Geotechnical Engineering Services

Dickerson Creek Culvert Replacements
Kitsap County, Washington

for
Northwest Hydraulic Consultants, Inc.

November 29, 2011

GeoEngineers
Earth Science + Technology

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File No. 1598-040-00

November 29, 2011

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INTRODUCTION

This report presents the results of our geotechnical engineering services for the Dickerson Creek Culvert Replacement Project located near Bremerton, Washington. The project is located in Kitsap County, within Sections 7 and 8 of Township 24 N and Range 01 E of the Willamette Meridian as approximately shown on the Vicinity Map, Figure 1. Relevant site features are shown on the Site Plans, Figures 2 and 3. Our geotechnical scope of service for this project is defined under Task 2 – Geotechnical Investigation in our Contract for Professional Services KC 401-09, which was authorized on November 4, 2009.

PROJECT DESCRIPTION

Kitsap County will be implementing improvements along Dickerson Creek for the purposes of improving fish passage, stream hydraulics and flood characteristics. Two culvert replacements are part of this project. The culverts are located where NW David Road and NW Taylor Road cross the creek. We understand that the type and size of replacement culverts have not yet been selected. Widening of the creek as part of flood plain restoration is planned south of NW David Road and north of NW Taylor Road.

PURPOSE AND SCOPE OF SERVICE

The purpose of this study is to evaluate subsurface conditions along Dickerson Creek near NW David Road and NW Taylor Road and based on the conditions observed, to provide recommendations pertaining to the geotechnical aspects of the project. Specifically, our scope includes the following:

1. Preparing an exploration plan; locating the explorations in the field and notifying the “One Call” utility locate service in accordance with Washington State law.
2. Exploring subsurface conditions by advancing one boring near each proposed culvert replacement area to depths of 51 and 51½ feet below ground surface (bgs).
3. Exploring subsurface conditions by excavating two test pits near each proposed culvert area to depths between 11 and 16 feet bgs.
4. Performing laboratory testing on selected samples to verify field classification and obtain pertinent engineering data. Laboratory testing included moisture content determinations, grain-size analyses and Atterberg limits tests.
5. Providing recommendations for site preparation including stripping, removal of loose, soft or otherwise unsuitable material, grading and backfill compaction, including imported structural backfill, reuse of on-site soil and wet weather construction considerations. We also include recommendations for erosion control during construction activities.
6. Providing recommendations for culvert spread footing foundations, including allowable soil bearing pressures, settlement (total and differential) estimates, lateral earth pressures and coefficient of friction for evaluating sliding resistance. We provide seismic design

considerations, consistent with the International Building Code (IBC) and our opinion of the liquefaction potential of site soils.

7. Providing recommendations for site drainage and control of groundwater that may be encountered.
8. Discussing temporary excavation support considerations and providing general recommendations for design of temporary shoring.

SITE CONDITIONS

Surface Conditions

Development in the vicinity of the NW David Road and NW Taylor Road culvert replacements consists of single family residential. Vegetation at both locations consists of manicured trees, shrubbery, and lawns on the residential parcels and deciduous and coniferous trees along the creek with an understory of brush.

NW David Road

NW David Road runs approximately east-west and is surfaced with asphalt concrete pavement (ACP). The paved road is approximately 20 feet wide. The ground surface along the road is level; at the creek crossing the road surface is at approximately Elevation 114 feet (NGVD 29).

Dickerson Creek flows from south to north passing under NW David Road through an existing 96-inch corrugated metal pipe (CMP) culvert. The stream bed is at approximately Elevation 106 feet south of NW David Road and Elevation 104 feet north of the road. The stream banks are on the order of 4 to 8 feet in height with inclinations between about 55 percent and 100 percent. Portions of the banks are armored with riprap north and south of NW David Road. The ground surface south of the road is generally level. The north side of the road has an embankment on the order of 2 to 3 feet in height sloping down to the north, except at the creek crossing where the ground slopes down to the top of the culvert.

A house located on the parcel southwest of the culvert was recently demolished. We understand the house was bulldozed and the debris from the superstructure removed from the site.

NW Taylor Road

NW Taylor Road runs approximately east-west and is surfaced with ACP. The paved road is approximately 20 feet wide. The ground surface along the road is level; at the creek crossing the road surface is at approximately Elevation 100 feet.

Dickerson Creek flows from south to north under NW Taylor Road through an existing “squash” pipe culvert with dimensions 5.7 feet high and 7.6 feet wide. The stream bed is at approximately Elevation 88 feet south of NW Taylor Road and Elevation 84 feet north of the road. The stream banks are on the order of 8 to 12 feet in height with inclinations between about 40 percent and 120 percent. Portions of the banks north and south of NW Taylor Road have rock walls at the stream level on the order of 2 to 4 feet in height. The ground surface west of the NW Taylor Road culvert generally slopes gently down to the northeast towards Dickerson Creek at about 5 percent.

The ground surface east of the NW Taylor Road culvert generally slopes gently down to the northwest towards Dickerson Creek at about 5 percent. At the stream crossing the road embankment slopes down towards the creek at about 55 percent. The embankment slope on the north side of NW Taylor Road is covered with ACP.

Subsurface Explorations

Subsurface explorations were completed on July 20, 2011, and consisted of drilling two borings and excavating four test pits. One boring was advanced near each proposed culvert replacement location. Two test pits were excavated south of NW David Road and two test pits were excavated north of NW Taylor Road. Approximate exploration locations are shown on Figures 2 and 3. Details of the subsurface explorations are presented in Appendix A and include logs of the borings and test pits, and results of the laboratory testing.

Additional samples were collected and tested to determine the streambed sediment gradation of Dickerson Creek and Chico Creek. Five samples were collected by Northwest Hydraulic Consultants and delivered to GeoEngineers for testing. Details of the tests performed and results are presented in Appendix A.

Subsurface Conditions

NW David Road

Our explorations near NW David Road generally encountered fill over native soil. Surface material consisted of ACP on NW David Road and sod in the parcel southwest of the culvert. At the locations explored we observed loose silty sand with organic material and debris (fine roots and wood fragments) below the ACP or sod to depths between about 3 and 9 feet bgs, which we interpret to be fill. Construction debris consisting of concrete rubble, PVC pipe and dimensional lumber were observed in test pit TP-2 at the approximate location of the demolished house.

Below the fill we encountered interbedded medium dense to dense gravel with sand, gravel with silt, silty gravel, and sand with silt; which extended to a depth of about 18.5 feet bgs in boring B-1 and to the depth explored in test pits TP-1 and TP-2. Below the sand and gravel in boring B-1 very stiff to hard silt and clay were observed to a depth of approximately 41 feet bgs. Below this depth, dense to very dense silty sand was observed to the depth explored.

Groundwater was observed at the time of exploration between about 6 feet to 11 feet bgs (Elevation 101 feet and 108 feet).

NW Taylor Road

Explorations near NW Taylor Road generally encountered fill over native soils. Surface material consisted of ACP on NW Taylor Road, and crushed rock and topsoil north of NW Taylor Road. At the locations explored, we observed loose to medium dense silty sand to depths between about 3 and 4 feet bgs, which we interpret to be fill. Below the fill, to the depths explored, we observed medium dense to dense sand, sand with silt, silty sand, gravel and gravel with silt, which we interpret to be native soil

Groundwater was observed at the time of exploration between approximately 9½ feet and 15 feet bgs (Elevation 85 feet and 82.5 feet).

CONCLUSIONS AND RECOMMENDATIONS

General

We understand that the replacement culvert systems have not been selected, nor has design been completed. Based on our experience the culvert footings will likely be placed below the stream level to protect against scour. In our opinion, existing native soil conditions near the probable bearing surface elevation are suitable for support of shallow spread footings. We recommend that if a prefabricated culvert structure is used, the manufacturer confirm that their product design assumptions are consistent with our recommendations and appropriate for the site conditions. We should also review the design plans to ensure that our recommendations have been incorporated.

In our opinion, the portion of culvert construction above the stream level could be accomplished by open-cut sloped excavation. Temporary shoring such as a sheet pile cofferdam could be used to divert the stream, help control groundwater and limit the size of the excavation below the stream level. The following sections of this report present conclusions and recommendations concerning culvert foundations, culvert walls, culvert backfill, seismic design considerations and construction considerations.

Culvert Design Considerations

Bearing Surfaces

In our opinion, the replacement culvert structures may be satisfactorily founded on continuous spread footings. Shallow foundations should bear on undisturbed, native medium dense to dense silty sand or silty gravel, which we encountered below about Elevation 105 feet and 96 feet in borings B-1 (NW David Road) and B-2 (NW Taylor Road), respectively.

DESIGN PARAMETERS

Spread footing foundations should be at least 24 inches wide. Foundations should bear a minimum of 18 inches below the lowest adjacent grade for frost protection. Additional depth may be required for scour protection. Shallow spread footings designed and constructed in accordance with our recommendations can be proportioned using an allowable soil bearing pressure provided below in Table 1. Our analysis assumes the footing bearing surface will be submerged, accordingly buoyant unit weights were used. These values apply to the total of dead plus long-term live loads exclusive of the weight of the footing and any overlying backfill. These values may be increased by up to one-third when considering short-term live loads such as seismic forces.

TABLE 1. ALLOWABLE SOIL BEARING PRESSURE

Footing Width (feet)	Allowable Soil Bearing Pressure (psf)
2	2,500
4	4,500
6	5,000

Note:
psf = pounds per square foot

LATERAL RESISTANCE

Resistance to lateral loads may be developed through base friction and through passive resistance on the embedded portion of walls and foundations. Base friction resistance may be computed using a coefficient of friction of 0.4 applied to the dead load forces. Passive pressure may be computed using an equivalent fluid density of 120 pounds per cubic foot (pcf) for a level ground surface, assuming that the footing or other below-grade element will be submerged, and that backfill comprises undisturbed native soil or structural fill compacted to at least 92 percent of the maximum dry density (MDD) determined in accordance with ASTM International (ASTM) D 1557. For material above stream level or water table, passive pressure may be computed using an equivalent fluid density of 300 pcf for a level ground surface. The friction and equivalent fluid density values include a factor of safety of about 1.5.

SETTLEMENT

We anticipate that post-construction settlements of the culvert foundations designed and constructed as recommended will be on the order of ½ inch to 1 inch, with differential settlements on the order of ¼ inch to ½ inch along 50 feet of continuous footing. We expect that most of the footing settlement will occur as loads are applied. The presence of loose, soft or disturbed soils not removed from the footing excavations prior to placing quarry spalls or crushed rock will result in increased settlement.

Culvert Walls

GENERAL

The lateral earth pressures acting on the culvert walls will depend on the nature, density and geometric configuration of the soil behind the wall and the amount of lateral wall movement that can occur as backfill is placed. For walls that are free to yield at the top earth pressures will be less than if movement is limited. Walls are generally considered restrained if lateral movement at the top of the wall is less than at least one-thousandth the height of the wall. Prefabricated culvert structures are typically rigid enough to be considered restrained. Wing-walls extending out from the culvert will likely experience enough lateral yielding to be considered unrestrained.

DESIGN PARAMETERS

We provide recommended lateral earth pressures for restrained, unrestrained, drained and undrained conditions. Recommended design values are presented below in Table 2. Traffic surcharge loads on the culvert walls should be included as appropriate and will depend partially on the amount of material placed over the structure.

TABLE 2. DESIGN LATERAL EARTH PRESSURES, PRESENTED AS EQUIVALENT FLUID WEIGHT (PCF)

Drainage Condition	Wall Restraint Condition	
	Unrestrained	Restrained
Drained (from road surface to high stream level)	35	50
Undrained (below high stream level)[1]	80	95

Note:

[1] Undrained lateral earth pressures include hydrostatic pressure.

DRAINAGE

A permanent drainage system is recommended above the high stream level to prevent the buildup of excess hydrostatic pressures in the culvert wall backfill. We recommend that backfill for drainage consist of free-draining sand and gravel backfill meeting the requirements of Washington State Department of Transportation (WSDOT) 2004 Standard Specification 9-03.12(4) "Gravel Backfill for Drains." This zone of sand and gravel against the wall should extend a minimum of 2 feet behind the wall and extend from the bottom of footing to the top of the culvert walls. The design should include positive drainage consisting of either a perforated drainpipe or weep-holes installed near the base of the culvert walls. If perforated drainpipe is used, rigid, smooth-walled, plastic perforated pipe with a diameter of at least 4 inches should be embedded within the free-draining backfill at the base of the wall along its entire length. Cleanouts for the collector pipe should be installed as appropriate. The drainpipe should discharge to a suitable disposal point. The culvert wall drainage should generally conform to WSDOT Standard Plan D-4 "Backfill and Drainage of Retaining Walls."

Culvert Construction Considerations

Excavations and Dewatering

The excavation for the culverts will likely extend to, or below the water level in the stream. Based on our explorations, most of the soils encountered within the excavation should comprise existing fill consisting of loose to medium dense silty sand with varying amounts of gravel. We expect that conventional excavating equipment should be suitable for excavation of these soils.

Local diversion of Dickerson Creek could be required to allow for construction of the footings. Even with the stream water rerouted or diverted, the lower portions of the excavation could need dewatering to maintain a dry working area. We expect that the groundwater level near the stream will typically be similar to the surface water level in the creek and that groundwater levels could vary seasonally.

The contractor should be responsible for determining what dewatering measures are needed. The contractor should be prepared to handle the discharge that will be generated from the dewatering system(s) used. The water may need to be treated in a settlement tank or basin in order to reduce sediment concentration and meet discharge permit requirements.

Temporary Cut Slopes

Maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the contractor. All temporary cuts in excess of 4 feet in height should be shored or should be sloped in accordance with Chapter 296-155, Part N of the Washington Administrative Code (WAC). In our opinion, based on our explorations, excavations in the fill and native soils should be inclined no steeper than 1.5H:1V (horizontal:vertical). This allowable cut slope inclination is applicable to excavations above the groundwater table only. Dewatering may be required to lower the groundwater table below the base of the cut slope. For open cuts, we recommend that:

- No traffic, construction equipment, stockpiles or building supplies be allowed within a distance of at least 10 feet from the top of the cut.

- Exposed soil along the slope be protected from surface erosion using waterproof tarps or plastic sheeting.
- Construction activities be scheduled so that the length of time the temporary cut is left open is minimized.
- Erosion control measures be implemented as appropriate so that runoff from the site is limited.
- Surface water be diverted away from the excavation.

Temporary Shoring

Because of the diversity of available shoring systems and construction techniques, the selection and design of a specific type of shoring is most appropriately left up to the contractor. However, we recommend that the shoring be designed by a professional engineer (PE) licensed in Washington, and that the shoring plans and calculations be submitted to the owner for review.

For temporary cantilevered shoring systems, we recommend a design earth pressure equivalent to a fluid weighing 35 pcf for conditions with level ground adjacent to the excavation. This value assumes that the groundwater level is below the base of the excavation. The lateral soil pressure recommended above does not include hydrostatic, traffic, or construction surcharges; these should be added separately, if appropriate. Where traffic will be allowed within a distance equal to three-quarters of the wall height, we recommend that the shoring be designed for a traffic influence equal to a uniform lateral pressure of 100 pounds per square foot (psf) acting over the height of the cantilevered portion of the shoring walls. More conservative pressure values should be used if the designer deems them appropriate. The designer should select higher earth pressures and the appropriate pressure distribution if the contractor elects to use a braced shoring system.

Passive earth pressure on the below-grade elements of the shoring system embedded below groundwater level can be evaluated using an equivalent fluid density of 120 pcf. Above the groundwater level an equivalent fluid density of 300 pcf may be used. These values includes a safety factor of about 1.5.

It should be noted that quarry spalls, riprap and boulders may underlie a portion of the proposed culvert footprint. Additionally, some of the site soils are in a very dense or very stiff condition. Drilling or driving shoring elements through these materials could be difficult. If obstructions or installation refusal is encountered, predrilling, spudding or other techniques may be required to install the temporary shoring system.

Surface and Groundwater Handling

Depending on the time of year, water level in the stream, and the footing elevations, foundation bearing surfaces could be wet. If water is present at or near the bearing surface elevation during construction it will be necessary to protect the subgrade soils from disturbance. We recommend that the condition of all footing excavations be observed by a representative from our firm to evaluate whether the work is completed in accordance with our recommendations and that the subsurface conditions are as anticipated.

Bearing Surface Preparation

Footing bearing surfaces should consist of firm and unyielding native silty sand or silty gravel. Standing or flowing water should not be present at the bearing surface. Standing water should be removed and flowing water should be diverted from bearing surfaces.

If, after removal and diversion efforts, water is present at footing bearing surfaces, we recommend overexcavating at least 12 inches below the design footing bearing surface elevation and backfilling with quarry spalls and crushed rock. We recommend at least 6 inches of 2- to 4-inch quarry spalls be tamped firmly into the native soil. At least 6 inches of crushed rock should be placed and compacted over the quarry spalls.

Fill Materials

GENERAL

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 structural fill will depend on the gradation, fines content (material passing the number 200 sieve), and moisture content of the soil.

STRUCTURAL FILL

Material used for structural fill during extended periods of dry weather should consist of material of approximately the same quality as “gravel borrow” described in Section 9-03.14(1) of the WSDOT Standard Specifications.

During the months of October through May or periods of extended wet weather or persistent wet conditions we recommend that material used for structural fill consist of approximately the same quality as “gravel backfill for walls” described in Section 9-03.12(2) of the WSDOT Standard Specifications.

CRUSHED ROCK

We recommend that crushed rock used for the leveling course consist of competent rock with at least one fractured face and a maximum size not exceeding ¾ inch. Section 9-13 of the WSDOT Standard Specifications provides recommended rock quality specifications.

QUARRY SPALLS

Quarry spalls should consist of broken durable stone free of cracks, seams or other defects. We recommend using quarry spalls approximately 2 to 4 inches in nominal size. Section 9-13 of the WSDOT Standard Specifications provides further guidance.

USE OF ON-SITE SOIL AS FILL

Based on our subsurface explorations, it is our opinion that existing on-site soils consisting of sand, sand with silt, silty sand, gravel, and gravel with silt may be considered for use as structural fill provided that they can be placed and compacted as recommended in the “Fill Placement and Compaction” section of this report. The silt and clay are not suitable for use as structural fill.

Fill Placement and Compaction

Fill and backfill material should be placed in uniform, horizontal lifts and should be uniformly densified with vibratory compaction equipment. The maximum lift thickness will vary depending on the material and compaction equipment used, but should generally not exceed 10 to 12 inches in loose thickness.

Structural fill should be compacted at a moisture content near optimum. The optimum moisture content varies with the soil gradation and should be evaluated during construction. Silty soil and other fine granular soil such as silt, silty sand, and sand with silt may be difficult or impossible to compact during persistent wet conditions. Structural fill should not be placed or compacted in wet or submerged conditions.

Measures should be taken to prevent the buildup of excess lateral soil pressures resulting from overcompaction of the backfill behind culvert walls. We recommend placing the backfill located within 2 feet of the culvert walls in lifts not exceeding 6 inches in loose thickness and compacting this zone with hand-operated compaction equipment.

Backfill should be compacted to 95 percent of the MDD as determined in accordance with ASTM D 1557 where it is within 2 feet of the finished surface in roadway pavement areas. All other wall backfill should be compacted to at least 92 percent of the MDD. Backfill on each side of the culvert should be constructed concurrently to the same grade to maintain equal pressures.

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

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.

IBC Design Considerations

Based on subsurface conditions encountered in our explorations and our understanding of the geologic conditions in the site vicinity, the site may be characterized as Class C in accordance with Section 1613 of the 2009 IBC. Seismic design parameters are provided in Table 3, below.

TABLE 3. 2009 IBC SEISMIC DESIGN VALUES

Site Coefficient	Site Factor
S_s = 1.49	F_a = 1.00
S_1 = 0.53	F_v = 1.30

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 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.

We reviewed the *Kitsap County Liquefaction Susceptibility Map* which indicated the site soils have a "very low" potential for liquefaction. In our opinion, the potential for liquefaction at the site is low.

Flood Plain Excavation

At the time this report was prepared the elevation to which the excavations will be completed had not been determined. The soils encountered in our test pit explorations consist of both native soil and fill material. Below we provide recommendations for construction of permanent cut and fill slopes.

We recommend permanent cut and fill slopes be constructed at a maximum inclination of 2H:1V. Where 2H:1V permanent slopes are not feasible, protective facings and/or retaining structures should be considered. Cut 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. To achieve uniform compaction, we recommend that fill slopes be overbuilt slightly and subsequently cut back to expose well compacted fill.

Slopes exposed to flowing water during any portion of the year will need to be protected. Slope protection may include decreasing the inclination of the slope, placing riprap or other armoring, planting vegetation to reduce scour potential, or a combination thereof.

LIMITATIONS

We have prepared this report for the exclusive use of Northwest Hydraulic Consultants and their authorized agents for the Dickerson Creek Culvert Replacements project on NW Taylor Road and NW David Road near Bremerton, 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

International Code Council. "2009 International Building Code." 2009.

Java Ground Motion Parameter Calculator, United States Geological Survey - Earthquake Hazards Program (http://earthquake.usgs.gov/hazards/designmaps/javacalc.php) Accessed April 19, 2011.

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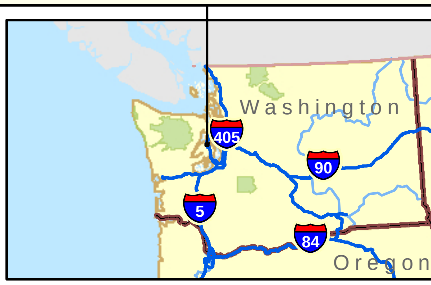
Palmer, S. P., Magsino, S. L., Bilderback, E. L., Poelstra, J. L., Folger, D. S., Neggemann, R. A. 2004. Liquefaction Susceptibility Map and Site Class maps of Washington State by County, Map

18A-Kitsap County Liquefaction Susceptibility, Sheet 35 of 78, Washington Division of Geology and Earth Resources, Open File Report 2004-20.

Washington State Department of Transportation, 2010, "Standard Specifications for Road, Bridge and Municipal Construction."



Notes:

1. The locations of all features shown are approximate.
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Data Sources: ESRI Data & Maps, Street Maps 2005

Transverse Mercator, State Plane South, North American Datum 1983
North arrow oriented to grid north

Vicinity Map

Dickerson Creek Culvert Replacements
Kitsap County, Washington

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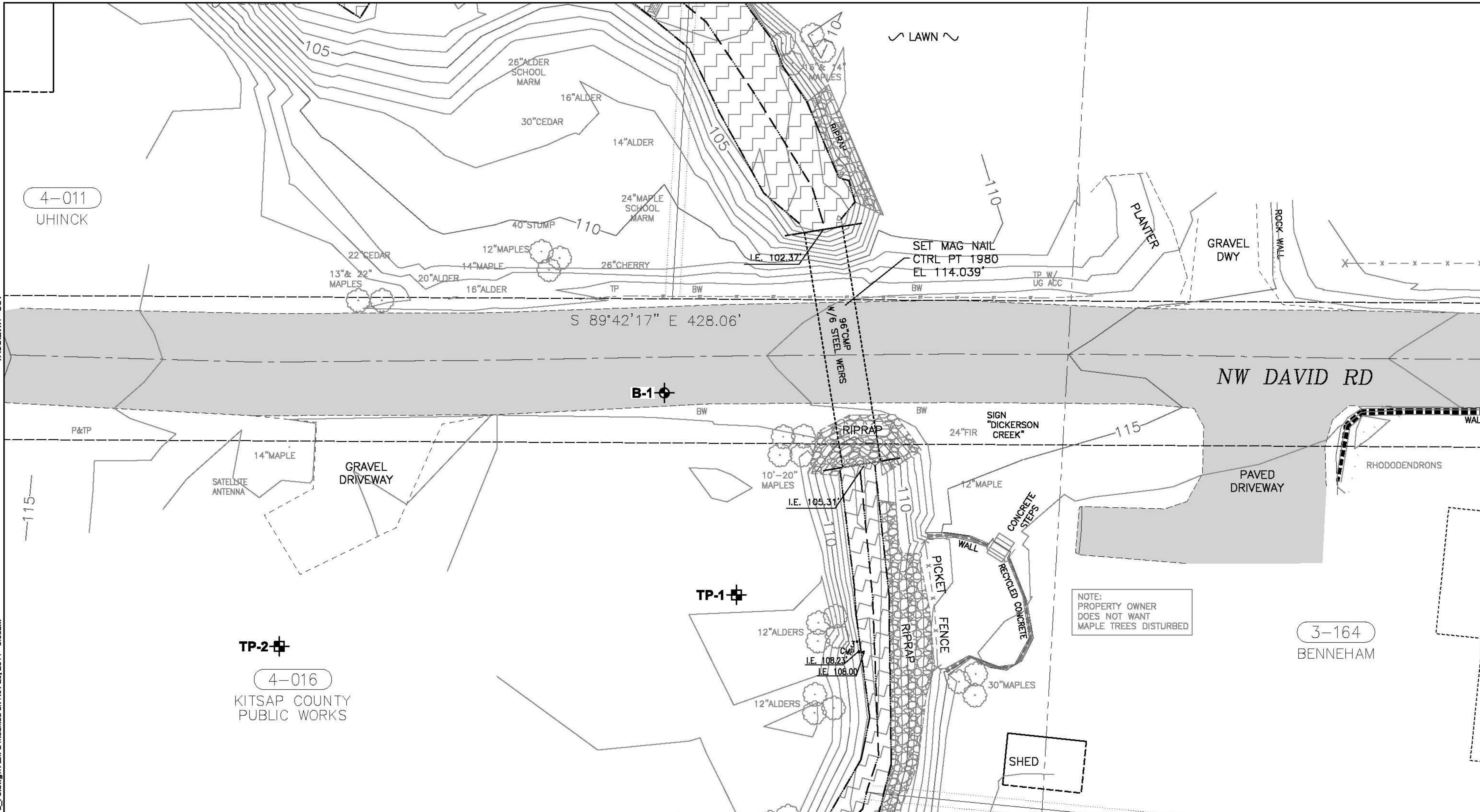
Figure 1

Office: TACO Path: P:\1\1598040\00\GIS\159804000_T200_F1.mxd Map Revised: 29 November 2011 syi



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Reference: Drawing provided by Kitsap County Department of Public Works; surveyed July, August, and December 2010; Mapped May 2011.

Legend

- B-1 Boring number and approximate location
- TP-1 Test pit number and approximate location
- Approximate extent of asphalt, concrete, and pavement

N, E, S, W

20 0 20
Feet

Site Plan - NW David RD

Dickerson Creek Culvert Replacements
Kitsap County, Washington

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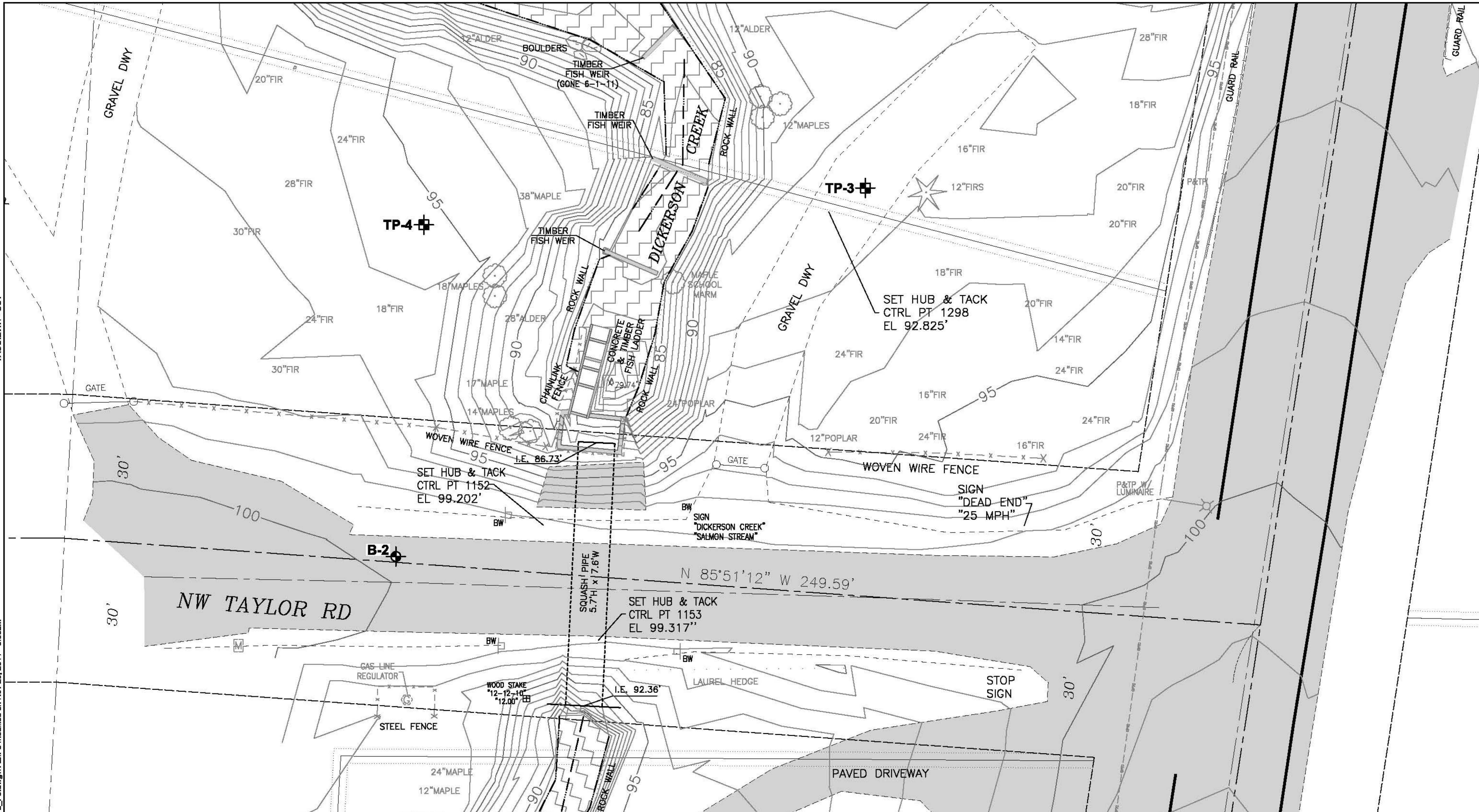
Figure 2



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Reference: Drawing provided by Kitsap County Department of Public Works; surveyed July, August, and December 2010; Mapped May 2011.

Legend

- B-2 Boring number and approximate location
- TP-3 Test pit number and approximate location
- Approximate extent of asphalt, concrete, and pavement

20 0 20
Feet

Site Plan - NW Taylor RD

Dickerson Creek Culvert Replacements
Kitsap County, Washington

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Figure 3

TACO:EWH : SCY

P:\11\159804000\CAD\159804000_T200_F2_F3.dwg\TAB:F3 modified on Nov 29, 2011 - 8:56am

APPENDIX A
Subsurface Explorations and Laboratory Testing

APPENDIX A
SUBSURFACE EXPLORATIONS AND LABORATORY TESTING

Subsurface Explorations

Subsurface conditions at the proposed culvert replacement locations were explored on July 20, 2011 by advancing two borings and excavating four test pits. The locations of explorations were determined by pacing from existing features such as edge of existing pavement and curbs. Locations of the explorations are provided on Figures 2 and 3 and should be considered approximate.

Borings

The borings were advanced by Holocene Drilling using a truck-mounted hollow-stem auger drill rig under subcontract to GeoEngineers. Borings B-1 and B-2 were advanced to depths between 51 feet and 51½ feet below ground surface (bgs). Soil samples were obtained from the borings using a 1.4-inch inside diameter split spoon sampler driven into the soil using a 140-pound hammer free falling a distance of 30 inches. The number of blows required to drive the sampler the last 12 inches or other indicated distance is recorded on the logs as the blow count.

Our representative continuously monitored the borings, maintained a log of the subsurface conditions, and made sample attempts at approximately 2.5- to 5-foot depth intervals. The soils encountered were visually classified in general accordance with the system described in Figure A-1, ASTM International (ASTM) D 2488. The boring logs are included as Figures A-2 and A-3.

Test Pits

The test pits were excavated by Kitsap County crews using a tracked excavator. Test pits were excavated to depths between 11 and 16 feet bgs. 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. The soils were classified visually in general accordance with the system described in Figure A-1. Summary logs of the explorations are included as Figures A-4 through A-7. The densities noted on the test pit exploration logs are based on the difficulty of excavation and our experience and judgment.

Streambed Samples

The streambed samples were collected by Northwest Hydraulic Consultants from Dickerson and Chico Creeks.

Laboratory Testing

General

Soil samples obtained from the borings were transported to GeoEngineers laboratory. Representative soil samples were selected for laboratory tests to confirm our field classification and aid in evaluating engineering 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 Test Method D 2216. The test results are used to aid in soil classification and correlation with other pertinent engineering soil properties. The test results are presented on the exploration logs.

Particle-Size Analyses (SA)

Particle-size sieve analyses were performed on selected samples in general accordance with ASTM Test Method D 422. 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. Figures A-8 and A-9 present the sieve test results.

Figures A-10 and A-11 present the sieve test results for the samples collected within the streambeds.

Atterberg Limit Testing (AL)

One Atterberg Limit Test was performed on a selected sample in general accordance with ASTM Test Method D 4318. This test method determines the liquid limit, plastic limit and plasticity index of soil particles passing the No. 40 sieve. The result of the test is used to assist in soil classification as well as engineering design. Figure A-12 presents the results of the Atterberg Limits Test.

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

Sonic Core

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

Drilled	Start: 7/20/2011	End: 7/20/2011	Total Depth (ft)	50.9	Logged By: HPD / Checked By: EWH	Driller: Holocene Drilling	Drilling Method: HSA

Surface Elevation (ft) / Vertical Datum	114.0	Hammer Data	Auto 140 (lbs) / 30 (in) Drop	Drilling Equipment	Truck-mounted Rig
Easting (X) / Northing (Y)		System Datum	NGVD 29	Groundwater	
Notes:					

Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
7/20/2011	6.2	107.8

Depth (feet)	Recovered (in)	Blows/foot	Sample Name / Testing	Water Level	Group Classification	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, (pcf)	REMARKS
0					AC	Asphalt concrete (2.5 inches thick)			
0.2					SM	Brown silty fine to medium sand with gravel and organics (fine roots, wood debris) (loose, moist) (fill)			
4					SM	Brown-orange silty fine to medium sand interbedded silt (loose, moist) (fill)			4 feet -Driller indicates easier drilling
5	13	5	2 / MC	▽ (6.2)			28		
9					GM	Brown silty fine to coarse gravel with sand (medium dense, wet)			9 feet-Driller indicates harder drilling
10	12	29	3 / SA				16		%F = 17%
15	3	46	4 / MC			Grades to dense	14		
18.5					ML	Grayish-brown silt with sand, occasional gravel (very stiff, wet)			
20	16	30	5 / MC				28		
25	18	44	6 / %F			Grades to without gravel, hard	30		%F = 74%
30	18	46	7 / MC				28		
35									

Elevation (feet): 110, 105, 100, 95, 90, 85, 80

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-1

GeoEngineers

Project: Dickerson Creek Culvert Replacements
Project Location: Kitsap County, Washington
Project Number: 1598-040-00

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, (pcf)	REMARKS
	35		0	50/5"		8							
75									CL	Dark gray clay with sand (hard, moist)			
	40		18	43		9 / AL					26		LL = 43, PI = 18
									SM/ML	Grayish-brown silty fine to medium sand interbedded silt (dense, wet)			
70									SM	Grayish-brown silty fine to medium sand (very dense, wet)			
	45		18	50/6"		10 / MC					23		
65													
	50		11	50/5"		11 / MC					23		

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-1 (continued)

GeoEngineers

Project: Dickerson Creek Culvert Replacements
Project Location: Kitsap County, Washington
Project Number: 1598-040-00

Drilled	Start 7/20/2011	End 7/20/2011	Total Depth (ft) 51.5	Logged By HPD / Checked By EWH	Driller Holocene Drilling	Drilling Method HSA

Surface Elevation (ft) / Vertical Datum	100.0	Hammer Data	Auto 140 (lbs) / 30 (in) Drop	Drilling Equipment	Truck-mounted Rig
Easting (X) / Northing (Y)		System Datum	NGVD 29	Groundwater	
Notes:				Date Measured: 7/20/2011	Depth to Water (ft): 15.0; Elevation (ft): 85.0

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, (pcf)	REMARKS
100	0								AC	Asphalt concrete (2.5 inches thick)			
									SM	Brown silty fine to medium sand with gravel (loose, moist) (fill)			
95	5		14	13		2 / %F			SM	Orange-brown silty fine to medium sand (medium dense, moist) (fill)	17		%F = 31%
90	10		15	21		3 / MC				Grades to with gravel	17		
85	15		11	42		4 / MC	▽		GM	Orange-brown silty fine to coarse gravel with sand (dense, wet)	9		
									SM	Orange-brown silty fine to medium sand (very dense, wet)			
80	20		14	62		5 / MC					23		
									GM	Orange-brown silty fine to coarse gravel with sand (very dense, wet)			
									SP-SM	Yellowish-brown fine to medium sand with silt and gravel (very dense, wet)			
75	25		18	67		6 / MC					20		
									SP-SM	Grayish-brown fine to medium sand with silt (very dense, wet)			
70	30		12	50/6"		7 / SA					23		%F = 8%
65	35												

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-2

GeoEngineers

Project: Dickerson Creek Culvert Replacements
Project Location: Kitsap County, Washington
Project Number: 1598-040-00

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, (pcf)	REMARKS
	35		12	74		8 / MC					21		
60	40		17	45		9 / MC				Grades to dense	23		
55	45		18	61		10 / MC				Grades to very dense	23		
50	50		17	50/5"		11 / MC					20		

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-2 (continued)

GEOENGINEERS

Project: Dickerson Creek Culvert Replacements
Project Location: Kitsap County, Washington
Project Number: 1598-040-00

Date Excavated: 7/20/2011

Equipment: Komatsu 160 Excavator

Logged By: EWH

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				SOD		2 inches sod		
112–110	0–3	2	1 / MC		SM		Brown and orange silty fine sand, trace organics, occasional debris (loose, moist) (fill)	12	
110–102	3–11	5	2 / MC		GP		Gray fine to coarse gravel with sand, trace silt (medium dense, moist)	6	
	7					∇	Grades to with cobbles		
	11	11	3 / MC					8	

Test pit completed at 11 feet.
Rapid groundwater seepage observed at 7 feet.
Severe caving observed from 3 to 11 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: Dickerson Creek Culvert Replacements
Project Location: Kitsap County, Washington
Project Number: 1598-040-00

Figure A-4
Sheet 1 of 1

Date Excavated:	7/20/2011	Logged By:	EWH
Equipment:	Komatsu 160 Excavator	Total Depth (ft)	13.0

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		
111–107	0.2–5.5				SM		Brown and red silty fine sand with debris (concrete rubble, PVC pipe, dimensional lumber, abandoned utilities) (loose, moist) (fill)		
109	2.7						Grades to with gravel		
107	5	X	1 MC					6	
106–101	5.5–11.5				SW-SM		Brown/red fine to coarse sand with silt and gravel interbedded with gravel (medium dense, moist)		
104	8	X	2 SA					12	%F = 9%
101	11					▽			
100–99	11.5–13				SM		Gray silty fine sand (medium dense, moist)		
100	12	X	3 %F					30	%F = 26%

Test pit completed at 13 feet.
Slow groundwater seepage observed at 11 feet.
Moderate caving observed from 5.5 to 11.5 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-2

GeoEngineers

Project: Dickerson Creek Culvert Replacements
Project Location: Kitsap County, Washington
Project Number: 1598-040-00

Date Excavated: 7/20/2011
Equipment: Komatsu 160 Excavator
Logged By: EWH
Total Depth (ft) 16.0

Elevation (feet)	Depth (feet)	Testing Sample	Sample Name / Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
92	0	X	1 MC		CR		Gray fine to coarse gravel with silt (crushed rock surfacing) (medium dense, moist)	5	
91	1				SP-SM		Gray fine sand with silt, occasional cobbles (medium dense, moist) (fill)		
89	3	X	2 MC					7	
88	4				GP-GM		Brown fine to coarse gravel with silt, sand and cobbles (dense, moist)		
86	6	X	3 SA					4	%F = 7%
83	9.5					▽			
81	11	X	4 MC					6	
80	12.5				SP		Brown fine to coarse sand with gravel, trace silt (very dense, wet)		
78	14	X	5 SA					10	%F = 2%
76	16								

Test pit completed at 16 feet.
Moderate groundwater seepage observed at 9.5 feet.
Minor caving observed from 4 to 16 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:11/29/11 Path:P:\1\1598040\GINT\159804000_LOGS.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_TESTPIT_1P_GEOTEC

Log of Test Pit TP-3

GEOENGINEERS

Project: Dickerson Creek Culvert Replacements
Project Location: Kitsap County, Washington
Project Number: 1598-040-00

Figure A-6
Sheet 1 of 1

Date Excavated: 7/20/2011 | Logged By: EWH

Equipment: Komatsu 160 Excavator | Total Depth (ft) 16.0

Elevation (feet)	Depth (feet)	Testing Sample	Sample Name / Testing	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content, %	REMARKS
95	0			TS		2 inches topsoil		
				SM		Reddish-brown silty fine sand, occasional gravel, trace organics (roots) (loose, moist) (fill)		
93	2	X	1 / MC				12	
92	3			GP-GM		Reddish-brown fine to coarse gravel with silt and sand (medium dense, moist)		
89	6.5	X	2 / %F				7	%F = 12%
85	10.5			GP		Gray fine to coarse gravel with sand, occasional cobbles, trace silt (loose, moist)		
83	12	X	3 / MC				5	
82	13				▽	Grades to wet		
80	16	X	4					

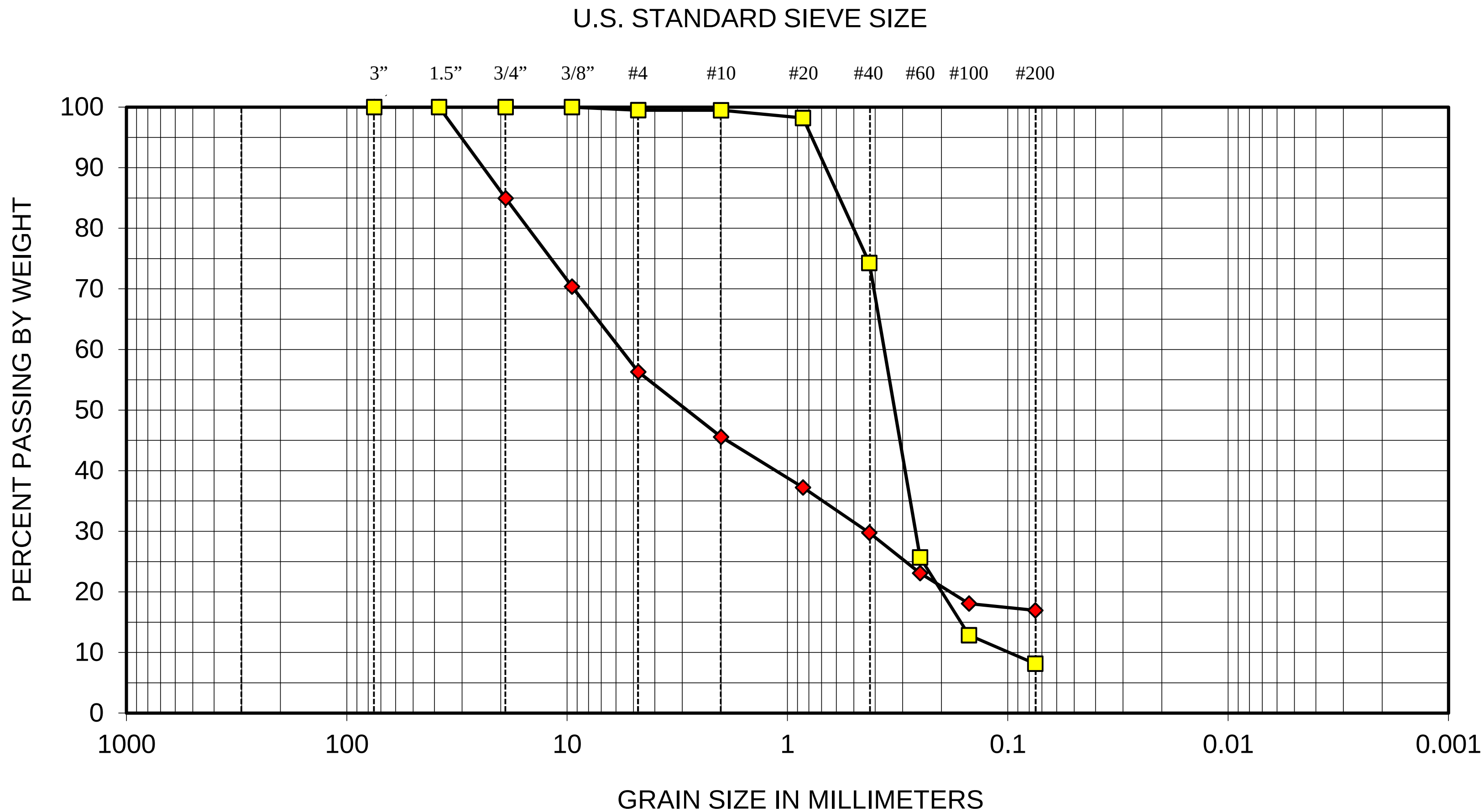
Test pit completed at 16 feet.
Rapid groundwater seepage observed at 13 feet.
Moderate caving observed from 3 to 13 feet.
Severe caving observed from 13 to 16 feet.

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: Dickerson Creek Culvert Replacements
Project Location: Kitsap County, Washington
Project Number: 1598-040-00



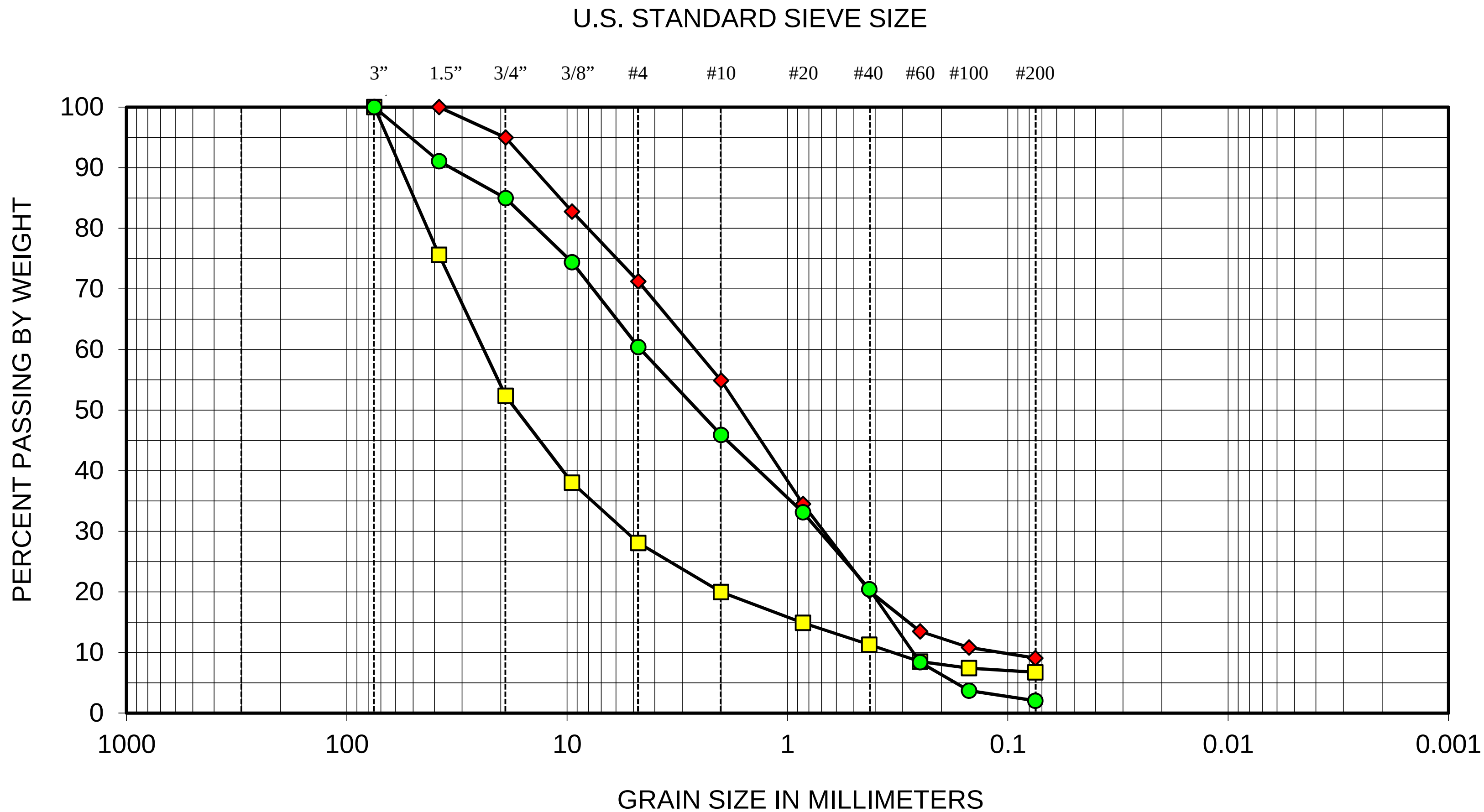
BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	MOISTURE CONTENT	SOIL CLASSIFICATION
◆ (red diamond)	B-1	11	16	Silty fine to coarse gravel with sand (GM)
■ (yellow square)	B-2	30	23	Fine to medium sand with silt (SP-SM)

SIEVE ANALYSIS RESULTS

FIGURE A-8

GEOENGINEERS



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	MOISTURE CONTENT	SOIL CLASSIFICATION
◆ (red diamond)	TP-2	8	12	Fine to coarse sand with silt and gravel (SW-SM)
■ (yellow square)	TP-3	6	4	Fine to coarse gravel with silt and sand (GP-GM)
● (green circle)	TP-3	14	10	Fine to coarse sand with gravel, trace silt (SP)

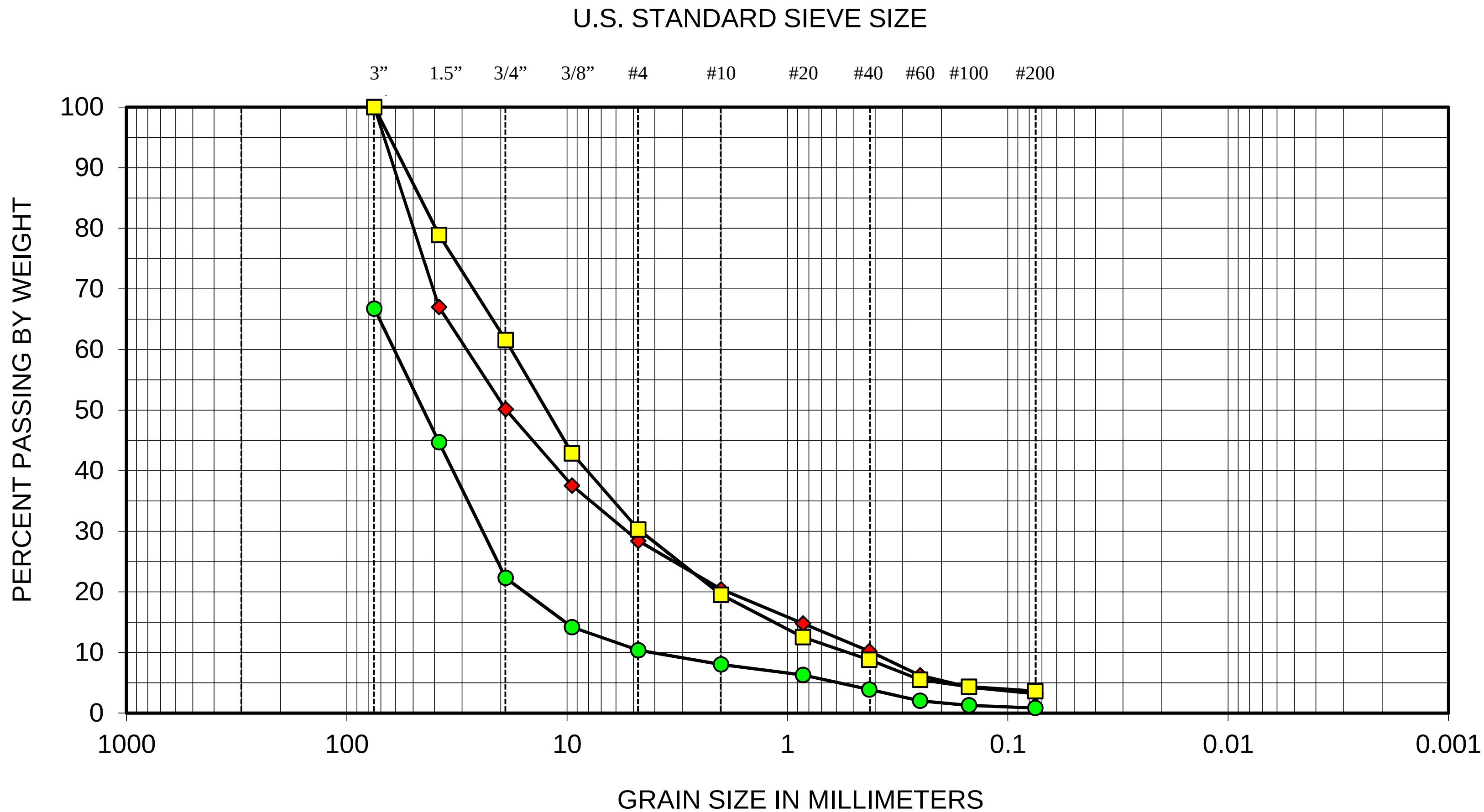
SIEVE ANALYSIS RESULTS

FIGURE A-9

GeoEngineers

SIEVE ANALYSIS RESULTS

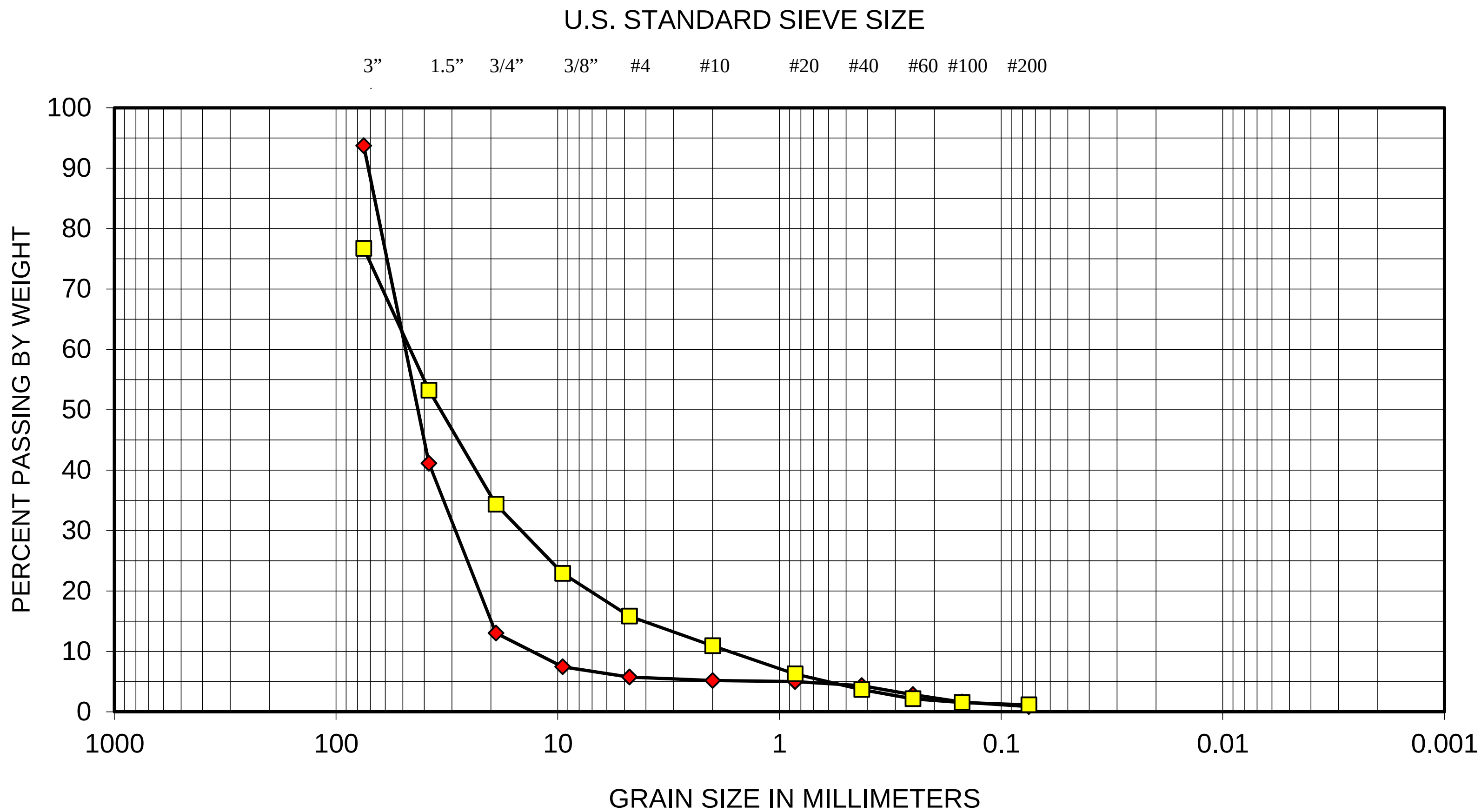
FIGURE A-10



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	SAMPLE	SOIL CLASSIFICATION
◆ (red diamond)	Site 1	Streambed	Well-graded gravel with sand (GW)
■ (yellow square)	Site 2	Streambed	Well-graded gravel with sand (GW)
● (green circle)	Site 3	Streambed	Well-graded gravel (GW)

GeoEngineers



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	SOIL CLASSIFICATION
◆ (red diamond)	Site 4	Streambed	Poorly graded gravel (GP)
■ (yellow square)	Chico 1	Streambed	Well graded gravel (GP)

SIEVE ANALYSIS RESULTS

FIGURE A-11

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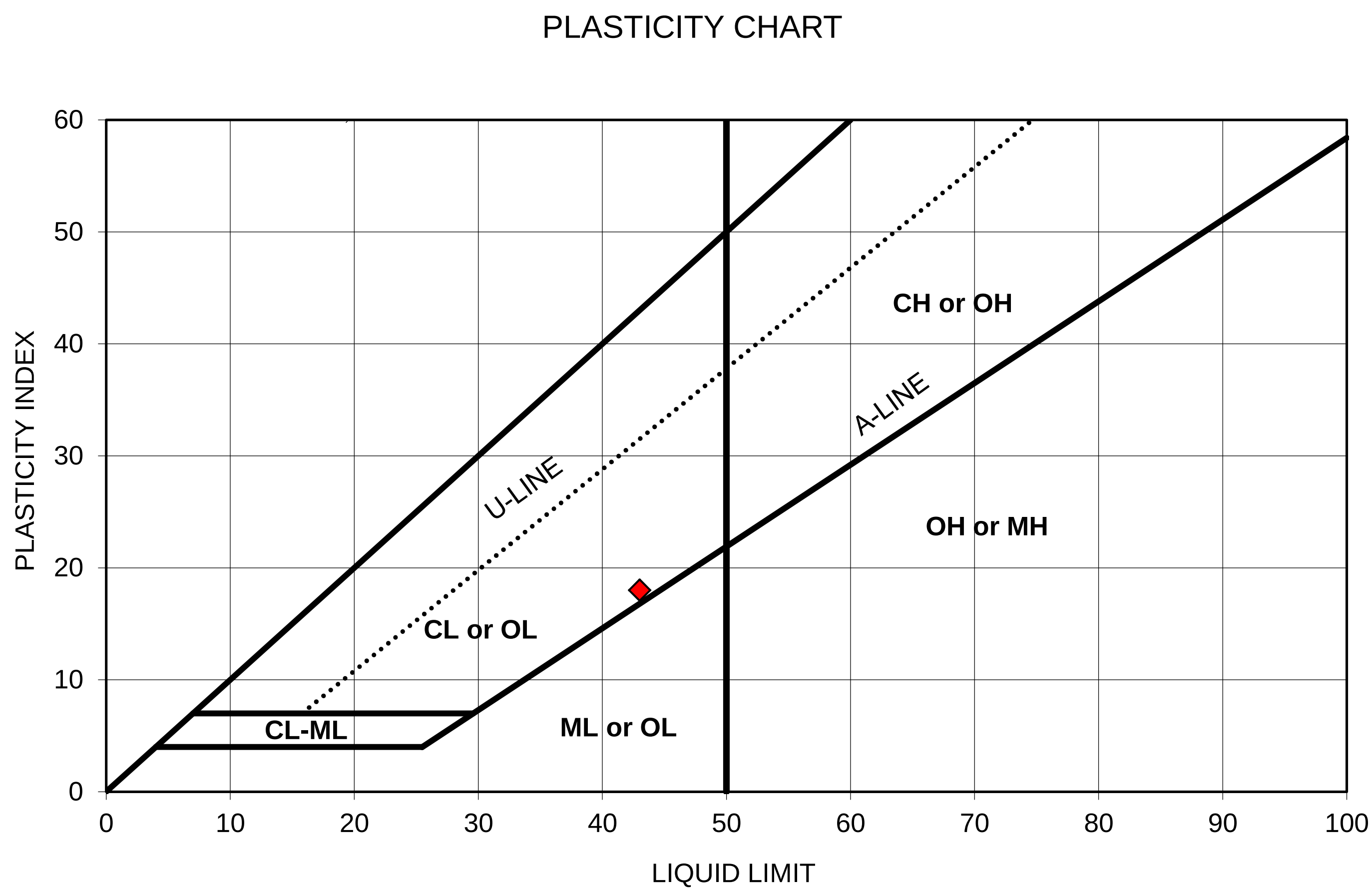
ATTERBERG LIMITS TEST RESULTS

FIGURE A-12



SYMBOL	EXPLORATION NUMBER	SAMPLE DEPTH (ft)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	SOIL DESCRIPTION
◆	B-1	40	26	43	18	Lean clay (CL)

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 Northwest Hydraulic Consultants and their authorized agents for the proposed Dickerson Creek Culvert Replacements project located on NW David Road and NW Taylor Road in Kitsap County, Washington. 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 and their authorized agents. 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 Proposed Dickerson Creek Culvert Replacements project located in Kitsap County, 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;

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

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

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.

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.