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Geotechnical Engineering Services

Lot "Y" Industrial Park
DuPont, Washington

for
DuPont Industrial Partners, LLC

October 10, 2011

GeoEngineers
Earth Science + Technology

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DuPont, Washington

File No. 16785-003-00

October 10, 2011

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INTRODUCTION AND PROJECT UNDERSTANDING

This report presents a summary of our findings, conclusions and recommendations regarding geotechnical engineering aspects of the proposed industrial park to be located west of the property addressed as 14464 Center Drive in DuPont, Washington. The location of the project area is included as Figure 1. Our understanding of the project is based on our discussions with you, project team meetings with Barghausen Engineers (project civil engineers) BCRA (project architects), review of preliminary conceptual plans and review of survey records completed by ESM Consulting Engineers, LLC. We have also prepared a cultural resources study for the subject site under separate cover.

We understand that the property will be developed as a mixed industrial and office park. Current plans are to construct up to 13 different structures over an irregular-shaped area of approximately 26 acres. The structures will range in size from 12,000 square feet to 57,000 square feet and will have one or two stories. Slabs-on-grade or dock-high slabs are anticipated; deep excavations for underground parking and/or a basement level are not planned. Additional improvements will include underground utility installation, asphalt concrete parking, and stormwater design and treatment (including infiltration) in accordance with the 2005 Washington State Department of Ecology (Ecology) Stormwater Management Manual for Western Washington (*SWMWW)*.

The exact layout of the development has not been determined at this time, including building locations, structural loads, and the size and location of infiltration facilities. Because structural loading information has not been provided, we have used assumed load values. Based on our experience with warehouse structures we assume column and wall loads of 300 kips and 5 kips per linear foot, respectively. We also use an assumed floor load of 650 pounds per square foot (psf).

SCOPE OF SERVICES

The purpose of our services was to conduct subsurface investigations to use as a basis for developing geotechnical recommendations for the proposed site improvements. Our specific scope of services includes:

1. Reviewing readily available published geologic data and select in-house files for subsurface information pertinent to soil and groundwater conditions in the site vicinity.
    - We understand that excavation and/or remediation of lead- and arsenic- contaminated soil has been completed at the project site. The clean-up efforts are documented and published. Our services included conducting a brief review of this data for geotechnical information pertinent to this project.
2. Coordinating clearance and location of existing utilities in the project area. We contacted the Washington Utilities Coordinating Council "One Call" service prior to beginning explorations.
3. Exploring subsurface conditions at the project site by excavating 22 test pits to depths between 8 and 11 feet below existing grades.

4. Performing laboratory tests on selected soil samples obtained from the explorations to assist in determining the physical and engineering properties of the site soils. The laboratory testing program consisted of 10 grain-size analyses.
5. Evaluating the results of the sieve analyses with the infiltration criteria presented in the 2005 Ecology *SWMWW*. We provide infiltration rates for the samples tested for use in preliminary design of infiltration ponds.
6. Providing a general discussion of site soil and groundwater conditions based on our review, explorations and laboratory testing.
7. Providing recommendations for site preparation and earthwork. We discuss clearing and stripping, temporary and permanent cut slopes, suitability of on-site soils for use as structural fill, including constraints for wet weather construction, specifications for imported soil for use as structural fill, and fill placement and compaction requirements.
8. Providing general recommendations for site drainage and control of groundwater.
9. Classifying the Seismic Site Class and soil profile in accordance with Table 1613.5.2 of the 2009 International Building Code (IBC) and providing our opinion of soil liquefaction susceptibility.
10. Providing recommendations for design of shallow foundations to support structures and conventional retaining walls, including allowable soil bearing pressures, total and differential settlement estimates, lateral earth pressures (active and passive) and coefficient of friction for evaluating sliding resistance. We discuss suitable foundation material and bearing surface preparation, including removal of uncontrolled fill, soft, organic or otherwise unsuitable material, and backfill compaction.
11. Providing recommendations for support of on-grade floor slabs including capillary break, vapor retarder, underslab drainage, and modulus of subgrade reaction, as appropriate.
12. Providing recommendations for asphalt concrete pavement (ACP) design, including base and subbase requirements for the proposed parking areas. We provide typical minimum ACP section recommendations based on our experience.

SITE GEOLOGY

Based on review of the Geologic Map of the Nisqually 7.5 Minute Quadrangle, Thurston and Pierce Counties, Washington (Walsh et al., 2003). Vashon recessional outwash sand and gravel is the dominant, near-surface, geologic material mapped in the immediate project area. This material is commonly known as Steilacoom gravel. Vashon recessional outwash was deposited by melt water streams in front of the most recent glacier during its retreat from the Puget Sound region approximately 10,000 to 15,000 years ago. These deposits generally consist of permeable sand, or sand and gravel. Cobbles and boulders can also be encountered in this deposit, depending on the depositional history. Glacial till and/or advance outwash is commonly encountered at depth below the recessional outwash.

The United States Department of Agriculture (USDA) Soil Conservation Service (SCS) Soil Survey of Pierce County Area, Washington, maps the project area as Spanaway gravelly sandy loam (41A).

This soil unit is described as being formed in glacial outwash. It is further described as somewhat excessively drained with moderately rapid permeability, slow surface runoff and little erosion hazard.

SITE CONDITIONS

Surface Conditions

The project area is located west of the intersection of Center Drive and Power Line Road in DuPont, Washington. The project area is bounded on all sides by undeveloped property. Sequalitchew Creek is located south of the project area. Properties to the north and west are occupied by dense forests. The property to the east is occupied by medium dense forests with sparse open areas and a few gravel roads; one of which is orientated east to west and leads into and is located in the southeast half of the project area, Lot Y.

The overall shape of the project area is irregular. Topography is flat or slightly sloping down to the southeast. Vegetation in the approximate southeast half of the project area is typically low growing and sparse to moderately thick and is mostly grasses and scotch broom. The approximate north and west half of the property is densely forested with large evergreen fir trees and some oak trees. A larger clearing area surfaced with gravel is located in the approximate center-west portion of the project site. Some other clearings exist in the approximate northeast portions of the project area. Based on information obtained by and discussions with you and members of Ecology, we understand that these areas are a result of remedial soil activities and removal of contaminated soil that occurred within the project area during 1999 and 2000.

During our time on site, we observed areas throughout the project area where gravel is exposed at the surface and other areas where forest duff was observed to be on the order of 12 to 24 inches thick in locations containing dense vegetation. We did not observe any evidence of surface depressions, slopes failures or erosion, nor standing water or indications of wet surface conditions during our time on site.

Subsurface Explorations

We explored subsurface conditions at the site by excavating 22 test pits on March 3 and 4, 2011. The approximate locations of each test pit are indicated on Figure 2. The test pit depths were between 8 and 11 feet below surrounding grade. Details of the exploratory program, laboratory testing program and the test pit logs are presented in Appendix A.

Subsurface Conditions

The following description of the subsurface conditions is based on our explorations and our understanding of the regional geology. For the purposes of this report, we have characterized the site soils into three general units: 1) fill, 2) weathered soil and 3) recessional outwash. These units are described below. Surface material at the site typically consists of about 2 inches of forest duff and grass sod.

- **Fill** was observed only at the location of test pit TP-9. The fill consisted of medium dense sand with gravel. Layers of silty gravel approximately 2 to 4 inches thick were observed at a depth of approximately 7 feet below existing grades (bgs). The fill extends to the full depth of exploration at this location. We anticipate that some fill may also exist in and near the locations where remedial activities occurred. Test pits TP-4, TP-11, TP-13, TP-14, TP-20 and TP-21 were located near areas where remedial activities were reported. We were unable to determine a distinct difference between the fill and native soil in these test pits.

- Weathered soil was typically observed to typically consist of dark brown to black silty sand or silty gravel with varying amounts of gravel or sand, cobbles and organic material at all test pit locations except TP-4, TP-9, TP-14 and TP-21. Where present, the weathered soil was observed to extend to depths between approximately 2 inches and 3 feet below surrounding grade. The weathered soil was observed to be in a loose to medium dense condition.
- Recessional Outwash observed in the explorations is typically described as medium dense or dense gravel with sand (GP and GW) and sand (SP); silty sand (SM) was observed in test pit TP-3. Cobbles were also observed in some of the test pits. Recessional outwash was observed at all of the test pit locations except TP-9.

Groundwater was observed in test pit TP-14 at a depth of about 8 feet bgs at the time of exploration. Groundwater conditions should be expected to vary as a result of season, precipitation and other factors. Based on our observations and previous explorations completed in the project vicinity, static groundwater elevations are expected to be below the depths of the test pit explorations completed for this project.

CONCLUSIONS AND RECOMMENDATIONS

General

Based on the results of our review, previous experience in the project vicinity and subsurface exploration program, it is our opinion that the site is generally suitable for the proposed development with regard to geotechnical considerations. A summary of the primary geotechnical considerations for the proposed development is provided below.

- Organic-rich surficial material should be stripped from all areas to be improved.
- Granular soils were generally encountered; however, we did observe that the majority of the explorations encountered soil with higher fines (particles passing the U.S. Standard No. 200 sieve) content; especially near the surface. Soil with a higher fines content are more sensitive to small changes in moisture content and may be difficult, if not impossible, to work and compact during wet weather conditions. This material can also be susceptible to disturbance from construction traffic when wet or if earthwork is performed during wet weather. Construction during periods of dry weather can reduce these possibilities.
- The proposed structures may be satisfactorily supported on continuous and isolated shallow foundations supported on compacted medium dense to very dense native soils or on structural fill that extends to native soil.
- Floor slabs may be supported on compacted native soil or on structural fill that extends to native soil.

- The glacial outwash deposits can contain cobbles and boulders. The contractor should be prepared for this possibility.
- On-site stormwater infiltration appears feasible. We provide preliminary infiltration rate recommendations further in this report. We recommend that we observe subsurface conditions in stormwater infiltration areas prior to construction to verify subsurface conditions and infiltration rates at the specific locations.

Stormwater Infiltration

Select soil samples obtained from test pits TP-2, TP-4, TP-7, TP-11, TP-12, TP-14, TP-15, TP-16, TP-20 and TP-22 were tested in general accordance with ASTM International (ASTM) D 422 to determine the grain-size distribution. The results of the grain-size distribution testing are presented in Appendix A, Figures A-24 through A-26. We followed the analysis procedures presented in the 2005 Ecology *SWMWW* to estimate design stormwater infiltration rates of the soil samples tested. Design stormwater infiltration rates for the soil samples tested are provided in the table below.

In general, it is our opinion that the recessional outwash encountered in our explorations should have adequate permeability and storage capacity to infiltrate stormwater from the site as proposed. We did not encounter groundwater seepage, staining or other indications of seasonal shallow groundwater in the explorations with the exception of test pit TP-14.

TABLE 1. SOIL INFILTRATION RATES[1]

Test Pit No.	Soil Sample No.	Soil Sample Depth (feet)	Percent Fines[2]	D10 Size (mm)[3]	USCS[4] Soil Classification	USDA[5] Soil Classification	Long-term Design Infiltration Rate[6] (Inches per Hour)
2	3	6	1.7	0.50	GP	Sand	9
4	1	4	1.0	0.50	SP	Sand	9
7	1	4	1.1	0.59	GP	Sand	9
11	2	4	1.5	0.53	GP	Sand	9
12	2	6	1.0	0.59	GP	Sand	9
14	3	6	2.0	1.75	GW	Loamy Sand	9
15	2	4	1.2	0.31	GP	Sand	6.5
16	2	6	0.6	1.23	GW	Sand	9
20	2	6	4.2	0.34	GP	Loamy Sand	6.5
22	1	4	1.1	0.47	GP	Sand	9

Notes:

[1] For selected soil samples.

[2] Fines = Silt and clay-sized particles passing U.S. No. 200 (0.75 mm) sieve.

[3] Based on ASTM D 422 Soil Gradation Test.

[4] Unified Soil Classification System (USCS).

[5] United States Department of Agriculture (USDA).

[6] Based on grain-size analysis and the procedures outlined in the 2005 Ecology Stormwater Management Manual for Western Washington Volume III Table 3.8.

The relatively clean sand and gravel soils encountered in the test pits should typically have adequate permeability and storage capacity to infiltrate stormwater from the site. In our opinion, the infiltration rates for the soil types presented may be used for design. However, because the exact location and elevation of the infiltration facilities has not yet been determined, the above infiltration rates should be considered preliminary. Once the facility location has been selected additional testing may be required. In addition, site and location-specific testing may be required by local jurisdictions. Stormwater should be treated in accordance with current regulations prior to infiltration. It should be noted that infiltration through fill is not permissible according to the 2005 Ecology *SWMWW* Volume III.

To help reduce clogging of infiltration facilities, we recommend they be protected during construction with siltation control facilities such as temporary settling basins, silt fences and hay bales. Suspended solids can clog the soil and reduce the infiltration rate. Periodic sweeping of paved areas, during and following construction, will help extend the life of the infiltration facilities. Equipment should not be permitted in the infiltration areas after they are excavated to grade because of the potential for compaction of the subgrade that could reduce the infiltration rate of the native soils.

Site Development and Earthwork

General

We anticipate that site development and earthwork will include stripping and clearing of surface vegetation, constructing foundations and then placing and compacting fill and backfill materials. We expect that the majority of site grading can be accomplished with conventional earthmoving equipment. The following sections provide recommendations for stripping, excavation, erosion control, subgrade development, fill materials, fill placement and compaction.

Stripping and Clearing

Based on our observations at the site, we estimate that the depth of stripping could be on the order of about 2 inches. Greater stripping depths may be required to remove localized zones of loose or organic soil and in areas where moderate to heavy vegetation is located. In addition, the primary root systems of shrubs and trees should be completely removed. Stripped material should be transported off site for disposal or processed and used as fill in landscaping areas.

Although we did not encounter boulders during our subsurface investigation, they can be present in the glacial deposits in the area and may also be in the existing fill. Accordingly, the contractor should be prepared to remove boulders, if encountered during grading or utility excavations. Boulders may be removed from the site or buried in landscape areas. Voids caused by boulder removal should be backfilled with structural fill.

Temporary Excavations, Support and Dewatering

Excavations deeper than 4 feet should be shored or laid back at a stable slope if workers are required to enter. Shoring and temporary slope inclinations must conform to the provisions of Title 296 Washington Administrative Code (WAC), Part N, "Excavation, Trenching and Shoring." Regardless of the soil type encountered in the excavation, shoring, trench boxes or sloped sidewalls will be required under Washington Industrial Safety and Health Act (WISHA). 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 structures. We provide additional recommendations in regard to temporary and permanent shoring below.

In general, temporary cut slopes should be inclined no steeper than about 1-1/2H to 1V (horizontal to vertical). This guideline assumes that all surface loads are kept at a minimum distance of at least one-half the depth of the cut away from the top of the slope and that significant seepage is not present on the slope face. Flatter cut slopes will be necessary where significant seepage occurs or if surcharge loads are anticipated. We observed caving in our explorations; on this basis, some sloughing and raveling of cut slopes should be expected. Temporary covering with heavy plastic sheeting should be used to protect these slopes during periods of wet weather.

Groundwater Handling During Construction

Based on our explorations and the proposed construction, we do not expect groundwater to be a major factor during shallow excavations and earthwork. However, some perched groundwater may occur in the near-surface soil depending on the time of year of construction. We anticipate that groundwater handling needs will typically be lower during the late summer and early fall months. We anticipate that shallow perched groundwater can typically be handled adequately with sumps, pumps, and/or diversion ditches, as necessary. Ultimately, we recommend that the contractor performing the work be made responsible for controlling and collecting groundwater encountered.

Permanent Cut and Fill Slopes

Based on site grades and the proposed construction, we anticipate that permanent cut and fill slopes may not be required for this project. However, if permanent slopes are necessary, we recommend they be constructed at a maximum inclination of 2H to 1V. Where 2H to 1V permanent slopes are not feasible, protective facings and/or retaining structures should be considered.

To achieve uniform compaction, we recommend that fill slopes be overbuilt slightly and subsequently cut back to expose well-compacted fill. Fill placement on slopes steeper than 5H to 1V should be benched into the slope face and include keyways. The configuration of the bench and keyway depends on the equipment being used. Bench excavations should be level and extend into the slope face. We recommend that a vertical cut of about 3 feet be maintained for benched excavations. Keyways should be about 1-1/2 times the width of the equipment used for grading or compaction.

Exposed areas should be re-vegetated as soon as practical to reduce the surface erosion and sloughing. Temporary protection should be used until permanent protection is established.

Surface Drainage

Surface water from roofs, driveways and landscape areas should be collected and controlled. Curbs or other appropriate measures such as sloping pavements, sidewalks and landscape areas should be used to direct surface flow away from the buildings, erosion sensitive areas and from behind retaining structures.

Erosion and Sedimentation Control

Potential sources or causes of erosion and sedimentation can be influenced by construction methods, slope length and gradient, amount of soil exposed and/or disturbed, soil type, construction sequencing and weather. Implementing an erosion and sedimentation control plan will reduce the project impact on erosion-prone areas. The plan should be designed in accordance with applicable city, county and/or state standards. The plan should incorporate basic planning principles, including:

- Scheduling grading and construction to reduce soil exposure.
- Re-vegetating or mulching denuded areas.
- Directing runoff away from denuded areas.
- Reducing the length and steepness of slopes with exposed soils.
- Decreasing runoff velocities.
- Preparing drainage ways and outlets to handle concentrated or increased runoff.
- Confining sediment to the project site.
- Inspecting and maintaining control measures frequently.

Some sloughing and raveling of exposed or disturbed soil on slopes should be expected. We recommend that disturbed soil be restored promptly so that surface runoff does not become channeled.

Temporary erosion protection should be used and maintained in areas with exposed or disturbed soils to help reduce erosion and reduce transport of sediment to adjacent areas and receiving waters. Permanent erosion protection should be provided by paving, structure construction or landscape planting.

Until the permanent erosion protection is established and the site is stabilized, site monitoring may be required by qualified personnel to evaluate the effectiveness of the erosion control measures and to repair and/or modify them as appropriate. Provisions for modifications to the erosion control system based on monitoring observations should be included in the erosion and sedimentation control plan.

Subgrade Preparation and Evaluation

Subgrade areas should be thoroughly compacted with heavy, smooth-drum vibratory equipment to a uniformly dense and unyielding condition prior to placement of structural fill or structural elements. We recommend that prepared subgrades be observed by a member of our firm, who will evaluate the suitability of the subgrade and identify any areas of yielding which are indicative of soft or loose soil. The exposed subgrade soil should be proof-rolled with heavy rubber-tired equipment and/or probed with a 1/2-inch-diameter steel rod, as appropriate depending on prevailing conditions. If soft, yielding or otherwise unsuitable areas revealed during probing or proof-rolling cannot be compacted to a stable and uniformly firm condition, we recommend that: 1) the subgrade soils be scarified (e.g., with a ripper or a farmer's disc), aerated and recompacted; or 2) the unsuitable soils be removed and replaced with structural fill, as needed.

Subgrade Protection and Wet Weather Considerations

The wet weather season generally begins in October and continues through May in western Washington; however, periods of wet weather can occur during any month of the year. In our opinion, site grading and fill placement could be considered during wet weather, but it should be noted that some of the soils encountered in our explorations, primarily near at the surface, contain a significant amount of fines and will be susceptible to disturbance during extended periods of wet weather. We provide the following recommendations if wet weather construction is considered:

- The ground surface in and around the work area should be sloped so that surface water is directed away from the work area. The ground surface should be graded so that areas of ponded water do not develop. Measures should be taken by the contractor to prevent surface water from collecting in excavations and trenches. Measures should be implemented to remove surface water from the work area.
- Earthwork activities should not take place during periods of heavy precipitation.
- Slopes with exposed soils should be covered with plastic sheeting.
- The contractor should take necessary measures to prevent on-site soils and other soils to be used as fill from becoming wet or unstable. These measures may include the use of plastic sheeting, sumps with pumps and grading. The site soils should not be left uncompacted and exposed to moisture. Sealing the surficial soils by rolling with a smooth-drum roller prior to periods of precipitation will help reduce the extent to which these soils become wet or unstable.
- Construction traffic should be restricted to specific areas of the site, preferably areas that are surfaced with working pad materials not susceptible to wet weather disturbance.
- Construction activities should be scheduled so that the length of time that soils are left exposed to moisture is reduced to the extent practical.
- Protective surfacing such as placing asphalt-treated base (ATB) or haul roads made of quarry spalls or a layer of free-draining material such as well graded pit-run sand and gravel may be necessary to protect completed areas. Typically, minimum gravel thicknesses on the order of 24 inches are necessary to provide adequate subgrade protection.
- During periods of wet weather, concrete should be placed as soon as practical after preparation of the footing excavations. Foundation bearing surfaces should not be exposed to standing water. Should water infiltrate and pool in the excavation, it should be removed before placing structural fill or reinforcing steel. Subgrade protection for foundations consisting of a lean concrete mat may be necessary if footing excavations are exposed to extended wet weather conditions.

Fill Materials

General

All fill that will support floor slabs, or foundations, or be placed in utility trenches should generally meet the criteria for structural fill presented below. Material used for fill should be free of debris, organic contaminants and rock fragments larger than 6 inches. The workability of material for use as fill will depend on the gradation and moisture content of the soil. As the amount of fines (material passing the U.S. Standard No. 200 sieve) increases, soil becomes increasingly more sensitive to small changes in moisture content and adequate compaction becomes more difficult or impossible to achieve.

Structural Fill

We recommend that structural fill placed during wet weather consist of material of approximately the same quality as "gravel backfill for walls," as described in Section 9-03.12(2) of the Washington State Department of Transportation (WSDOT) Standard Specifications. Structural fill placed during dry weather may consist of material of approximately the same quality as "Gravel Borrow," as described in Section 9-03.14(1) of the WSDOT Standard Specifications.

Pipe Bedding

We recommend that fill placed below and around buried utility pipe consist of material of approximately the same quality as "Gravel Backfill for Pipe Zone Bedding," as described in Section 9-03.12(3) of the WSDOT Standard Specifications.

Quarry Spalls

We recommend that quarry spalls consist of material of approximately the same quality as described in Section 9-13.6 of the WSDOT Standard Specifications.

Footing Drains

In general, we do not anticipate the need for footing drains for foundations founded at depths about 3 feet below surrounding grade provided that soil exposed during foundation excavation is granular recessional outwash and contains small amounts of fines (typically GP, SP, GW, SW soil types). Where required, drain rock placed for footing drains (drainage zone) should consist of material of approximately the same quality as "gravel backfill for drains," as described in Section 9-03.12(4) of the 2010 WSDOT Standard Specifications.

Capillary Break Material

Capillary break below building slabs-on-grade should consist of material in general conformance with Section 9-03.1(4)C, grading No. 57 of the 2010 WSDOT Standard Specifications. Alternatively, a crushed base course conforming to section 9-03.9(3) conforming to the same specifications is in our opinion also appropriate.

Reuse of On-site Soils

Based on our observations and experience, it is our opinion that the native sand and gravel soils (SP, GP and GW) may be considered for re-use as structural fill. Some of the granular native soils contain a significant amount of fines; silty sand (SM), gravel with silt (GP-GM), and silty gravel (GM) may not be suitable for use as fill during periods of wet weather. There may also be instances where native soils that comprise silt (ML) is encountered. In our opinion, these soils are suitable for use as fill only during extended periods of dry weather.

Recycled Materials

Crushed asphalt and concrete may be considered for use as structural fill provided it meets the gradation criteria described above and that the material can be compacted to a uniformly firm and unyielding condition. The maximum particle size should not exceed 6 inches. Gradation of the recycled asphalt is typically difficult to control and because of this, we recommend it not be used where free-draining material is required, such as for retaining wall backfill. In addition, crushed asphalt has the potential to creep under large and sustained loads. We recommend that crushed/ recycled asphalt not be used under foundation elements. Recycled glass may be considered for use as capillary break material or pipe bedding. In general, we recommend “Recycled Materials” conform to Section 9-03.21 of the WSDOT Standard Specifications.

Fill Placement and Compaction

General

Fill materials should be compacted at a moisture content near optimum. The maximum allowable moisture content varies with the soil gradation and should be evaluated during construction. Fill and backfill material should be placed in uniform, horizontal lifts, and uniformly densified with vibratory compaction equipment. The maximum lift thickness will vary depending on the material and the compaction equipment used, but generally should not exceed 10 to 12 inches in loose thickness.

Area Fills and Bases

Fill placed to raise site grades and materials under pavements and slabs should be placed on a prepared subgrade that consists of densely compacted inorganic native soils or compacted fill. In general, we recommend fill be compacted to at least 95 percent of the maximum dry density (MDD) determined by ASTM Test Method D 1557 (modified Proctor).

Quarry Spall Placement

Quarry spalls may be used to stabilize wet subgrades and bearing surfaces. The spalls should be placed and tamped into place using the bucket of a backhoe or excavator until a firm and unyielding condition is observed.

Shallow Foundations

Where required, fill placed to establish grade for shallow spread footings should be placed on a subgrade that consists of proof-compacted existing soil. We recommend that structural fill be placed and compacted to at least 95 percent of the MDD determined by ASTM Test Method D 1557. If soft or disturbed soil is encountered we recommend overexcavation and replacement with structural fill. The zone of compacted structural fill should extend laterally beyond the footing edges a horizontal distance at least equal to the overexcavation depth for foundation embedment. Although not anticipated, if groundwater is encountered quarry spalls may be used to stabilize the base of the excavation prior to placing and compacting structural fill.

Trench Backfill

For utility excavations, we recommend that the initial lift of fill over the pipe be thick enough to reduce the potential for damage during compaction but generally should not be greater than about

18 inches. In addition, rock fragments greater than about 1 inch in maximum dimension should be excluded from this lift.

In pavement and structural areas, trench backfill should consist of structural fill and should be uniformly compacted in horizontal lifts to at least 95 percent of the MDD in the upper 2 feet below subgrade. Fill placed below a depth of 2 feet from subgrade may consist of common fill and should be compacted to at least 90 percent of the MDD. In nonstructural areas, trench backfill should be compacted to a firm condition that will support construction equipment, as necessary.

Seismic Design Considerations

General

The site is located in western Washington, which is seismically active. Seismicity in this region is attributed primarily to the interaction between the Pacific, Juan de Fuca and North American plates. The Juan de Fuca plate is subducting beneath the North American plate at the Cascadia Subduction Zone (CSZ). This produces both intercrustal (between plates) and intracrustal (within a plate) earthquakes.

Research is ongoing regarding large magnitude CSZ-related intercrustal earthquake activity along the Washington and Oregon coasts. Geologists are reporting evidence that suggests several large magnitude earthquakes (magnitude 8 to 9) have occurred along the CSZ in the last 1,500 years, the most recent of which occurred about 300 years ago. Five large subduction zone earthquakes of this magnitude have been observed globally since 1960: 1) in 1960, a magnitude 9.5 earthquake occurred in Chile; 2) in 1964, a magnitude 9.2 earthquake occurred in Alaska; 3) in 2006, a magnitude 9.2 earthquake occurred in Indonesia; and 4) in 2010 a magnitude 8.8 occurred of the coast of Chile; and 5) in 2011 a magnitude 9.0 occurred in Japan. No documented earthquakes of this magnitude have occurred along the CSZ during the recorded history of the Pacific Northwest.

Hundreds of smaller intracrustal earthquakes have been recorded in western Washington. Four of the most recent earthquakes were: 1) in 1946, a magnitude 7.2 earthquake occurred in the Vancouver Island, British Columbia area; 2) in 1949, a magnitude 7.1 earthquake occurred in the Olympia area; 3) in 1965, a magnitude 6.5 earthquake occurred between Seattle and Tacoma; and 4) on February 28, 2001, a magnitude 6.8 occurred at Nisqually near Olympia.

Based on our explorations, laboratory testing, experience and understanding of the geologic setting and seismic hazards, including liquefaction, lateral spreading, fault rupture and earthquake induced landsliding, it is our opinion that the site has a low risk of fault rupture and earthquake-induced landsliding. Recommended seismic design parameters and a discussion of soil liquefaction are provided below.

Seismic Design Criteria

Based on subsurface conditions encountered in our explorations and our understanding of the geologic conditions in the site vicinity, it is our opinion that the subsurface profile should be characterized as Site Class C in accordance with Section 1613 of the 2009 IBC. Seismic design parameters are provided in Table 2, below.

TABLE 2. SEISMIC DESIGN PARAMETERS

Site Coefficient	Site Factor
S_s = 1.182	F_a = 1.0
S_1 = 0.577	F_v = 1.383

Liquefaction Potential

Liquefaction refers to a condition where vibration or shaking of the ground, usually from earthquake forces, results in development of excess pore pressures in loose, saturated soils and subsequent loss of strength in the deposit of soil so affected. In general, soils that are susceptible to liquefaction include loose to medium dense "clean" to silty sands that are below the water table. Based on a review of the Liquefaction Susceptibility Map of Pierce County Washington the site is in an area mapped as having a "Very Low to Low" liquefaction susceptibility. In our opinion, the site soils have low susceptibility to liquefaction.

Shallow Foundations

Foundation Support and Minimum Size

Proposed structures can be satisfactorily founded on continuous wall or isolated column footings supported on compacted native granular soils, or on structural fill placed over native soils. The weathered soil encountered in the explorations will require additional compaction when excavated for foundation support. The exterior footings should be established at least 18 inches below the lowest adjacent grade. The recommended minimum footing depth is greater than the anticipated frost depth. Interior footings can be founded a minimum of 12 inches below the top of the floor slab. Isolated column and continuous wall footings should have minimum widths of 24 and 18 inches, respectively.

Bearing Capacity

We recommend that footings founded as recommended be proportioned using an allowable soil bearing pressure of 4,000 psf. The bearing pressure applies to the total of dead and long-term live loads and may be increased by one third when considering total loads, including earthquake or wind loads. This is a net bearing pressure. The weight of the footing and overlying backfill can be ignored in calculating footing sizes.

Footing Bearing Surface Preparation

Footing excavations should be performed using a smooth-edged bucket to limit bearing surface disturbance. The foundation bearing surface should be thoroughly compacted to a dense, non-yielding condition. Loose or disturbed materials present at the base of footing excavations should be removed or compacted. Foundation bearing surfaces should not be exposed to standing water. Should water infiltrate and pool in the excavation, it should be removed before placing structural fill or reinforcing steel.

We recommend that a member from our firm observe foundation excavations before placing reinforcing steel in order to confirm that adequate bearing surfaces have been prepared or provide recommendations for removal of unsuitable soil. Unsuitable bearing materials should be recompacted or removed and replaced with compacted structural fill as recommended by the geotechnical engineer.

Foundation Settlement

We estimate that settlement of footings designed and constructed as recommended will be less than 1 inch, for an assumed loading condition of 300 kips per column. Differential settlements between comparably loaded isolated column footings or along 50 feet of continuous footing should be less than 1/2 inch. Settlement is expected to occur rapidly as loads are applied. Settlements could be larger than estimated if footings are placed on loose or disturbed soil.

Lateral Resistance

The ability of the soil to resist lateral loads is a function of frictional resistance, which can develop on the base of footings and slabs and the passive resistance, which can develop on the face of below-grade elements of the structure as these elements tend to move into the soil. For footings and floor slabs founded in accordance with the recommendations presented above, the allowable frictional resistance may be computed using a coefficient of friction of 0.40 applied to vertical dead-load forces. The allowable passive resistance on the face of footings, grade beams or other embedded foundation elements may be computed using an equivalent fluid density of 300 pounds per cubic foot (pcf) for undisturbed on-site soils or structural fill extending out from the face of the foundation element a distance at least equal to two and one-half times the depth of the element.

The passive earth pressure and friction components may be combined provided that the passive component does not exceed two-thirds of the total. The passive earth pressure value is based on the assumptions that the adjacent grade is level and that groundwater remains below the base of the footing throughout the year. The top foot of soil should be neglected when calculating passive lateral earth pressures unless the foundation area is covered with pavement or slab-on-grade. The lateral resistance values include a safety factor of approximately 1.5.

Conventional Subgrade and Retaining Walls

Drainage

Positive drainage is imperative behind any retaining structure. This can be accomplished by providing a drainage zone of free-draining material behind the wall with perforated pipes to discharge the collected water. The drainage material should consist of coarse sand and gravel containing less than 5 percent fines based on the fraction of material passing the 3/4-inch sieve. The wall drainage zone should extend horizontally at least 18 inches from the back of the wall.

A perforated smooth-walled rigid PVC pipe having a minimum diameter of 4 inches should be placed at the bottom of the drainage zone along the entire length of the wall, with the pipe invert at or below the base of the wall footing. The drainpipes should discharge to a tightline leading to an appropriate collection and disposal system. An adequate number of cleanouts should be incorporated into the design of the drains in order to provide access for regular maintenance. In general, roof downspouts, perimeter drains or other types of drainage systems should not be connected to retaining wall drain systems.

Design Parameters

The pressures presented assume that backfill placed within 2 feet of the wall is compacted by hand-operated equipment to a density of 90 percent of the MDD and that wall drainage measures are included as previously recommended. For walls constructed as described above, we recommend using an active lateral earth pressure corresponding to an equivalent fluid density of 35 pcf for the level backfill condition. For walls with backfill sloping upward behind the wall at 2H to 1V, an equivalent fluid density of 55 pcf should be used. This assumes that the tops of the walls are not structurally restrained and are free to rotate. For the at-rest condition (walls restrained from movement at the top) an equivalent fluid density of 55 pcf should be used for design. For seismic conditions, we recommend a uniform lateral pressure of 4H (where H is the height of the wall) psf be added to these lateral pressures. Note that if the retaining system is designed as a braced system but is expected to yield a small amount during a seismic event, an active earth pressure condition may be assumed and combined with the uniform seismic surcharge pressure.

The recommended pressures do not include the effects of surcharges from surface loads. If vehicles will be operated within one-half the height of the wall, a traffic surcharge should be added to the wall pressure. The traffic surcharge can be approximated by the equivalent weight of an additional 2 feet of backfill behind the wall. Additional surcharge loading conditions should also be considered on a case-by-case basis.

Retaining walls founded on native soil or structural fill extending to these materials may be designed using the allowable soil bearing values and lateral resistance values presented above in the "Shallow Foundations" section of this report. We estimate settlement of retaining structures will be similar to the values previously presented for building foundations.

Building Pads and Floor Slabs

A modulus of subgrade reaction of 300 pounds per cubic inch (pci) can be used for designing the building floor slab provided that the subgrade consists of dense native soil or structural fill and has been prepared in accordance with the "Site Development and Earthwork" section of this report. If silt is present at the proposed subgrade elevation, we recommend overexcavation and replacement of silt to a depth of 2 feet or to dense native granular soils, whichever is less.

Settlement for floor slabs designed and constructed as recommended are estimated to be less than 3/4 inch for a floor load of 650 psf. We estimate that differential settlement of floor slabs will be 1/2 inch or less over a span of 50 feet providing that the fill below the slab is compacted as specified. The subgrade soils are non-expansive, so heave is not anticipated beneath the floor slab.

We recommend that on-grade slabs be underlain by a minimum 6-inch-thick capillary break layer to reduce the potential for moisture migration into the slab. The capillary break material should consist of material as described above. The material should be placed as recommended in the "Fill Placement and Compaction" section of this report. If dry slabs are required (e.g., where adhesives are used to anchor carpet or tile to the slab), a waterproof liner may be placed as a vapor barrier below the slab.

Pavement Recommendations

Asphaltic Concrete Pavement

Pavement subgrades and fill should be prepared and placed as previously described. The crushed rock base course layer and subbase layer should be moisture conditioned near the optimum moisture content and compacted to at least 95 percent of the MDD determined in accordance with ASTM D 1557 test procedures. An appropriate number of in-place density tests should be conducted on the compacted base course to check that adequate compaction has been obtained. Crushed rock base course should conform to applicable sections of 4-04 and 9-03.9(3) of the WSDOT Standards. Subbase should generally consist of a gravel borrow conforming to Section 9-03.14(1) of the WSDOT Standards except as noted below.

For this project, we based the recommended pavement sections described below on an assumed in-situ California Bearing Ratio (CBR) between 15 and 20. The heavy-duty pavement section thickness is based on a traffic loading of about 1,000,000, 18-kip equivalent single-axle loads (ESALs); we used a design life of 10 years. The standard-duty section is appropriate for areas that will not be exposed to heavy truck loads. Hot mix asphalt (HMA) should conform to applicable sections of 5-04, 9-02 and 9-03 of the WSDOT Standards. The recommended pavement sections assume that final improvements surrounding the pavement will be designed and constructed such that stormwater or excess irrigation water from landscape areas does not infiltrate below the pavement section into the crushed base.

STANDARD-DUTY ASPHALTIC CONCRETE PAVEMENT

- 2 inches of hot mix asphalt.
- 4 inches of crushed surfacing base course and/or top course compacted as recommended.
- 12 inches compacted depth granular subbase. Native soil may be considered for use as the subbase provided that it is granular sand and gravel recessional outwash encountered below the weathered zone as indicated in the test pit logs.

HEAVY-DUTY ASPHALTIC CONCRETE PAVEMENT

- 3 inches of hot mix asphalt.
- 6 inches of crushed surfacing base course and/or top course compacted as recommended.
- 12 inches compacted depth granular subbase. Native soil may be considered for use as the subbase provided that it is granular sand and gravel recessional outwash encountered below the weathered zone as indicated in the test pit logs.

LIMITATIONS

We have prepared this report for the exclusive use by DuPont Industrial Partners, LLC and their authorized agents for the Lot "Y" Industrial Development site, which will be located west of the intersection of Center Drive and Power Line Road in DuPont, Washington. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

Please refer to Appendix B titled "Report Limitations and Guidelines for Use" for additional information pertaining to use of this report.

REFERENCES

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Lot Y

T19N, R 1E, Section 26
USGS 7.5' Topographic Map Series, Nisqually (1981) Quad.

1:24,000

2,000 0 2,000

Feet

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: ESRI Data & Maps, Street Maps 2005

Transverse Mercator, Zone 10 N North, North American Datum 1983
North arrow oriented to grid north

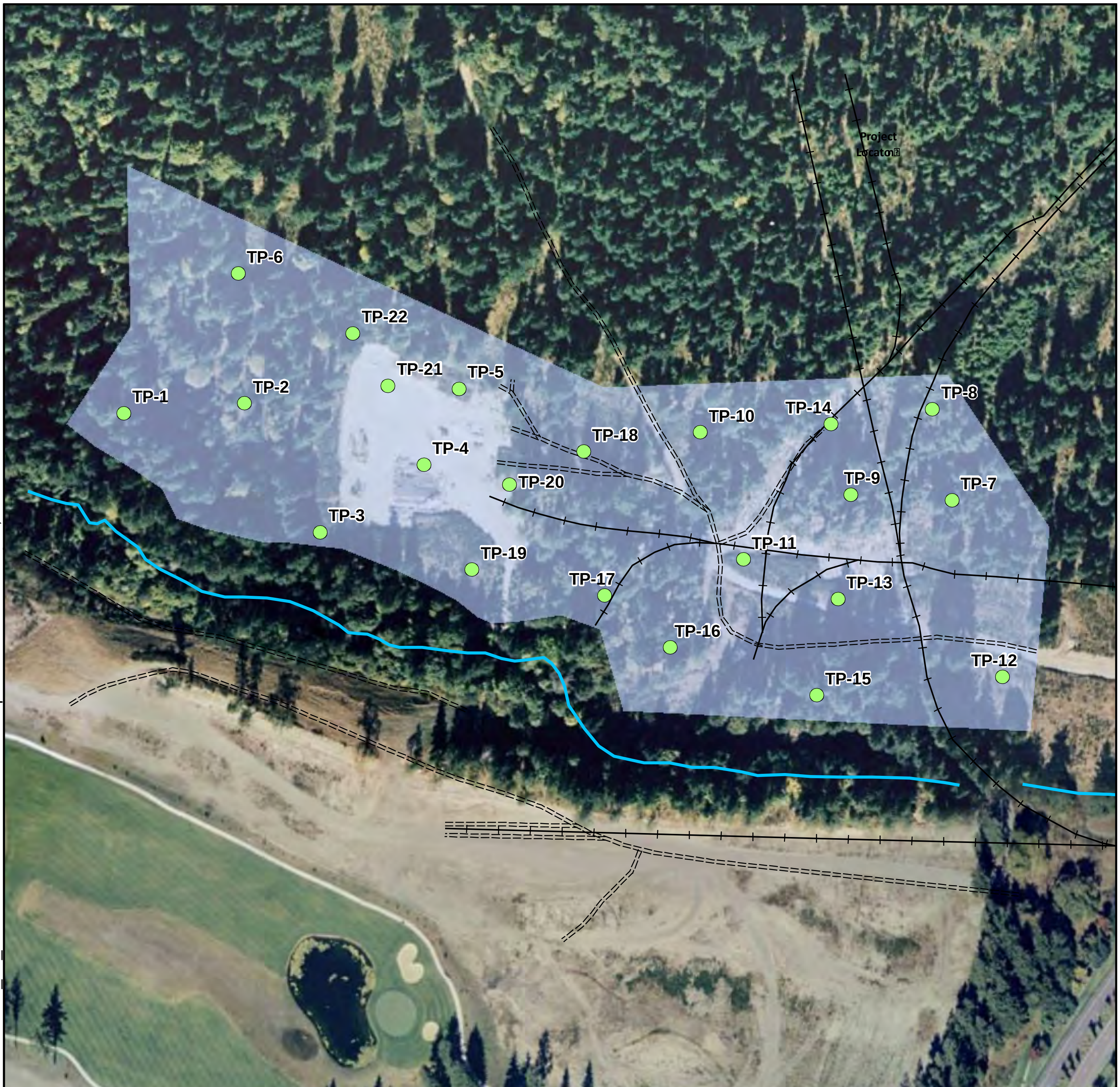
Vicinity Map

Lot Y Industrial Park
DuPont, Washington

GEOENGINEERS

Figure 1

Office: Tacoma Path: W:\Tacoma\Projects\16\1678500300\GIS\1678500300_F1_LocationMap.mxd Map Revised: October 10, 2011 CRC



Test Pit Locations

Lot Y

Sequalitchew Creek

Dirt Road

Railroad

N
W E
S

300 0 300

Feet

T19N, R 1E, Section 26
USGS 7.5' Topographic Map Series, Nisqually (1981) Quad.

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: ESRI Data & Maps, Street Maps 2005
Bing Aerial from ESRI Data Online.

Transverse Mercator, Zone 10 N North, North American Datum 1983
North arrow oriented to grid north

Site Plan

Lot Y Industrial Park
DuPont, Washington

GeoEngineers

Figure 2

Office: Tacoma Path: \\tac\projects\16\16785003\GIS\00\1678500300_F2_TestPitLocations.mxd Map Revised: October 10, 2011 CRC:AMM

APPENDIX A
Field Explorations and Laboratory Testing

APPENDIX A
FIELD EXPLORATIONS AND LABORATORY TESTING

Subsurface Explorations

Soil and groundwater conditions at the proposed development site were explored by excavating 22 test pits on March 3 and 4, 2011. Subsurface exploratory services were subcontracted to GeoEngineers, Inc. The test pit explorations extended to depths between 8 and 11 feet below existing site grades.

The locations of the test pits were determined by pacing and visual triangulation from existing site features such as roadways and property corners and by a handheld Trimble GeoXT global positioning system (GPS) unit where applicable. The elevations presented on the test pit logs are based on an abbreviated aerial survey obtained from Barghausen Consulting Engineers and the GPS unit, where applicable. The locations and elevations of the explorations should be considered approximate. Locations of the explorations are provided on the Site Plan, Figure 2.

Our field representative obtained samples, classified the soils, maintained a detailed log of each exploration and observed groundwater conditions where applicable. The samples were retained in sealed plastic bags to prevent moisture loss. The soils were classified visually in general accordance with the system described in Figure A-1, which includes a key to the exploration logs. Summary logs of the explorations are included as Figures A-2 through A-23. The densities noted on the test pit exploration logs are based on the difficulty of excavation, observations of caving and our experience and judgment.

Laboratory Testing

General

Representative soil samples were selected for laboratory tests to confirm our field classification and aid in evaluating infiltration characteristics. The following paragraphs provide a description of the tests performed.

Moisture Content (MC)

The moisture content of selected samples was determined in general accordance with ASTM International (ASTM) Test Method D 2216. The test results are used to aid in correlation with other pertinent engineering soil properties. The test results are presented on the test pit logs.

Particle-Size Analyses (SA)

Particle-size sieve analyses were performed on 12 samples in general accordance with ASTM Test Method C 136. This test method covers the quantitative determination of the distribution of particle sizes in soils. The distribution of particle sizes larger than the U.S. No. 200 sieve (75 micrometers) was determined by mechanical sieving. The results of the tests were used for soil classification and in determining engineering properties of the soil. Figures A-24 through A-26 present the sieve test results.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS
				SP	POORLY-GRADED SANDS, GRAVELLY SAND
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	CC	Cement Concrete
	AC	Asphalt Concrete
	CR	Crushed Rock/ Quarry Spalls
	TS	Topsoil/ Forest Duff/Sod

Measured groundwater level in exploration, well, or piezometer

Groundwater observed at time of exploration

Perched water observed at time of exploration

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata or geologic units

Approximate location of soil strata change within a geologic soil unit

Material Description Contact

Distinct contact between soil strata or geologic units

Approximate location of soil strata change within a geologic soil unit

Sampler Symbol Descriptions

2.4-inch I.D. split barrel

Standard Penetration Test (SPT)

Shelby tube

Piston

Direct-Push

Bulk or grab

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

A "P" indicates sampler pushed using the weight of the drill rig.

Laboratory / Field Tests

%F	Percent fines
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
OC	Organic content
PM	Permeability or hydraulic conductivity
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen
NT	Not Tested

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

KEY TO EXPLORATION LOGS

GEOENGINEERS

FIGURE A-1

Date Excavated: 3/3/2011

Equipment: Deere 410E

Logged By: EAW

Total Depth (ft) 10.5

Elevation (feet)	Depth (feet)	Testing Sample	Sample Name / Testing	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0			DUFF		2 inches duff		
				SM		Black silty fine to coarse sand with organics and occasional gravel (loose, moist) (weathered)		
209	1							
				GP-GM		Brown fine to coarse gravel with sand and silt (dense, moist) (recessional outwash)		
208	2							
		X	1					
207	3							
206	4							
205	5	X	2					
204	6							
203	7							
202	8	X	3					
201	9							
200	10	X	4					

Test pit completed at 10.5 feet
No groundwater seepage observed
Minor caving observed at ~2+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-1

GeoEngineers

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Figure A-2
Sheet 1 of 1

Date Excavated: 3/3/2011 | Logged By: EAW

Equipment: Deere 410E | Total Depth (ft) 10.5

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				DUFF		2 inches duff		
208	1				GM		Black silty fine to coarse gravel with sand and organics (medium dense, moist) (weathered)		
207	2				SP		Brown fine to coarse sand with gravel, trace sand (dense, moist) (recessional outwash)		
206	3	X	1						
205	4				GP		Brown fine to coarse gravel with sand, trace silt (very dense, moist) (recessional outwash)		
204	5	X	2						
203	6	X	3 SA					4	%F=1.7
202	7								
201	8	X	4						
200	9								
199	10	X	5						

Test pit completed at 10.5 feet
No groundwater seepage observed
Minor caving observed at ~3+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-2

GeoEngineers

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Figure A-3
Sheet 1 of 1

Date Excavated: 3/3/2011

Equipment: Deere 410E

Logged By: EAW

Total Depth (ft) 10.5

Elevation (feet)	Depth (feet)	Testing Sample	Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				DUFF		2 inches duff and sod		
					SM		Black silty fine to coarse sand with gravel and organics (loose, moist) (weathered)		
208	1				SM		Red/brown silty fine to coarse sand (medium dense, moist) (recessional outwash)		
207	2	X	1						
206	3				GP-GM		Yellow/brown fine to coarse gravel with sand and silt, occasional cobbles (dense, moist) (recessional outwash)		
205	4								
204	5								
203	6	X	2						
202	7								
201	8	X	3						
200	9								
199	10	X	4						

Test pit completed at 10.5 feet
No groundwater seepage observed
Minor caving observed at ~4+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-3

GEOENGINEERS

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Date Excavated: 3/3/2011

Equipment: Deere 410E

Logged By: EAW

Total Depth (ft) 10.0

Elevation (feet)	Depth (feet)	Testing Sample	Sample Name Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				SP		Brown medium to coarse sand with gravel, trace silt (dense, moist) (recessional outwash)		
209	1								
208	2								
207	3								
206	4	X	1 SA					4	%F=1.0
205	5								
204	6	X	2						
	6.5				GP-GM		Brown fine to coarse gravel with sand and silt (dense, moist) (recessional outwash)		
203	7				GP		Brown fine to coarse gravel with sand, trace silt (dense, moist) (recessional outwash)		
202	8	X	3						
201	9								
200	10								

Test pit completed at 10 feet
No groundwater seepage observed
Minor caving observed at ~3+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-4

GEOENGINEERS

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Figure A-5
Sheet 1 of 1

Date Excavated: 3/3/2011
Equipment: Deere 410E
Logged By: EAW
Total Depth (ft) 10.0

Elevation (feet)	Depth (feet)	Testing Sample	Sample Name Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				DUFF		2 inches forest duff		
209	1				GM		Black silty fine to coarse gravel with sand (medium dense, moist) (weathered)		
208	2				GP		Brown fine to coarse gravel with sand, trace silt (dense, moist) (recessional outwash)		
207	3								
206	4	X	1						
205	5								
204	6	X	2		SP		Gray/brown fine to coarse sand with gravel, trace silt (dense, moist) (recessional outwash)		
203	7								
202	8	X	3						
201	9								
200	10								

Test pit completed at 10 feet
No groundwater seepage observed
Minor caving observed at ~3+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-5

GeoEngineers

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Date Excavated: 3/3/2011

Equipment: Deere 410E

Logged By: EAW

Total Depth (ft) 10.5

Elevation (feet)	Depth (feet)	Testing Sample	Sample Name Testing	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0			DUFF		2 inches duff		
		X	1	SM		Black silty fine to coarse sand with gravel and organics (medium dense, moist) (weathered)		
206	1							
205	2							
	2.5			GP		Brown fine to coarse gravel with sand, trace silt (dense, moist) (recessional outwash)		
204	3	X	2					
203	4	X	3	SP		Gray/brown fine to coarse sand with gravel, trace silt (dense, moist) (recessional outwash)		
202	5			GP		Brown fine to coarse gravel with sand, trace silt (dense, moist) (recessional outwash)		
201	6	X	4					
200	7							
199	8							
198	9					Occasional cobbles		
	9.5			GP-GM		Gray fine to coarse gravel with silt and sand (dense, moist)		
197	10	X	5					

Test pit completed at 10.5 feet
No groundwater seepage observed
Minor caving observed at ~3+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Tacoma: Date:10/10/11 Path:P:\16\16785003\GINT\1678500300.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_TESTPIT_1P_GEOTEC

Log of Test Pit TP-6

GeoEngineers

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Figure A-7
Sheet 1 of 1

Date Excavated: 3/3/2011
Equipment: Deere 410E
Logged By: EAW
Total Depth (ft) 10.5

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
					DUFF		2 inches		
					GM		Black/brown silty fine to coarse gravel with sand and organics (medium dense, moist) (weathered)		
210	1								
					GW		Brown fine to coarse gravel with sand, trace silt (dense, moist) (recessional outwash)		
209	2								
208	3								
207	4	X	1 / SA					4	%F=1.1
206	5								
205	6	X	2						
204	7								
203	8								
202	9								
201	10								

Test pit completed at 10.5 feet
No groundwater seepage observed
Minor caving observed at ~3+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-7

GEOENGINEERS

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Date Excavated: 3/3/2011
Equipment: Deere 410E
Logged By: EAW
Total Depth (ft) 11.0

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				DUFF		2 inches duff		
214–212	0–3				SM		Black silty fine to coarse sand with gravel and organics (medium dense, moist) (weathered)		
212–205	3–10	X (4)	1		SP		Brown fine to coarse sand with gravel, trace silt (dense, moist) (recessional outwash)		
		X (6)	2						
205–204	10–11	X (10.5)	3		GP-GM		Brown fine to coarse gravel with silt and sand (dense, moist) (recessional outwash)		

Test pit completed at 11 feet
No groundwater seepage observed
Minor caving observed at ~3+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-8

GEOENGINEERS

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Figure A-9
Sheet 1 of 1

Date Excavated: 3/3/2011
Equipment: Deere 410E

Logged By: EAW
Total Depth (ft) 8.0

Elevation (feet)	Depth (feet)	Testing Sample	Sample Name Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
					DUFF		2 inches duff		
					SP		Brown fine to coarse sand with gravel, trace silt (medium dense, moist) (fill)		
208	1								
207	2								
206	3								
205	4	X	1						
204	5								
203	6	X	2						
202	7						Occasional layers of black silty fine to coarse gravel 2 to 4 inches thick		
201	8								

Test pit completed at 8 feet
No groundwater seepage observed
Minor caving observed at ~4+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-9

GeoEngineers

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Figure A-10
Sheet 1 of 1

Date Excavated: 3/3/2011

Equipment: Deere 410E

Logged By: EAW

Total Depth (ft) 9.0

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				DUFF		2 inches duff		
					SM		Black silty fine to coarse sand with gravel and organics (loose, moist) (weathered)		
200	1	X	1						
					GP		Brown fine to coarse gravel with sand, trace silt (dense, moist) (recessional outwash)		
199	2								
					SP		Gray fine to coarse sand with gravel, trace silt (dense, moist) (recessional outwash)		
198	3								
197	4	X	2						
196	5								
195	6	X	3						
194	7								
193	8								
192	9								

Test pit completed at 9 feet
No groundwater seepage observed
Minor to severe caving observed at ~4+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-10

GeoEngineers

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Figure A-11
Sheet 1 of 1

Date Excavated: 3/3/2011

Equipment: Deere 410E

Logged By: EAW

Total Depth (ft) 10.5

Elevation (feet)	Depth (feet)	Testing Sample	Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				SM		2 inches black silty sand with gravel and organics (medium dense, moist)		
					GP		Brown fine to coarse gravel with sand, trace silt, occasional cobbles (very dense, moist) (recessional outwash)		
193	1								
192	2	X	1						
191	3								
190	4	X	2 / SA					4	%F=1.5
189	5								
188	6	X	3						
187	7								
186	8								
185	9								
184	10	X	4						

Test pit completed at 10.5 feet
No groundwater seepage observed
Moderate caving observed at ~5+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-11

GEOENGINEERS

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Date Excavated: 3/4/2011

Equipment: Deere 410E

Logged By: EAW

Total Depth (ft) 10.0

Elevation (feet)	Depth (feet)	Testing Sample	Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				SOD		2 inches sod		
201	1				SM		Black silty fine to coarse sand with gravel and organics (medium dense, moist)		
200	2				GP		Brown fine to coarse gravel with sand, trace silt (dense, moist) (recessional outwash)		
199	3								
198	4	X	1						
197	5								
196	6	X	2 / SA					4	%F=1.0
195	7								
194	8								
193	9								
192	10								

Test pit completed at 10 feet
No groundwater seepage observed
Minor caving observed at ~3+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Tacoma: Date:10/10/11 Path:P:\16\16785003\GINT\1678500300.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_TESTPIT_1P_GEOTEC

Log of Test Pit TP-12

GeoEngineers

Project: Lot Y Industrial Park

Project Location: DuPont, Washington

Project Number: 16785-003-00

Figure A-13
Sheet 1 of 1

Date Excavated: 3/4/2011
Equipment: Deere 410E

Logged By: EAW
Total Depth (ft) 10.5

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				SOD		2 inches sod with sand		
					GM		Black silty fine to coarse gravel with sand and organics (loose, moist) (weathered)		
202	1								
					GP		Brown fine to coarse gravel with sand, trace silt (dense, moist) (recessional outwash)		
201	2								
200	3								
199	4	X	1						
198	5								
197	6	X	2						
196	7								
195	8								
194	9								
193	10	X	3						

Test pit completed at 10.5 feet
No groundwater seepage observed
No caving observed

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-13

GEOENGINEERS

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Date Excavated: 3/4/2011
Equipment: Deere 410E
Logged By: EAW
Total Depth (ft) 10.0

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				GP		Brown fine to coarse gravel with sand, trace silt (dense, moist) (recessional outwash)		
203	1	X	1						
202	2								
201	3								
200	4	X	2						
199	5						Grades to wet		
198	6	X	3 / SA		GW		Brown fine to coarse gravel with sand, trace silt (dense, moist) (recessional outwash)	5	%F=2.0
197	7								
196	8					▽			
195	9								
194	10								

Test pit completed at 10 feet
Moderate groundwater seepage observed at 8 feet
Moderate caving observed at ~2+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-14

GeoEngineers

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Figure A-15
Sheet 1 of 1

Date Excavated: 3/4/2011

Equipment: Deere 410E

Logged By: EAW

Total Depth (ft) 10.0

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				DUFF		2 inches sod/duff		
					SM		Black silty fine to coarse sand with gravel and organics (medium dense, moist) (weathered)		
202	1	X	1						
201	2								
200	3				GP		Brown fine to coarse gravel with sand, trace silt (dense, moist) (recessional outwash)		
199	4	X	2 SA					5	%F=1.2
198	5								
197	6	X	3						
196	7								
195	8								
194	9								
193	10								

Test pit completed at 10 feet
No groundwater seepage observed
Moderate caving observed at ~4+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Tacoma: Date:10/10/11 Path:P:\16\16785003\GINT\1678500300.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_TESTPIT_1P_GEOTEC

Log of Test Pit TP-15

GeoEngineers

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Figure A-16
Sheet 1 of 1

Date Excavated: 3/4/2011

Equipment: Deere 410E

Logged By: EAW

Total Depth (ft) 10.0

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				DUFF		2 inches duff/sod		
					SM		Black silty fine to coarse sand with gravel and organics (medium dense, moist) (weathered)		
214	1								
213	2				GW		Brown fine to coarse gravel with sand, trace silt (dense, moist) (recessional outwash)		
212	3								
211	4	X	1						
210	5								
209	6	X	2 / SA					3	%F=0.6
208	7								
207	8								
206	9								
205	10								

Test pit completed at 10 feet
No groundwater seepage observed
Moderate caving observed at ~4+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-16

GEOENGINEERS

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Date Excavated: 3/4/2011

Equipment: Deere 410E

Logged By: EAW

Total Depth (ft) 10.0

Elevation (feet)	Depth (feet)	SAMPLE Testing Sample	Sample Name Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				DUFF		2 inches duff/sod		
204	1				SM		Black silty fine to coarse sand with gravel and organics (loose, moist) (weathered)		
203	2				GP		Brown fine to coarse gravel with sand, trace silt (dense, moist) (recessional outwash)		
202	3								
201	4	X	1						
200	5								
199	6	X	2						
198	7								
197	8								
196	9								
195	10								

Test pit completed at 10 feet
No groundwater seepage observed
Moderate caving observed at ~5+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-17

GEOENGINEERS

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Figure A-18
Sheet 1 of 1

Date Excavated: 3/4/2011

Equipment: Deere 410E

Logged By: EAW

Total Depth (ft) 8.0

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0–0.2				SOD		2 inches sod		
216	1				GM		Black silty fine to coarse gravel with sand and organics (loose, moist) (weathered)		
215	2				GP		Brown fine to coarse gravel with sand, trace silt (dense, moist) (recessional outwash)		
214	3								
213	4	X	1						
212	5								
211	6	X	2						
210	7								
209	8								

Test pit completed at 8 feet
No groundwater seepage observed
Moderate to severe caving observed at ~2+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-18

GeoEngineers

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Date Excavated: 3/4/2011

Equipment: Deere 410E

Logged By: EAW

Total Depth (ft) 10.5

Elevation (feet)	Depth (feet)	Testing Sample	Sample Name Testing	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0			SOD		2 inches sod		
	0.2			SM		Black silty fine to coarse sand with gravel and organics (medium dense, moist) (weathered)		
206	1							
	1.5			GP		Gray fine to coarse gravel with sand, trace silt (dense, moist) (recessional outwash)		
205	2							
204	3					Grades to brown		
203	4	X	1					
202	5							
201	6	X	2					
200	7							
199	8							
	8.5	X	3	GP-GM		Gray fine to coarse gravel with sand and silt (dense, moist) (recessional outwash)		
198	9							
197	10	X	4					

Test pit completed at 10.5 feet
No groundwater seepage observed
Moderate caving observed at ~3+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Tacoma: Date:10/10/11 Path:P:\16\16785003\GINT\1678500300.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_TESTPIT_1P_GEOTEC

Log of Test Pit TP-19

GeoEngineers

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Figure A-20
Sheet 1 of 1

Date Excavated: 3/4/2011

Equipment: Deere 410E

Logged By: EAW

Total Depth (ft) 10.5

Elevation (feet)	Depth (feet)	Testing Sample	Sample Name / Testing	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0			GM		Dark brown silty fine to coarse gravel with sand (medium dense, moist) (weathered)		
197	1			GP		Brown fine to coarse gravel with sand, trace silt, occasional cobbles (dense, moist) (recessional outwash)		
196	2							
195	3							
194	4	X	1					
193	5							
192	6	X	2 SA				6	%F=4.2
191	7							
190	8							
189	9							
	9.5			GP-GM		Gray fine to coarse gravel with sand and silt, occasional cobbles (dense, moist) (recessional outwash)		
188	10	X	3					

Test pit completed at 10.5 feet
No groundwater seepage observed
Minimal caving observed at ~3+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-20

GeoEngineers

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Date Excavated: 3/4/2011

Equipment: Deere 410E

Logged By: EAW

Total Depth (ft) 8.0

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				GP		Brown fine to coarse gravel with sand, trace silt, occasional cobbles (dense, moist) (recessional outwash)		
200	1								
199	2								
198	3								
197	4	X	1						
196	5								
195	6	X	2						
194	7								
193	8								

Test pit completed at 8 feet
No groundwater seepage observed
Severe caving observed at ~3+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Log of Test Pit TP-21

GEOENGINEERS

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Date Excavated: 3/4/2011

Equipment: Deere 410E

Logged By: EAW

Total Depth (ft) 10.0

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
	0				SOD		2 inches sod/duff		
					GM		Black silty fine to coarse gravel with sand and organics (loose, moist) (weathered)		
					GP		Brown fine to coarse gravel with sand, trace silt, occasional cobbles (dense, moist) (recessional outwash)		
206	4	☒	1 / SA					4	%F=1.1
204	6	☒	2						
201	9	☒	3						
200	10								

Elevation (feet)	Depth (feet)
209	1
208	2
207	3
206	4
205	5
204	6
203	7
202	8
201	9
200	10

Test pit completed at 10 feet
No groundwater seepage observed
Moderate to severe caving observed at ~1.5+ feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

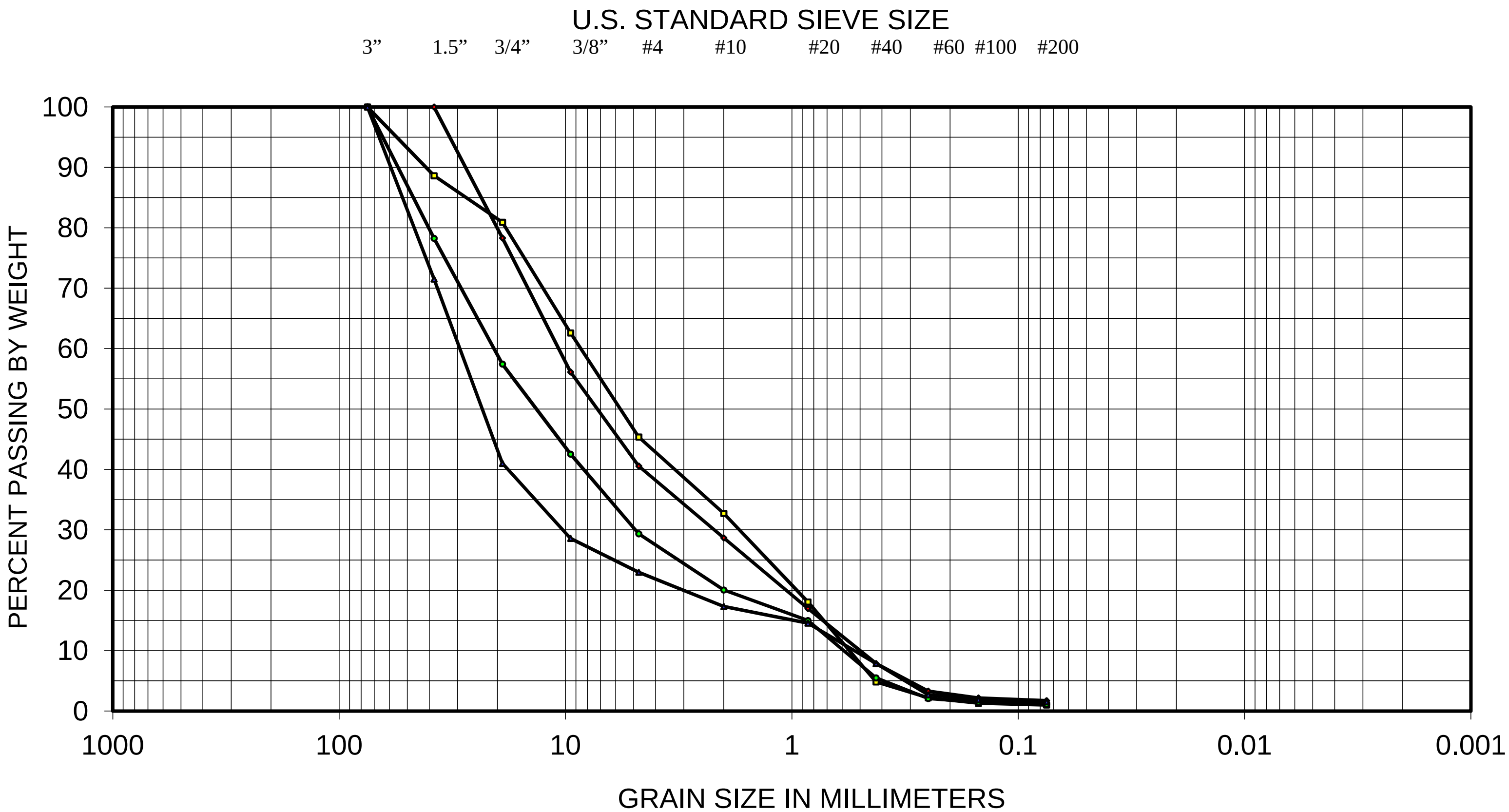
Log of Test Pit TP-22

GEOENGINEERS

Project: Lot Y Industrial Park
Project Location: DuPont, Washington
Project Number: 16785-003-00

Figure A-23
Sheet 1 of 1

16785-003-00



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	MOISTURE (%)	SOIL CLASSIFICATION
◆ (red diamond)	TP-2	6	4	Fine to coarse gravel with sand (GP)
■ (yellow square)	TP-4	4	4	Fine to coarse sand with gravel (SP)
● (green circle)	TP-7	4	4	Fine to coarse gravel with sand (GW)
▲ (blue triangle)	TP-11	4	4	Fine to coarse gravel with sand (GP)

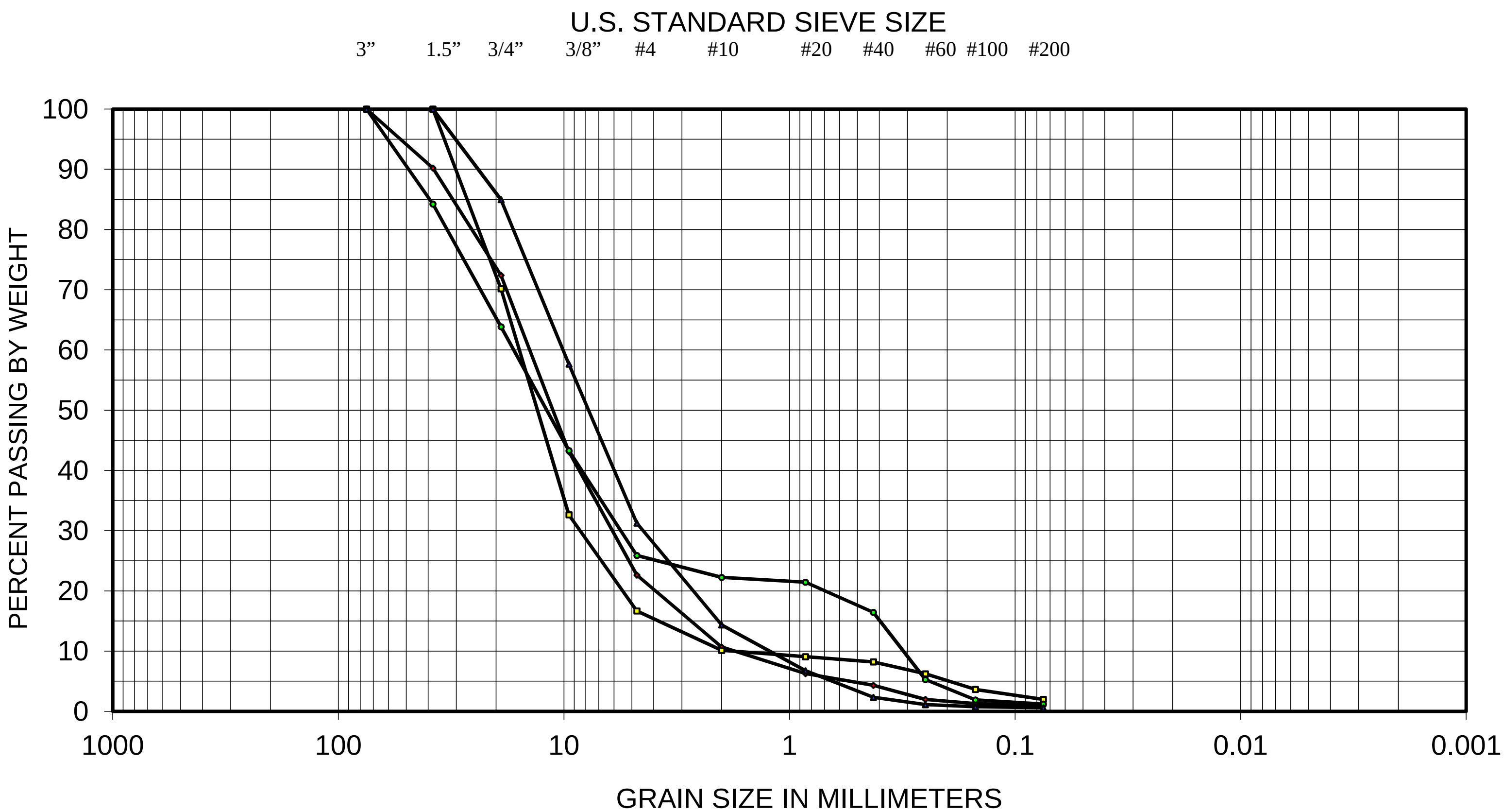
GEOENGINEERS

Sieve Analysis Results

Lot Y Industrial Park
DuPont, Washington

Figure A-24

16758-003-00



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	MOISTURE (%)	SOIL CLASSIFICATION
◆ (red diamond)	TP-12	6	4	Fine to coarse gravel with sand (GW)
■ (yellow square)	TP-14	6	5	Fine to coarse gravel with sand (GW)
● (green circle)	TP-15	4	5	Fine to coarse gravel with sand (GP)
▲ (blue triangle)	TP-16	6	3	Fine to coarse gravel with sand (GW)

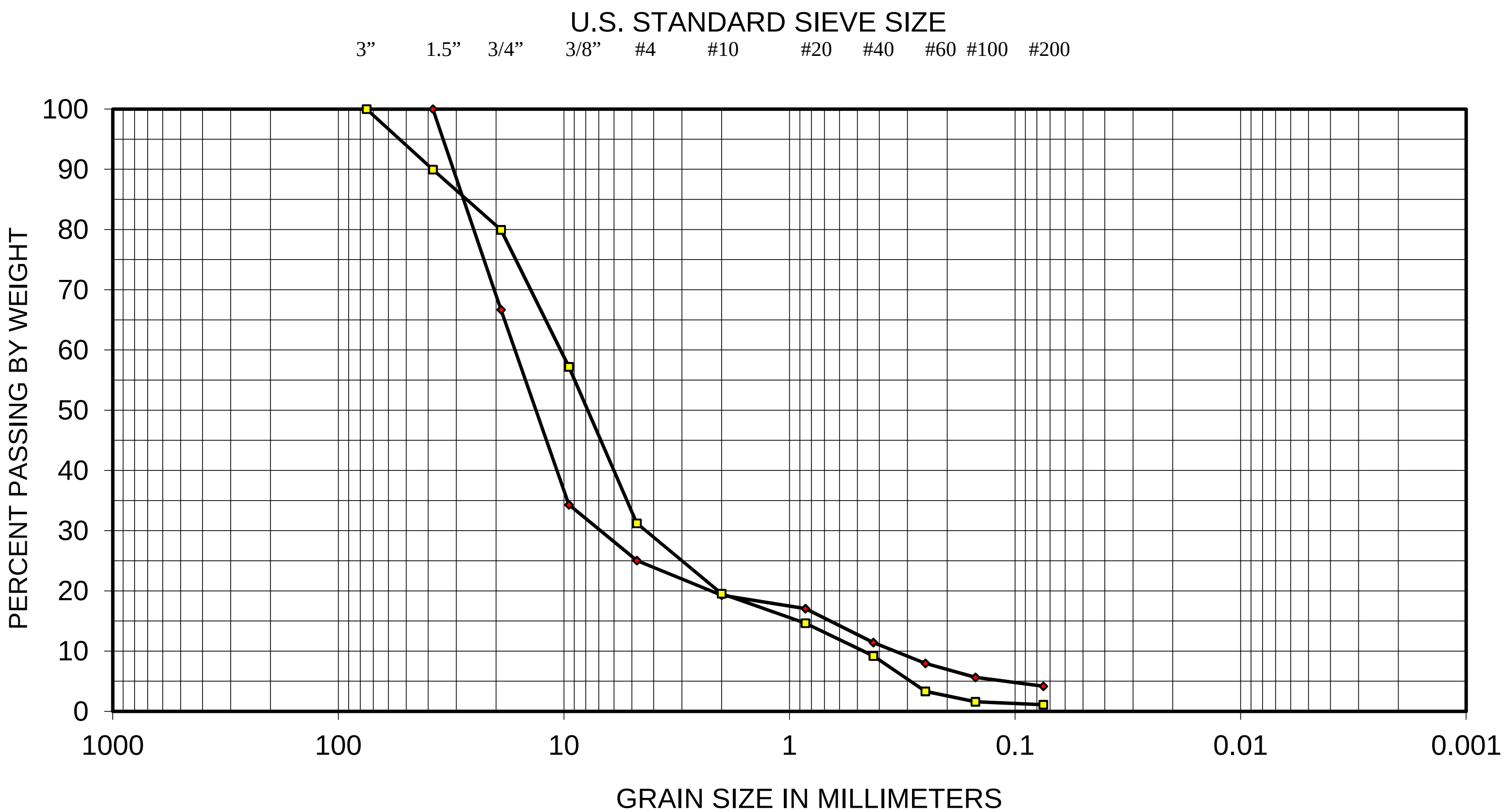
GeoEngineers

Lot Y Industrial Park
DuPont, Washington

Sieve Analysis Results

Figure A-25

16785-003-00



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	MOISTURE (%)	SOIL CLASSIFICATION
◆ (red diamond)	TP-20	6	6	Fine to coarse gravel with sand (GP)
■ (yellow square)	TP-22	4	4	Fine to coarse gravel with sand (GP)

GEOENGINEERS

Lot Y Industrial Park
DuPont, Washington

Sieve Analysis Results

Figure A-26

APPENDIX B
Report Limitations and Guidelines for Use

APPENDIX B
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This appendix provides information to help you manage your risks with respect to the use of this report.

Geotechnical Services are Performed for Specific Purposes, Persons and Projects

This report has been prepared for the exclusive use of DuPont Industrial Partners, LLC and their authorized agents. This report is not intended for use by others, and the information contained herein is not applicable to other sites.

GeoEngineers structures our services to meet the specific needs of our clients. For example, a geotechnical or geologic study conducted for a civil engineer or architect may not fulfill the needs of a construction contractor or even another civil engineer or architect that are involved in the same project. Because each geotechnical or geologic study is unique, each geotechnical engineering or geologic report is unique, prepared solely for the specific client and project site. Our report is prepared for the exclusive use of our Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against open-ended liability claims by third parties with whom there would otherwise be no contractual limits to their actions. Within the limitations of scope, schedule and budget, our services have been executed in accordance with our Agreement with the Client and generally accepted geotechnical practices in this area at the time this report was prepared. This report should not be applied for any purpose or project except the one originally contemplated.

A Geotechnical Engineering or Geologic Report is Based on a Unique Set of Project-Specific Factors

This report has been prepared for the Lot "Y" Industrial Park in DuPont, Washington. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, do not rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

For example, changes that can affect the applicability of this report include those that affect:

- the function of the proposed structure;
- elevation, configuration, location, orientation or weight of the proposed structure;

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[1] Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org.

- composition of the design team; or
- project ownership.

If important changes are made after the date of this report, GeoEngineers should be given the opportunity to review our interpretations and recommendations and provide written modifications or confirmation, as appropriate.

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by manmade events such as construction on or adjacent to the site, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. Always contact GeoEngineers before applying a report to determine if it remains applicable.

Most Geotechnical and Geologic Findings Are Professional Opinions

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied our professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. Our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

Geotechnical Engineering Report Recommendations Are Not Final

Do not over-rely on the preliminary construction recommendations included in this report. These recommendations are not final, because they were developed principally from GeoEngineers' professional judgment and opinion. GeoEngineers' recommendations can be finalized only by observing actual subsurface conditions revealed during construction. GeoEngineers cannot assume responsibility or liability for this report's recommendations if we do not perform construction observation.

Sufficient monitoring, testing and consultation by GeoEngineers should be provided during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether or not earthwork activities are completed in accordance with our recommendations. Retaining GeoEngineers for construction observation for this project is the most effective method of managing the risks associated with unanticipated conditions.

A Geotechnical Engineering or Geologic Report Could be Subject to Misinterpretation

Misinterpretation of this report by other design team members can result in costly problems. You could lower that risk by having GeoEngineers confer with appropriate members of the design team after submitting the report. Also retain GeoEngineers to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering or geologic report. Reduce that risk by having GeoEngineers participate in pre-bid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Exploration Logs

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognize that separating logs from the report can elevate risk.

Give Contractors a Complete Report and Guidance

Some owners and design professionals believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering or geologic report, but preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with GeoEngineers and/or to conduct additional study to obtain the specific types of information they need or prefer. A pre-bid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might an owner be in a position to give contractors the best information available, while requiring them to at least share the financial responsibilities stemming from unanticipated conditions. Further, a contingency for unanticipated conditions should be included in your project budget and schedule.

Contractors are Responsible for Site Safety on their Own Construction Projects

Our geotechnical recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and to adjacent properties.

Read These Provisions Closely

Some clients, design professionals and contractors may not recognize that the geoscience practices (geotechnical engineering or geology) are far less exact than other engineering and natural science disciplines. This lack of understanding can create unrealistic expectations that could lead to disappointments, claims and disputes. GeoEngineers includes these explanatory "limitations" provisions in our reports to help reduce such risks. Please confer with GeoEngineers if you are unclear how these "Report Limitations and Guidelines for Use" apply to your project or site.

Geotechnical, Geologic and Environmental Reports Should not be Interchanged

The equipment, techniques and personnel used to perform an environmental study differ significantly from those used to perform a geotechnical or geologic study and vice versa. For that reason, a geotechnical engineering or geologic report does not usually relate any environmental findings, conclusions or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding a specific project.

Biological Pollutants

GeoEngineers' Scope of Work specifically excludes the investigation, detection, prevention, or assessment of the presence of Biological Pollutants in or around any structure. Accordingly, this report includes no interpretations, recommendations, findings, or conclusions for the purpose of detecting, preventing, assessing, or abating Biological Pollutants. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria, and viruses, and/or any of their byproducts.

Topsoil

For the purposes of this report, we consider topsoil to consist of generally fine-grained soil with an appreciable amount of organic matter based on visual examination, and to be unsuitable for direct support of the proposed improvements. However, the organic content and other mineralogical and gradational characteristics used to evaluate the suitability of soil for use in landscaping and agricultural purposes was not determined, nor considered in our analyses. Therefore, the information and recommendations in this report, and our logs and descriptions should not be used as a basis for estimating the volume of topsoil available for such purposes.