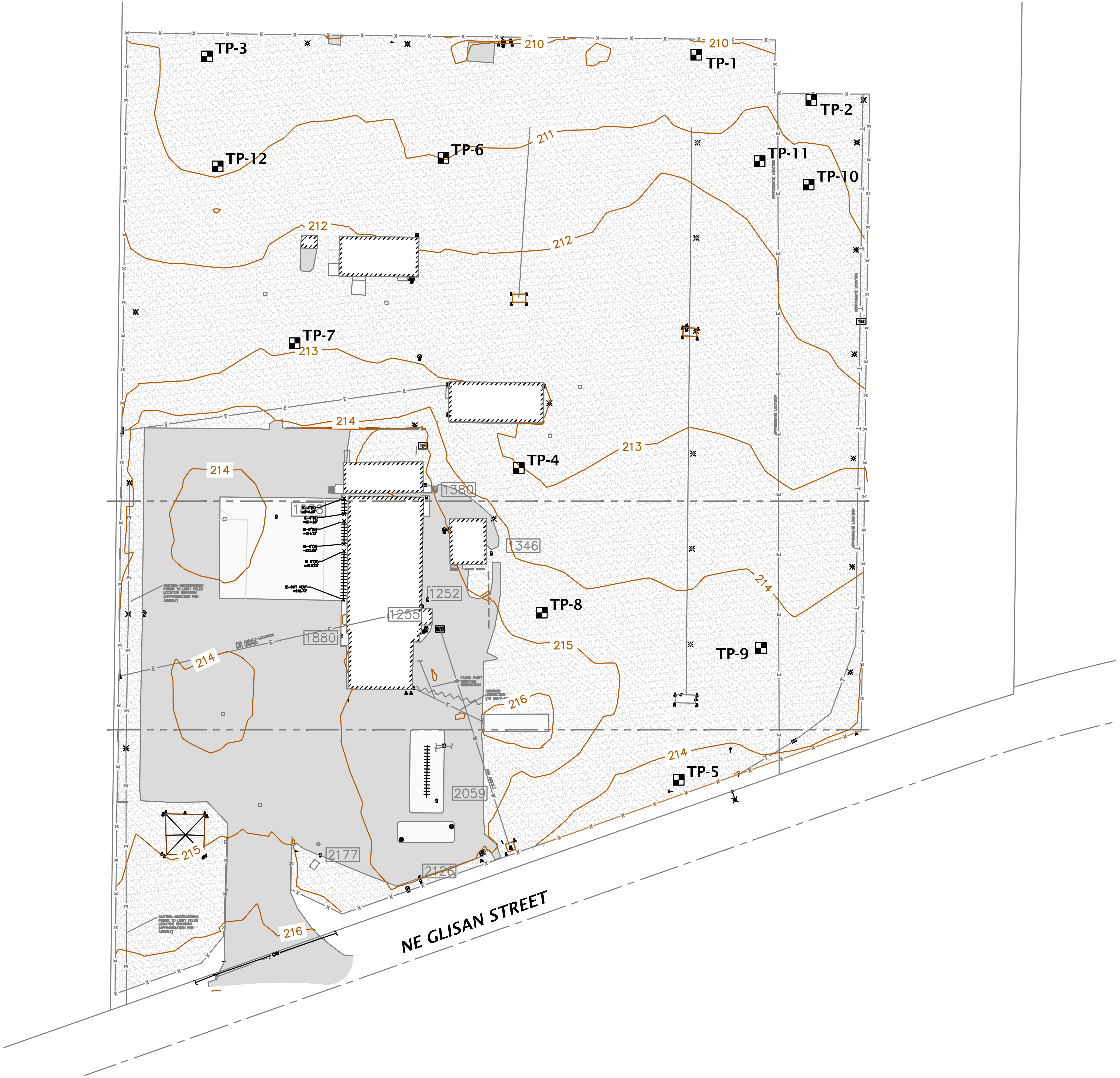
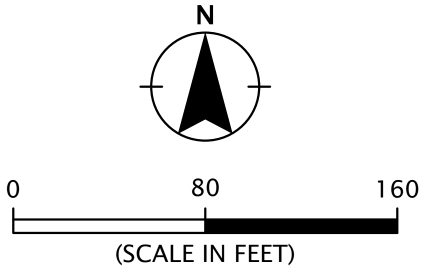


LEGEND:

TP-1 ▣ TEST PIT



SITE PLAN BASED ON DRAWING PROVIDED BY
HARPER HOUF PETERSON RIGHELLIS, INC.

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OCTOBER 2015

SITE PLAN

REYNOLDS SCHOOL DISTRICT BUS FACILITY
FAIRVIEW, OR

FIGURE 2

ATTACHMENT

ATTACHMENT

FIELD EXPLORATIONS

GENERAL

We explored subsurface conditions by excavating 12 test pits (TP-1 through TP-12) to depths of 2.0 to 5.5 feet BGS. The test pits were excavated by Dan J. Fischer Excavating, Inc. using a John Deere 310 E backhoe. The approximate locations of the explorations are shown on Figure 2. The explorations were located in the field relative to existing site features and should be considered approximate. Longitudes/latitudes were determined by overlaying these locations on Google Earth. Our estimates of the longitudes/latitudes are shown on the exploration logs. A member of our geology staff observed the explorations.

SOIL SAMPLING

Representative grab samples of the soil observed in the test pit explorations were obtained from the test pit walls and/or base using the backhoe bucket. Soil classifications, sampler type, and sampling intervals are presented on the exploration logs included in this attachment. A hand-held pocket penetrometer was used to estimate the unconfined shear strength of the fine-grained soil. Classifications and sampling intervals are shown on the exploration logs presented in this attachment.

SOIL CLASSIFICATION

The soil samples were classified in accordance with the “Exploration Key” (Table A-1) and “Soil Classification System” (Table A-2), which are presented in this attachment. The exploration logs indicate the depths at which the soils or their characteristics change, although the change could be gradual. A horizontal line between soil types indicates an observed (visual or drill action) change. If the change occurred between sample locations and was not observed or obvious, the depth was interpreted and the change is indicated using a dashed line. Classifications and sampling intervals are shown on the exploration logs presented in this attachment.

INFILTRATION TESTING

Infiltration tests were conducted in test pits TP-1 through TP-5. Because of the shallow depth to groundwater, the infiltration tests were completed at depths ranging between approximately 4 and 5 feet BGS. The infiltration rates were estimated by embedding a 6-inch-inside diameter pipe into the base of the pit and filling the pipe with water, allowing the area to saturate, and then measuring the drop in water with time. The tests were conducted under a hydrostatic head of less than approximately 12 inches. Representative soil samples were collected from at or below the infiltration test locations for grain-size distribution analyses, as described in this attachment.

LABORATORY TESTING

We visually examined soil samples obtained from the explorations to confirm field classifications. We also performed the following laboratory testing.

MOISTURE CONTENT

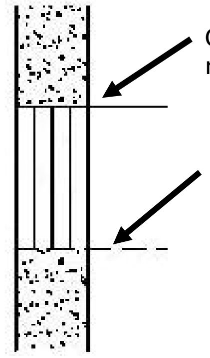
We tested the natural moisture content of selected soil samples obtained from the explorations in general accordance with ASTM D 2216. The natural moisture content is a ratio of the weight of the water to soil in a test sample and is expressed as a percentage. The test results are presented in this attachment.

FINES CONTENT ANALYSIS

Fines content analyses were performed on four soil samples in general accordance with ASTM C 117 and ASTM D 1140. This test is a quantitative determination of the amount of material finer than the U.S. Standard No. 200 Sieve expressed as a percentage of soil weight. The test results are presented in this attachment.

SYMBOL	SAMPLING DESCRIPTION
▯	Location of sample obtained in general accordance with ASTM D 1586 Standard Penetration Test with recovery
▮	Location of sample obtained using thin-wall Shelby tube or Geoprobe® sampler in general accordance with ASTM D 1587 with recovery
▤	Location of sample obtained using Dames & Moore sampler and 300-pound hammer or pushed with recovery
▦	Location of sample obtained using Dames & Moore and 140-pound hammer or pushed with recovery
◩	Location of sample obtained using 3-inch-O.D. California split-spoon sampler and 140-pound hammer
⊠	Location of grab sample
▒	Rock coring interval
▽	Water level during drilling
▼	Water level taken on date shown

Graphic Log of Soil and Rock Types



Observed contact between soil or rock units (at depth indicated)

Inferred contact between soil or rock units (at approximate depths indicated)

GEOTECHNICAL TESTING EXPLANATIONS

ATT	Atterberg Limits	PP	Pocket Penetrometer
CBR	California Bearing Ratio	P200	Percent Passing U.S. Standard No. 200 Sieve
CON	Consolidation		
DD	Dry Density	RES	Resilient Modulus
DS	Direct Shear	SIEV	Sieve Gradation
HYD	Hydrometer Gradation	TOR	Torvane
MC	Moisture Content	UC	Unconfined Compressive Strength
MD	Moisture-Density Relationship	VS	Vane Shear
OC	Organic Content	kPa	Kilopascal
P	Pushed Sample		

ENVIRONMENTAL TESTING EXPLANATIONS

CA	Sample Submitted for Chemical Analysis	ND	Not Detected
P	Pushed Sample	NS	No Visible Sheen
PID	Photoionization Detector Headspace Analysis	SS	Slight Sheen
		MS	Moderate Sheen
ppm	Parts per Million	HS	Heavy Sheen

RELATIVE DENSITY - COARSE-GRAINED SOILS

Relative Density	Standard Penetration Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)
Very Loose	0 – 4	0 - 11	0 - 4
Loose	4 – 10	11 - 26	4 - 10
Medium Dense	10 – 30	26 - 74	10 - 30
Dense	30 – 50	74 - 120	30 - 47
Very Dense	More than 50	More than 120	More than 47

CONSISTENCY - FINE-GRAINED SOILS

Consistency	Standard Penetration Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)	Unconfined Compressive Strength (tsf)
Very Soft	Less than 2	Less than 3	Less than 2	Less than 0.25
Soft	2 - 4	3 – 6	2 - 5	0.25 - 0.50
Medium Stiff	4 - 8	6 – 12	5 - 9	0.50 - 1.0
Stiff	8 - 15	12 – 25	9 - 19	1.0 - 2.0
Very Stiff	15 - 30	25 – 65	19 – 31	2.0 - 4.0
Hard	More than 30	More than 65	More than 31	More than 4.0

PRIMARY SOIL DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOILS (more than 50% retained on No. 200 sieve)	GRAVEL (more than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVELS (< 5% fines)	GW or GP	GRAVEL
		GRAVEL WITH FINES (≥ 5% and ≤ 12% fines)	GW-GM or GP-GM	GRAVEL with silt
			GW-GC or GP-GC	GRAVEL with clay
		GRAVELS WITH FINES (> 12% fines)	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND (50% or more of coarse fraction passing No. 4 sieve)	CLEAN SANDS (<5% fines)	SW or SP	SAND
		SANDS WITH FINES (≥ 5% and ≤ 12% fines)	SW-SM or SP-SM	SAND with silt
			SW-SC or SP-SC	SAND with clay
		SANDS WITH FINES (> 12% fines)	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOILS (50% or more passing No. 200 sieve)	SILT AND CLAY	Liquid limit less than 50	ML	SILT
			CL	CLAY
			CL-ML	silty CLAY
			OL	ORGANIC SILT or ORGANIC CLAY
		Liquid limit 50 or greater	MH	SILT
			CH	CLAY
			OH	ORGANIC SILT or ORGANIC CLAY
HIGHLY ORGANIC SOILS			PT	PEAT

MOISTURE CLASSIFICATION

Term	Field Test
dry	very low moisture, dry to touch
moist	damp, without visible moisture
wet	visible free water, usually saturated

ADDITIONAL CONSTITUENTS

Secondary granular components or other materials such as organics, man-made debris, etc.

Percent	Silt and Clay In:		Percent	Sand and Gravel In:	
	Fine-Grained Soils	Coarse-Grained Soils		Fine-Grained Soils	Coarse-Grained Soils
< 5	trace	trace	< 5	trace	trace
5 – 12	minor	with	5 – 15	minor	minor
> 12	some	silty/clayey	15 – 30	with	with
			> 30	sandy/gravelly	Indicate %

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SOIL CLASSIFICATION SYSTEM

TABLE A-2

TP-1

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT (%) 0 50 100	COMMENTS
0.0	Medium dense, gray-brown, silty GRAVEL with sand and debris (concrete) (GM); moist, subangular (2-inch-thick root zone) - **FILL**.	1.0		☒		Pit-run 3-inch-minus gravel.
	Medium stiff, brown-light gray SILT with sand (ML); moist - **FILL**.	1.5				
2.5	Medium dense, brown-gray, silty GRAVEL with cobbles (GM), minor sand; moist, subrounded - **FILL**.	2.5		☒	●	
	Medium stiff, brown-orange SILT with sand (ML), minor gravel, trace organics (rootlets); moist.	3.5	P200	☒	●	Infiltration test at 4.5 feet. P200 = 14%
5.0	Medium dense, brown-orange, silty GRAVEL with cobbles (GM), minor sand; moist.	5.0				No groundwater seepage observed to the depth explored. No caving observed to the depth explored.
7.5	Exploration completed at a depth of 5.0 feet. Latitude: 45.529093 Longitude: -122.452252 (determined from Google Earth)					Surface elevation was not measured at the time of exploration.

TP-2

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT (%) 0 50 100	COMMENTS
0.0	Medium dense, gray GRAVEL with silt and sand (GP-GM); moist (1/2- to 1-inch-thick root zone) - **FILL**.	1.0				Angular 3-inch-minus gravel.
	Medium stiff, brown-gray SILT with sand (ML), minor gravel; moist - **FILL**.			☒		
2.5	Medium stiff, brown-orange SILT with sand (ML), minor gravel, trace organics (rootlets); moist.	2.0		☒	●	
5.0	Medium dense, brown-orange-gray, silty GRAVEL with cobbles and boulders (GM), minor sand; moist.	4.0		☒	●	Infiltration test at 5.0 feet.
7.5	Exploration completed at a depth of 5.5 feet. Latitude: 45.529005 Longitude: -122.451910 (determined from Google Earth)	5.5				No groundwater seepage observed to the depth explored. No caving observed to the depth explored. Surface elevation was not measured at the time of exploration.

EXCAVATED BY: Dan J. Fischer Excavating, Inc.

LOGGED BY: JGH

COMPLETED: 09/22/15

EXCAVATION METHOD: backhoe (see document text)

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TEST PIT

REYNOLDS SCHOOL DISTRICT BUS FACILITY
FAIRVIEW, OR

FIGURE A-1

TEST PIT LOG - 2 PER PAGE REYNOLDSSD-1-01-TP1_12.GPJ GEODESIGN.GDT PRINT DATE: 10/30/15:KT

TP-3

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT (%) 0 50 100	COMMENTS
0.0		Medium dense, gray-dark gray GRAVEL with silt and sand (GP-GM); moist, subrounded to angular (1/2- to 3/4-inch-thick root zone) - **FILL**.			☒		3 1/4- to 1-inch-minus gravel.
		Medium stiff, brown-orange SILT with sand (ML), minor gravel, trace organics (rootlets); moist, sand is fine.	1.2				Geotextile fabric at 1.2 feet.
2.5				PP	☒		PP = 2.5 tsf
		Medium dense, brown-orange, silty GRAVEL with cobbles and boulders (GM), minor sand; moist.	3.5				Hard excavating.
				P200	☒	●	Infiltration test at 4.5 feet. P200 = 29%
5.0		Exploration completed at a depth of 5.0 feet. Latitude: 45.529065 Longitude: -122.453692 (determined from Google Earth)	5.0				No groundwater seepage observed to the depth explored. No caving observed to the depth explored. Surface elevation was not measured at the time of exploration.
7.5							

TP-4

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT (%) 0 50 100	COMMENTS
0.0		Medium dense, gray GRAVEL with silt and sand (GP-GM); moist - **FILL**.	0.3				Minor caving from 0.0 to 5.0 feet.
		Medium dense, brown, silty GRAVEL with cobbles and sand (GM), trace organics (rootlets, occasional woody debris); moist, organics are 1/2-inch diameter - **FILL**.			☒		
2.5		Medium dense, brown-orange, silty GRAVEL with cobbles and boulders (GM), minor sand; moist, boulders ar up to 3-foot diameter.	2.0		☒		Hard excavating at 2.0 feet.
				P200	☒	●	Infiltration test at 4.5 feet. P200 = 11%
5.0		Exploration completed at a depth of 5.0 feet. Latitude: 45.528229 Longitude: -122.452745 (determined from Google Earth)	5.0				No groundwater seepage observed to the depth explored. Surface elevation was not measured at the time of exploration.
7.5							

EXCAVATED BY: Dan J. Fischer Excavating, Inc.   LOGGED BY: JGH   COMPLETED: 09/22/15

EXCAVATION METHOD: backhoe (see document text)

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TEST PIT

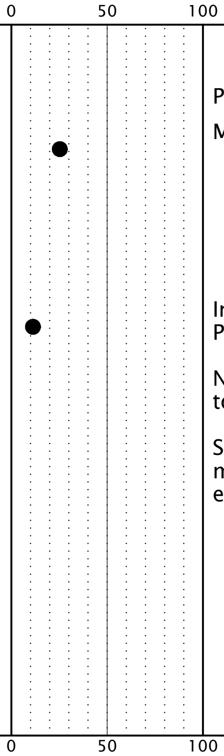
REYNOLDS SCHOOL DISTRICT BUS FACILITY
FAIRVIEW, OR

FIGURE A-2

TEST PIT LOG - 2 PER PAGE REYNOLDSSD-1-01-TP1_12.GPJ GEODESIGN.GDT PRINT DATE: 10/30/15:KT

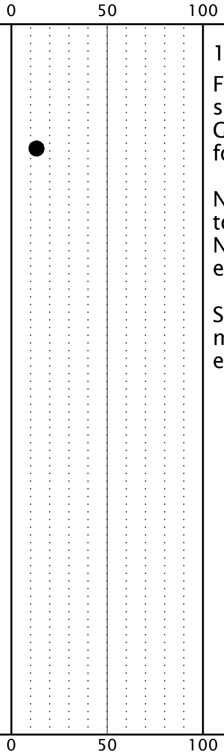
TP-5

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	COMMENTS
0.0	Medium dense, gray GRAVEL with silt and sand (GP-GM); moist (0- to 1/2-inch-thick root zone) - **FILL**.	0.6		☒	
	Medium stiff, gray-brown SILT with gravel (ML), minor sand, trace debris (glass) and organics (wood); moist, debris is 6 inches by 1/4 inch - **FILL**.	1.3	PP	☒	PP = 1.25 tsf Minor caving at 1.5 feet.
2.5	Medium stiff, brown-orange SILT (ML), minor sand and gravel; moist.	2.5			
	Medium dense, brown-orange, silty GRAVEL with cobbles and boulders (GM), minor sand; moist.	4.5	P200	☒	Infiltration test at 4.0 feet. P200 = 15%
5.0	Exploration completed at a depth of 4.5 feet. Latitude: 45.527592 Longitude: -122.452252 (determined from Google Earth)				No groundwater seepage observed to the depth explored. Surface elevation was not measured at the time of exploration.
7.5					



TP-6

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	COMMENTS
0.0	Medium dense, gray GRAVEL with silt and sand (GP-GM); moist, subangular - **FILL**.	0.4		☒	1-inch-minus gravel.
	Medium dense, brown-gray, silty GRAVEL with cobbles (GM), minor sand; moist, subrounded - **FILL**.	1.0		☒	Foundation probe: medium stiff to stiff at 1.0 foot. Gravel at 3.5 feet based on foundation probe.
2.5	Medium stiff, brown-orange SILT with gravel and sand (ML); moist.	2.0			
	Exploration completed at a depth of 2.0 feet. Latitude: 45.528867 Longitude: -122.452989 (determined from Google Earth)				No groundwater seepage observed to the depth explored. No caving observed to the depth explored. Surface elevation was not measured at the time of exploration.
5.0					
7.5					



EXCAVATED BY: Dan J. Fischer Excavating, Inc. LOGGED BY: JGH COMPLETED: 09/22/15

EXCAVATION METHOD: backhoe (see document text)

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Portland OR 97224
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TEST PIT

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FAIRVIEW, OR

FIGURE A-3

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT (%)	COMMENTS

TP-7

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	SAMPLE	● MOISTURE CONTENT (%) 0 50 100	COMMENTS
0.0	Medium dense, gray GRAVEL with silt and sand (GP-GM); moist, subangular to subrounded - **FILL**.	0.4	☒		Pothole depression. Foundation probe: dense, 1/2-inch penetration at 0.5 foot.
	Medium dense, brown-gray, silty GRAVEL with cobbles and debris (rubber fragment, asphalt concrete) (GM), minor sand; moist, subrounded, asphalt concrete up to 8-inch aggregates - **FILL**.	2.0	☒		Foundation probe: dense, 1/2-inch penetration at 1.0 foot. Foundation probe: medium stiff at 2.0 feet.
2.5	Medium stiff, brown-orange SILT with gravel, cobbles, and sand (ML); moist.	2.5			No groundwater seepage observed to the depth explored. No caving observed to the depth explored. Surface elevation was not measured at the time of exploration.
	Exploration completed at a depth of 2.5 feet. Latitude: 45.528476 (determined from Google Earth)				
5.0					
7.5					

TP-8

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	SAMPLE	● MOISTURE CONTENT (%) 0 50 100	COMMENTS
0.0	Medium dense, gray, silty GRAVEL with sand (GM); moist, subangular to subrounded - **FILL**.	0.5	☒		Small pothole. Foundation probe: stiff, 1-inch penetration with weight at 1.0 foot.
	Medium dense, brown-orange, silty GRAVEL with cobbles and boulders (GM), minor sand; moist, rounded to subrounded - **FILL**.	2.5	☒	●	Foundation probe: little penetration with weight at 2.0 feet.
2.5	Exploration completed at a depth of 2.5 feet. Latitude: 45.527931 Longitude: -122.452667 (determined from Google Earth)				No groundwater seepage observed to the depth explored. No caving observed to the depth explored. Surface elevation was not measured at the time of exploration.
5.0					
7.5					

EXCAVATED BY: Dan J. Fischer Excavating, Inc. LOGGED BY: JGH COMPLETED: 09/23/15

EXCAVATION METHOD: backhoe (see document text)

GEODESIGN INC 15575 SW Sequoia Parkway - Suite 100 Portland OR 97224 Off 503.968.8787 Fax 503.968.3068	REYNOLDSSD-1-01	**TEST PIT**
	OCTOBER 2015	REYNOLDS SCHOOL DISTRICT BUS FACILITY FAIRVIEW, OR — **FIGURE A-4**

TP-9

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT (%) 0 50 100	COMMENTS
0.0		Medium dense, gray, silty GRAVEL with sand (GM); moist, subangular - **FILL**.	0.5				Minor pothole. Foundation probe: 1-inch penetration with weight at 0.5 foot.
2.5		Medium dense, brown-orange, silty GRAVEL with cobbles and debris (glass fragments) (GM), minor sand; moist, rounded to subrounded - **FILL**.	3.0				Foundation probe: 1-inch penetration with weight at 2.0 feet. Glass at 2.5 feet. Foundation probe: 1-inch penetration with weight at .0 feet.
5.0 7.5		Exploration completed at a depth of 3.0 feet. Latitude: 45.527869 Longitude: -122.452019 (determined from Google Earth)					No groundwater seepage observed to the depth explored. No caving observed to the depth explored. Surface elevation was not measured at the time of exploration.

TP-10

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT (%) 0 50 100	COMMENTS
0.0		Medium dense, gray, silty GRAVEL to GRAVEL with silt and sand (GM/GP-GM); moist, subangular - **FILL**.	0.4		☒		
		Stiff, brown-gray SILT with gravel and boulders (ML), minor sand; moist - **FILL**.	1.3		☒		Foundation probe: 1/2- to 1-inch penetration at 1.0 foot. Isolated boulder (13-inch diameter) at 1.0 foot.
2.5		Medium stiff, brown-orange SILT with gravel and sand (ML); moist.	2.5		☒	●	Foundation probe: stiff, 3- to 4-inch penetration at 2.0 feet.
5.0 7.5		Exploration completed at a depth of 2.5 feet. Latitude: 45.528830 Longitude: -122.451912 (determined from Google Earth)					No groundwater seepage observed to the depth explored. No caving observed to the depth explored. Surface elevation was not measured at the time of exploration.

EXCAVATED BY: Dan J. Fischer Excavating, Inc. LOGGED BY: JGH COMPLETED: 09/23/15

EXCAVATION METHOD: backhoe (see document text)

GEODESIGN INC
15575 SW Sequoia Parkway - Suite 100
Portland OR 97224
Off 503.968.8787 Fax 503.968.3068

REYNOLDSSD-1-01

OCTOBER 2015

TEST PIT

REYNOLDS SCHOOL DISTRICT BUS FACILITY
FAIRVIEW, OR

FIGURE A-5

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT (%)	COMMENTS

TP-11

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	0 50 100	COMMENTS
0.0		Medium dense, gray, silty GRAVEL with sand (GM); moist, subangular to subrounded - **FILL**.	0.7		☒		Pothole silty. Geotextile fabric at 0.7 foot. Occasional cobbles.
		Stiff, gray SILT with cobbles and sand (ML), minor gravel; moist - **FILL**.	1.8		☒		Foundation probe: stiff at 1.0 foot.
2.5		Medium stiff, brown-orange SILT with sand (ML); moist.	3.0		☒		Foundation probe: medium stiff at 2.0 feet.
5.0 7.5		Exploration completed at a depth of 3.0 feet. Latitude: 45.528876 Longitude: -122.452068 (determined from Google Earth)					No groundwater seepage observed to the depth explored. No caving observed to the depth explored. Surface elevation was not measured at the time of exploration.

0 50 100

TP-12

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	0 50 100	COMMENTS
0.0		Medium dense, gray, silty GRAVEL with sand (GM); moist - **FILL**.	0.3		☒		
		Medium dense, brown-gray, silty GRAVEL with cobbles to SILT with gravel and cobbles (GM/ML), minor sand; moist.	1.5		☒ ☒	●	Foundation probe: stiff, 2- to 3-inch penetration at 1.0 foot. Foundation probe: medium stiff to stiff at 1.5 feet.
2.5		Medium stiff, brown-orange SILT with sand (ML), trace gravel; moist.	2.5				Teeth chatter on gravel at 2.5 feet.
5.0 7.5		Exploration completed at a depth of 2.5 feet. Latitude: 45.528838 Longitude: -122.453653 (determined from Google Earth)					No groundwater seepage observed to the depth explored. No caving observed to the depth explored. Surface elevation was not measured at the time of exploration.

0 50 100

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LOGGED BY: JGH

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FIGURE A-6

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
TP-1	2.5		25							
TP-1	4.5		14				14			
TP-2	2.0		26							
TP-2	5.0		24							
TP-3	4.5		19				29			
TP-4	4.5		13				11			
TP-5	1.5		25							
TP-5	4.0		11				15			
TP-6	1.5		13							
TP-8	1.0		8							
TP-10	1.5		18							
TP-12	2.0		19							

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SUMMARY OF LABORATORY DATA

REYNOLDS SCHOOL DISTRICT BUS FACILITY
FAIRVIEW, OR

FIGURE A-7