GEOTECHNICAL EVALUATION
VOIGHTS CREEK FISH HATCHERY
REHABILITATION PROJECT, PHASE 1
ORTING, WASHINGTON

NOVEMBER 17, 2008

FOR
MWH AMERICAS, INC.

GEOENGINEERS

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GEOTECHNICAL EVALUATION
VOIGHTS CREEK FISH HATCHERY REHABILITATION PROJECT, PHASE 1
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FOR
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INTRODUCTION

This report summarizes the results of our geotechnical engineering study for specific elements of the Voights Creek Fish Hatchery Rehabilitation project, Phase 1. The hatchery facility is located north and northeast of Voights Creek, southeast of Orting, Washington, as shown in Figure 1.

We understand that the hatchery facility was constructed in the early 1900s. The major existing features at the site include a hatchery building, two above-grade concrete raceway structures, two below-grade asphalt-lined rearing ponds, a fish ladder, a below-grade adult holding pond and a below-grade pollution abatement pond. The approximate locations of these existing features are shown in Figure 2.

We understand that design and construction of new features at the site will be completed in at least two phases. Features to be constructed as a part of Phase 1 include a new pollution abatement pond, new adult holding ponds, a new fish ladder structure and a new pump station structure. Features to be constructed as a part of Phase 2 include new rearing ponds. The proposed locations of these features are shown in Figure 3. Our understanding of the composition and proposed locations of these features is based on information provided by MWH Americas, Inc. (MWH).

Our services are provided in general accordance with our proposal dated July 21, 2008, as authorized on August 5, 2008. For this portion of the project, we are to provide geotechnical analyses and recommendations for features to be built at the site during Phase 1. These include the following:

- Pollution Abatement Pond
- Adult Holding Pond
- Concrete Fish Ladder
- Pump Station

We understand these features will typically be constructed using on-grade slabs with thickened edges and will not include separate strip footings or isolated column footings.

SCOPE OF SERVICES

The purpose of our services is to complete a geotechnical evaluation of specific elements of the Phase 1 development at the site. The scope of services completed for this portion of the project includes the following tasks:

1. Coordinate with MWH and Washington Department of Fish and Wildlife (WDFW) regarding advancing subsurface explorations at two general locations at the site.
2. Review available and published geological and hydrogeological reports/maps that include the site and site area.

3. Complete three drilled borings to depths of 14 to 34 feet below existing site grade. The borings were completed in the southeast part of the site near the proposed new adult holding pond, new fish ladder and new pump station structures.
4. Perform soil sampling at approximately 5-foot-depth intervals during drilling.
5. Evaluate and describe the soil encountered in general accordance with American Society for Testing and Materials (ASTM) D 2488.
6. Complete two test pit explorations to depths of about 12 feet each in the area of the proposed pollution abatement pond.
7. Complete laboratory testing of selected soil sample obtained from the test pits and borings. The laboratory testing included grain-size distribution, moisture content, proctor compaction tests, two pH and sulfate content tests and two soil resistivity tests.
8. Develop geotechnical recommendations for specific elements of the project based on the results of our subsurface explorations and review of preliminary design data provided by MWH. Specifically, we provide:
   - Recommendations for site preparation and earthwork, including clearing and stripping, temporary and permanent cut and fill slopes.
   - Evaluation of on-site soils for reuse as backfill and recommendations for imported fill materials, if appropriate.
   - Comments on construction considerations, including temporary excavation support and moisture sensitivity of on-site soils.
   - Recommendations regarding allowable bearing capacity and expected settlement for the new adult holding and pollution abatement pond foundations, including an evaluation of potential hydrostatic loading for lateral and uplift conditions.
   - Lateral soil pressures for the design of the pond walls.
   - A discussion of seismic design considerations and seismic design criteria consistent with the 2006 edition of the International Building Code (IBC). We also provide our opinion of the liquefaction potential of site soils.
   - Pipe bedding recommendations for the new yard pipelines.
   - 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.
   - A discussion regarding the feasibility of temporary dewatering at the site.

SITE CONDITIONS

GENERAL

The site is located in a valley floor area where the Carbon and Puyallup River valleys intersect. The valley floor is up to 1 mile wide in the site vicinity and is bordered to the south, north and southwest by upland terraces. The Carbon River is located north of the site and flows from the northeast to the southwest in this area. The Puyallup River is located west of the site and flows from the southeast to the northwest in the site area. Voights Creek flows in a westerly direction near the site and empties into the Carbon River about 2/5 of a mile to the northeast. The Voights Creek channel is relatively narrow at the

site location and drains a glacial upland terrace area to the south of the hatchery complex. We understand that the hatchery facility has been periodically inundated by flooding from Voights Creek.

SURFACE CONDITIONS

The ground surface within the hatchery complex ranges from about Elevation 220 to 230 feet above mean sea level (MSL), based on our review of a map with spot elevations, provided by MWH. It appears the existing topography at the site is a result of past earthwork and construction relating to the hatchery. Low-lying, water-filled areas are located in the east part of the site. These areas comprise the existing pollution abatement and existing adult holding ponds. We understand that these areas may have been a former channel of Voights Creek that was enlarged during a previous phase of hatchery construction.

The existing hatchery building and above-grade concrete raceway structures 1 and 2 (Figure 2) are located west of the existing pollution abatement pond and adult holding pond. The below-grade asphalt-lined existing rearing ponds are located in the west part of the site. An asphaltic-concrete paved parking area is located near the center of the site. This area is lower in elevation relative to the surrounding structures.

Features adjacent or within Voights Creek at the site include a fish ladder and fish trap. We understand that that an existing fish barrier is buried under gravel within the Voights Creek channel.

MAPPED GEOLOGIC CONDITIONS

Geologic conditions at the site were evaluated by reviewing the "Water Supply Bulletin Number 22, Ground Water Occurrence and Stratigraphy of Unconsolidated Deposits, Central Pierce County, Washington, 1968" prepared for the United States Geological Survey (USGS). Native geologic materials mapped at and near the site consist of Alluvium (map symbol Qa) and Electron Mudflow (map symbol Qem). The alluvial material can consist of gravel to clay-sized particles and was deposited by recent streams/rivers. The Electron Mudflow deposit is the result of a large slope failure on Mount Rainier and generally consists of boulder to gravel-sized particles in a fine-grained matrix. The mapped surface contact between these materials in the site area is located westerly of Voights Creek and generally parallels the creek channel.

SUBSURFACE EXPLORATION

Subsurface conditions at the site were evaluated by advancing two test pits on September 4, 2008 and three power borings on September 5, 2008 at the approximate locations shown in Figure 2. The test pits were advanced to depths of about 12 feet each. The borings were advanced to depths ranging from 14 to 34 feet. A detailed description of our subsurface exploration program is provided in Appendix A.

LABORATORY TESTING

The soil samples were brought to our laboratory for further examination and to check field classifications. Moisture content, grain-size distribution, percent fines determinations and compaction tests were performed on selected samples. We also completed corrosivity tests on two samples. The details and results of our laboratory testing program are presented in Appendix B.

SUBSURFACE CONDITIONS

Soil

Surficial soil encountered in test pits TP-1 and TP-2 consisted of about 3 to 12 inches of loose to medium dense silty sand topsoil. Fill, consisting of loose to medium dense silty sand or gravel with sand, was encountered to depths of about 4.5 to 5.5 feet in the test pits. We observed concrete debris and cobbles in the fill at the location of TP-1. Alluvial deposits were encountered beneath the fill to the full depth explored. The alluvial soils consisted of interbedded medium dense silty sand and sand with gravel, and an occasional layer of stiff sandy silt.

Fill material, consisting of medium dense to dense sand, sand with silt and gravel, silty gravel and silty sand was encountered in borings B-1 through B-3 to depths ranging between 3.5 and 8 feet. Alluvial soils, consisting of loose to medium dense silty sand, sand and/or gravel with varying silt content were encountered beneath the fill to depths ranging from about 13 to 17 feet in borings B-1 and B-2, and to the full depth explored in boring B-3.

Mudflow deposits, consisting of a loose to medium dense silty sand and sand with silt containing a variable amount of gravel, cobbles, occasional boulders and organic matter were encountered below the alluvium to the full depth explored in borings B-1 and B-2 (34 and 29 feet, respectively).

Groundwater

Groundwater was encountered during drilling/excavating at depths ranging from 3.5 to 5 feet in the borings and at a depth of about 9.5 feet in the test pits.

Groundwater levels observed in test pits and borings can be somewhat variable because it can take time for the groundwater seepage to reach equilibrium with the shallow groundwater table. Groundwater seepage often shows first in sandier lenses, which may be located below the localized water table level.

We anticipate that the groundwater levels at this site will fluctuate seasonally and with precipitation. They may rise near or above the ground surface during the wet winter months, particularly during flood events.

CONCLUSIONS AND RECOMMENDATIONS

GENERAL

Based on our findings, we conclude that the planned structures can be satisfactorily supported on shallow slab foundations. The surficial soils are susceptible to disturbance when wet, and the groundwater table is relatively shallow. To reduce grading and construction costs, we recommend that the earthwork and subsurface portions of construction be performed during dry weather. Even during dry weather, construction dewatering could be necessary for subsurface elements of the project due to the shallow water table.

The new adult holding pond, pump station and fish ladder are to be located in an area that presently consists of a water-filled swale that is used as the adult holding pond. We understand this area will be drained and partially filled with structural fill to achieve design grades for the new adult pond. We recommend that the swale area be dewatered and any soft soil and or organic deposits in the swale be removed after dewatering and prior to placement of structural fill.

Pertinent conclusions and recommendations regarding the design and construction of the proposed structures are presented in subsequent sections of this report.

SITE PREPARATION AND GRADING

General

We anticipate that the on-site soils can be excavated with conventional equipment provided that the work is completed during the relatively dry summer months. We recommend that all vegetation, asphalt concrete pavement and soft surficial soils be removed from the area of the proposed structures. Cobbles and boulders were not observed in the explorations; however, they may be encountered and the contractor should be prepared to remove them as necessary.

Subgrade Preparation

In subgrade areas or where structural fill is to be placed, the upper 12 inches of existing subgrade soil should be compacted and then evaluated prior to structural fill placement by either probing or proof-rolling with heavy, rubber-tired construction equipment. Probing should be used to evaluate the subgrades where proof-rolling is not possible or if site grading takes place during wet weather. Soft zones disclosed by proof-rolling or probing should be overexcavated to firm bearing and then backfilled with compacted structural fill.

Erosion and Sedimentation Control

Potential sources or causes of erosion and sedimentation depend upon construction methods, slope length and gradient, amount of soil exposed and/or disturbed, soil type, construction sequencing and weather. The site soils are erosion-sensitive. We recommend that a temporary erosion control plan be prepared in accordance with applicable city and/or county standards. The plan should incorporate basic planning principles, including:

- Scheduling grading and construction to reduce soil exposure;
- Retaining existing vegetation whenever feasible;
- Revegetating or mulching denuded areas;
- Directing runoff away from denuded areas;
- Minimizing the length and steepness of slopes with exposed soils;
- Decreasing runoff velocities;
- Confining sediment to the project site; and
- Inspecting and maintaining control measures frequently.

Until permanent erosion protection is established and the site is stabilized, site monitoring should be performed by qualified personnel to evaluate the effectiveness of the erosion control measures and 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.

STRUCTURAL FILL

General

All fill used to achieve design grades for the project should be placed as structural fill. Material used for structural fill should be free of organics, debris, trash and particles greater than 6 inches in diameter. Particle sizes larger than 3 inches should be excluded from the top 1 foot of fill. The moisture content of the fill material should be adjusted as necessary for proper compaction.

Our explorations typically disclosed loose to dense soil with variable silt content in the upper 14 to 15 feet of the site. The silt content of soil samples we tested varies from about 6 percent to 34 percent. The fill material encountered in test pit TP-1 also contains large pieces of concrete with reinforcing steel.

We recommend that the near-surface material encountered in our explorations be considered for use as structural fill only during extended periods of dry weather. If this material becomes wet, it will be necessary to reduce its moisture content before it can be adequately compacted. During wet weather, we recommend use of imported or on-site sand and gravel with less than 5 percent fines based on the fraction passing the 3/4-inch sieve.

We understand that relatively clean sand and gravel soils have been periodically excavated from the Voights Creek channel at the site. Some of this material is presently stockpiled on the west stream bank at the site. In our opinion, this material could be considered for use as structural fill at the site during wet or dry weather conditions.

Pipe Bedding

Backfill for the bedding and pipe zone should consist of well-graded granular material with a maximum particle size of 3/4-inch and less than 5 percent passing the U.S. Standard No. 200 sieve. The material should be free of roots, debris, organic matter and other deleterious material.

Trench Backfill

We recommend that all trench backfill consist of material of approximately the same quality as “gravel borrow” described in Section 9-03.14(1) of the Washington State Department of Transportation (WSDOT) Standard Specifications. Fill should be placed in horizontal lifts at the appropriate thickness for compaction. For compaction recommendations refer to the “Fill Placement and Compaction” section of this report.

FILL PLACEMENT AND COMPACTION

General

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 silty sand and silty gravel can be difficult or impossible to compact during persistent wet conditions.

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 compaction equipment used, but should generally not exceed 10 to 12 inches in loose thickness.

Area Fills and Bases

Structural fill placed to raise site grades and aggregate base materials under slabs and pavements should be placed on a prepared subgrade that consists of uniformly firm and unyielding inorganic native soils or compacted fill. We recommend that structural fill be compacted to at least 95 percent of the maximum dry density (MDD) determined by ASTM Test Method D 1557 (modified Proctor).

Trench Backfill

For utility excavations, we recommend that the initial lift of fill over the pipe bedding be thick enough to reduce the potential for damage during compaction but generally should not be greater than about 18 inches. In building areas, trench backfill should be uniformly compacted in horizontal lifts to at least 95 percent of the MDD (ASTM D 1557). Fill placed below a depth of 2 feet in pavement areas should be compacted to at least 90 percent of the MDD (ASTM D 1557). In nonstructural areas, trench backfill should be compacted to a firm condition that can support construction equipment. Suitable native soils or select granular soils should be acceptable in non-structural areas, in our opinion.

Weather Considerations

The silt and native soil contains a variable percentage of fines on site. The soils are moisture sensitive with respect to compaction and to construction traffic. Operation of equipment on these soils under wet conditions will be difficult. Disturbance of the near-surface soils should be expected if earthwork is completed during periods of wet weather.

The wet weather season generally begins in October and continues through May in the Puget Sound region; however, periods of wet weather can occur during any month of the year. The optimum earthwork period for these types of soils is typically June through September. If wet weather earthwork is unavoidable, we recommend that:

- Site stripping be accomplished using track-mounted equipment.
- Only limited areas be opened at any time and that structural fill be placed promptly after the areas are exposed and prepared.
- The ground surface in and around the work area be sloped so that surface water is directed away from the work area. The ground surface should be graded such 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.

Temporary Slopes

The soils encountered at the site are classified as Type C soil in accordance with the provisions of Title 296-155 Washington Administrative Code (WAC), Part N, "Excavation, Trenching, and Shoring." We recommend that temporary slopes in excess of 4 feet in height be inclined no steeper than 1-1/2H:1V (horizontal:vertical). Flatter slopes may be necessary if localized sloughing occurs or if seepage is present. For open cuts at the site we recommend that:

- Construction traffic, equipment, stockpiles or building supplies not be allowed within a distance of 5 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 kept as short as possible.
- Erosion control measures be implemented as appropriate such that runoff from the site is reduced to the extent practical.
- Surface water is diverted away from the excavation.
- The general condition of the slopes be observed periodically by a geotechnical engineer to confirm adequate stability.

Because the contractor has control of the construction operations, the contractor should be made responsible for the stability of cut slopes, as well as the safety of the excavations. All shoring and temporary slopes must conform to applicable local, state and federal safety regulations.

Permanent Slopes

We recommend that permanent cut and fill slopes if required for the project, be constructed no steeper than 2H:1V.

DEWATERING

Construction Dewatering

Although the groundwater table should be lower during the summer months, constructing the subsurface structures could require dewatering regardless of when the construction occurs. The existing water-filled swale feature will need to be drained and dewatered before site preparation and fill placement begins in this portion of the site.

The effort required to dewater the temporary excavations should be less if construction occurs during the summer and early fall months. We recommend that the groundwater table be lowered to and maintained at least 2 feet below the planned bottom of the excavations during construction. We recommend that the temporary dewatering system consist of wells or well points. The contractor selected for the construction of the subsurface structures should be responsible for design and installation of the temporary dewatering system.

Permanent Dewatering

Groundwater was encountered at depths ranging from 3.5 to 5 feet in the borings and at about 9.5 feet in the test pits. Our explorations were completed in early September, when groundwater levels are typically relatively low. We understand that the bottom of the pollution abatement pond slab will be about 2 feet below the existing ground surface (bgs) and that the bottom of the deepest part of the adult holding pond slab will be about 5 feet bgs. In addition, the water filled swale that comprises the existing adult holding pond will be partially filled to construct the new adult holding pond.

We expect that the groundwater table will rise during the winter months above what was encountered in our explorations. Groundwater should not be a concern when the ponds are full of water; however, when the ponds are empty, there could be significant hydrostatic uplift force on the pond bottom slabs. We

understand that the ponds must be emptied periodically for cleaning and maintenance. If possible, that the cleaning should be performed with the ponds filled with water in the same fashion that swimming pools are cleaned. If this is not possible, the ponds must either be designed to resist uplift, or the groundwater table must be lowered adjacent to the ponds before they are emptied.

An active dewatering system such as wells or well points could be installed to temporarily lower the groundwater table around the ponds when the ponds are to be drained. We recommend that monitor wells be installed adjacent to the ponds so that water levels may be measured at the time the ponds are drained.

SEISMIC CONSIDERATIONS

General

Seismic hazard areas are those areas subject to severe risk of earthquake damage as a result of seismically induced settlement or liquefaction. Criteria associated with seismically induced settlement include presence of cohesionless soils of low relative density with a high water table.

The Puget Lowland area is a seismically active region that has experienced many earthquakes in historical time. Seismic hazards represent risk of injury or damage to humans and property resulting directly from earthquakes. Seismic hazard mechanisms include surface fault rupture, ground shaking and associated ground failure such as liquefaction and landsliding.

Seismic Design Criteria

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 D in accordance with the 2006 IBC. Seismic design for the building area may be performed using the equivalent static force procedure outlined in the 2006 IBC using the parameters provided in Table 1, below.

Table 1. Seismic Design Parameters 2006 IBC

2006 IBC Parameter	Recommended Value
Spectral Response Acceleration at Short Periods (S_{mS})	1.199g
Spectral Response Acceleration at 1 Second Periods (S_{m1})	0.629g
Site Class	D
Site Coefficient (F_A)	1.038
Site Coefficient (F_V)	1.628

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. We encountered potentially liquefiable soils in the borings completed at the site.

The structures on the site also have the potential to be impacted by earthquake-induced settlement resulting from liquefaction. We identified a layer of potentially liquefiable loose silty sand based on empirical correlations between anticipated peak ground accelerations (PGA) and soil relative density. We

estimate liquefaction during an earthquake with a PGA of 0.33g and a magnitude of 7.0 could result in settlement at ground surface on the order of 4 to 6 inches. Because of the unpredictable nature of earthquakes and variability of soil conditions, differential settlement under earthquake conditions could be similar to the total settlement.

FOUNDATION SUPPORT

General

We understand that the proposed features to be constructed during Phase 1 (pollution abatement pond, adult holding pond, fish ladder and pump station) will be comprised of reinforced concrete with a slab-on-grade.

Preliminary design drawings for the fish ladder, pump station and pollution abatement pond were not available at the time of this report. Preliminary drawings for the adult holding ponds were available and were reviewed prior to completion of this report.

We understand that the pollution abatement pond will be a slab-on-grade structure, about 40 feet wide and 120 feet long, embedded about 2 feet below existing grade. The adult holding pond will be about 160 feet long, about 60 feet wide and range in depth from about 8 feet to less than 1 foot bgs. The bottom of the north part of the pond is planned to slope downward to the south at about 9.6 percent. This area is about 21 feet long, from north to south. The remaining pond bottom (about 95 feet) is to have a very slight downward slope from north to south.

We understand that earthwork to establish the adult holding pond subgrade will consist of partially filling the existing adult holding pond area and excavating up to 5 feet of on-site soil on either side of the south end of the existing pond.

Slab-on-Grade Subgrade Preparation

Subgrades should be thoroughly compacted to a dense, non-yielding condition. Loose or disturbed materials present at the base of the excavations should be removed or compacted. 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 to provide recommendations for removal of unsuitable bearing soil. Unsuitable foundation subgrade soils should be recompacted or removed and replaced with compacted structural fill as recommended by the geotechnical engineer.

Slab Support

We understand that you anticipate slab loads ranging from 400 pounds per square foot (psf) (pollution abatement pond) to 600 psf (adult holding ponds). We recommend that slabs-on-grade for the proposed structures be underlain by at least 1 foot of compacted structural fill because of the anticipated loads.

A modulus of subgrade reaction of 300 pounds per cubic inch (pci) can be used for designing building or pond slabs, provided that the subgrade consists of at least 1 foot of compacted structural fill and has been prepared in accordance with the recommendations presented in the “Site Preparation and Earthwork”

section of this report. Settlements for the floor slab designed and constructed as recommended are estimated to be less than 3/4 inch for the anticipated loads. We estimate that differential settlement of the floor slabs will be 1/2 inch or less over a span of 50 feet, provided that the fill below the slab is compacted as recommended.

Lateral Pressure

The lateral soil pressures acting on the pond walls depend on the nature and density 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 at least one-thousandth of the height of the wall, active lateral soil pressure will develop. If the wall is braced or otherwise restricted from yielding, at-rest lateral pressures will develop. If the walls are backfilled and drained as described in the following paragraphs, the design active or at-rest lateral pressures may be estimated using equivalent fluid densities of 35 and 50 pounds per cubic foot (pcf), respectively. Backfill in the zone behind the wall for a distance equal to the height of the wall should consist of clean (less than 5 percent fines) medium to coarse sand and gravel. This zone should be compacted to about 92 percent of MDD as determined by the ASTM D 1557 test method. Over-compaction should be avoided.

The above-recommended lateral soil pressures do not include the effects of surcharges such as floor loads, traffic loads or other surface loading. The effective wall height used to calculate lateral pressures should be increased by 1 foot for each 100 psf of surcharge load.

If the walls are not drained as described above, they will have to be designed to withstand hydrostatic pressure for the full heights of the wall. For undrained conditions, we recommend equivalent fluid densities of 85 pcf and 95 pcf for the active and at-rest conditions, respectively.

Lateral Resistance

The ability of the soil to resist lateral loads is a function of frictional resistance, which can develop on the base of slabs, and 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 slabs founded in accordance with the recommendations presented above, the allowable frictional resistance may be computed using a coefficient of friction of 0.4 applied to vertical dead-load forces. The allowable passive resistance on the face of slab, walls, 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 structural element throughout the year. The top 1 foot of soil should be ignored when calculating passive lateral earth pressures, unless the foundation area is covered with pavement or a slab-on-grade. The lateral resistance values include a factor of safety of approximately 1.5.

Uplift

Based on our current project understanding, we anticipate that the bottom of the proposed pollution abatement pond should be above groundwater for most of the year. We also expect that the groundwater table will rise during the winter months in response to precipitation and surface water levels within

Voights Creek, the Puyallup and Carbon Rivers. The pond could be designed to resist potential hydrostatic uplift forces either by anchoring the pond into the underlying fill, or by providing sufficient concrete mass to overcome the buoyant forces. Uplift can also be addressed by installing permanent dewatering system to keep groundwater levels temporarily below the bottom elevation of the pond structures.

SOIL CORROSIVITY

We submitted representative soil samples from borings B-1 and B-3 and from test pit TP-2 for laboratory soil resistivity, pH and soluble sulfate testing. Test results indicate soil resistivity at the natural moisture content ranges from about 200 to 1,500 ohm-centimeters. Soil pH ranges from 6.04 to 6.4. Soluble sulfates range from 7.2 to 208 milligrams per liter (mg/L). We judge the results are generally representative of soil of this type and moisture condition. Based on the test results it is our further conclusion that site soil is unlikely to be reactive with Portland cement concrete and has a low corrosion potential for underground piping and tanks. In our opinion, there is a low risk of the presence of expansive soils at the site. The laboratory test results are included in Appendix B.

PAVEMENT RECOMMENDATIONS

We recommend that the pavement subgrade be prepared in accordance with the recommendations in the "Site Preparation" and "Structural Fill" sections. We recommend that the pavement section in automobile parking areas consist of at least 2-1/2 inches of not mix asphalt (HMA), Class 1/2 inch, PG 58-22 and 4 inches of crushed surfacing. In driveway and truck loading areas, the minimum thickness should be 3-1/2 inches of asphalt concrete over 6 inches of crushed surfacing. The crushed surfacing should be compacted to at least 95 percent of the maximum dry density obtained in general accordance with the ASTM D 1557 test procedure.

We recommend placement of asphalt treated base (ATB) if construction equipment will use the pavement areas in wet weather conditions. The ATB layer might be damaged under heavy construction traffic and will likely need repair and/or replacement before placing the surface course. If ATB is used, we recommend that the pavement section in automobile parking areas consist of at least 1-1/2 inches of asphalt concrete, 3 inches of ATB and 3 inches of crushed surfacing. In roadway and truck loading areas, the pavement section should consist of 2-1/2 inches of asphalt concrete, 4 inches of ATB and 3 inches of crushed surfacing. The crushed surfacing layer may be eliminated when the ATB section is used, provided that there is at least 12 inches of structural fill consisting of sand and gravel with less than 5 percent fines.

We recommend that the ATB be evaluated by proof-rolling prior to placing the pavement surface course. Yielding areas observed during proof rolling should be removed and the subgrade repaired as recommended above in the "Site Preparation" section.

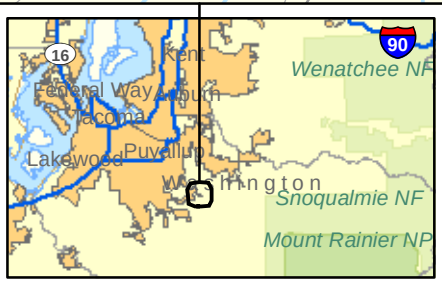
The asphaltic concrete surfacing material should be PG 58-22 placed and compacted in general accordance with Sections 5-04, 9-02 and applicable sections of 9-03 of the 2006 WSDOT Standard Specifications. The crushed surfacing should conform to Section 9-03.9(3) of the 2006 WSDOT Standard Specifications.

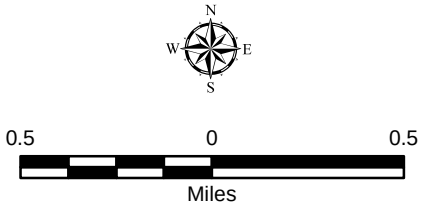
LIMITATIONS

We have prepared this report for use by MWH Americas, Inc. and understand the information may be submitted to regulatory agencies. The interpretations made in this report should not be construed as a warranty of subsurface conditions. Actual subsurface conditions may vary with location and time.

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

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





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

Voights Creek Hatchery - Phase 1
Pierce County, Washington

GEOENGINEERS

Figure 1

Map Revised: 10/3/08, DBC

Path: \\tac\Projects\3\3730099\GIS\3730099\02_F1_VicinityMap.mxd

Legend

B-1 Boring number and approximate location

TP-1 Test Pit number and approximate location

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.

Reference: Drawing provided by Washington State Department of Fish and Wildlife.

Site Plan, Existing Conditions

Voights Creek Hatchery Project
Orting, Washington

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Figure 2

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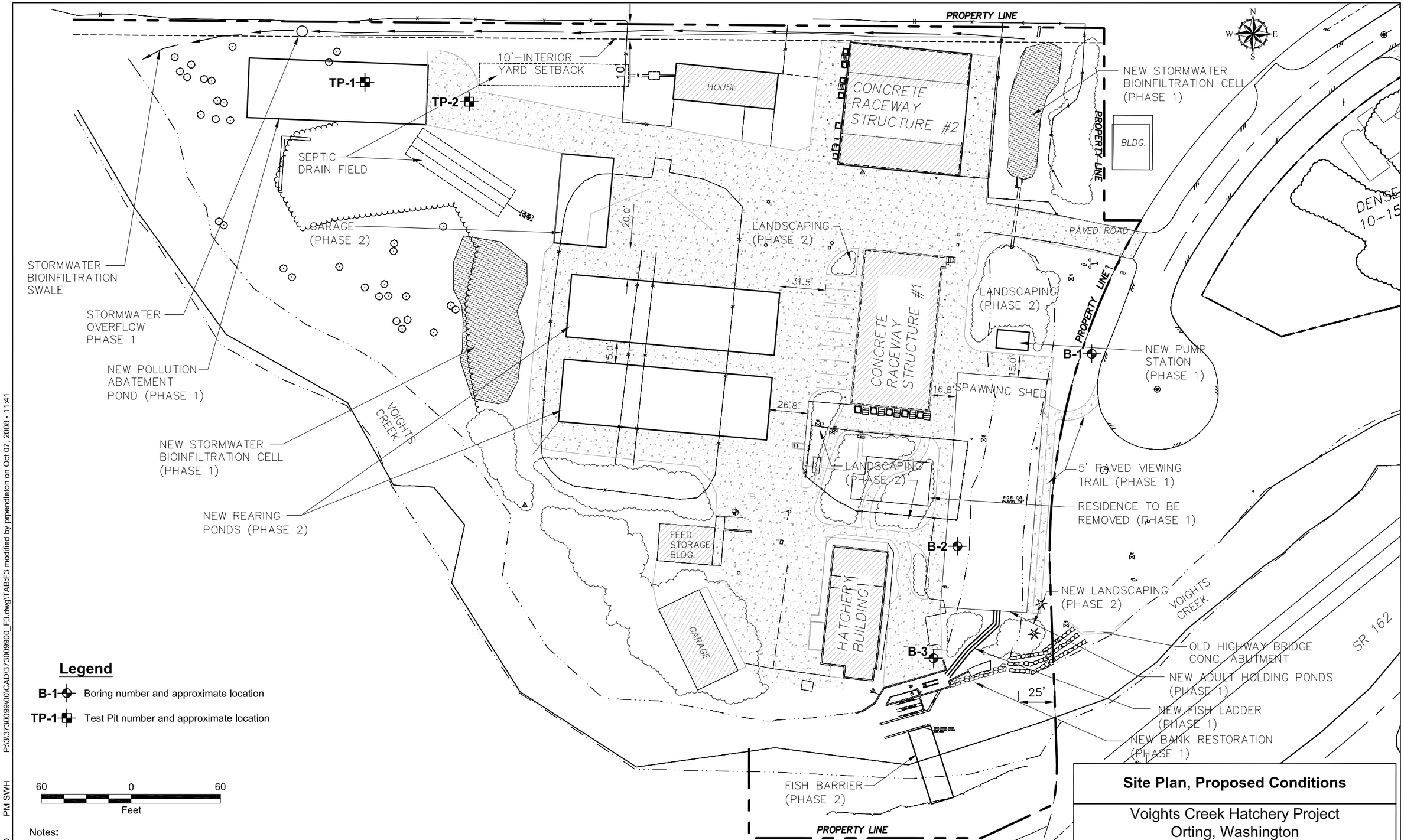

Legend

B-1 Boring number and approximate location

TP-1 Test Pit number and approximate location

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.

Reference: Drawing provided by Washington State Department of Fish and Wildlife.

Site Plan, Proposed Conditions

Voights Creek Hatchery Project
Orting, Washington

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Figure 3

OFFICE:TACO PM SWH P:\3\3730099\00\CAD\373009900_F3.dwg\TAB:F3 modified by prpendleton on Oct 07, 2008 - 11:41

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Appendix A
Field Explorations

APPENDIX A
FIELD EXPLORATIONS

Subsurface conditions at specific locations of the site were explored by advancing two test pits and three borings on September 4 and 5, 2008, respectively. Subsurface exploration locations are shown on Figures 2 and 3. The exploration locations were established in the field using a hand-held GPS device. The locations should be considered accurate to the degree implied by the method used. The approximate ground surface elevations are shown on the exploration logs. Elevations at the exploration locations were estimated by interpolating between topographic contours on Figures 2 and 3.

Test pits were completed using rubber-tired equipment owned and operated by Homestead Excavating. The borings were completed using trailer-mounted, hollow-stem auger equipment owned and operated by Geologic Drill. The borings and test pits were advanced under the full-time observation of a representative from GeoEngineers.

Samples were collected from the test pits at various depths from the backhoe bucket. The samples were placed in plastic bags. Soil samples were obtained from the borings using either a 1.4-inch inside-diameter or 2.3-inch inside-diameter split-spoon samplers. The samplers were driven into the soil a total of 18 inches using a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler the last 12 inches, or other indicated distances, is recorded on the boring logs.

The test pits and borings were logged by a geologist from our firm who identified the exploration locations, classified the soils encountered, obtained representative soil samples and maintained a detailed log of each exploration. The soils observed in the explorations were visually classified in the field in general accordance with the Unified Soil Classification System (USCS), ASTM D 2488, and the system described on Figure A-1. Representative soil samples were obtained from the explorations, logged, placed in durable containers or plastic bags and transported to our laboratory in Tacoma, Washington. The field classifications were checked in our laboratory.

Summary boring and test pit exploration logs are presented on Figures A-2 through A-6. A key to the symbols and terms used on the logs are included on Figure A-1. These logs are based on our interpretation of the field and laboratory data and indicate the various types of soils encountered. They also indicate the approximate depths at which the soils or their characteristics change, although the change may actually be gradual. If a change occurred between samples in the explorations, it was interpreted.

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, SAND-GRAVEL MIXTURES
				SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES
		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

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FIGURE A-1

Date Excavated: 09/04/08

Logged by: TSD

Equipment: Case Extendahoe

Surface Elevation (ft): 226

Elevation feet	Depth feet	Sample	Sample Number	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	OTHER TESTS AND NOTES
	0				TS	Topsoil, dark brown silty sand (loose, moist)		
225		☒	1		SM	Light brown silty sand with gravel, cobbles and debris (large concrete pieces with rebar) (medium dense, moist) (fill)		
	5	☒	2		SM	Gray/brown silty sand with gravel, wood (medium dense, moist) (alluvium)	5	SA; %F=17
220		☒	3					
	10				SP	Gray fine to coarse sand with gravel and occasional cobbles (medium dense, wet) (alluvium)		
215		☒	4					
						Test pit completed at 12 feet on 09/04/08 Rapid groundwater seepage observed at 9.5 feet Moderate caving observed at 9 feet		
	15							
210								
	20							
205								
	25							

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: Voights Creek Hatchery
Project Location: Orting, Washington
Project Number: 3730-099-00, Task 0000

Figure A-2
Sheet 1 of 1

V6_GTTPIT P:\3\3730099\00\FINALS\373009900.GPJ GEIV6_1.GDT 10/7/08

Date Excavated: 09/04/08 Logged by: TSD

Equipment: Case Extendahoe Surface Elevation (ft): 226

Elevation feet	Depth feet	Sample	Sample Number	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	OTHER TESTS AND NOTES
	0				TS	Topsoil, brown silty sand with gravel, organics and roots (medium dense, moist)		
225		☒	1		GW-GM	Light brown fine to coarse gravel with silt and sand (loose, moist) (fill)	6	SA; Proctor; %F=7
	5				SP	Gray/brown fine to medium sand with trace silt and occasional wood/roots (medium dense, moist) (alluvium)		
220		☒	2		ML	Gray sandy silt (stiff, moist) (alluvium)		
		☒	3		SP	Gray fine to medium sand with trace silt, occasional gravel (medium dense, moist) (alluvium)		
		▼			SP	Gray fine to coarse sand with gravel and cobbles (medium dense, wet) (alluvium)		
	10							
215								
						Test pit completed at 12 feet on 09/04/08 Rapid groundwater seepage observed at 9.5 feet Heavy caving observed at 8 feet		
	15							
210								
	20							
205								
	25							

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: Voights Creek Hatchery
Project Location: Orting, Washington
Project Number: 3730-099-00, Task 0000

Figure A-3
Sheet 1 of 1

V6_GTTPIT P:\3\3730099\00\FINALS\373009900.GPJ GEIV6_1.GDT 10/7/08

Date(s) Drilled	09/05/08	Logged By	TSD	Checked By	SWH
Drilling Contractor	Geologic Drill	Drilling Method	Hollow Stem Auger	Sampling Methods	Spilt Spoon & California Sampler
Auger Data	4 inch	Hammer Data	140 lb hammer/30 in drop	Drilling Equipment	Deep Rock XL Trailer Rig
Total Depth (ft)	34	Surface Elevation (ft)	226	Groundwater Elevation (ft)	221
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Elevation feet	Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
225	0							SP-SM	Light brown fine to medium sand with silt and gravel (dense, moist) (fill)			
								SM	Dark brown silty fine sand (medium dense, moist) (fill)			
			0	7	1					21		SA; %F=34
220	5							SP	Gray/brown fine to medium sand with occasional gravel (dense, wet) (alluvium)			
			18	59	2			GP	Gray/brown fine to coarse gravel with fine to coarse sand (dense, wet) (alluvium			
215	10							SP	Gray/brown fine to medium sand with occasional gravel (dense, less wet) (alluvium)			
			6	59	3							
210	15							SM	Gray/brown silty sand (loose to medium dense, moist) (mudflow)			
			6	16	4					22		%F=30%
205	20											
			10	6	5							SA; %F=30
200	25							SM	Gray silty fine to coarse sand with occasional gravel (loose, moist to wet) (mudflow)			
			18	6	6							
195	30							SM	Gray silty fine to coarse sand with gravel (medium dense, moist) (mudflow)			
			12	12	7							
	35											

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

LOG OF BORING B-1

GEOENGINEERS

Project: Voights Creek Hatchery
Project Location: Orting, Washington
Project Number: 3730-099-00, Task 0000

Figure A-4
Sheet 1 of 1

V6_GTBORING P:\3\373009900\FINALS\373009900.GPJ GEIV6_1.GDT 10/7/08

Date(s) Drilled	09/05/08	Logged By	TSD	Checked By	SWH
Drilling Contractor	Geologic Drill	Drilling Method	Hollow Stem Auger	Sampling Methods	Spilt Spoon & California Sampler
Auger Data	4 inch	Hammer Data		Drilling Equipment	Deep Rock XL Trailer Rig
Total Depth (ft)	29	Surface Elevation (ft)	224	Groundwater Elevation (ft)	219.5
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Elevation feet	Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
0								SP-SM	Light brown fine to coarse sand with silt and gravel (medium dense, moist) (fill)			
								SM	Dark brown silty fine to coarse sand with gravel (medium dense, moist) (fill)			
			0	7	1							
220			12	5	2	▼		SP-SM	Dark brown fine sand with silt (loose, wet) (alluvium)			
	5											
								SP-SM	Gray sand with silt (dense, wet) (alluvium)			
			18	50/6"	3					26		SA; %F=6
215												
	10											
								SP	Gray/brown fine to medium sand (medium dense, wet) (alluvium)			
			18	16	4			SM	Gray fine to coarse silty sand (dense, wet) (mudflow)	25		SA; %F=18
210												
	15											
								SM	Gray silty sand (loose, wet) (mudflow)			
			12	8	5							
205												
	20											
			0	8	6							
200												
	25							SP-SM	Gray fine to coarse sand with silt and gravel (medium dense, wet) (mudflow)			
			12	17	7							
195												
	30											
190												
	35											

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

LOG OF BORING B-2

GEOENGINEERS

Project: Voights Creek Hatchery
Project Location: Orting, Washington
Project Number: 3730-099-00, Task 0000

Figure A-5
Sheet 1 of 1

V6_GTBORING P:\3\3730099\00\FINALS\373009900.GPJ GEIV6_1.GDT 10/7/08

Date(s) Drilled	09/05/08	Logged By	TSD	Checked By	SWH
Drilling Contractor	Geologic Drill	Drilling Method	Hollow Stem Auger	Sampling Methods	Spilt Spoon & California Sampler
Auger Data	4 inch	Hammer Data		Drilling Equipment	Deep Rock XL Trailer Rig
Total Depth (ft)	14	Surface Elevation (ft)	223	Groundwater Elevation (ft)	219.5
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Elevation feet	Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	0		6	11	1			AC	2 inches asphalt concrete			
								GM	Brown silty gravel with sand (medium dense, moist) (fill)			
220			10	50/6"	2	▼						
	5		12	23	3					28		%F=28
215								SP	Gray fine to coarse sand with occasional gravel and silt (dense, wet) (alluvium)			
	10		5	50/3"	4							
								GP	Gray/brown fine gravel with occasional sand and silt (medium dense, moist) (alluvium)			
210			12	24	5							
	15											
205												
	20											
200												
	25											
195												
	30											
190												
	35											

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

LOG OF BORING B-3

GEOENGINEERS

Project: Voights Creek Hatchery
Project Location: Orting, Washington
Project Number: 3730-099-00, Task 0000

Figure A-6
Sheet 1 of 1

V6_GTBORING P:\3\3730099\00\FINALS\373009900.GPJ GEIV6_1.GDT 10/7/08

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Appendix B
Laboratory Testing

APPENDIX B
LABORATORY TESTING

GENERAL

Soil samples obtained from the borings and test pits were transported to our laboratory and examined to confirm or modify field classifications, as well as to evaluate engineering and index properties of the soil samples. Representative samples were selected for laboratory testing including moisture content, grain-size distribution, compaction tests and corrosivity assessment tests. The tests were performed in general accordance with test methods of the American Society for Testing and Materials (ASTM) or other applicable procedures.

SOIL CLASSIFICATIONS

Soil samples obtained from the explorations were visually classified in the field and/or in our laboratory using a system based on the Unified Soil Classification System (USCS) and ASTM classification methods. The soil samples were visually classified in general accordance with ASTM test method D 2488, and the general methodology of ASTM D 2487 was used to classify the soils based on laboratory tests results. These classification procedures are incorporated in the explorations logs shown in Figures A-2 through A-6 in Appendix A.

MOISTURE CONTENT TESTING

Moisture content tests were completed in general accordance with ASTM D 2216 for representative samples obtained from the explorations. The results of these tests are presented on the boring and test pit logs in Appendix A at the depths at which the samples were obtained.

COMPACTION TESTING

One compaction test (modified Proctor per ASTM D 1557) was completed on a sample of material from test pit TP-2 at a depth of 1 to 4 feet. The results of the compaction test are presented in Figure B-1.

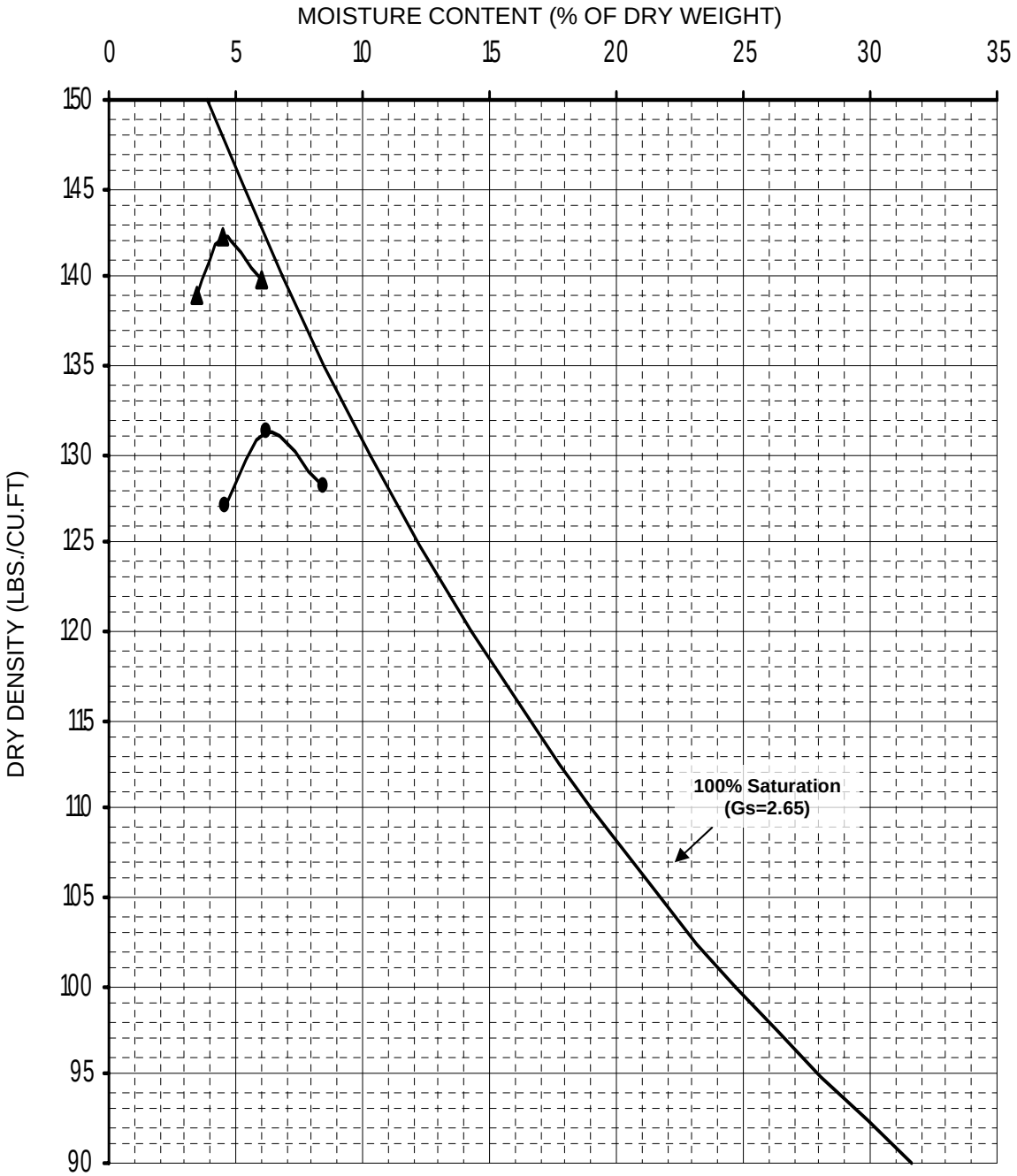
SIEVE ANALYSES

Partial and full sieve analyses were performed on selected soil samples from the explorations. The tests were completed in general accordance with ASTM D 422. The wet sieve analysis method was used to determine the percentage of soil greater than the U.S. No. 200 mesh sieve. The results of the grain-size analyses were plotted, classified in general accordance with the USCS, and presented in Figures B-2 and B-3.

CORROSIVITY ANALYSES

Tests were conducted to evaluate the corrosion potential of one sample from the test pits and two samples from the borings. The tests which include pH, resistivity and soluble sulfate determinations are presented in the table below.

Exploration Number	Sample Depth (feet)	Soil Description	pH	Resistivity (ohm/cm)	Soluble Sulfates (mg/L)
TP-2	1-4	Gravel with sand (GP)	6.4	1.5×10^3	150.4
B-1	5	Silty sand (SM)	6.07	0.2×10^3	208.9
B-3	10	Sand with occasional gravel and silt (SP)	6.04	0.3×10^3	7.2



EXPLORATION NUMBER	SAMPLE NUMBER	SOIL CLASSIFICATION	OPTIMUM MOISTURE CONTENT	MAXIMUM DRY DENSITY (LBS/FT³)
TP-2	1	Gravel with sand and silt (GW-GM)	4.5 ▲	142.2▲
			6.2 ●	131.2 ●

NOTE: Tests performed in accordance with ASTM D 1557; ● = uncorrected; ▲ = corrected

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COMPACTION TEST RESULTS

FIGURE B-1

TACO:\3\3730099\00\Finals\373009900FigureB1.ppt SWH:CS:tt 100808

TACO:\3\3730099\00\Finals\373009900FigureB2.ppt SWH:BAR :tt 100808

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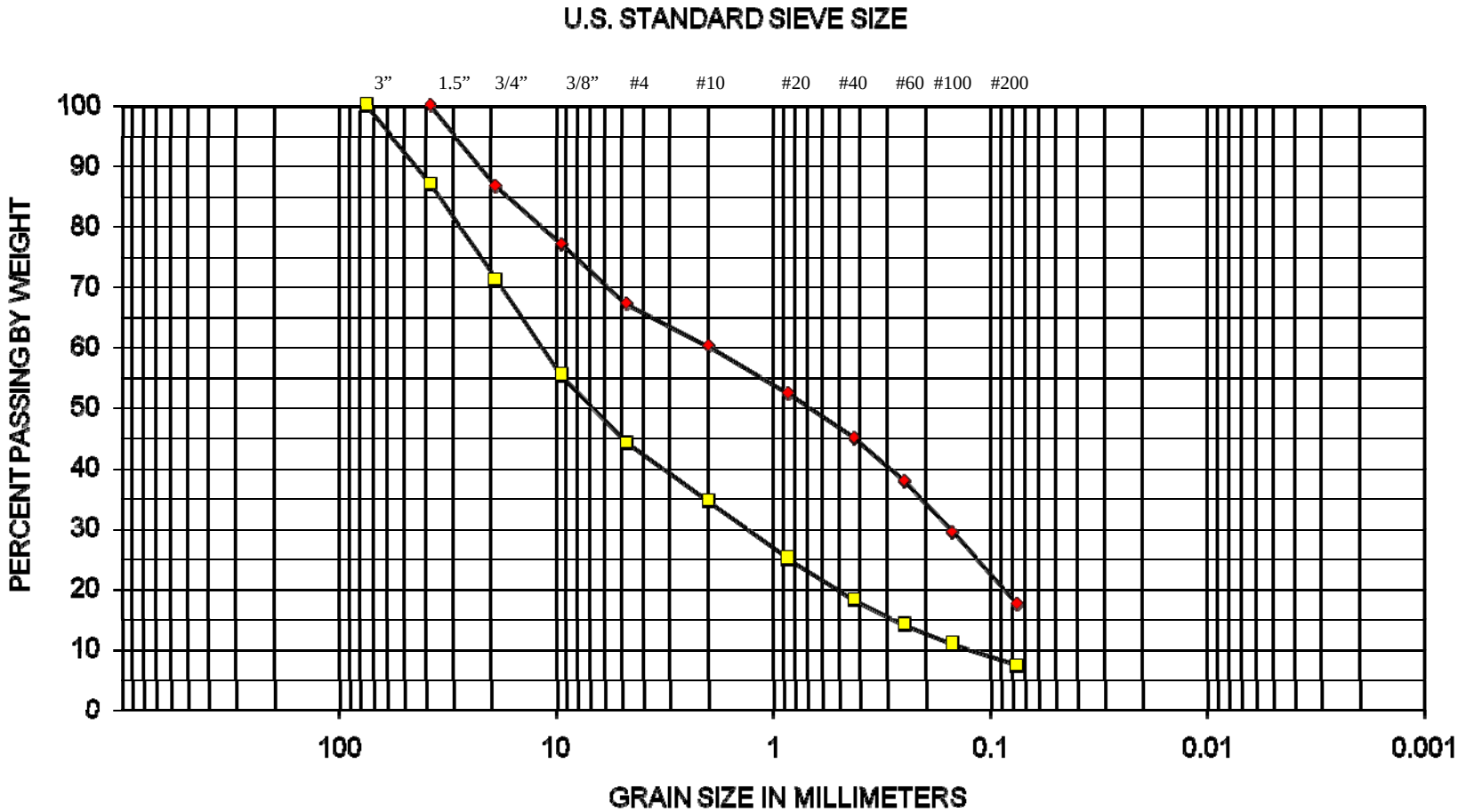

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	MOISTURE (%)	SOIL CLASSIFICATION
◆	TP-1	5	5	Silty sand with gravel (SM)
■	TP-2	1-4	6	Gravel with sand and silt (GW-GM)

SIEVE ANALYSIS RESULTS

FIGURE B-2

TACO:\3\3730099\00\Finals\373009900FigureB-3.ppt SWH:BAR:tt 100308

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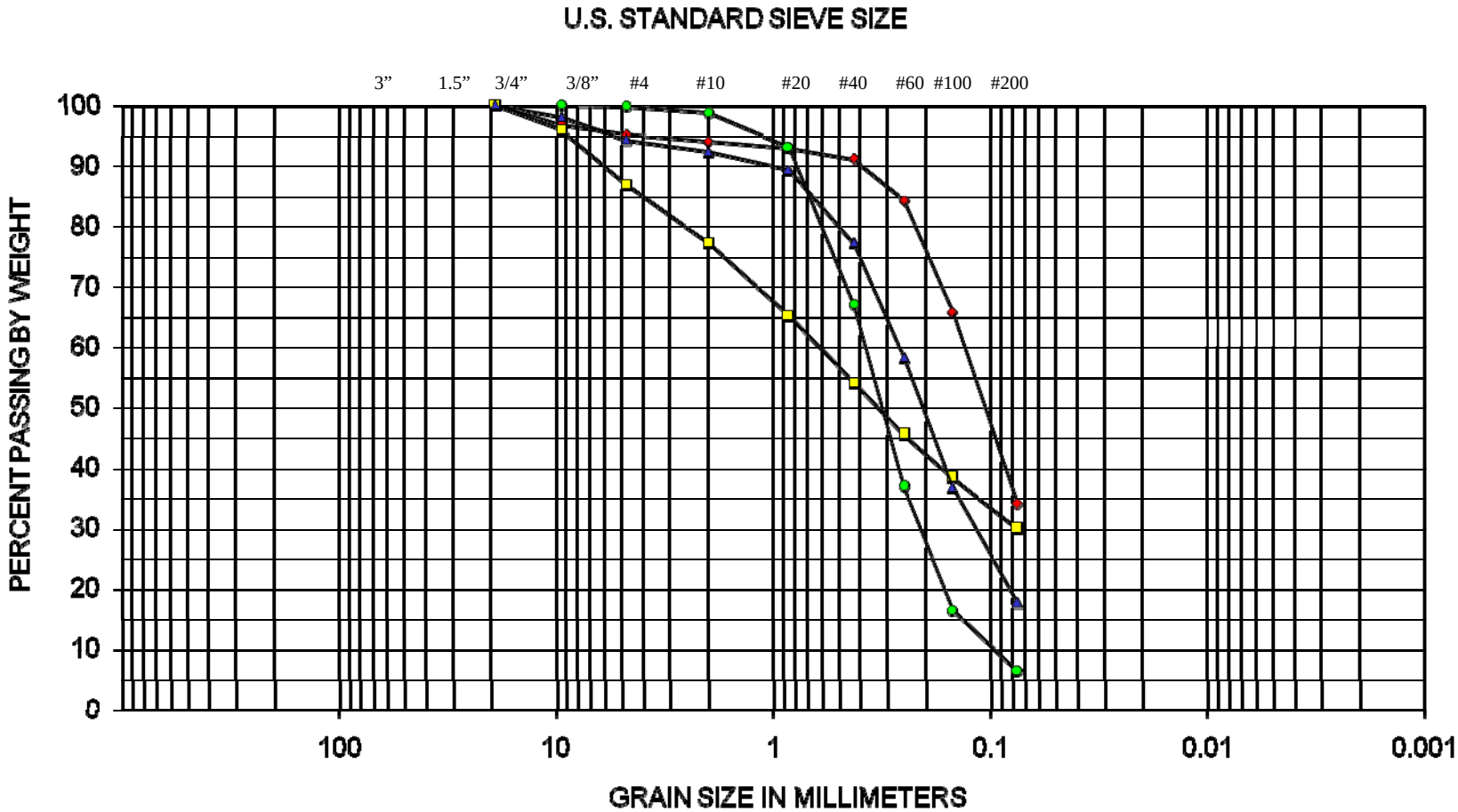

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	MOISTURE (%)	SOIL CLASSIFICATION
◆	B-1	2.5	21	Silty sand (SM)
□	B-1	23	22	Silty sand (SM)
●	B-2	8	26	Sand with silt (SP-SM)
▲	B-2	12.5	25	Silty sand (SM)

SIEVE ANALYSIS RESULTS

FIGURE B-3

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APPENDIX C

REPORT LIMITATIONS AND GUIDELINES FOR USE

APPENDIX C
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 MWH Americas, Inc. and their authorized agents. This report may be made available to regulatory agencies for review. 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 part of the Voights Creek Hatchery project. 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;
- composition of the design team; or
- project ownership.

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

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.