Report of Additional Geotechnical Engineering Services

The Hedges Development—Building D
Tualatin, Oregon

for
Martin Development

July 10, 2019

GeoEngineers
Earth Science + Technology

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The Hedges Development—Building D
Tualatin, Oregon

File No. 0821-014-06

July 10, 2019

Prepared for:

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1.0 INTRODUCTION

This report presents the results of GeoEngineers' additional geotechnical engineering services for the proposed Hedges D site at the Hedges Development in Tualatin, Oregon. The site is located at the west end of SW 115th Street and is bounded by private properties, or undeveloped riparian wetlands, to the north, west and south, and by the Hedges Creek channel on the east. The location of the site is shown in the Vicinity Map, Figure 1.

GeoEngineers completed a Due Diligence and Preliminary Geotechnical Engineering Services Report for Hedges C & D, dated September 6, 2018 (Preliminary Report). Since the Preliminary Report was finalized, the proposed Hedges D development has been modified from a single 64,500-square-foot (sf) building to two buildings—a northern 34,600-sf building and a southern 25,000-sf building. Building loads have not been developed at the time this report was prepared, but we understand the proposed buildings will be a single-story, concrete tilt panel construction with the possibility of 50 percent mezzanine.

Subsurface conditions encountered during the due diligence phase encountered a variable thickness of human placed fill material over alluvium, including a variable layer of very soft elastic silt, very loose silty sand and peat.

2.0 SCOPE OF SERVICES

The purpose of this report is to better define the subsurface conditions beneath the proposed buildings and update our recommendations from the Preliminary Report, as appropriate. Our proposed scope of services included the following:

1. Reviewed previous explorations completed at the site.
2. Coordinated utility locating prior to our explorations by contacting the public "One Call" locating service.
3. Explored subsurface soil and groundwater conditions at the site by completing up to four cone penetrometer tests (CPT), to depths between 47 and 81 feet below ground surface (bgs). The CPTs were located within the proposed building footprints and completed in a single day.
4. Prepared this report that summarizes our findings and provides our recommendations for aggregate piers, including layout, estimated depths, and whether grouted aggregate piers are appropriate. Our report includes a description of surface and subsurface conditions and a Site Plan showing explorations locations and other pertinent features. Results of the CPTs, as well as updated subsurface cross sections are included.

3.0 FIELD EXPLORATIONS AND LABORATORY TESTING

3.1. Field Explorations

The subsurface conditions at the proposed building locations were evaluated by performing four CPTs to depths between 47 and 81 feet below ground surface (bgs), in addition to the three geotechnical borings to depths ranging from 41½ to 81½ feet bgs, performed for the Preliminary Report. We also reviewed logs of borings performed during earlier explorations of the site by others (GeoDesign, Inc. 1997).

The approximate locations of the explorations, including those performed by others, are shown in Figure 2. The results of our explorations are presented in Appendix A.

3.2. Laboratory Testing

Soil samples are not collected when performing CPT's, so laboratory testing was not completed for this phase of the project. Laboratory tests completed for Hedges D during the due diligence phase are presented in Appendix A.

4.0 SITE CONDITIONS

4.1. Surface Conditions

The site is an approximately 5-acre parcel located west of the Hedges Creek canal. Similar drainage canals have been excavated along the north and much of the west side of the parcel. The site is currently vacant and is covered with rough field grass and small trees. The site surface is flat to very gently undulating, with elevations across the site ranging from approximately 150 feet above mean sea level (MSL) to 153 feet MSL.

4.2. Subsurface Conditions

The project site is located within the Tualatin River valley, once dominated by the active floodplains and alluvial terraces of the Tualatin River and its tributaries such as Hedges Creek.

During agricultural development and later urbanization of Tualatin-Sherwood metropolitan area, these lowlands were altered, largely by channelization of the tributary streams as well as raising the grade of the original riparian lowlands by placing a variety of fill materials ranging from ditch channel spoil, silt, sand, gravel, and construction and demolition debris. The original topography of Hedges Creek as well as the surrounding agricultural areas were never documented or, if so, was not preserved, so the thickness, extent, and location of these fills are not well defined. The project site is mantled with these man-made fills.

Two types of soil were encountered underlying the site within the depth of exploration—fill and alluvial sediments. The latter are further divided into Holocene-age alluvial silt, fine sand, and clay overlying Pleistocene-age silts and sand to gravel alluvium deposited by the catastrophic Missoula Floods. Records of site grading indicate that silty and sandy man-made fill was placed across the bulk of the site in the late 1990s, raising the site grades between 8 and 19 feet.

Subsurface conditions beneath each building are described below.

4.2.1. Northern Building (Building A)

The fill extends between 10 and 18 feet bgs across the northern building footprint. The composition of the fill is likely variable across the building footprint, varying between stiff to very stiff silt and dense silty sand to soft silt or loose silty fine sand. The CPTs were predrilled through the fill, so information pertaining to the consistency of the fill is limited to the borings conducted for the Preliminary Report.

Very soft to medium stiff silt, sandy silt or elastic silt and loose silty sand or silty gravel was encountered below the fill to depths ranging between 70 and 89 feet. A layer of highly organic peat ranging between 8 and 22 feet thick was encountered underlying the building footprint, at depths between 20 and 24 feet bgs. Beneath the very soft/loose alluvial deposits, very stiff silt with sand and dense to very dense silty gravels and sands were encountered. Dense gravels were encountered in B-02D at 40 feet bgs and in GeoDesign, Inc. (GDI) B-3 at a depth of 89 feet bgs.

4.2.2. Southern Building (Building B)

Beneath the southern building footprint, the fill extends between 9 and 10 feet bgs. No borings or CPTs were conducted within the fill beneath the southern building, but based on our explorations and surface observations, we anticipate the fill conditions are like those encountered below the northern building.

Very soft to medium stiff silt, sandy silt, elastic silt or organic silt, and very loose to loose silty gravel and sand was encountered to depths between 65 and 70 feet bgs. Similar to the northern building, a layer of highly organic peat or organic silt ranging between 19 and 28 feet thick was encountered at depths between 15 and 18 feet bgs. Beneath the very soft/very loose alluvial deposits, very stiff to hard silt or dense to very dense silty gravels and sands were encountered. The dense gravels were observed at a depth of 66 feet bgs in GDI B-7 and at 80 feet bgs in CPT-2.

4.2.3. Groundwater

During our drilling program completed in February 2018, groundwater was encountered within ½ foot to 4 feet bgs in B-01D and B-02D, respectively. Pore water dissipation tests performed during the CPT soundings estimate static groundwater between 7 and 15 feet bgs.

Groundwater conditions are expected to vary seasonally due to rainfall events and other factors.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1. Summary

A summary of geotechnical considerations is provided below. The summary is presented for introductory purposes only and should be used in conjunction with the complete recommendations presented in this report.

- An 8 to 28-foot-thick layer of organic silt and peat was encountered under the proposed building footprints. This organic material is highly compressible and will likely continue to settle with additional loading, although the majority of settlement under the weight of the existing fill has likely occurred.
- Based on pore pressure readings, groundwater was estimated between approximately 7 to 15 feet bgs during CPT soundings completed in June 2019. Based on drilled borings completed in February 2018, groundwater was encountered at or near the surface.
- The buildings can be supported on aggregate piers under the building footings or the entire building footprint. Grouted aggregate piers will likely be required to mitigate for the organic soils encountered.

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

6.0 EARTHWORK RECOMMENDATIONS

6.1. Site Preparation

Initial site preparation and earthwork operations will include stripping and grading the site, and excavating for utilities and foundations.

Depending on the final layout of the buildings, stripping of grass rootzone and removal and grubbing of shrubs/trees surrounding the structures may be required. Existing shrubs/trees should be removed from the site in all proposed building pad and pavement areas and for a 5-foot margin around such areas. Typically, the depth of stripping is approximately 6 to 8 inches, although thicker stripping depths may be required. The actual stripping depth should be based on field observations at the time of construction. Stripped material should be transported off site for disposal or used in landscaped areas.

Trees and their root balls should be grubbed to the depth of the roots, which could exceed 3 feet bgs. Depending on the methods used to remove the preceding material, considerable disturbance and loosening of the subgrade could occur. We recommend that disturbed soil be removed to expose medium stiff or stiffer native soil. The resulting excavations should be backfilled with structural fill.

6.2. Subgrade Preparation and Evaluation

Upon completion of site preparation activities, the exposed subgrade should be proof-rolled with a fully-loaded dump truck or similar heavy rubber-tired construction equipment to identify soft, loose or unsuitable areas. Proof-rolling should be conducted prior to placing fill, and should be observed by a representative of GeoEngineers who will evaluate the suitability of the subgrade and identify areas of yielding that are indicative of soft or loose soil. If soft or loose zones are identified during proof-rolling, these areas should be excavated to the extent indicated by our representative and replaced with Imported Select Structural Fill as defined in this report.

During wet weather, or when the exposed subgrade is wet or unsuitable for proof-rolling, the prepared subgrade should be evaluated by observing excavation activity and probing with a steel foundation probe. Observations, probing and compaction testing should be performed by a member of our staff. Wet soil that has been disturbed due to site preparation activities or soft or loose zones identified during probing, should be removed and replaced with Imported Select Structural Fill as defined in this report.

6.3. Wet Weather Construction

The fine-grained soils at the site are highly susceptible to moisture. Wet weather construction practices will be necessary if work is performed during periods of wet weather. If site grading will occur during wet weather conditions, it will be necessary to use track-mounted equipment, use gravel working pads and employ other methods to reduce ground disturbance. The contractor should be responsible to protect the subgrade during construction.

During wet weather we recommend that:

- The ground surface in and around the work area should be sloped so that surface water is directed to a sump or discharge location. The ground surface should be graded such that areas of ponded water do not develop.
- The site soils should not be left uncompacted and exposed to moisture. Sealing the surficial soils by rolling with a smooth-drum roller prior to periods of precipitation will reduce the extent to which these soils become wet or unstable.
- Construction activities should be scheduled so that the length of time that soils are left exposed to moisture is reduced to the extent practicable.

- During periods of wet weather, concrete should be placed as soon as practical after preparing foundation excavations. Foundation bearing surfaces should not be exposed to standing water. Should water infiltrate and pool in the excavation, the water should be removed, and the foundation subgrade should be re-evaluated before placing reinforcing steel or concrete. Foundation subgrade protection, such as a 3- to 4-inch-thickness of crushed rock, may be necessary if footing excavations are exposed to extended wet weather conditions.

6.4. Excavation

It is our opinion that conventional earthmoving equipment in proper working condition should be capable of making necessary general excavations. The earthwork contractor should be responsible for reviewing this report, including the exploration logs, providing their own assessments, and providing equipment and methods needed to excavate the site soils while protecting subgrades.

6.5. Dewatering

As discussed in Section 4.2.3 of this report, depending on the time of year construction is completed, groundwater may be encountered at or near the ground surface. If groundwater is encountered, saturated/wet soils should be dewatered. Sump pumps are expected to adequately address groundwater encountered in shallow excavations.

6.6. Shoring

All trench excavations should be made in accordance with applicable Occupational Safety and Health Administration (OSHA) and state regulations. Site soils within expected excavation depths consist of a variable human placed fill, classified as OSHA Soil Type C, provided there is no seepage and excavations occur during periods of dry weather. Excavations deeper than 4 feet should be shored or laid back at an inclination of 1.5H:1V (horizontal to vertical) for Type C soils. Flatter slopes may be necessary if workers are required to enter. Excavations made to construct footings or other structural elements should be laid back or shored at the surface as necessary to prevent soil from falling into excavations.

Shoring for trenches less than 6 feet deep that are above the effects of groundwater should be possible with a conventional box system. Moderate sloughing should be expected outside the box. Shoring deeper than 6 feet or below the groundwater table should be designed by a registered engineer before installation. Further, the shoring design engineer should be provided with a copy of this report.

In our opinion, the contractor will be in the best position to observe subsurface conditions continuously throughout the construction process and to respond to the soil and groundwater conditions. Construction site safety is generally the sole responsibility of the contractor, who also is solely responsible for the means, methods and sequencing of the construction operations and choices regarding excavations and shoring. Under no circumstances should the information provided by GeoEngineers be interpreted to mean that GeoEngineers is assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

6.7. Structural Fill and Backfill

6.7.1. General

Materials used to support building foundations, floor slabs, hardscape, pavements and any other areas intended to support structures or within the influence zone of structures are classified as structural fill for the purposes of this report.

All structural fill should be free of debris, clay balls, roots, organic matter, frozen soil, man-made contaminants, particles with greatest dimension exceeding 4 inches and other deleterious materials. The suitability of soil for use as structural fill will depend on the gradation and moisture content of the soil. As the amount of fines in the soil matrix increases, the soil becomes increasingly more sensitive to small changes in moisture content and achieving the required degree of compaction becomes more difficult or impossible. Recommendations for suitable fill material are provided in the following sections.

6.7.2. Use of On-site Soil

As described in Section 4.2, the on-site near surface soil consists of variable silty fill. On-site soils can be used as structural fill, provided the material meets the above requirements, although due to moisture sensitivity, this material will likely be unsuitable as structural fill during most of the year. If the soil is too wet to achieve satisfactory compaction, moisture conditioning by drying back the material will be required. If the material cannot be properly moisture conditioned, we recommend using imported material for structural fill.

An experienced geotechnical engineer from GeoEngineers should determine the suitability of on-site soil encountered during earthwork activities for reuse as structural fill.

6.7.3. Imported Select Structural Fill

Imported select granular material may be used as structural fill. Imported Select Structural Fill should consist of pit or quarry run rock, crushed rock, or crushed gravel and sand that is fairly well-graded between coarse and fine sizes, with approximately 25 to 65 percent passing the U.S. No. 4 sieve. It should have less than 5 percent passing the U.S. No. 200 sieve and have a minimum of two mechanically fractured faces. During dry weather, the fines content can be increased to a maximum of 12 percent.

6.7.4. Aggregate Base

Aggregate base material located under floor slabs and pavements, and crushed rock used in footing overexcavations, should consist of imported clean, durable, crushed angular rock. Aggregate base material should be well-graded, have a maximum particle size of 1 inch and have less than 5 percent passing the U.S. No. 200 sieve. In addition, aggregate base shall have a minimum of 75 percent fractured particles according to American Association of State Highway and Transportation Officials (AASHTO) TP-61 and a sand equivalent of not less than 30 percent based on AASHTO T-176.

6.7.5. Trench Backfill

Backfill for pipe bedding and in the pipe zone should consist of well-graded granular material with a maximum particle size of ¾ inch and less than 5 percent passing the U.S. No. 200 sieve. Trench backfill material should be free of organic matter and other deleterious materials. Further, the backfill should meet the pipe manufacturer's recommendations. Above the pipe zone, Imported Select Structural Fill may be used as described above.

6.7.6. Fill Placement and Compaction

Structural fill should be compacted to a minimum of 95 percent of the maximum dry density (MDD) at moisture contents that are within 3 percent of the optimum moisture content as determined by ASTM International (ASTM) Standard Practices Test Method D 1557 (Modified Proctor). The optimum moisture content varies with gradation and should be evaluated during construction. Fill material that is not near the optimum moisture content should be moisture conditioned prior to compaction.

Fill and backfill material should be placed in uniform, horizontal lifts and compacted with appropriate equipment. The appropriate lift thickness will vary depending on the material and compaction equipment used. It is the contractor's responsibility to select appropriate compaction equipment and place the material in lifts that are thin enough to meet these criteria. However, in no case should the loose lift thickness exceed 18 inches.

A representative from GeoEngineers should evaluate compaction of each lift of fill. Compaction should be evaluated by compaction testing, unless other methods are proposed for oversized materials and are approved by GeoEngineers prior to fill placement. These other methods typically involve procedural placement and compaction specifications together with verifying requirements such as proof-rolling.

6.8. Temporary Cut Slopes

Earthwork activities are expected to occur at grade, we do not expect significant cut slopes at the site.

7.0 STRUCTURAL DESIGN RECOMMENDATIONS

The foundation support recommendations provided below are based on our analysis and collaborative discussion considering required performance and cost for the project. We have carefully evaluated foundation support and subgrade preparation to provide efficient foundation design and adequate performance for the proposed building, while still considering the project schedule, soil conditions and cost of earthwork.

7.1. Foundation Support Recommendations

7.1.1. Aggregate Piers

Shallow spread footings supported on aggregate piers would provide relatively high bearing capacity and reduced settlement by creating a stiff soil subgrade. Ground improvement methods can consist of the Rammed Aggregate Pier® (RAP) System constructed by GeoPier Foundation Company, Vibro Piers™ constructed by Hayward Baker, or alternate systems if approved in advance by GeoEngineers. Aggregate pier systems are typically designed and constructed by the specialty contractor to a performance specification. They should submit a ground improvement design that has been completed and stamped by a registered professional engineer with experience in such projects. We recommend that GeoEngineers review the design on behalf of the Owner, although the specialty contractor will retain responsibility for the design and construction of the ground improvements to the specified performance criteria.

The inclusion of grout to the aggregate pier system provides additional structural rigidity within the pier element that extends through the soft compressible peat material. We anticipate that the aggregate piers would extend from footing subgrade to approximately 45 feet bgs, although the grout-improved zone would likely not extend the full depth.

We anticipate aggregate piers will extend one row outside the building footprint. They should be designed to meet the final bearing capacity and settlement tolerances provided by the structural engineer. The specialty contractor would provide final design and in-house quality control for the piers. We recommend that GeoEngineers provide construction quality assurance for the Owner during the construction process.

7.1.2. Bearing Capacity

The bearing capacity of the aggregate pier-improved subgrade would be determined by the specialty contractor and will be dependent on actual building loads and acceptable settlement magnitudes. Based on conversations with GeoPier, their aggregate piers typically can achieve bearing capacity of approximately 4,000 to 6,000 pounds per square foot (psf) in soils similar to those at the site that have been improved with aggregate piers. This value may be increased by one third when considering earthquake or wind loads.

We recommend footings have a minimum width of 24 inches and the bottom of the exterior footings be founded at least 18 inches below the lowest adjacent grade, or as needed to meet the design loads. The recommended minimum footing depth is greater than the anticipated frost depth.

7.1.3. Foundation Settlement

Settlement for shallow foundations supported on an aggregate pier improved subgrade, as described above, would depend on the specialty contractor's design. Typically, the systems are designed to a performance specification that is normally on the order of approximately 1 inch.

7.1.4. Lateral Resistance

Lateral foundation loads may be resisted by passive resistance on the sides of footings and by friction on the base of the shallow foundations. For shallow foundations supported on subgrade soils prepared as described 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 may be computed using an equivalent fluid density of 280 pounds per cubic foot (pcf) (triangular distribution). These values are appropriate for foundation elements that are poured directly against undisturbed soils or surrounded by structural fill.

The above coefficient of friction and passive equivalent fluid density values incorporate a factor of safety of about 1.5.

7.2. Drainage Considerations

We recommend the ground surface be sloped away from the buildings at least 2 percent. All downspouts should be tightlined away from the building foundation areas and should also be discharged into a stormwater disposal system. Downspouts should not be connected to footing drains.

We recommend that perimeter footing drains be installed around the proposed buildings at the base of the exterior footings. The perimeter footing drains should be provided with cleanouts and should consist of at least 4-inch-diameter perforated pipe placed on a 3-inch bed of, and surrounded by, 6 inches of drainage material enclosed in a non-woven geotextile such as Mirafi 140N (or approved alternate) to prevent fine soil from migrating into the drain material. We recommend against using flexible tubing for footing drainpipes. The perimeter drains should be sloped to drain by gravity to a suitable discharge point, preferably a storm drain. We recommend that the cleanouts be covered and placed in flush-mounted utility boxes. Water collected in roof downspout lines must not be routed to the footing drain lines.

7.3. Slab-on-Grade Floors

The exposed subgrade should be evaluated after site grading is complete. Proof-rolling with heavy, rubber-tired construction equipment should be used for this purpose during dry weather. Probing should be used to evaluate the subgrade during periods of wet weather. The exposed soil should be firm and unyielding, and without significant groundwater. Loose and disturbed areas should be removed and replaced with compacted structural fill.

We recommend that GeoEngineers observe the condition of all subgrade areas to evaluate whether the work is completed in accordance with our recommendations.

Conventional slabs may be supported on-grade, provided the subgrade soils are prepared as recommended above. For slabs designed as a beam on an elastic foundation, a modulus of subgrade reaction of 150 pounds per cubic inch (pci) may be used for subgrade soils prepared as recommended over the capillary break. It should be noted that this minimum thickness of capillary break will not provide adequate support of construction traffic.

We recommend that the slab-on-grade floors be underlain by a 6-inch-thick capillary break consisting of clean (less than 5 percent passing the No. 200 sieve) ¾-inch crushed gravel. We recommend that the capillary break be compacted to at least 95 percent of the MDD in accordance with ASTM Test Method D 1557. We also recommend that an appropriate vapor retarder be installed below the floor slab to further reduce the risk of moisture migration through the on-grade floor slabs if they are inhabited spaces.

Slab-on-grade settlements will be estimated by the ground improvement subcontractor.

8.0 RECOMMENDED ADDITIONAL GEOTECHNICAL SERVICES

During construction, GeoEngineers should observe the installation of the ground improvements, evaluate the suitability of the foundation subgrades, evaluate structural backfill, and provide a summary letter of our construction observation services. The purposes of GeoEngineers construction phase services are to confirm that the subsurface conditions are consistent with those observed in the explorations and other reasons described in Appendix B, Report Limitations and Guidelines for Use.

9.0 LIMITATIONS

We have prepared this report for the exclusive use of Martin Development and their authorized agents for The Hedges Development—Building D Project in Tualatin, Oregon.

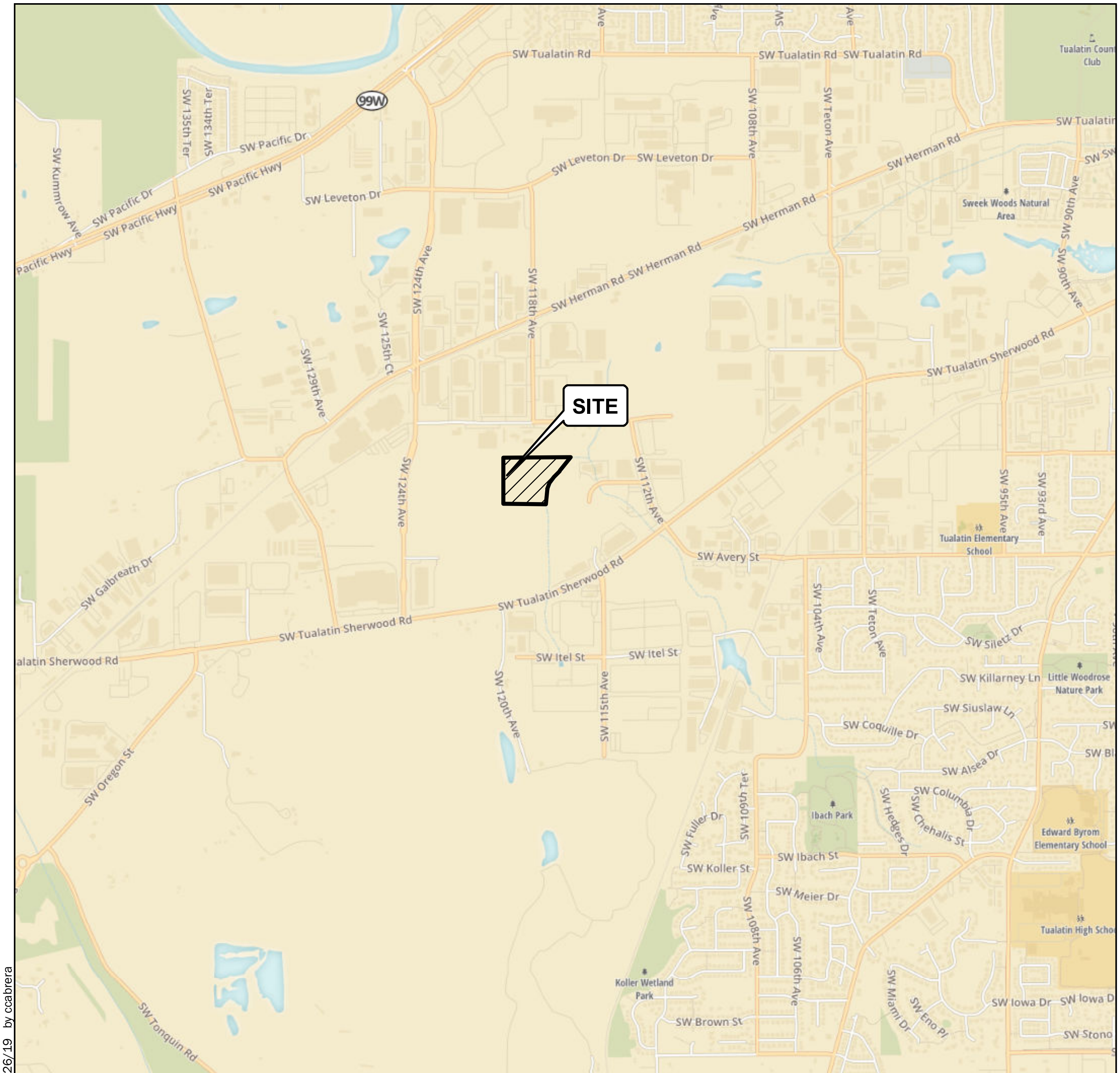
Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

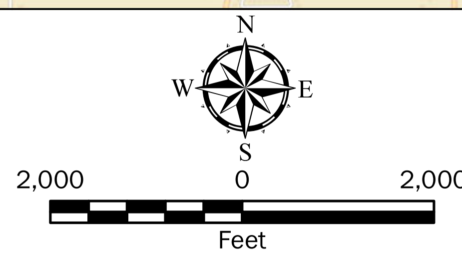
Please refer to Appendix B titled "Report Limitations and Guidelines for Use" for additional information pertaining to use of this report.

10.0 REFERENCES

GeoDesign, Inc. 1997. Report of Geotechnical Engineering Services, Lots 11 and 12, Franklin Business Park, Southwest Avery Street and Tualatin-Sherwood Road, Tualatin, Oregon, GDI Project: Drake-3, prepared for Drake Management Company, dated June 6, 1997.

FIGURES





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.

Data Source: Mapbox Open Street Map, 2016

Projection: NAD 1983 UTM Zone 10N

Vicinity Map

Hedges D
Tualatin, Oregon

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Figure 1

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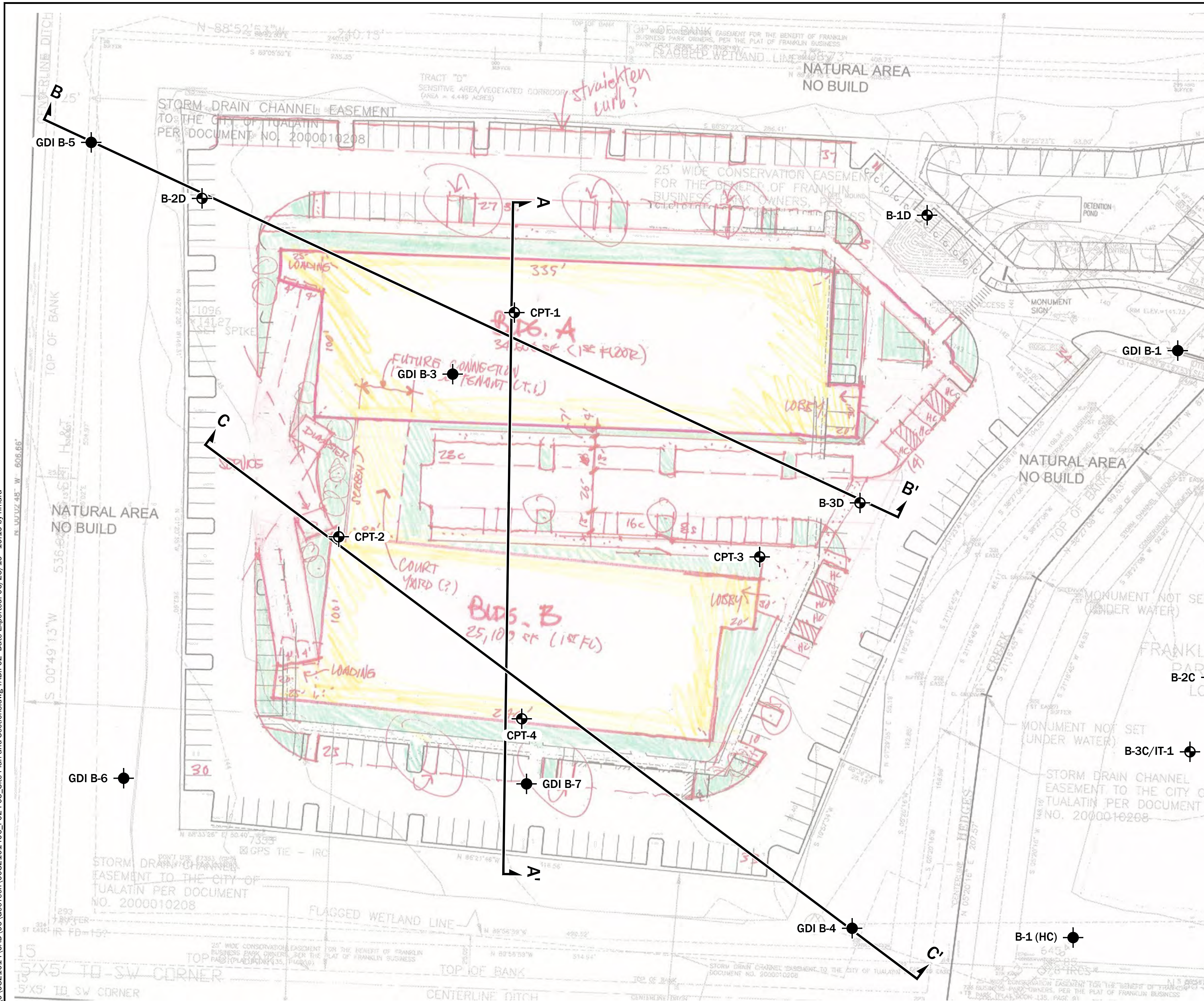

Legend

- B-1D: GeoEngineers Exploration Number and Approximate Location
- GDI B-1: Exploration Number and Approximate Location (by Others)
- A – A': Cross Section Location

Notes:

1. The locations of all features shown are approximate.
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Data Source: Background PDF from Lance Muller Associates dated 4/19/19.

Projection: OR State Plane, North Zone, NAD83, US Foot

N
W E
S

60 0 60
Feet

Site Plan

Hedges D
Tualatin, Oregon

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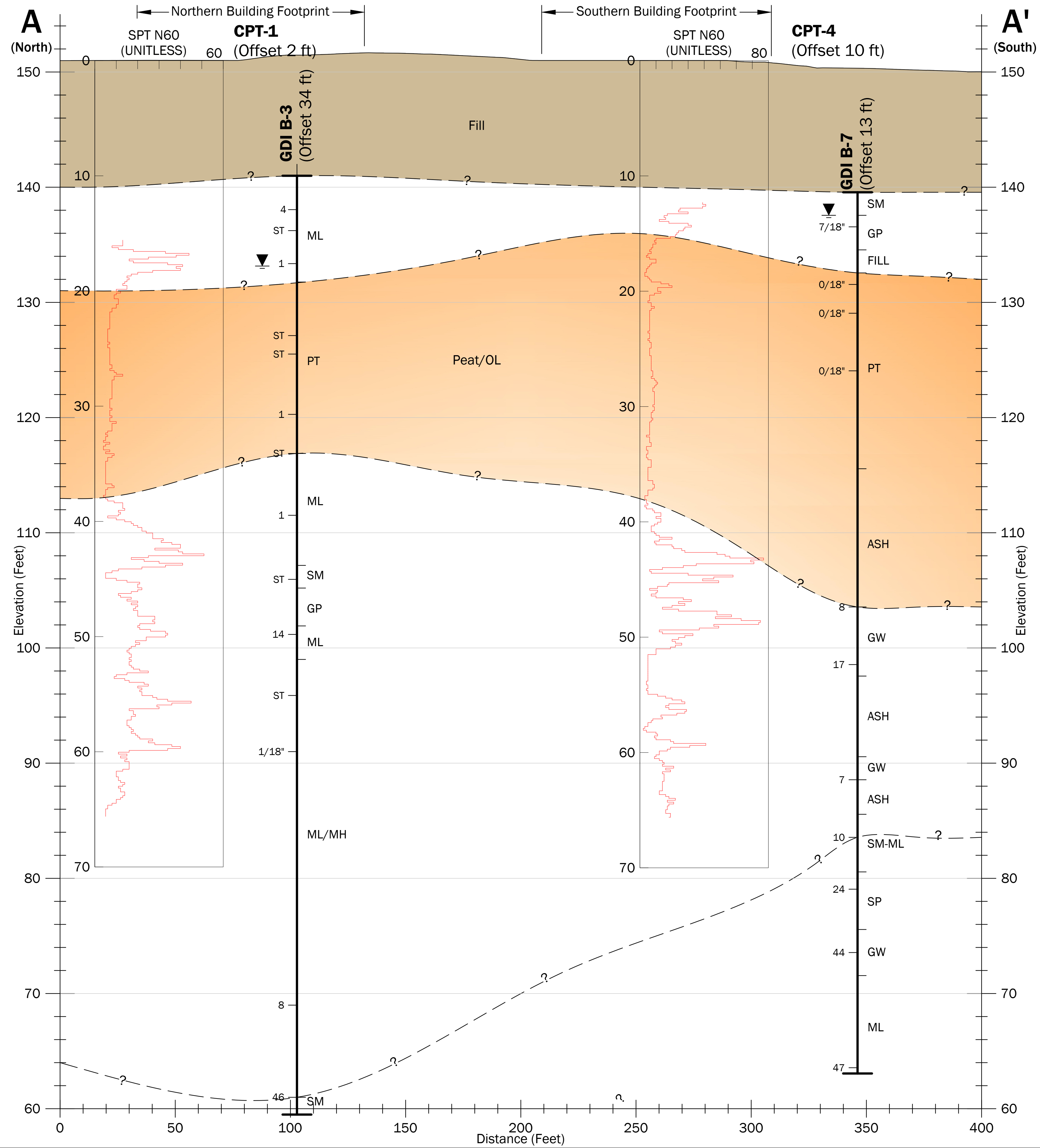
Figure 2



Legend

B-1D (Offset 2 ft)

Boring

Inferred Soil Contact

SM Soil Classification

Groundwater Measured in Piezometer

20 Blow Count

Fill

Peat/OL

Notes:

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Datum: NAVD 88, unless otherwise noted.

50 0 50
Horizontal Scale in Feet

10 0 10
Vertical Scale in Feet
Vertical Exaggeration: 5X

Cross Section A-A'

Hedges D
Tualatin, Oregon

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Figure 3

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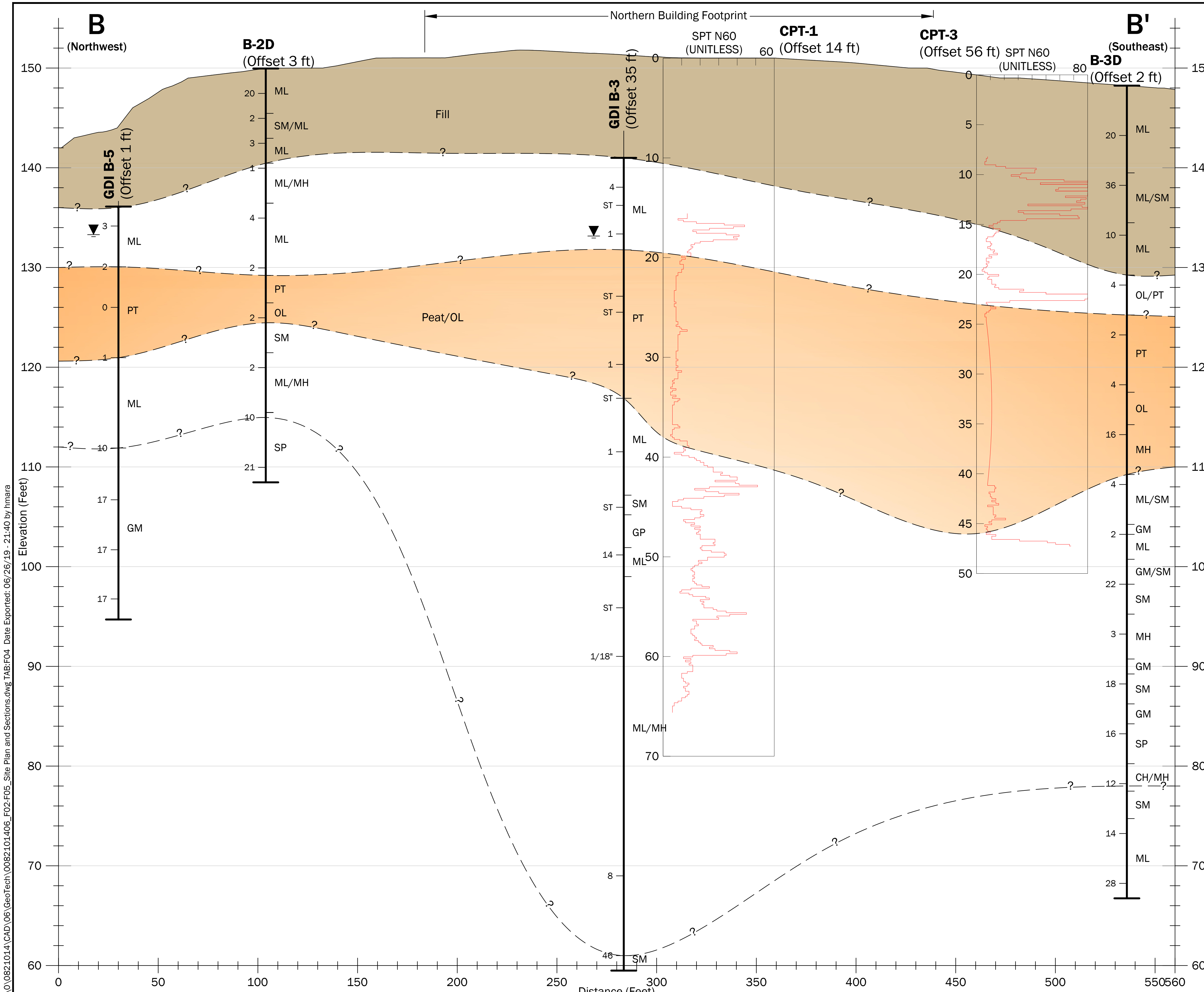

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Cross Section B-B'

Hedges D
Tualatin, Oregon

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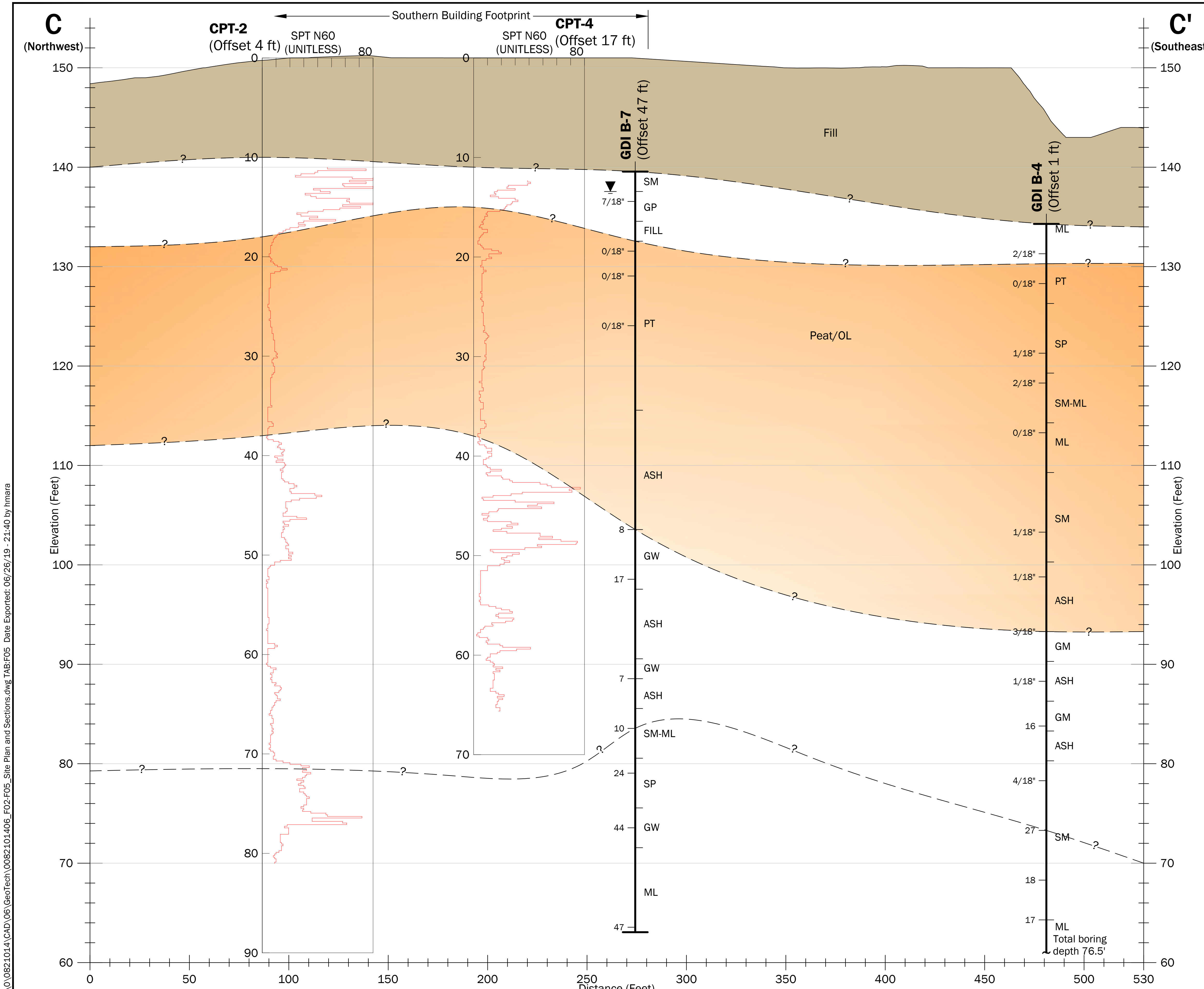
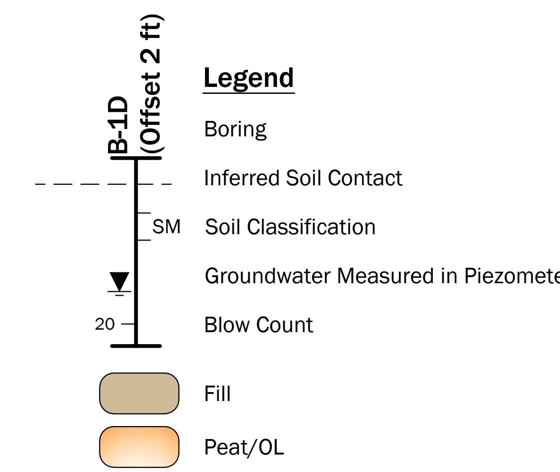
Figure 4





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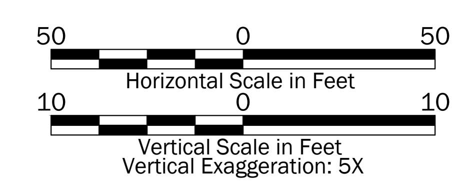
2. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. Data were compiled from sources as listed in this figure. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication of this figure. This figure is a copy of a master document. The hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.

Datum: NAVD 88, unless otherwise noted.



Cross Section C-C'

Hedges D
Tualatin, Oregon

GeoEngineers

Figure 5

APPENDICES

GeoEngineers

APPENDIX A
Field Exploration and Laboratory Testing

APPENDIX A
FIELD EXPLORATIONS AND LABORATORY TESTING

Subsurface conditions were explored by drilling two borings with a trailer-mounted drill rig employing sold-stem auger techniques provided by Dan Fisher Drilling on February 15, 2018, one boring with a tracked rig and mud-rotary techniques provided by Western States Drilling on February 21, 2018, and four cone CPT soundings on June 10, 2019, with a truck rig owned and operated by Oregon Geotechnical Explorations. The locations of the explorations were estimated by taping/pacing from existing site features. The approximate exploration locations are shown in the Site Plan, Figure 2.

Borings (Completed during Due Diligence Phase)

The drilling was continuously monitored by an engineering geologist from our office who maintained a detailed log of subsurface explorations, visually classified the soil encountered and obtained representative soil samples from the borings.

Representative soil samples were obtained from each boring at approximate 2½- to 10-foot-depth intervals using either: (1) a 1-inch, inside-diameter, standard split spoon sampler; or (2) a 2.4-inch, inside-diameter, split-barrel ring sampler (Dames & Moore [D&M]). The samplers were driven into the soil using a 140-pound hammer free-falling 30 inches on each blow; the trailer-mounted (Fisher) rig using rope-and-cathead methods, the track (Western States) using an autohammer.

The number of blows required to drive the sampler each of three, 6-inch increments of penetration were recorded in the field. The sum of the blow counts for the last two, 6-inch increments of penetration is reported on the boring logs as the ASTM International (ASTM) Standard Practices Test Method D 1556 standard penetration test (SPT) N-value. The N-value for D&M samples have been reduced by approximately 50 percent from the field readings to roughly correlate with the SPT N-values.

Recovered soil samples were visually classified in the field in general accordance with ASTM D 2488 and the classification chart listed in Key to Exploration Logs, Figure A-1. Logs of the borings are presented in Figures A-2 through A-4. The logs are based on interpretation of the field and laboratory data and indicate the depth at which subsurface materials or their characteristics change, although these changes might actually be gradual.

Cone Penetration Tests (CPT)

The CPT is a subsurface exploration technique in which a small-diameter steel tip with adjacent sleeve is continuously advanced with hydraulically operated equipment. Measurements of tip and sleeve resistance allow interpretation of the soil profile and the consistency of the strata penetrated. The tip, sleeve resistance and pore water pressure are recorded on the CPT logs. The logs of the CPT probes are presented in Figures A-5 through A-8.

Laboratory Testing (completed during Due Diligence Phase)

Soil samples obtained from the explorations were transported to GeoEngineers' laboratory and evaluated to confirm or modify field classifications, as well as to evaluate engineering properties of the soil samples. Representative samples were selected for laboratory testing to determine the moisture content, moisture-density, percent fines (material passing the U.S. No. 200 sieve), and organic content. The tests were performed in general accordance with ASTM standard practices or other applicable procedures.

The results of the moisture content and percent fines determinations are presented at the respective sample depths in the exploration logs in Appendix A.

Moisture Content

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 in the exploration logs in Appendix A at the depths at which the samples were obtained.

Moisture-Density

We completed moisture density (dry density) testing on selected D&M samples in general accordance with the ASTM D 2937 test method. The results are presented on the boring logs.

Percent Passing U.S. No. 200 Sieve (%F)

Selected samples were "washed" through the U.S. No. 200 mesh sieve to estimate the relative percentages of coarse- and fine-grained particles in the soil. The percent passing value represents the percentage by weight of the sample finer than the U.S. No. 200 sieve. These tests were conducted to verify field descriptions and to estimate the fines content for analysis purposes. The tests were conducted in accordance with ASTM D 1140, and the results are shown in the exploration logs in Appendix A at the respective sample depths.

Organic Content

Organic content tests were performed to determine the amount of organic material present in selected samples in general accordance with ASTM D 2974, Method C. The results of the organic content tests are presented in the exploration logs in Appendix A.

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 ON 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

Sampler Symbol Descriptions

- 2.4-inch I.D. split barrel
- Standard Penetration Test (SPT)
- Shelby tube
- Piston
- Direct-Push
- Bulk or grab
- Continuous Coring

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.

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

"WOH" indicates sampler pushed using the weight of the hammer.

ADDITIONAL MATERIAL SYMBOLS

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

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata

Approximate contact between soil strata

Material Description Contact

Contact between geologic units

Contact between soil of the same geologic unit

Laboratory / Field Tests

%F	Percent fines
%G	Percent gravel
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DD	Dry density
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture density
Mohs	Mohs hardness scale
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
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

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 2/15/2018	End 2/15/2018	Total Depth (ft)	41.5	Logged By JLL Checked By GL	Driller Dan Fischer Drilling	Drilling Method Solid-stem Auger

Surface Elevation (ft) Vertical Datum	149 NAVD88	Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Paul Bunyan Trailer
Easting (X) Northing (Y)	7611554 631175	System Datum	OR State Plane North NAD83 (feet)	See "Remarks" section for groundwater observed	

Notes: D&M N-value reduced by 50 percent to approximate SPT N-value

Elevation (feet)	Depth (feet)	FIELD DATA: Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0							ML	Brown silt, low to medium plasticity, grass roots to 6 to 8 inches, trace to occasional sand (very stiff, moist) (fill)			Groundwater observed at approximately 6 inches below ground surface during drilling
145			10	22		1						
	5		14	9		2		SM	Brown silty fine to medium sand, fine gravel (loose, moist to wet)			
			0	8		3						
140	10		12	8		4		ML	Light gray-brown fine sandy silt, low plasticity, trace brick fragments and gravel (medium stiff, moist to wet)			
									Drill action indicates cobble or debris 12½ to 14½ feet			
135	15		0	12		5			Dark gray fine to medium sandy silt with gravel, angular basalt gravel to 4 inches (stiff, wet)			
130	20		10	6		6 MD		ML	Dark gray silt, moderate plasticity, trace to occasional roots and organic fibers, trace fine sand (medium stiff, wet) (alluvium)	31		DD = 86 pcf
125	25		12	3		7 OC		OL/PT	Dark gray to black organic silt with fine sand, occasional interbeds of brown peat, much fibrous organic matter (soft, wet)	276		OC = 40 percent
120	30		1	4		8 OC			Gray sandy silt with organic silt (soft to medium stiff, wet)	95		OC = 10 percent
115	35							ML/MH	Dark gray silt, moderate plasticity, trace fine sand (medium stiff, wet)			

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on USGS Topo. Vertical approximated based on USGS Topo.

Date:3/6/18 Path:P:\0\0821014\GINT\082101402.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_STANDARD_%F_NO_GW

Log of Boring B-01D

GeoEngineers

Project: The Hedges - Building C and D
Project Location: Tualatin, Oregon
Project Number: 0821-014-02

Figure A-2
Sheet 1 of 2

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	35	X	1	5		9						
110								SM	Dark gray silty medium to coarse sand, occasional gravel (dense, wet)			
	40	X	12	38		10		GM	Dark gray silty gravel with coarse sand, angular basalt gravel to 1-inch (dense, wet)			

Log of Boring B-01D (continued)

GeoEngineers

Project: The Hedges - Building C and D
Project Location: Tualatin, Oregon
Project Number: 0821-014-02

Drilled	Start	End	Total Depth (ft)	Logged By	Checked By	Driller	Drilling Method
	2/15/2018	2/15/2018	41.5	JLL	GL	Dan Fischer Drilling	Solid-stem Auger

Surface Elevation (ft) Vertical Datum	150 NAVD88	Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Paul Bunyan Trailer
Easting (X) Northing (Y)	7611117 631187	System Datum	OR State Plane North NAD83 (feet)	See "Remarks" section for groundwater observed	

Notes: D&M N-value reduced by 50 percent to approximate SPT N-value

Elevation (feet)	Depth (feet)	Recovered (in)	Blows/foot	Sample Name / Testing	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
150	0				ML	Dark brown silt, trace sand and debris (roots to 6 to 8 inches) (stiff, moist) (fill)			
		12	20	1		Mixed gray and brown silt with fine to medium sand, occasional gravel, low plasticity (very stiff, moist)			Groundwater observed at approximately 4 feet below ground surface during drilling
145	5	14	2	2 %F	SM	Brown silty fine sand with occasional interbeds of sandy silt, occasional gravel to ¾-inch, low plasticity to non-plastic (loose and soft, wet)	26	37	
		14	3	3 MD	ML	Dark gray to occasional brown mottling silt, trace fine sand, low to moderate plasticity (soft, wet)	30		DD = 95 pcf
140	10	12	1	4	ML/MH	Gray-brown silt to elastic silt, trace fine sand, occasional gravel, moderate plasticity (very soft, wet) (alluvium)			
135	15	16	4	5 MD	ML	Dark gray silt, low to moderate plasticity, occasional organic fragments including fibers, roots and stems, occasional 3- to 4-inch-thick organic silt layers with much organic matter (soft, wet)	31		DD = 88 pcf
130	20	0	2	6 MD			212		DD = 33 pcf
					OL	Brown organic silt, trace peat, fibrous organic matter, trace fine sand (soft, wet)			
						Becomes yellow-brown with red-brown mottling, moderate plasticity, stems and grass blades			
125	25	4	2	7	SM	Dark gray silty fine sand, massive (very loose, wet)			
120	30	8	2	8	ML/MH	Mixed light gray and brown elastic silt with gray-brown silt, trace organic matter, low to medium plasticity (soft, wet)			
115	35								

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on USGS Topo. Vertical approximated based on USGS Topo.

Log of Boring B-02D

GEOENGINEERS

Project: The Hedges - Building C and D
Project Location: Tualatin, Oregon
Project Number: 0821-014-02

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	35		12	10		9		SP	Dark gray poorly-graded coarse sand, massive (loose, wet)			
110	40		6	21		10			Becomes medium dense			

Log of Boring B-02D (continued)

GeoEngineers

Project: The Hedges - Building C and D

Project Location: Tualatin, Oregon

Project Number: 0821-014-02

Drilled	Start 2/21/2018	End 2/21/2018	Total Depth (ft) 81.5	Logged By JLL / Checked By GL	Driller: Western States Soil Conservation, Inc.	Drilling Method: Mud Rotary

Surface Elevation (ft) / Vertical Datum: 149 / NAVD88	Hammer Data: Roper & Cathead, 140 (lbs) / 30 (in) Drop	Drilling Equipment: CME-850 Truck	
Easting (X) / Northing (Y): 7611497 / 630994	System Datum: OR State Plane North, NAD83 (feet)	Groundwater not observed at time of exploration	

Notes: D&M N-value reduced by 50 percent to approximate SPT N-value

Elevation (feet)	Depth (feet)	Recovered (in)	Blows/foot	Sample Name / Testing	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				ML	Dark brown silt, roots and organic matter to 6 to 8 inches, low to moderate plasticity (soft, wet) (fill)			
145						Drill action and cuttings indicate occasional cobbles, cobble-sized brick, concrete debris 2 to 4 feet			
	5	12	20	1		Becomes dark gray, trace fine sand, occasional fine sandy silt, low plasticity to non-plastic (very stiff, moist)			
						Large debris/cobble fragments 7½ to 9 feet			
140					ML/SM	Dark gray, occasional brown silt with fine to medium sand and gravel to silty medium to coarse sand with gravel, round to angular basalt gravels (dense and hard, moist)			
	10	14	36	2 %F			18	36	
135					ML	Dark gray, green, occasional medium silt, low plasticity, trace fine sand, occasional sand, trace angular gravel, brick fragments (stiff, moist)			
	15	14	10	3					
130					PT	Black, occasional brown peat, low plasticity, fibrous organic matter (soft, moist) (alluvium)			
	20	18	4	4 OC			404		OC = 56 percent
125						Occasional wood fragments, wet			
	25	18	2	5 MD			304		DD = 17 pcf
120									
	30	18	4	6 OC			329		OC = 42 percent
					OL	Brown organic silt, much organic fibers, low plasticity, fine horizontal layers (soft, moist)			
115					MH	Gray elastic silt, trace organic matter, moderate			
	35								

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on USGS Topo. Vertical approximated based on USGS Topo.

Log of Boring B-03D

GeoEngineers

Project: The Hedges - Building C and D
Project Location: Tualatin, Oregon
Project Number: 0821-014-02

Elevation (feet)	Depth (feet)	Recovered (in)	Blows/foot	Sample Name / Testing	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	35	16	P	7		plasticity (very soft, moist)			
110					ML/SM	Interbedded gray silt, low plasticity, trace fine sand and silty fine sand, occasional 1-inch layers of coarse sand (soft and loose, wet)			
	40	18	4	8 MD			57		DD = 67 pcf
105					GM	Drill action indicates gravel 44 to 45 feet			
	45	12	2	9	ML	Gray silt, low to moderate plasticity, trace fine sand (soft, wet)			Lost circulation at 45 feet
100					GM/SM				Drill action indicates gravel, occasional cobble 47½ to 50 feet, coarse sand and gravel in cuttings Lost circulation at 48 feet
	50	0	22	10	SM	Dark gray silty coarse sand with gravel to silty gravel with coarse sand (medium dense, wet)			
95					MH	Gray elastic silt, massive (soft, wet)			
	55	16	3	11					
90					GM				Drill action indicates gravel at 57½ Lost circulation at 58 feet
					SM	Dark gray silty coarse sand with gravel, angular basalt gravel to 1½ inches (medium dense, wet)			
	60	6	18	12					
85					GM				Driller reports very loose to loose gravel
					SP	Dark gray poorly-graded coarse sand with gravel (medium dense, wet)			
	65	10	16	13					
80				AL	ML	Light gray silt, moderate to high plasticity (very soft, wet)	61		AL (LL = 40, PL = 29, PI = 17)
	70	16	12	14					
					SM	Gray-green silty fine sand, massive to horizontal layers (medium dense, wet)			
75					ML	Gray-green silt, low plasticity, trace fine sand, massive (stiff, moist)			
	75	18	14	15					

Log of Boring B-03D (continued)

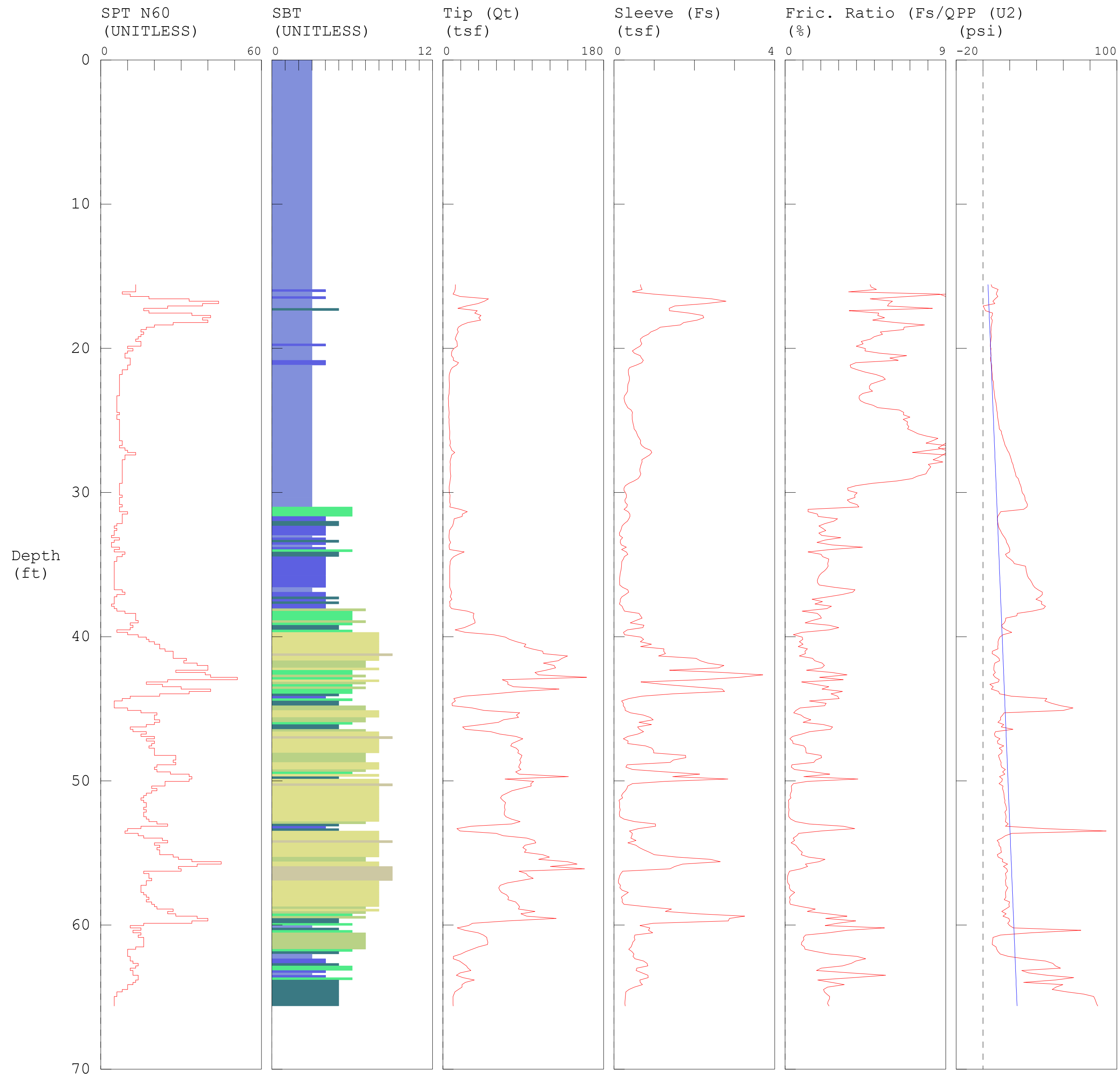
GEOENGINEERS

Project: The Hedges - Building C and D
Project Location: Tualatin, Oregon
Project Number: 0821-014-02

Elevation (feet)	Depth (feet)	FIELD DATA: Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
70												
	80	☒	0	28		16			Becomes gray-green with brown mottling, very stiff			

GeoEngineers / CPT-1 / Hedges SW 115th Street Tualatin

OPERATOR: OGE TAJ
CONE ID: DPG1386
HOLE NUMBER: CPT-1
TEST DATE: 6/10/2019 1:10:12 PM
TOTAL DEPTH: 65.617 ft



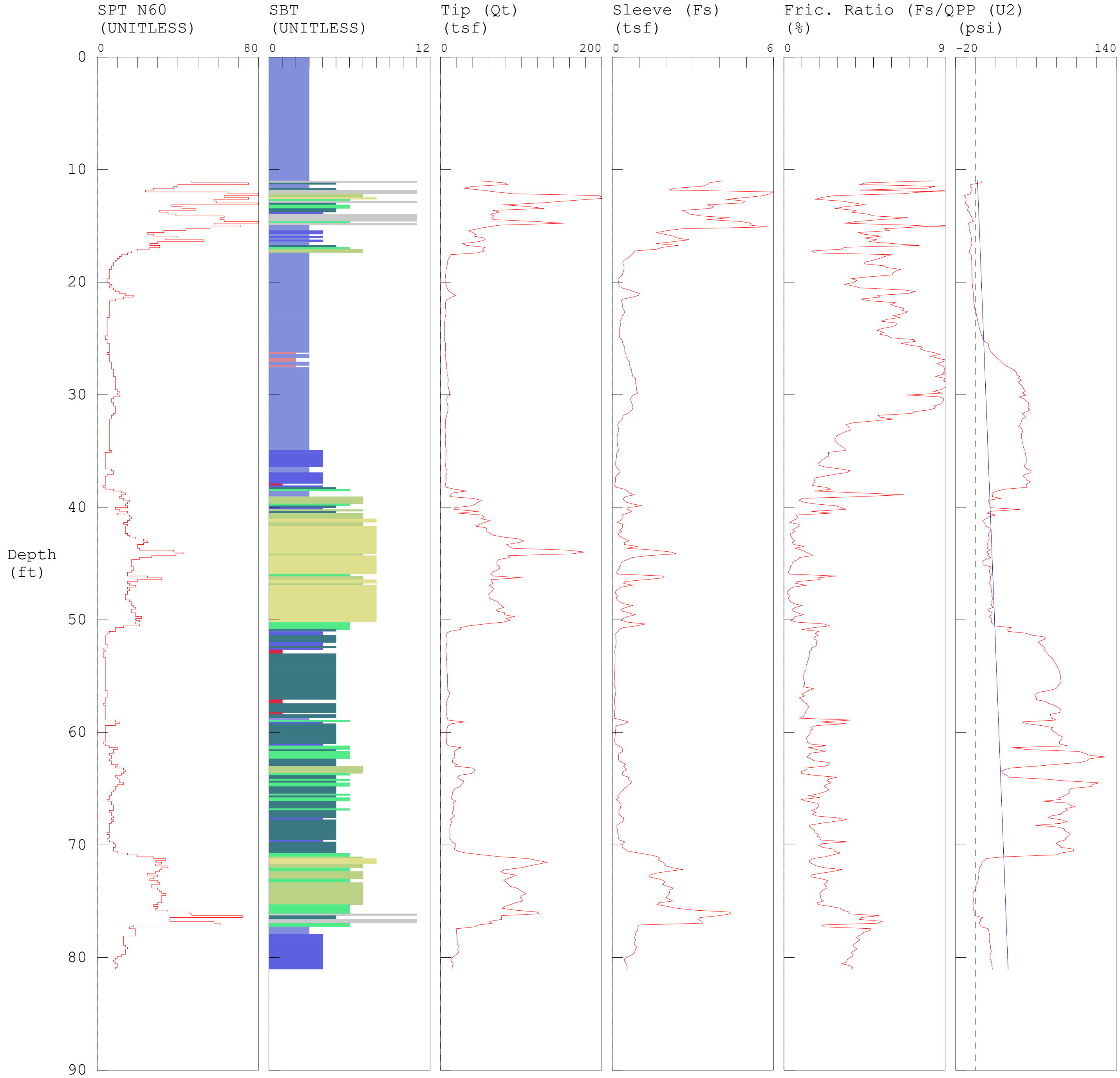
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty cl
6 sandy silt to clayey si
7 silty sand to sandy sil
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Figure A-5

GeoEngineers / CPT-2 / Hedges SW 115th Street Tualatin

OPERATOR: OGE TAJ
CONE ID: DPG1386
HOLE NUMBER: CPT-2
TEST DATE: 6/10/2019 11:38:23 AM
TOTAL DEPTH: 81.037 ft



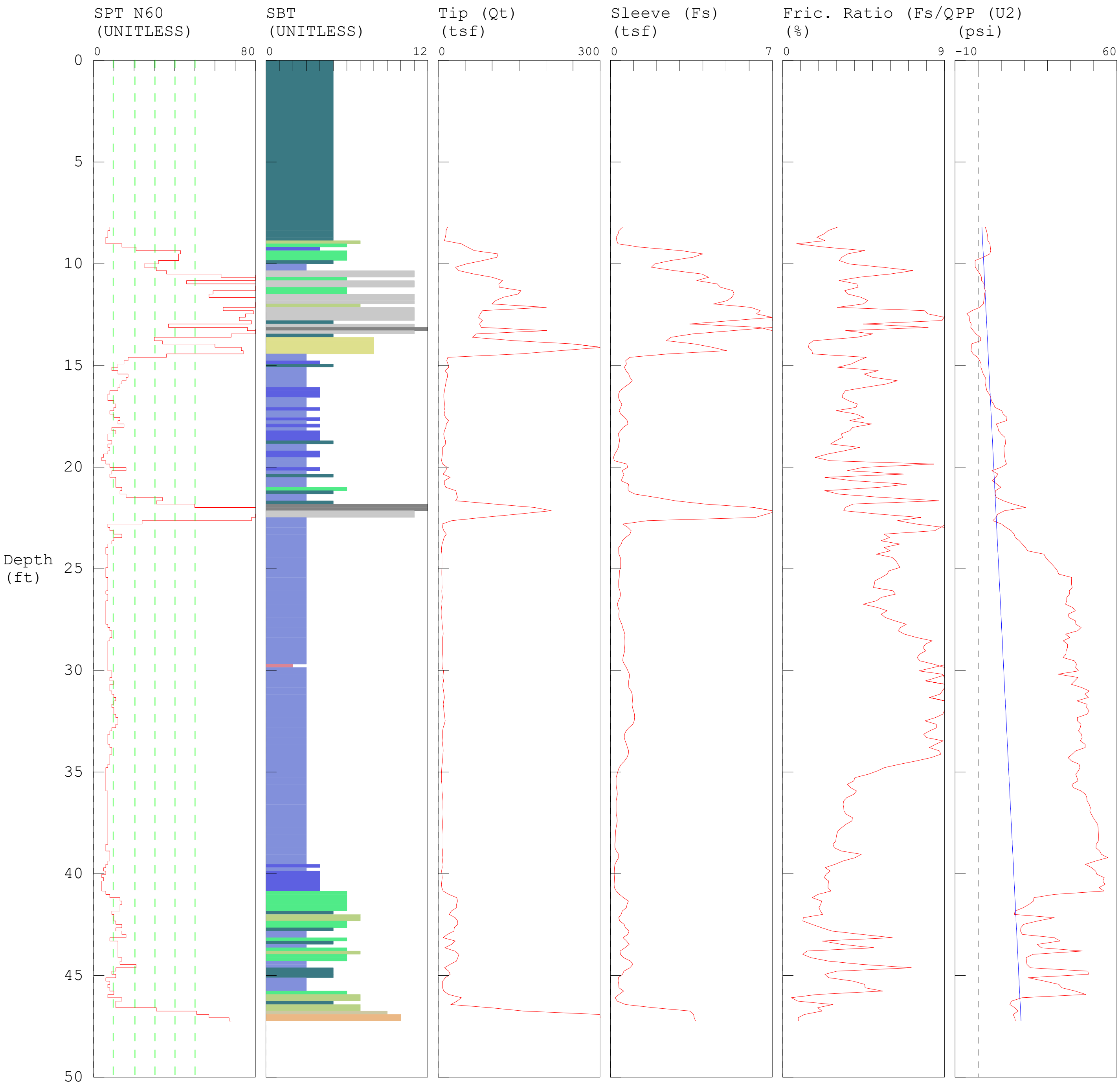
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty cl
6 sandy silt to clayey si
7 silty sand to sandy sil
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Figure A-6

GeoEngineers / CPT-3 / Hedges SW 115th Street Tualatin

OPERATOR: OGE TAJ
CONE ID: DPG1386
HOLE NUMBER: CPT-3
TEST DATE: 6/10/2019 9:48:19 AM
TOTAL DEPTH: 47.244 ft



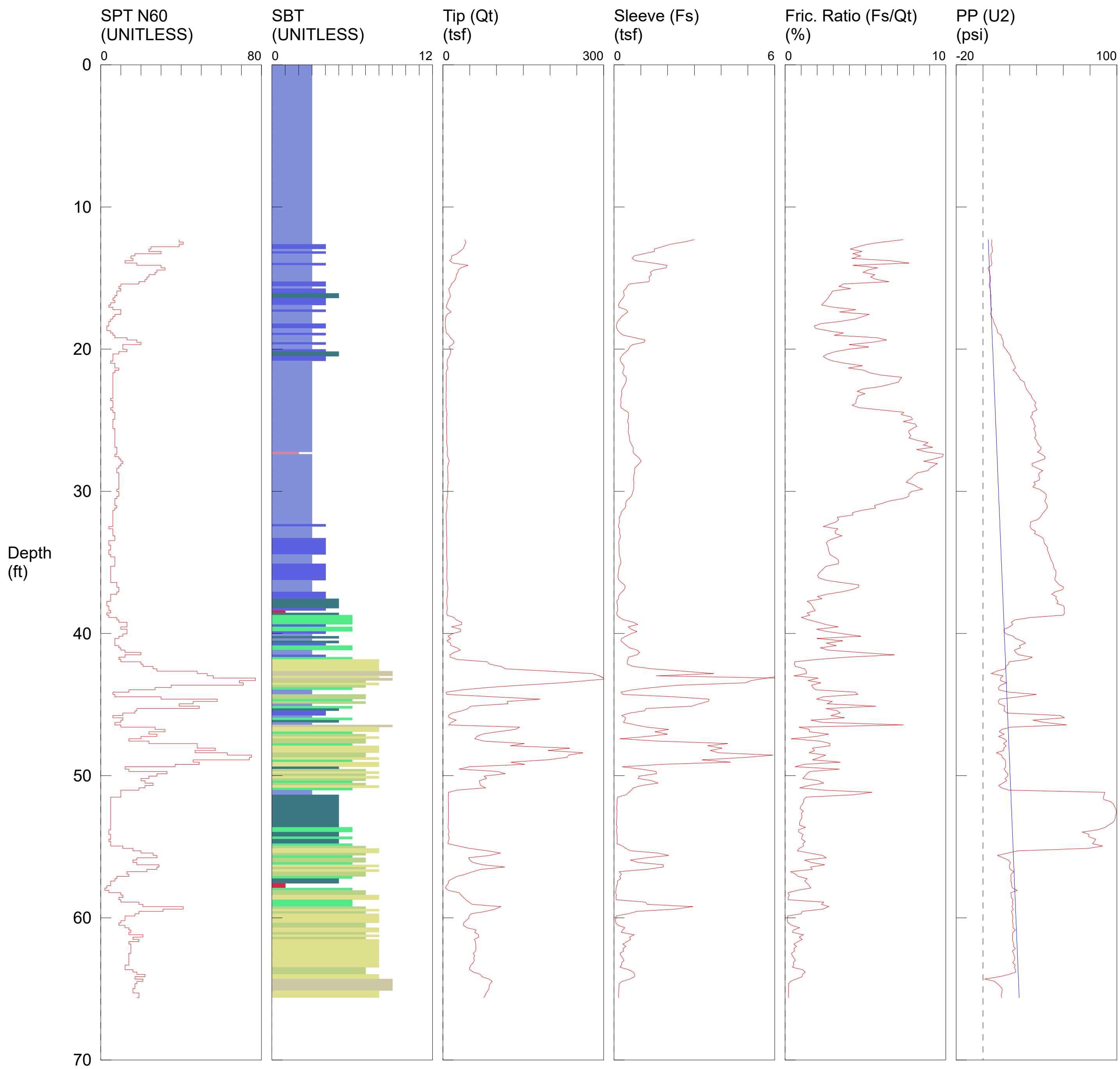
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty cl
6 sandy silt to clayey si
7 silty sand to sandy sil
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Figure A-7

GeoEngineers / CPT-4 / Hedges SW 115th Street Tualatin

OPERATOR: OGE TAJ
CONE ID: DPG1386
HOLE NUMBER: CPT-4
TEST DATE: 6/10/2019 2:19:25 PM
TOTAL DEPTH: 65.617 ft



1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Figure A-8

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 the Martin Development and for the Project specifically identified in the report. The information contained herein is not applicable to other sites or projects.

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

A Geotechnical Engineering or Geologic Report Is Based on a Unique Set of Project-specific Factors

This report has been prepared for The Hedges Development—Building D Project in Tualatin, Oregon. 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.

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[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.

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. Accordingly, this report does not include any interpretations, recommendations, findings, or conclusions regarding the detecting, assessing, preventing or abating of Biological Pollutants and no conclusions or inferences should be drawn regarding Biological Pollutants, as they may relate to this project. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria, and viruses, and/or any of their byproducts.

If Client desires these specialized services, they should be obtained from a consultant who offers services in this specialized field.

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