Geotechnical Site Investigation

La Center Middle School

La Center, Washington

October 3, 2018

Geotechnical ■ Environmental ■ Special Inspections

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GEOTECHNICAL SITE INVESTIGATION
LA CENTER MIDDLE SCHOOL
LA CENTER, WASHINGTON

Prepared For:	**Mr. Dave Holmes, Superintendent** **La Center School District** **725 NE Highland Avenue** **La Center, Washington**
Site Location:	**Southwest of the intersection of NE Lockwood Creek Road and NE 23rd Avenue** **Parcel Nos: Northern portion of 209064000, 209120000, 209118000, and 209119000** **La Center, Washington**
Prepared By:	**Columbia West Engineering, Inc.** **11917 NE 95th Street** **Vancouver, Washington 98682** **Phone: 360-823-2900** **Fax: 360-823-2901**
Date Prepared:	**October 3, 2018**

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1.0 INTRODUCTION

Columbia West Engineering, Inc. (Columbia West) was retained by La Center School District to conduct a geotechnical site investigation for the proposed La Center Middle School project located in La Center, Washington. The purpose of the investigation was to observe and assess subsurface soil conditions at specific locations and provide geotechnical engineering analyses, planning, and design recommendations for proposed development. This report supplements Columbia West's previously published report *18084, La Center Middle School Geotechnical Feasibility Assessment* dated May 17, 2018. The specific scope of services was outlined in a proposal contract dated June 19, 2018. This report summarizes the investigation and provides field assessment documentation and laboratory analytical test reports. This report is subject to the limitations expressed in Section 6.0, *Conclusion and Limitations*, and Appendix F.

1.1 General Site Information

As indicated on Figures 1 and 2, the subject site is located southwest of the intersection of NE Lockwood Creek Road and NE 23rd Avenue in La Center, Washington. The site is comprised of tax parcels 209120000, 209118000, 209119000, and the northern portion of 209064000 totaling approximately 24.5 acres. The regulatory jurisdictional agency is the City of La Center, Washington. The approximate latitude and longitude are N 45° 51' 26" and W 122° 38' 58", and the legal description are portions of the SE ¼ and NE ¼ of Section 02, T4N, R1E, Willamette Meridian.

La Center Municipal Code Sections 18.300.090 (4) and (5) define geologic hazard requirements for parcels proposed for development in areas subject to La Center jurisdiction. Four potential geologic hazards are identified: (4a) erosion hazard, (4b) landslide hazard areas, (4c) seismic hazard areas, and (5) slopes greater than 25 percent. Columbia West reviewed whether these geologic hazards are present at the subject property proposed for development. The geologic hazard review was based upon physical and visual reconnaissance, subsurface exploration, laboratory analysis of collected soil samples, and review of maps and other published technical literature. The results of the geologic hazard review for the potential geologic hazards indicated that only (4c) seismic hazard areas exist at the site. Erosion hazard, landslide hazard and slopes greater than 25 percent are not mapped or observed at the site. Seismic hazard issues pertaining to site development are discussed in *Section 5.10, Seismic Design Considerations, Section 5.11, Soil Liquefaction* and *Dynamic Settlement, and Section 5.12, Settlement Mitigation and Soil Improvements*.

1.2 Proposed Development

Based upon correspondence with the La Center School District (LCSD) and review of a preliminary site plan, Columbia West understands that a middle school building and associated infrastructure are proposed. Figure 2A indicates the proposed site layout. In addition, proposed development is likely to include essential utilities for structures, stormwater management facilities, as well as asphalt concrete paving to provide vehicle and bus access to the school. Columbia West has not reviewed preliminary grading plans but understands that cut and fill areas may be proposed. This report is based upon proposed development as described and may not be applicable if modified.

2.0 REGIONAL GEOLOGY AND SOIL CONDITIONS

The subject site lies within the Willamette Valley/Puget Sound Lowland, a wide physiographic depression flanked by the mountainous Coast Range on the west and the Cascade Range on the east. Inclined or uplifted structural zones within the Willamette Valley/Puget Sound Lowland constitute highland areas and depressed structural zones form sediment-filled basins. The site is located in the northern portion of the Portland/Vancouver Basin, an open, somewhat elliptical, northwest-trending syncline approximately 60 miles wide.

According to the *Geologic Map of the Ridgefield Quadrangle, Clark and Cowlitz Counties, Washington* (Russell C. Evarts, USGS Geological Survey Scientific Investigation Map 2844, 2004), near-surface soils are expected to consist of Pleistocene-aged, unconsolidated, rhythmically bedded, periglacial clay, silt, and fine- to medium-textured sand deposits derived from catastrophic outburst floods of Glacial Lake Missoula (Qfs). The fine-textured flood deposits are underlain by Pleistocene to Pliocene, unconsolidated to cemented, deeply weathered, pebble to boulder sedimentary conglomerate (QTc).

The *Web Soil Survey* (United States Department of Agriculture, Natural Resource Conservation Service [USDA NRCS], 2018 Website) identifies surface soils primarily as Gee silt loam and Odne silt loam. Gee and Odne series soils are generally fine-textured clays and silts with very low permeability, moderate to high water capacity, and low shear strength. Gee and Odne soils are generally moisture sensitive, somewhat compressible, and described as having moderate shrink-swell potential. The erosion hazard is slight primarily based upon slope grade.

3.0 REGIONAL SEISMOLOGY

Recent research and subsurface mapping investigations within the Pacific Northwest appear to suggest the historic potential risk for a large earthquake event with strong localized ground movement may be underestimated. Past earthquakes in the Pacific Northwest appear to have caused landslides and ground subsidence, in addition to severe flooding near coastal areas. Earthquakes may also induce soil liquefaction, which occurs when elevated horizontal ground acceleration and velocity cause soil particles to interact as a fluid as opposed to a solid. Liquefaction of soil can result in lateral spreading and temporary loss of bearing capacity and shear strength.

There are at least four major known fault zones in the vicinity of the site that may be capable of generating potentially destructive horizontal accelerations. These fault zones are described briefly in the following text.

Portland Hills Fault Zone

The Portland Hills Fault Zone consists of several northwest-trending faults located along the northeastern margin of the Tualatin Mountains, also known as the Portland Hills, and the southwest margin of the Portland Basin. The fault zone is approximately 25 to 30 miles in length and is located approximately 17 miles southwest of the site. According to *Seismic Design Mapping, State of Oregon* (Geomatrix Consultants, 1995), there is no definitive consensus among geologists as to the zone fault type. Several alternate interpretations have been suggested.

According to the *USGS Earthquake Hazards Program*, the fault was originally mapped as a down-to-the-northeast normal fault but has also been mapped as part of a regional-scale zone of right-lateral, oblique slip faults, and as a steep escarpment caused by asymmetrical folding above a south-west dipping, blind thrust fault. The Portland Hills fault offsets Miocene Columbia River Basalts, and Miocene to Pliocene sedimentary rocks of the Troutdale Formation. No fault scarps on surficial Quaternary deposits have been described along the fault trace, and the fault is mapped as buried by the Pleistocene-aged Missoula flood deposits.

However, evidence suggests that fault movement has impacted shallow Holocene deposits and deeper Pleistocene sediments. Seismologists recorded a M3.2 earthquake thought to be associated with the fault zone near Kelly Point Park in November 2012, a M3.9 earthquake thought to be associated with the fault zone near Kelly Point Park in April 2003, and a M3.5 earthquake possibly associated with the fault zone occurred approximately 1.3 miles east of the fault in 1991. Therefore, the Portland Hills Fault Zone is generally thought to be potentially active and capable of producing possible damaging earthquakes.

Gales Creek-Newberg-Mt. Angel Fault Zone

Located approximately 32 miles southwest of the site, the northwest-striking, approximately 50-mile long Gales Creek-Newberg-Mt. Angel Structural Zone forms the northwestern boundary between the Oregon Coast Range and the Willamette Valley, and consists of a series of discontinuous northwest-trending faults. The southern end of the fault zone forms the southwest margin of the Tualatin basin. Possible late-Quaternary geomorphic surface deformation may exist along the structural zone (Geomatrix Consultants, 1995).

According to the *USGS Earthquake Hazards Program*, the Mount Angel fault is mapped as a high-angle, reverse-oblique fault, which offsets Miocene rocks of the Columbia River Basalts, and Miocene and Pliocene sedimentary rocks. The fault appears to have controlled emplacement of the Frenchman Spring Member of the Wanapum Basalts, and thus must have a history that predates the Miocene age of these rocks. No unequivocal evidence of deformation of Quaternary deposits has been described, but a thick sequence of sediments deposited by the Missoula floods covers much of the southern part of the fault trace.

Although no definitive evidence of impacts to Holocene sediments have clearly been identified, the Mount Angel fault appears to have been the location of minor earthquake swarms in 1990 near Woodburn, Oregon, and a M5.6 earthquake in March 1993 near Scotts Mills, approximately four miles south of the mapped extent of the Mt. Angel fault. It is unclear if the earthquake occurred along the fault zone or a parallel structure. Therefore, the Gales Creek-Newberg-Mt. Angel Structural Zone is considered potentially active.

Lacamas Lake-Sandy River Fault Zone

The northwest-trending Lacamas Lake Fault and northeast-trending Sandy River Fault intersect north of Camas, Washington approximately 21 miles southeast of the site, and form part of the northeastern margin of the Portland basin. According to *Geology and Groundwater Conditions of Clark County Washington* (USGS Water Supply Paper 1600, Mundorff, 1964) and the *Geologic Map of the Lake Oswego Quadrangle* (Oregon DOGAMI Series GMS-59, 1989), the Lacamas Lake fault zone consists of shear contact between the Troutdale Formation and underlying Oligocene andesite-basalt bedrock. Secondary shear contact associated with the fault zone may have produced a series of prominent northwest-southeast geomorphic lineaments in proximity to the site.

According to the *USGS Earthquake Hazards Program* the fault has been mapped as a normal fault with down-to-the-southwest displacement and has also been described as a steeply northeast or southwest-dipping, oblique, right-lateral, slip-fault. The trace of the Lacamas Lake fault is marked by the very linear lower reach of Lacamas Creek. No fault scarps on Quaternary surficial deposits have been described. The Lacamas Lake fault offsets Pliocene-aged sedimentary conglomerates generally identified as the Troutdale formation, and Pliocene- to Pleistocene-aged basalts generally identified as the Boring Lava formation.

Recent seismic reflection data across the probable trace of the fault under the Columbia River yielded no unequivocal evidence of displacement underlying the Missoula flood deposits, however, recorded mild seismic activity during the recent past indicates this area may be potentially seismogenic.

Cascadia Subduction Zone

The Cascadia Subduction Zone has recently been recognized as a potential source of strong earthquake activity in the Portland/Vancouver Basin. This phenomenon is the result of the earth’s large tectonic plate movement. Geologic evidence indicates that volcanic ocean floor activity along the Juan de Fuca ridge in the Pacific Ocean causes the Juan de Fuca Plate to perpetually move east and subduct under the North American Continental Plate. The subduction zone results in historic volcanic and potential earthquake activity in proximity to the plate interface, believed to lie approximately 20 to 50 miles west of the general location of the Oregon and Washington coast (Geomatrix Consultants, 1995).

4.0 GEOTECHNICAL AND GEOLOGIC FIELD INVESTIGATION

A geotechnical field investigation consisting of visual reconnaissance, five test pits (TP-11 through TP-15), four infiltration tests (IT-1 through IT-4), two soil borings (SB-3 and SB-4), and three CPT soundings (CPT-1 through CPT-3) was conducted at the subject site on August 8, 22, and 31, 2018. Test pit explorations TP-1 through TP-10 and soil borings SB-1 and SB-2 were conducted on April 19 and 20, 2018 as part of Columbia West's original geotechnical field investigation (*18084, La Center Middle School Geotechnical Feasibility Assessment, May 17, 2018).* Soil borings were conducted with a trailer-mounted solid-stem drill rig. CPT soundings were conducted with a track-mounted cone penetrometer rig. Test pits were conducted with a track-mounted excavator. Subsurface soil profiles were logged in accordance with Unified Soil Classification System (USCS) specifications. Disturbed soil samples were collected from relevant soil horizons and submitted for laboratory analysis. Analytical laboratory test results are presented in Appendix A. Exploration locations are indicated on Figure 2. Subsurface exploration logs are presented in Appendix B. Soil descriptions and classification information are provided in Appendix C. A photo log is presented in Appendix D.

4.1 Surface Investigation and Site Description

The approximate 24.5-acre subject site consists of four parcels located southwest of the intersection of NE Lockwood Road and NE 23rd Avenue. The subject site is currently undeveloped and primarily vegetated with grass and mature trees lining the south site boundary. Evidence of remnant structure debris and surface disturbance was observed on the southern portion of the site. Field reconnaissance and review of site topographic mapping indicate site grades are relatively flat, ranging from 0 to 5 percent. Visual reconnaissance conducted during site visits indicate the site has been subjected to grading activity. Site elevations in the proposed development area range from 146 feet amsl at the northeast site corner to 128 feet amsl at the southwest site corner.

4.2 Subsurface Exploration and Investigation

Soil borings were advanced to a maximum depth of 55.3 feet below ground surface (bgs). Test pits were advanced to a maximum depth of 15 feet bgs. Exploration locations were selected to observe subsurface soil characteristics in proximity to proposed development areas and are indicated on Figure 2.

4.2.1 Soil Type Description

The field investigation indicated the presence of approximately 12 to 18 inches of till zone with sod and topsoil in the observed locations. Underlying the topsoil layer, subsurface soils resembling native USDA Gee and Odne soil series descriptions were encountered. Subsurface lithology was reasonably consistent at all explored locations and may generally be described by soil types identified in the following text.

<u>Disturbed Clay Fill</u>

Disturbed CLAY FILL soils were encountered in test pits TP-9 and TP-10 in the southern parcel to a depth of 4 and 5 feet, respectively. Remnant structure debris was also encountered. Disturbed soil depth may be greater or lesser in areas not explored on the southern parcel, due to previous use and structure demolition.

<u>Soil Type 1 – Lean CLAY / Sandy Lean CLAY / Lean CLAY with Sand</u>

Soil Type 1 was observed to primarily consist of orange-brown, moist to wet, soft to medium stiff lean CLAY, lean CLAY with sand, and sandy lean CLAY. Soil Type 1 was observed below the topsoil layer in soil borings SB-1 through SB-4, TP-1 through TP-8, TP-11 through TP-15, as well as below the disturbed clay fill in test pits TP-9 and TP-10. Soil Type 1 extended to depths between 4.5 and 10 feet in test pits TP-1 through TP-15 and soil borings SB-1 through SB-4 where it was underlain by Soil Type 2.

Analytical laboratory testing conducted upon representative soil samples obtained from test pits TP-1 and TP-15 and soil borings SB-1, SB-2, and SB-3 indicated 66.9 to 88.9 percent by weight passing the No. 200 sieve and in situ moistures ranging from 19.2 to 41.8 percent. Atterberg Limits analysis indicated liquid limits ranging from 30 to 46 percent and plasticity indices ranging from 8 to 22 percent. The laboratory tested samples of Soil Type 1 are classified CL according to USCS specifications and A-7-6(19), A-7-6(14), and A-6(9) according to AASHTO specifications.

<u>Soil Type 2 – SILT / SILT with Sand / Silty SAND / Clayey SAND / Silty CLAY with Sand</u>

Soil Type 2 was observed to primarily consist of brown to blue-grey, moist to wet, soft to hard SILT, SILT with sand, and silty CLAY with sand, and loose to medium dense silty SAND and clayey SAND. Soil Type 2 was observed below Soil Type 1 in test pits TP-1 through TP-15, and soil borings SB-1 through SB-4. Soil Type 2 extended to a maximum depth of 33.4 feet in soil borings SB-1 through SB-4 where it was underlain by Soil Type 3.

Analytical laboratory testing conducted upon representative soil samples obtained from test pits TP-1, TP-4, and TP-5 and soil borings SB-1 and SB-2 indicated 32.4 to 92.7 percent by weight passing the No. 200 sieve and in situ moistures ranging from approximately 24.9 to 42.2 percent. Atterberg Limits analysis indicated liquid limits ranging from 26 to 33 percent and plasticity indices ranging from 3 to 12 percent. Several laboratory tested samples of Soil Type 2 exhibited nonplastic soil behavior. The laboratory tested samples of Soil Type 2 are classified SM, ML, CL-ML, and SC according to USCS specifications and A-4(2), A-4(3), A-4(4), A-4(5), A-4(0), A-4(8), and A-2-6(0) according to AASHTO specifications.

<u>Soil Type 3 – Weathered Conglomerate</u>

Semi-consolidated to unconsolidated conglomerate was encountered beneath Soil Type 2 at depths of 32 to 33.4 feet bgs in soil borings SB-1 through SB-4. Soil Type 3 was explored to a maximum depth of 55.3 feet bgs where exploration was terminated due to practical refusal of the drill rig. Soil Type 3 was visually observed to consist of orange-brown to varicolored, moist, very dense clayey gravel with sand and silt. Gravels, where present, were observed to be rounded to sub-rounded volcanic and sedimentary parent material. Analytical laboratory testing was not conducted upon soil samples obtained by SPT split-spoon samplers due to small quantities of recovery.

4.2.2 Groundwater

Groundwater seeps were encountered in test pit explorations TP-1 through TP-10 at depths ranging from 1 to 4 feet on April 18, 2018. Piezometers were installed in borings SB-1 and SB-2 to depths of 28 and 28.5 feet, respectively. Piezometers consist of 2-inch PVC pipe with 10 feet of screen at the bottom of the piezometer. Initial readings indicated groundwater as shallow as 3 feet below the piezometer lid elevation. Figure 2B presents piezometer locations and groundwater monitoring observations. Piezometers should be decommissioned in accordance with Washington Department of Ecology regulations prior to site improvements construction.

Groundwater levels are often subject to seasonal variance and may rise during extended periods of increased precipitation. Perched groundwater may also be present in localized areas. Seeps and springs may become evident during site grading, primarily along slopes or in areas cut below existing grade. Structures, roads, and drainage design should be planned accordingly.

Ponding water was observed at the ground surface throughout the site during the subsurface investigation conducted on April 18, 2018 and surficial drainage appeared to be poor. Runoff and groundwater from higher elevations to the north and northeast of the site likely impact the shallow water table on the property. A drainage ditch follows NE 23rd Avenue on its north side along the south boundary of the study area and carries runoff to the south and west. The drainage ditch contained ponded water at the time of the investigation on April 18, 2018, indicating inadequate gradient or blockage downstream.

5.0 DESIGN RECOMMENDATIONS

The geotechnical site investigation suggests the proposed development is generally compatible with surface and subsurface soils, provided the recommendations presented in this report are utilized and incorporated into the design and construction processes. The primary geotechnical concerns with the subject site are shallow groundwater and dynamic settlement. Design recommendations are presented in the following text sections.

5.1 Site Preparation and Grading

Vegetation, organic material, unsuitable fill, and deleterious material that may be encountered should be cleared from areas identified for structures and site grading. Vegetation, other organic material, and debris should be removed from the site. Stripped topsoil should also be removed or used only as landscape fill in nonstructural areas with slopes less than 25 percent. The stripping depth for sod and highly organic topsoil is anticipated to vary between 12 and 18 inches. The required stripping depth may increase in areas of existing fill, heavy organics, or previously existing structures. Actual stripping depths should be determined based upon visual observations made during construction when soil conditions are exposed. The post-construction maximum depth of landscape fill placed or spread at any location onsite should not exceed one foot.

Previously disturbed soil, debris, or unconsolidated fill encountered during grading or construction activities should be removed completely and thoroughly from structural areas. Demolition work prior to site improvements construction may generate unsuitable fill and disturbed soils in areas of old foundations, basement walls, utilities, and debris. These materials should also be thoroughly removed from structural areas and backfilled with engineered structural fill.

Test pits excavated during site exploration were backfilled loosely with onsite soils. These test pits should be located and properly backfilled with structural fill during site improvements construction. Trees, stumps, and associated roots should also be removed from structural areas, individually and carefully. Resulting cavities and excavation areas should be backfilled with engineered structural fill.

Site grading activities should be performed in accordance with requirements specified in the 2015 *International Building Code* (IBC), Chapter 18 and Appendix J, with exceptions noted in the text herein. Site preparation, soil stripping, and grading activities should be observed and documented by Columbia West.

5.2 Engineered Structural Fill

Areas proposed for fill placement should be appropriately prepared as described in the preceding text. Surface soils should then be scarified and compacted prior to additional fill placement. Engineered structural fill should be placed in loose lifts not exceeding 12 inches in depth and compacted using standard conventional compaction equipment. The soil moisture content should be within two percentage points of optimum conditions. A field density at least equal to 95 percent of the maximum dry density, obtained from the standard Proctor moisture-density relationship test (ASTM D698), is recommended for structural fill placement. For engineered structural fill placed on sloped grades, the area should be benched to provide a horizontal surface for compaction.

Compaction of engineered structural fill should be verified by nuclear gauge field compaction testing performed in accordance with ASTM D6938. Field compaction testing should be performed for each vertical foot of engineered fill placed. Engineered fill placement should be observed by Columbia West.

Engineered structural fill placement activities should be performed during dry summer months if possible. Clean fine-textured native soils may be suitable for use as structural fill if adequately dried or moisture-conditioned to achieve recommended compaction specifications. Native soils may require addition of moisture during periods of dry weather. Compacted fill soils should be covered shortly after placement.

Because they are moisture-sensitive, fine-textured soils are often difficult to excavate and compact during wet weather conditions. If adequate compaction is not achievable with clean native soils, import structural fill consisting of granular fill meeting WSDOT specifications for *Gravel Borrow 9-03.14(1)* is recommended.

Representative samples of proposed engineered structural fill should be submitted for laboratory analysis and approval by Columbia West prior to placement. Laboratory analyses should include particle-size gradation and standard Proctor moisture-density analysis.

5.3 Cut and Fill Slopes

Fill placed on existing grades steeper than 5H:1V should be horizontally benched at least 10 feet into the slope. Fill slopes greater than six feet in height should be vertically keyed into existing subsurface soil. A typical fill slope cross-section is shown in Figure 3. Drainage implementations, including subdrains or perforated drain pipe trenches, may also be necessary in proximity to cut and fill slopes if seeps or springs are encountered. Drainage design may be performed on a case-by-case basis. Extent, depth, and location of drainage may be determined in the field by Columbia West during construction when soil conditions are exposed. Failure to provide adequate drainage may result in soil sloughing, settlement, or erosion.

Final cut or fill slopes at the site should not exceed 2H:1V or 20 feet in height without individual slope stability analysis. The values above assume a minimum horizontal setback for loads of 10 feet from top of cut or fill slope face or overall slope height divided by three (H/3), whichever is greater. A minimum slope setback detail for structures is presented in Figure 4.

Concentrated drainage or water flow over the face of slopes should be prohibited, and adequate protection against erosion is required. Fill slopes should be constructed by placing fill material in maximum 12-inch level lifts, compacting as described in Section 5.2, *Engineered Structural Fill* and horizontally benching where appropriate. Fill slopes should be overbuilt, compacted, and trimmed at least two feet horizontally to provide adequate compaction of the outer slope face. Proper cut and fill slope construction is critical to overall project stability and should be observed and documented by Columbia West.

5.4 Foundations

Building foundations are anticipated to consist of shallow continuous perimeter or column spread footings. Footings should be designed by a licensed structural engineer and conform to the recommendations below. Typical building loads are not expected to exceed approximately 4 to 6 kips per foot for perimeter footings or 130 kips per column. If actual loading exceeds anticipated loading, additional analysis should be conducted for the specific load conditions and proposed footing dimensions.

The existing ground surface should be prepared as described in Section 5.1, *Site Preparation and Grading*, and Section 5.2, *Engineered Structural Fill*. Foundations should bear upon firm native soil or engineered structural fill.

To evaluate bearing capacity for proposed structures, serviceability and reliability of shear resistance for subsurface soils was considered. Allowable bearing capacity is typically a function of footing dimension and subsurface soil properties, including settlement and shear resistance. Based upon in situ field testing and laboratory analysis, the estimated allowable bearing capacity for well-drained foundations prepared as described above is 2,000 psf. Bearing capacity may be increased by one-third for transient lateral forces such as seismic or wind. The estimated coefficient of friction between in situ compacted native soil or engineered structural fill and in-place poured concrete is 0.45. Lateral forces may also be resisted by an assumed passive soil equivalent fluid pressure of 250 psf/f against embedded footings. The upper six inches of soil should be neglected in passive pressure calculations.

Footings should extend to a depth at least 18 inches below lowest adjacent grade to provide adequate bearing capacity and protection against frost heave. Foundations constructed during wet weather conditions will require over-excavation of saturated subgrade soils and granular structural backfill prior to concrete placement. Over-excavation recommendations should be provided by Columbia West during foundation excavation and construction. Excavations adjacent to foundations should not extend within a 1.5H:1V angle projected down from the outside bottom footing edge without additional geotechnical analysis.

Foundations should not be permitted to bear upon existing fill or disturbed soil. Because soil is often heterogeneous and anisotropic, Columbia West should observe foundation excavations prior to placing forms or reinforcing bar to verify subgrade support conditions are as anticipated in this report.

5.4.1 Luminaire, Signal, and Sign Foundations

Foundations for luminaire, signal, and sign poles should be designed in accordance with the *International Building Code (IBC) Chapter 18* by a licensed structural engineer. Based upon review of *IBC* literature, and SPT blow count observations made during the field exploration, the allowable lateral bearing pressure for foundations installed in competent native soils or engineered structural fill is 100 psf/ft up to a maximum of 1,000 psf. Columbia West should be contacted to review foundation designs and evaluate compatibility with geotechnical design assumptions.

5.5 Slabs on Grade

Proposed structures may have slab-on-grade floors. Slabs should be supported on firm, competent, in situ soil or engineered structural fill. Disturbed soils and unsuitable fills in proposed slab locations should be removed and replaced with structural fill. The modulus of subgrade reaction is estimated to be 100 psi/inch.

Preparation and compaction beneath slabs should be performed in accordance with the recommendations presented in Section 5.1, *Site Preparation and Grading* and Section 5.2, *Engineered Structural Fill*. Slabs should be underlain by at least 6 inches of 1 ¼”-0 crushed aggregate meeting WSDOT 9-03.9(3). Geotextile filter fabric conforming to *WSDOT 2010 Standard Specification M 41-10, 9-33.2(1), Geotextile Properties, Table 3: Geotextile for Separation or Soil Stabilization* may be used below the crushed aggregate to increase subgrade support. If desired, a moisture barrier may be constructed beneath the slabs. Slabs should be appropriately waterproofed in accordance with the desired type of finished flooring. Slab thickness and reinforcement should be designed by an experienced structural engineer in accordance with anticipated loads.

5.6 Static Settlement

Based upon the anticipated structural loading and allowable soil bearing pressure described above, Columbia West analyzed estimated static settlement for the proposed structure. Settlement analysis was conducted using Schmertmann's (1970, 1978) method to calculate vertical foundation displacement using CPT results.

Total long-term static footing displacement for shallow foundations constructed as described in this report is not anticipated to exceed approximately 1 inch. Differential settlement between comparably loaded footing elements is not expected to exceed approximately ½ inch over a span of 50 feet. The resulting vertical displacement after loading may be due to elastic distortion, dissipation of excess pore pressure, or soil creep.

The values above assume fill placement of no more than 4 feet across the proposed building footprint. Shallow foundations bearing upon engineered structural fill greater than 4 feet in thickness may be subject to additional settlement associated with large-area surcharge loading. Columbia West should be contacted to assess potential areal fill settlements once final grading plans and associated cut and fill plans are available.

5.7 Excavation

Soil borings SB-1 through SB-4 were advanced with mud-rotary and trailer-mounted solid-stem drill rigs to a maximum depth of 55.3 feet bgs due to practical refusal of the drill rig on competent conglomerate. Due to documented depths of bedrock in the explored locations, blasting or specialized rock-excavation techniques are not anticipated. As indicated previously in Section 4.2.2, *Groundwater,* seeps were encountered as shallow as one foot bgs. Documented groundwater depths on May 1, 2018 in piezometers P-1 and P-2 were observed at 4.2 and 3.5 feet bgs, respectively. Recommendations as described in Section 5.8, *Dewatering* should be considered in locations where subsurface construction activities intersect the water table

Based upon laboratory analysis and field testing, near-surface soils may be Washington State Industrial Safety and Health Administration (WISHA) Type C. For temporary open-cut excavations deeper than four feet, but less than 20 feet in soils of these types, the maximum allowable slope is 1.5H:1V. WISHA soil type should be confirmed during field construction activities by the contractor. Soil is often anisotropic and heterogeneous, and it is possible that WISHA soil types determined in the field may differ from those described above.

Site-specific shoring design may be required if open-cut excavations are infeasible or if excavations are proposed adjacent to existing infrastructure. Typical methods for stabilizing excavations consist of soldier piles and timber lagging, sheet pile walls, tiebacks and shotcrete, or pre-fabricated hydraulic shoring. Because lateral earth pressure distributions acting on below-grade structures are dependent upon the type of shoring system used, Columbia West should be contacted to conduct additional analysis when shoring type, excavation depths, and locations are known.

The contractor should be held responsible for site safety, sloping, and shoring. Columbia West is not responsible for contractor activities and in no case should excavation be conducted in excess of all applicable local, state, and federal laws.

5.8 Dewatering

Groundwater elevation and hydrostatic pressure should be carefully considered during design of utilities, retaining walls, or other structures that require below-grade excavation. As described previously, shallow seasonal groundwater may be encountered in areas proposed for development. Utility trenches in shallow groundwater areas or excavations and cuts that remain open for even short periods of time may undermine or collapse due to groundwater effects. Placement of layers of riprap or quarry spalls in localized areas on shallow excavation side slopes may be required to limit instability. Over-excavation and stabilization of pipe trenches or other excavations with imported crushed aggregate or gabion rock may also be necessary to provide adequate subgrade support.

Significant pumping and dewatering may be required to temporarily reduce the groundwater elevation to allow construction of proposed below-grade structures, installation of utilities, or placement of structural fills. Dewatering via a sump within excavation zones may be insufficient to control groundwater and provide excavation side slope stability. Dewatering may be more feasibly conducted by installing a system of temporary well points and pumps around proposed excavation areas or utility trenches. Depending on proposed utility depths, a site-specific dewatering plan may be necessary. Well pumps should remain functioning at all times during the excavation and construction period. Suitable back-up pumps and power supplies should be available to prevent unanticipated shut-down of dewatering equipment. Failure to operate pumps full-time may result in flooding of the excavation zones, resulting in damage to forms, slopes, or equipment.

Columbia West recommends that the contractor be required to prepare and present a detailed dewatering plan. The contractor should consult with a dewatering professional, as necessary, to provide an adequate dewatering plan for site conditions. If additional subsurface information not provided in the site-specific geotechnical report is necessary to complete the dewatering plan, the contractor shall be responsible for securing all the required information necessary for the design of the system. The contractor should be required to acknowledge the existence of challenging surface and subsurface soil conditions including, but not limited to, shallow groundwater, low-strength soils, potential running sands, and potential collapsing trench conditions.

The dewatering plan should be submitted and reviewed by the owner prior to commencement of construction activities requiring dewatering. The dewatering plan should include, at a minimum, well construction details, pumping rates, radius of influence of pumping wells, effluent flow rates, water disposal locations, outfall scour considerations, and all applicable environmental considerations.

5.9 Lateral Earth Pressure

If retaining walls are proposed, lateral earth pressures should be carefully considered in the design process. Hydrostatic pressure and additional surcharge loading should also be considered. Retained material may include engineered structural backfill or undisturbed native soil. Structural wall backfill should consist of imported granular material meeting *Section 9-03.12(2)* of WSDOT Standard Specifications. Backfill should be prepared and compacted to at least 95 percent of maximum dry density as determined by the modified Proctor test (ASTM D1557). Recommended parameters for lateral earth pressures for retained soils and engineered structural backfill consisting of imported granular fill meeting WSDOT specifications for *Gravel Backfill for Walls 9-03.12(2)* are presented in Table 1.

The design parameters presented in Table 1 are valid for static loading cases only and are based upon in situ soils or compacted granular fill. The recommended earth pressures do not include surcharge loads, dynamic loading, hydrostatic pressure, or seismic design.

If seismic design is required for unrestrained walls, seismic forces may be calculated by superimposing a uniform lateral force of $10H^2$ pounds per lineal foot of wall, where H is the total wall height in feet. If seismic design is required for restrained walls, seismic forces may be calculated by superimposing a uniform lateral force of $25H^2$ pounds per lineal foot of wall. The resultant force should be applied at 0.6H from the base of the wall. If sloped backfill conditions are proposed for the site, Columbia West should be contacted for additional analysis and associated recommendations.

Table 1. Lateral Earth Pressure Parameters for Level Backfill

Retained Soil	Equivalent Fluid Pressure for Level Backfill			Wet Density	Drained Internal Angle of Friction
	At-rest	Active	Passive		
Undisturbed native Lean CLAY / Lean CLAY with Sand / Sandy Lean CLAY (Soil Type 1)	58 pcf	40 pcf	305 pcf	110 pcf	28°
Approved Structural Backfill Material	52 pcf	32 pcf	568 pcf	135 pcf	38°
WSDOT 9-03.12(2) compacted aggregate backfill					

** The upper 6 inches of soil should be neglected in passive pressure calculations. If exterior grade from top or toe of retaining wall is sloped, Columbia West should be contacted to provide location-specific lateral earth pressures.*

A continuous one-foot-thick zone of free-draining, washed, open-graded 1-inch by 2-inch drain rock and a 4-inch perforated gravity drain pipe is assumed behind retaining walls. Geotextile filter fabric should be placed between the drain rock and backfill soil. Specifications for drainpipe design are presented in Section 5.14, *Drainage*. If walls cannot be gravity drained, saturated base conditions and/or applicable hydrostatic pressures should be assumed.

Final retaining wall design should be reviewed and approved by Columbia West. Retaining wall subgrade and backfill activities should also be observed and tested for compliance with recommended specifications by Columbia West during construction.

5.10 Seismic Design Considerations

According to the *United States Geologic Survey (USGS) 2012 Seismic Design Maps Summary Report,* the anticipated peak ground and maximum considered earthquake spectral response accelerations resulting from seismic activity for the subject site are summarized in Table 2.

Table 2. Approximate Probabilistic Ground Motion Values for 'firm rock' sites based on subject property longitude and latitude

	2% Probability of Exceedance in 50 yrs
Peak Ground Acceleration	0.39 g
0.2 sec Spectral Acceleration	0.89 g
1.0 sec Spectral Acceleration	0.40 g

The listed probabilistic ground motion values are based upon "firm rock" sites with an assumed shear wave velocity of 2,500 ft/s in the upper 100 feet of soil profile. These values should be adjusted for site class effects by applying site coefficients Fa and Fv as defined in *2015 IBC Tables 1613.3.3(1)* and *(2)*; the PGA should be adjusted by applying the site coefficient F_{PGA} as defined by *ASCE 7, Chapter 11, Table 11.8-1.* The site coefficients are intended to more accurately characterize estimated peak ground and respective earthquake spectral response accelerations by considering site-specific soil characteristics and index properties.

The *Site Class Map of Clark County, Washington* (Washington State Department of Natural Resources, 2004), indicates site soils may be represented by Site Class C as defined in 2015 IBC Section 1613.3.5. However, subsurface exploration, in situ soil testing, and review of local well logs and geologic maps indicates that site soils exhibit characteristics of Site Class D. This site class designation indicates that some amplification of seismic energy may occur during a seismic event because of subsurface conditions.

Localized peak ground accelerations exceeding the adjusted values may occur in some areas in direct proximity to an earthquake's origin. This may be a result of amplification of seismic energy due to depth to competent bedrock, compression and shear wave velocity of bedrock, presence and thickness of loose, unconsolidated alluvial deposits, soil plasticity, grain size, and other factors.

Identification of specific seismic response spectra is beyond the scope of this investigation. If site structures are designed in accordance with recommendations specified in the *2015 IBC*, the potential for peak ground accelerations in excess of the adjusted and amplified values should be understood.

5.11 Soil Liquefaction and Dynamic Settlement

According to the *Liquefaction Susceptibility Map of Clark County Washington* (Washington State Department of Natural Resources, 2004), the site is mapped as very low susceptibility for liquefaction. However, approximately one-half south and southwest of the subject site toward the East Fork Lewis River, hazard mapping indicates the area has moderate to high susceptibility to liquefaction.

Procedures for evaluation of liquefaction resistance of soils have been developed based upon empirical data from liquefaction case studies and have become standard of practice in the United States. These empirical procedures are based upon correlation with SPT data or CPT data. CPT data obtained in the field are used in a series of empirical equations developed using previous data from liquefaction case studies. The procedure uses the CPT data to calculate two variables: the cyclic stress ratio (CSR), or the demand imposed on the soil layer due to an expected seismic event; and the cyclic resistance ratio (CRR), or the capacity of the soil to resist liquefaction. The ability of a soil to resist liquefaction can be calculated as the ratio of CRR to CSR and represented as a factor of safety. In general, a factor of safety greater than 1.3 is considered an acceptable risk.

Soils most susceptible to liquefaction are generally saturated, cohesionless, loose to medium-dense sands within 50 feet of the ground surface. Recent research has also indicated that low plasticity silts and clays may also be subject to sand-like liquefaction behavior if the plasticity index determined by the Atterberg Limits analysis is less than 8. Potentially liquefiable soils located above the existing, historic, or expected groundwater levels do not generally pose a liquefaction hazard. It is important to note that changes in perched groundwater elevation may occur due to project development or other factors not observed at the time of investigation.

The liquefaction potential for soils underlying the site was analyzed using the CLiq program and the Robertson NCEER method of analysis. Liquefaction analysis was conducted to explored depths of 31.3 to 34.4 feet bgs on the soil profiles obtained from explorations CPT-1 through CPT-3. Using a peak horizontal ground acceleration of 0.39g, an earthquake moment magnitude of 7.82 (based upon deaggregation of seismic hazards for the site using the *National Seismic Hazards Mapping Project, USGS 2008)*, and a design groundwater depth of 3 feet below existing grade, the factor of safety was less than 1.3 for several soil layers, indicating high potential for liquefaction during a seismic event.

Table 3. Estimated Total Settlement Induced by Liquefaction

Exploration	Liquefaction Evaluation Method	Anticipated Vertical Settlement with Depth Weighting Factor Applied
CPT-1	Robertson (NCEER 1998, 2009)	2.2 inches
CPT-2	Robertson (NCEER 1998, 2009)	2.2 inches
CPT-3	Robertson (NCEER 1998, 2009)	4.9 inches

Based upon the empirical procedures and input data described above, the total estimated settlement due to liquefaction at the analyzed location is presented in Table 3. The analysis output of CLiq is presented in Appendix E. Note that dynamic settlement induced by liquefaction occurs via different mechanisms than the estimated static settlement described in Section 5.6, *Static Settlement*. Differential liquefaction settlement between comparably loaded footings over a span of 50 feet is not expected to exceed approximately half of the highest total settlement estimate shown in Table 3.

According to Cetin et al, a depth weighting factor may be applied to the analysis of dynamic settlement. The depth weighting factor captures the effects of void ratio redistribution in shallower sublayers, reduced shear stresses and number of shear cycles transmitted to deeper soils due to the liquefaction of shallower soils, and arching of non-liquefiable soil layers.

5.12 Settlement Mitigation and Soil Improvements

As described below, potential earthquake-induced liquefaction settlements may be reduced by soil improvements. One or a combination of these soil improvement or mitigation methods may be desired to increase soil shear strength and reduce the amount of potential settlement. As previously mentioned, if structural fills are placed in excess of four feet in thickness, shallow foundations may be subject to additional static settlement associated with large-area surcharge loading. Columbia West should be contacted to assess potential areal fill settlements once final grading plans and associated cut and fill plans are available.

In-situ soil densification may be considered to reduce potential liquefaction settlement. A variety of soil improvement methods are available. Some improvement methods, such as dynamic compaction, may not be feasible due to observed subsurface conditions. However, other improvement methods such as compaction grouting, rammed-aggregate piers, or stone columns may be possible. The compaction grouting process consists of injecting pressurized grout into the loose or weak soil layer in a closely-spaced grid pattern. Stone columns and rammed-aggregate piers are similarly constructed in a grid pattern and may be installed by vibratory or other methods. Both methods increase relative density by densifying the soil between the grout or stone column locations, thereby reducing potential for liquefaction. Stone columns may also provide drainage pathways to allow pore pressures in potentially liquefiable layers to dissipate more quickly. Other mitigation techniques may include driven grout piles or standard steel or concrete piles. Proposed soil improvement programs should be developed by a specialized contractor working in cooperation with licensed geotechnical and structural engineers.

Soil improvements may reduce the potential liquefaction-induced movements to an acceptable level of risk. After an appropriate mitigation plan is selected, additional in-situ testing prior to construction may be conducted to determine the level of improvement achieved and reevaluate the liquefaction potential. Selection of an appropriate mitigation plan may depend upon site planning, architectural, and structural engineering factors in addition to geotechnical concerns. All parties involved should work closely together to develop a suitable improvement plan with a clear understanding of the risks.

5.13 Infiltration Testing Results

To investigate the feasibility of subsurface disposal of stormwater, Columbia West conducted in situ infiltration testing at four locations within the project area on August 31, 2018. Results of in situ infiltration testing are presented in Table 4. The soil classifications presented in Table 4 are based upon visual assessment. The measured infiltration rates are presented as a coefficient of permeability (k) and have been reported without application of a factor of safety.

As indicated in Table 4, tests were conducted in test pits TP-11 through TP-14 at the indicated depths. Tested native soils are visually classified as lean CLAY.

Table 4. Infiltration Test Data

Test Number	Location	Approximate Test Depth (feet bgs)	Groundwater Depth **(8-31-18)**	Soil Type (Visual Classification)	Passing No. 200 Sieve (%)	Infiltration Rate (*Coefficient of Permeability, k)
IT-1	TP-11	2.0	Not encountered to 2 feet bgs	CL, Lean CLAY	-	0.20
IT-2	TP-12	2.0	Not encountered to 2 feet bgs	CL, Lean CLAY	-	0.05
IT-3	TP-13	2.0	Not encountered to 2 feet bgs	CL, Lean CLAY	-	0.01
IT-4	TP-14	2.0	Not encountered to 14 feet bgs	CL, Lean CLAY	-	0.02

*Infiltration rate as defined by soil's approximate vertical coefficient of permeability (k).

Single-ring, falling head infiltration testing was performed by inserting three-inch diameter pipes into the soil at the noted depths. The tests were conducted by filling the pipes with water and measuring time relative to changes in hydraulic head at regular intervals. Using Darcy's Law for saturated flow in homogeneous media, the coefficient of permeability (k) was then calculated.

Due to the presence of fine-textured, low permeability soils at the site, subsurface disposal of concentrated stormwater is likely infeasible and is not recommended without further study.

5.14 Drainage

At a minimum, site drainage should include surface water collection and conveyance to properly designed stormwater management structures and facilities. Drainage design in general should conform to City of La Center regulations. Finished site grading should be conducted with positive drainage away from structures. Depressions or shallow areas that may retain ponding water should be avoided. Roof drains, low-point drains, and perimeter foundation drains are recommended for structures. Drains should consist of separate systems and gravity flow with a minimum two-percent slope away from foundations into the stormwater system or approved discharge location.

Perimeter foundation drains should consist of 3-inch perforated PVC pipe surrounded by a minimum of 1 ft^3 of clean, washed drain rock per linear foot of pipe and wrapped with geotextile filter fabric. Open-graded drain rock with a maximum particle size of 3 inches and less than 2 percent passing the No. 200 sieve is recommended. Geotextile filter fabric should consist of Mirafi 140N or approved equivalent, with AOS between No. 70 and No. 100 sieve. The water permittivity should be greater than 1.5/sec. Figure 5 presents a typical foundation drain. Perimeter drains may limit increased hydrostatic pressure beneath footings and assist in reducing potential perched moisture areas.

Subdrains should also be considered if portions of the site are cut below surrounding grades. Shallow groundwater, springs, or seeps should be conveyed via drainage channel or perforated pipe into the stormwater management system or an approved discharge. Recommendations for design and installation of perforated drainage pipe may be performed on a case-by-case basis by the geotechnical engineer during construction. Failure to provide adequate surface and sub-surface drainage may result in soil slumping or unanticipated settlement of structures exceeding tolerable limits. A typical perforated drain pipe trench detail is presented in Figure 6.

Site improvements construction in some areas may occur at or near the shallow seasonal groundwater table, particularly if work is conducted during wet-weather conditions. Dewatering may be necessary and a drainage mat may be required to achieve sufficient elevation for fill placement. A typical drainage mat is shown on Figure 7. Columbia West should determine drainage mat location, extent, and thickness when subsurface conditions are exposed. Drainage mats may need to be constructed in conjunction with subdrains to convey captured water to an approved discharge location. If slabs are proposed at cut or existing grade elevations, underdrains may be needed to provide adequate drainage.

Foundation drains and subdrains should be closely monitored after construction to assess their effectiveness. If additional surface or shallow subsurface seeps become evident, the drainage provisions may require modification or additional drains. Columbia West should be consulted to provide appropriate recommendations.

5.15 Bituminous Asphalt and Portland Cement Concrete

Review of site layout plans and correspondence with the design team indicates that proposed development includes asphalt paved access drives and parking lots for passenger cars and school busses. Columbia West conducted engineering analysis for flexible pavement design using the 1993 *AASHTO Guide for Design of Pavement Structures* in general accordance with Washington State Department of Transportation (WSDOT) structural design policy. Design Equivalent Single Axle Loads (ESALS) over a 20-year period are primarily based upon bus count information provided by PBS Engineering and Environmental, Inc. and commonly published Load Equivalency Factors (LEFs). Construction traffic was not included in the analysis. Minimum structural thickness recommendations and associated specifications for proposed flexible pavement structures are provided in Table 5.

Table 5. Flexible Pavement Section Recommendations

Pavement Section Layer	Minimum Layer Thickness		Specifications
	Passenger Car Parking and Access Drives*	Heavy Vehicle Parking and Access Drives**	
Asphalt concrete surface HMA Class ½” PG 70-22	3 inches	4 inches	91 percent of maximum Rice density (ASTM D2041)
Base course (WSDOT 9-03.9(3) 1¼”-0 crushed aggregate	6 inches	12 inches	Compacted to 95 percent of maximum modified Proctor density (ASTM D1557)
Scarified and compacted existing subgrade material	12 inches	12 inches	Compacted to 95 percent of maximum standard Proctor density (ASTM D1557)

* Design recommendations assume that passenger car parking and access drives are not subject to bus or other heavy traffic.

** General recommendations based up on maximum traffic loading of up to 34 heavy vehicles or busses per day. If actual truck traffic substantially exceeds 34 trucks per day, reduced pavement serviceability and design life should be expected.

For dry weather construction, pavement surface sections should bear upon competent subgrade consisting of scarified and compacted native soil or engineered structural fill. Wet weather pavement construction is discussed in Section 5.16, *Wet Weather Construction Methods and Techniques*. Subgrade conditions should be evaluated and tested by Columbia West prior to placement of crushed aggregate base. Subgrade evaluation should include nuclear gauge density testing and wheel proof-roll observations conducted with a 12-cubic yard, double-axle dump truck or equivalent. Nuclear gauge density testing should be conducted at 150-foot intervals or as determined by the onsite geotechnical engineer. Subgrade soil should be compacted to at least 95 percent of the modified Proctor dry density, as determined by ASTM D1557. Areas of observed deflection or rutting during proof-roll evaluation should be excavated to a firm surface and replaced with compacted crushed aggregate.

Crushed aggregate base should be compacted and tested in accordance with the specifications outlined above. Asphalt concrete pavement should be compacted to at least 91 percent of maximum Rice density. Nuclear gauge density testing should be conducted to verify adherence to recommended specifications. Testing frequency should be in accordance with Washington Department of Transportation and City of La Center specifications.

Portland cement concrete curbs and sidewalks should be installed in accordance with City of La Center specifications. Curb and sidewalk aggregate base should be observed and proof-rolled by Columbia West. Soft areas that deflect or rut should be stabilized prior to pouring concrete. Concrete should be tested during installation in accordance with ASTM C171, C138, C231, C143, C1064, and C31. This includes casting of cylinder specimen at a frequency of four cylinders per 100 cubic yards of poured concrete. Recommended field concrete testing includes slump, air entrainment, temperature, and unit weight.

5.16 Wet Weather Construction Methods and Techniques

Wet weather construction often results in significant shear strength reduction and soft areas that may rut or deflect. Installation of granular working layers may be necessary to provide a firm support base and sustain construction equipment. Granular layers should consist of all-weather gravel, 2x4-inch gabion, or other similar material (six-inch maximum size with less than five percent passing the No. 200 sieve).

Construction equipment traffic across exposed soil should be minimized. Equipment traffic induces dynamic loading, which may result in weak areas and significant reduction in shear strength for wet soils. Wet weather construction may also result in generation of significant excess quantities of soft wet soil. This material should be removed from the site or stockpiled in a designated area.

Construction during wet weather conditions may require increased base thickness. Over-excavation of subgrade soils or subgrade amendment with lime and/or cement may be necessary to provide a firm base upon which to place crushed aggregate. Geotextile filter fabric is also recommended. If soil amendment with lime or cement is considered, Columbia West should be contacted to provide appropriate recommendations based upon observed field conditions and desired performance criteria.

Crushed aggregate base should be installed in a single lift with trucks end-dumping from an advancing pad of granular fill. During extended wet periods, stripping activities may also need to be conducted from an advancing pad of granular fill. Once installed, the crushed aggregate base should be compacted with several passes from a static drum roller. A vibratory compactor is not recommended because it may further disturb the subgrade. Subdrains may also be necessary to provide subgrade drainage and maintain structural integrity.

Crushed aggregate base should be compacted to at least 95 percent of maximum dry density according to the modified Proctor density test (ASTM D1557). Compaction should be verified by nuclear gauge density testing. Observation of a proof-roll with a loaded dump truck is also recommended as an indication of the compacted aggregate's performance.

It should be understood that wet weather construction is risky and costly. Columbia West should observe and document wet weather construction activities. Proper construction methods and techniques are critical to overall project integrity.

5.17 Erosion Control Measures

Based upon field observations and laboratory testing, the erosion hazard for site soils in flat to shallow-gradient portions of the property is likely to be low. The potential for erosion generally increases in sloped areas. Therefore, disturbance to vegetation in sloped areas should be minimized during construction activities. Soil is also prone to erosion if unprotected and unvegetated during periods of increased precipitation. Erosion can be minimized by performing construction activities during dry summer months.

Site-specific erosion control measures should be implemented to address the maintenance of exposed areas. This may include silt fence, biofilter bags, straw wattles, or other suitable methods. During construction activities, exposed areas should be well-compacted and protected from erosion with visqueen, surface tackifier, or other means, as appropriate. Temporary slopes or exposed areas may be covered with straw, crushed aggregate, or riprap in localized areas to minimize erosion. Erosion and water runoff during wet weather conditions may be controlled by application of strategically placed channels and small detention depressions with overflow pipes.

After grading, exposed surfaces should be vegetated as soon as possible with erosion-resistant native vegetation. Jute mesh or straw may be applied to enhance vegetation. Once established, vegetation should be properly maintained. Disturbance to existing native vegetation and surrounding organic soil should also be minimized during construction activities.

5.18 Soil Shrink/Swell Potential

Based upon laboratory analysis, near-surface soils may contain as much as 88.9 percent by weight passing the No. 200 sieve and exhibit a plasticity index ranging from 0 to 22 percent. This indicates the potential for soil shrinking or swelling and underscores the importance of proper moisture conditioning during fill placement. Medium to high plasticity soils should be placed and compacted at a moisture content approximately two percent above optimum as determined by laboratory analysis.

5.19 Utility Installation

Utility installation may require subsurface excavation and trenching. Excavation, trenching and shoring should conform to federal (Occupational Safety and Health Administration) (OSHA) (29 CFR, Part 1926) and *WISHA* (WAC, Chapter 296-155) regulations. Site soils may slough when cut vertically and sudden precipitation events or perched groundwater may result in accumulation of water within excavation zones and trenches.

Utilities should be installed in general accordance with manufacturer's recommendations. Utility trench backfill should consist of *WSDOT 9-03.19 Bank Run Gravel for Trench Backfill* or *WSDOT 9-03.14(2) Select Borrow* with a maximum particle size of 2 ½-inches. Trench backfill material within 18 inches of the top of utility pipes should be hand compacted (i.e., no heavy compaction equipment). The remaining backfill should be compacted to at least 95 percent of maximum dry density as determined by the standard Proctor moisture-density test (ASTM D698). Clean, free-draining, fine bedding sand is recommended for use in the pipe zone. With exception of the pipe zone, backfill should be placed in loose lifts not exceeding 12 inches in thickness.

Compaction of utility trench backfill material should be verified by nuclear gauge field compaction testing performed in accordance with ASTM D6938. It is recommended that field compaction testing be performed at 200-foot intervals along the utility trench centerline at the surface and midpoint depth of the trench. Compaction frequency and specifications may be modified for non-structural areas in accordance with recommendations of the site geotechnical engineer.

6.0 CONCLUSION AND LIMITATIONS

This geotechnical site investigation report was prepared in accordance with accepted standard conventional principles and practices of geotechnical engineering. This investigation pertains only to material tested and observed as of the date of this report and is based upon proposed site development as described in the text herein. This report is a professional opinion containing recommendations established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. Soil conditions may differ between tested locations or over time. Slight variations may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent QA/QC construction observation and testing to verify soil conditions are as anticipated in this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Columbia West cannot accept responsibility for deviations from recommendations described in this report. Future performance of structural facilities is often related to the degree of construction observation by qualified personnel. These services should be performed to the full extent recommended.

This report is not an environmental assessment and should not be construed as a representative warranty of site subsurface conditions. The discovery of adverse environmental conditions, or subsurface soils that deviate significantly from those described in this report, should immediately prompt further investigation. The above statements are in lieu of all other statements expressed or implied.

This report was prepared solely for the client and is not to be reproduced without prior authorization from Columbia West. Final engineering plans and specifications for the project should be reviewed and approved by Columbia West as they relate to geotechnical and grading issues prior to final design approval. Columbia West is not responsible for independent conclusions or recommendations made by other parties based upon information presented in this report. Unless a particular service was expressly included in the scope, it was not performed and there should be no assumptions based upon services not provided. Additional report limitations and important information about this document are presented in Appendix F. This information should be carefully read and understood by the client and other parties reviewing this document.

Sincerely,
COLUMBIA WEST ENGINEERING, Inc.

Lance V. Lehto, PE, GE
President

LANCE V. LEHTO
36301
10-3-18

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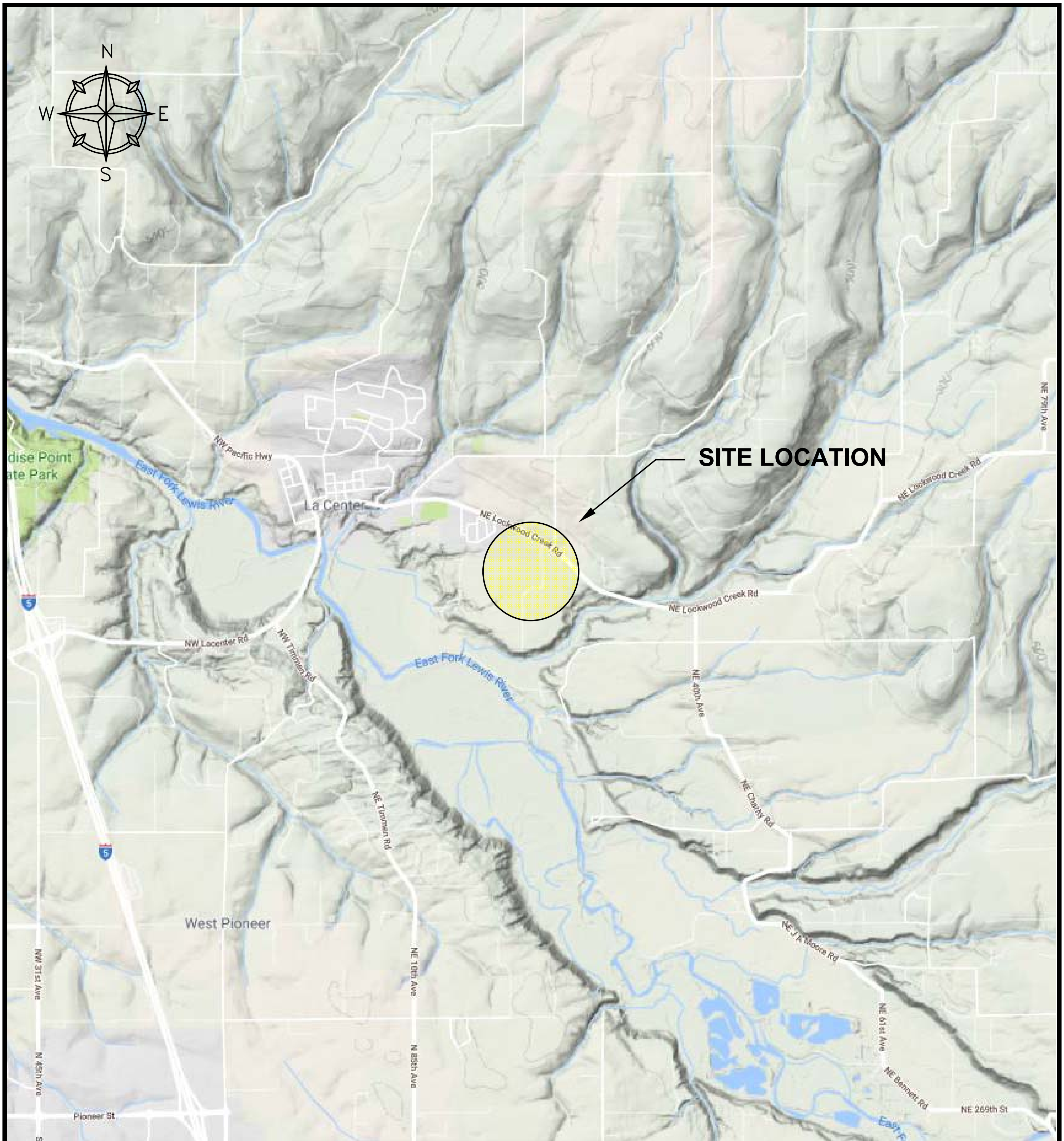
FIGURES



MAP SOURCE: Google Maps 2018

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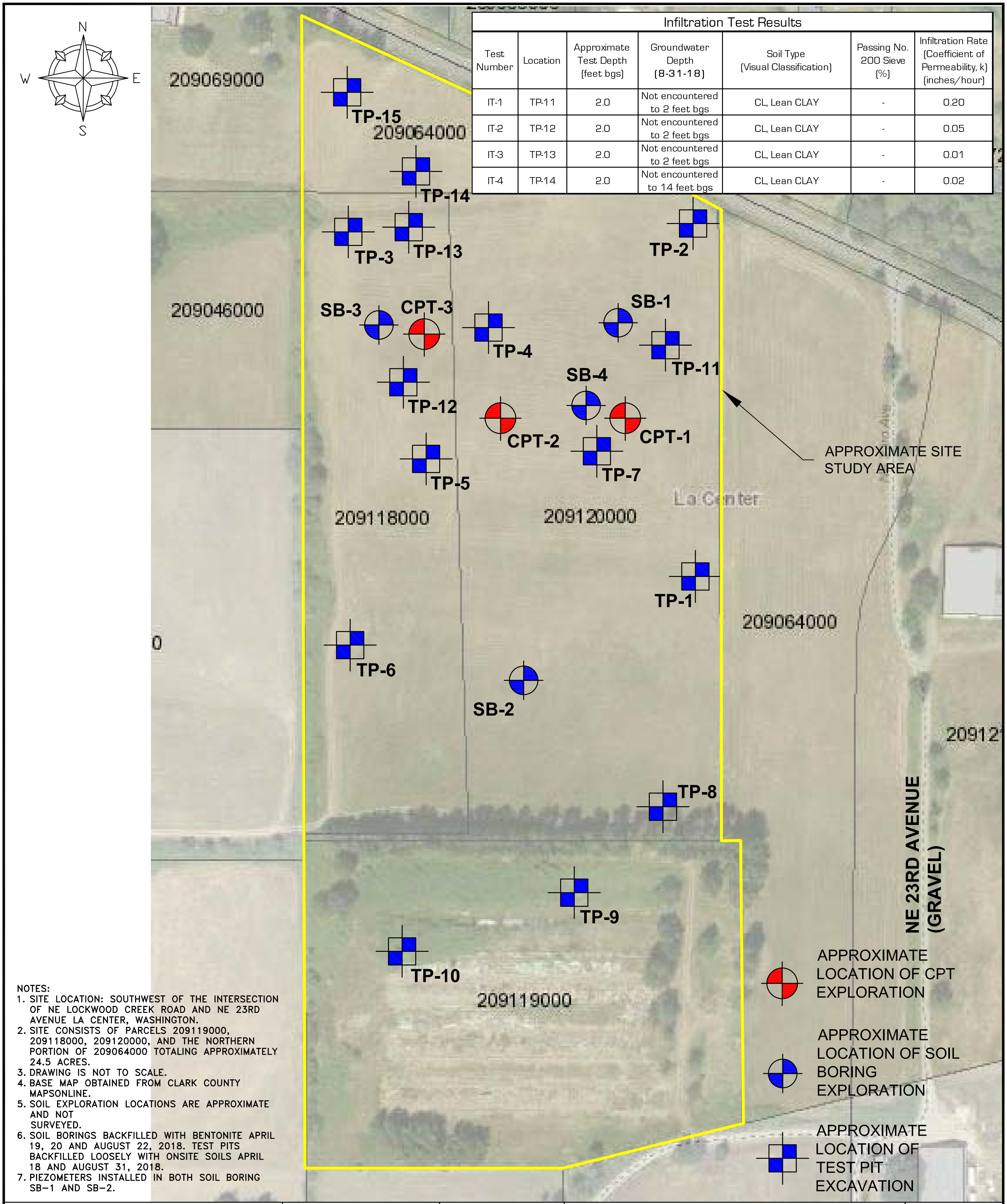
Design	Drawn: HDG		
Checked: ASR	Date: 08/09/2018		
Client: LCSD	Rev	By	Date
Job No.: 18084			
CAD File: FIGURE 1			
Scale: NTS			

SITE LOCATION MAP

LA CENTER MIDDLE SCHOOL
LA CENTER, WASHINGTON

FIGURE
1



Infiltration Test Results

Test Number	Location	Approximate Test Depth (feet bgs)	Groundwater Depth (8-31-18)	Soil Type (Visual Classification)	Passing No. 200 Sieve (%)	Infiltration Rate (Coefficient of Permeability, k) (inches/hour)
IT-1	TP-11	2.0	Not encountered to 2 feet bgs	CL, Lean CLAY	-	0.20
IT-2	TP-12	2.0	Not encountered to 2 feet bgs	CL, Lean CLAY	-	0.05
IT-3	TP-13	2.0	Not encountered to 2 feet bgs	CL, Lean CLAY	-	0.01
IT-4	TP-14	2.0	Not encountered to 14 feet bgs	CL, Lean CLAY	-	0.02

NOTES:
1. SITE LOCATION: SOUTHWEST OF THE INTERSECTION OF NE LOCKWOOD CREEK ROAD AND NE 23RD AVENUE LA CENTER, WASHINGTON.
2. SITE CONSISTS OF PARCELS 209119000, 209118000, 209120000, AND THE NORTHERN PORTION OF 209064000 TOTALING APPROXIMATELY 24.5 ACRES.
3. DRAWING IS NOT TO SCALE.
4. BASE MAP OBTAINED FROM CLARK COUNTY MAPSONLINE.
5. SOIL EXPLORATION LOCATIONS ARE APPROXIMATE AND NOT SURVEYED.
6. SOIL BORINGS BACKFILLED WITH BENTONITE APRIL 19, 20 AND AUGUST 22, 2018. TEST PITS BACKFILLED LOOSELY WITH ONSITE SOILS APRIL 18 AND AUGUST 31, 2018.
7. PIEZOMETERS INSTALLED IN BOTH SOIL BORING SB-1 AND SB-2.

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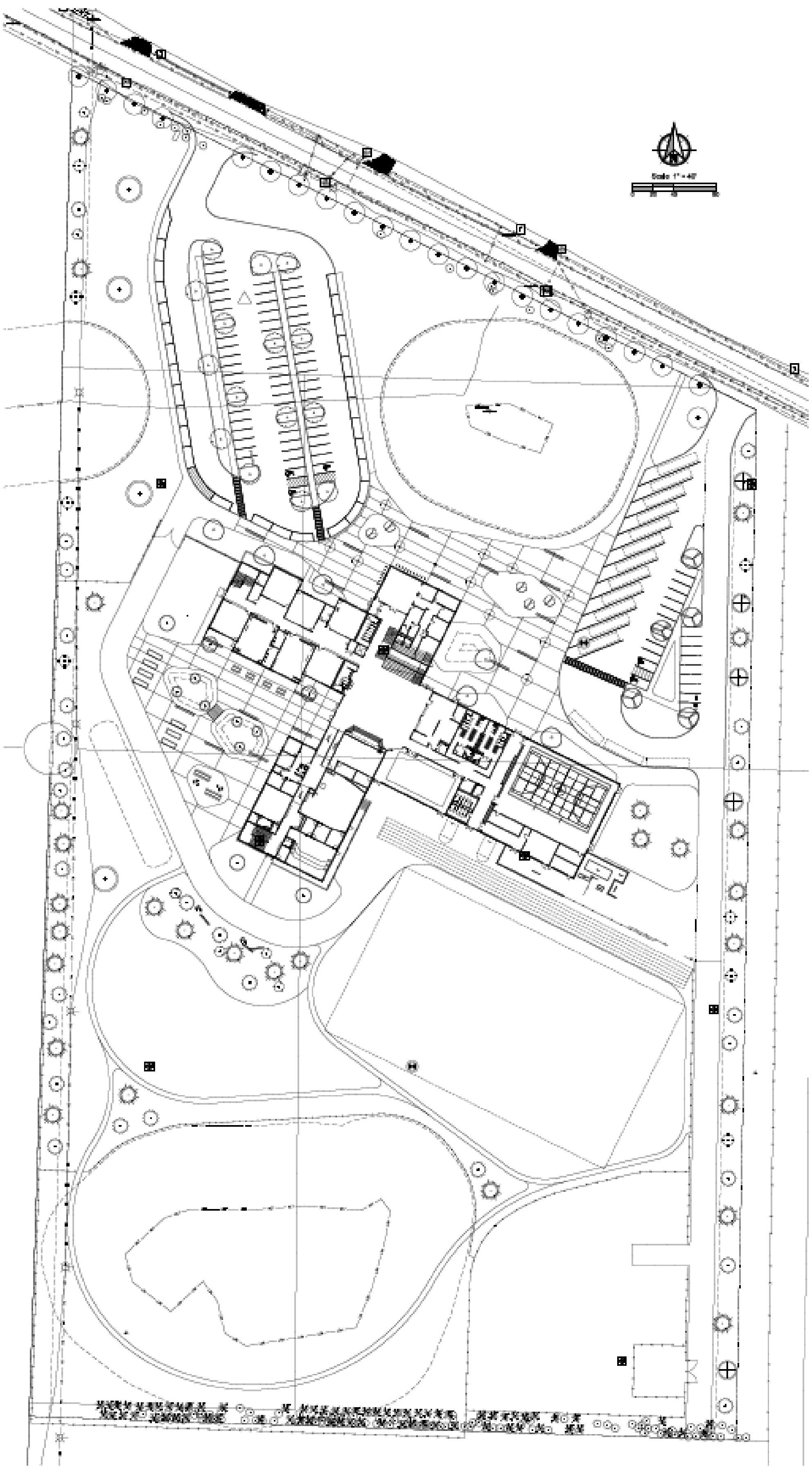
Design:
Checked: ASR
Client: LCSD
Job No: 18084
CAD File: FIGURE 2
Scale: NONE
Drawn: HDG
Date: 9/14/18

Rev	By	Date

SUBSURFACE EXPLORATION LOCATION MAP

LA CENTER MIDDLE SCHOOL
LA CENTER, WASHINGTON

FIGURE
2



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Design:
Checked: ASR
Client: LCSD
Job No: 18084
CAD File: FIGURE 2A
Scale: NONE

Drawn: HDG
Date: 10/2/18

Rev	By	Date

PROPOSED SITE PLAN

LA CENTER MIDDLE SCHOOL
LA CENTER, WASHINGTON

FIGURE
2A

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FIGURE
2B

La Center Middle School
La Center School District
La Center, Washington
CWE W.O. #: 18084

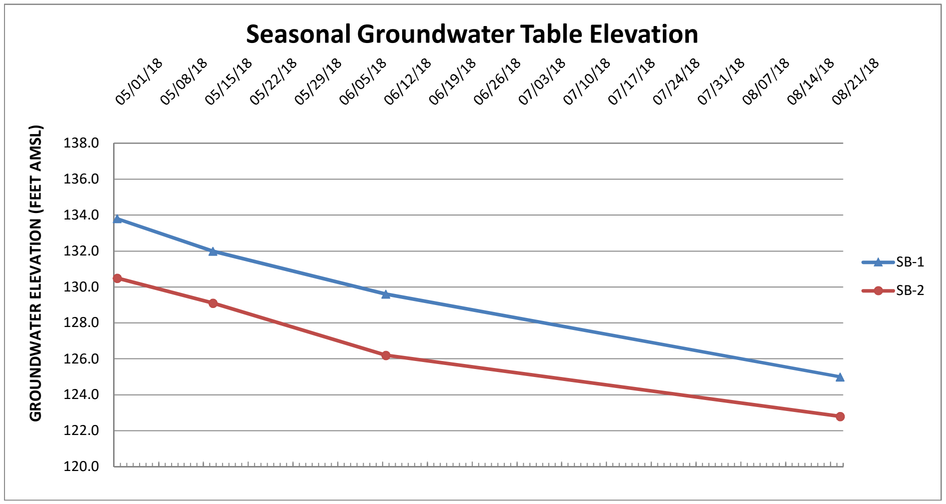
- 2" PVC Piezometers installed on 4/19 and 4/20 2018.
- All elevations approximate based upon Clark County GIS topographic info.
- Lid Elevation = Ground Surface for depth measurements.

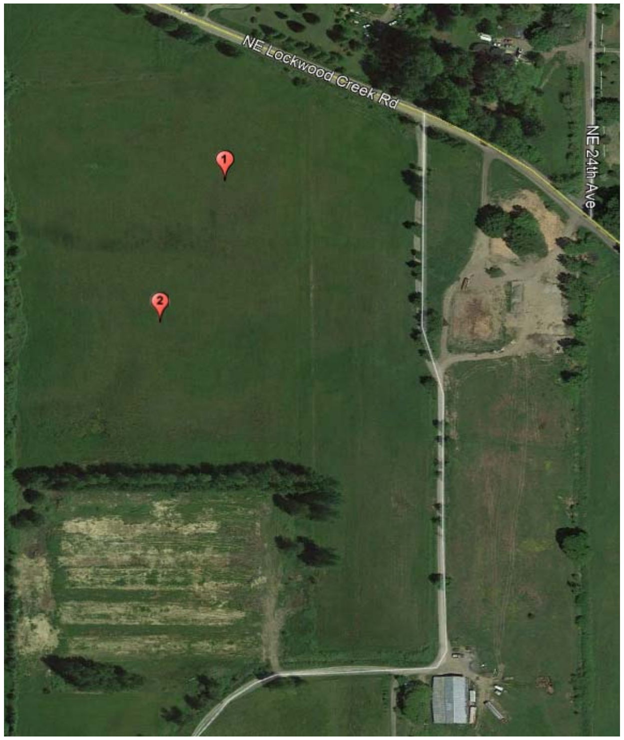
* Initial water level measurement taken during construction of wells. This value is not plotted on the chart below.

SB-1
Piezometer Depth (ft) = 28.5
Apx. Lid Elevation (ft) = 138

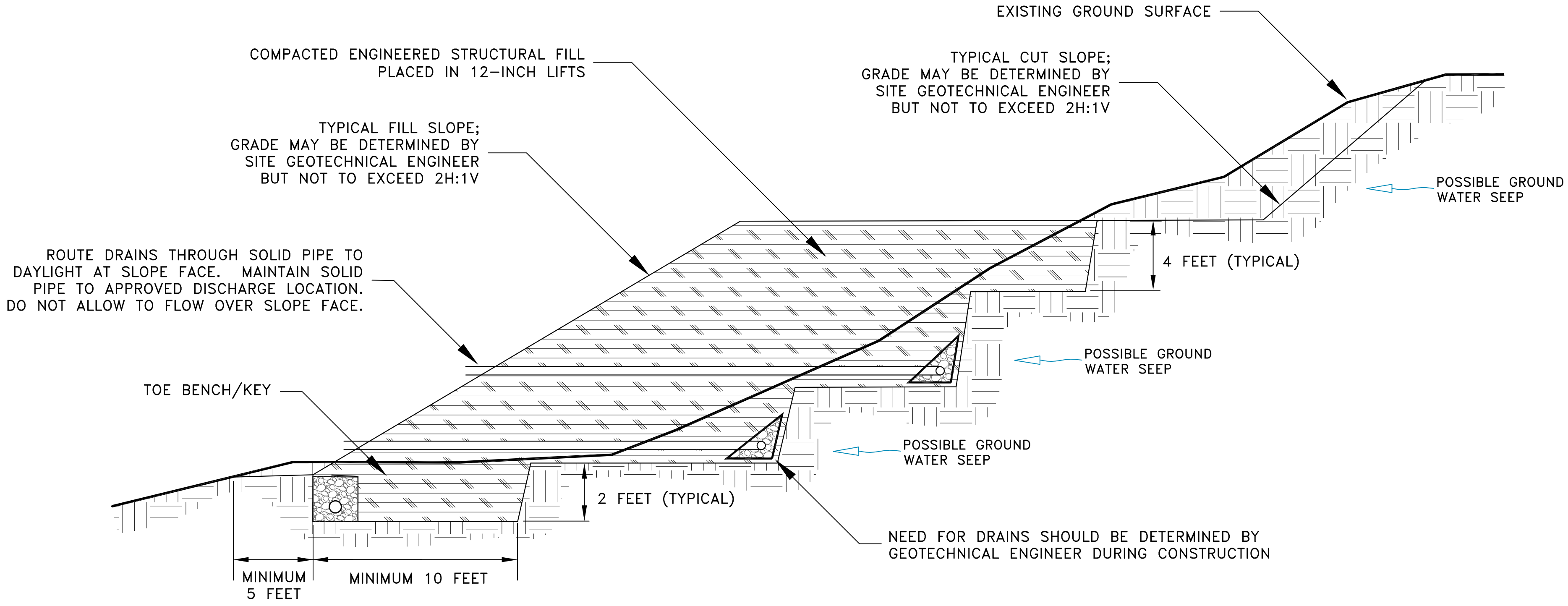
SB-2
Piezometer Depth (ft) = 28
Apx. Lid Elevation (ft) = 134

	SB-1				SB-2			
	Groundwater Level				Groundwater Level			
Date	depth (bgs)		feet (amsl)		depth (bgs)		feet (amsl)	
4/20/2018	3.0	INITIAL*	135.0		3.0	INITIAL*	131.0	
5/1/2018	4.2		133.8		3.5		130.5	
5/16/2018	6.0		132.0		4.9		129.1	
6/12/2018	8.4		129.6		7.8		126.2	
8/22/2018	13.0		125.0		11.2		122.8	

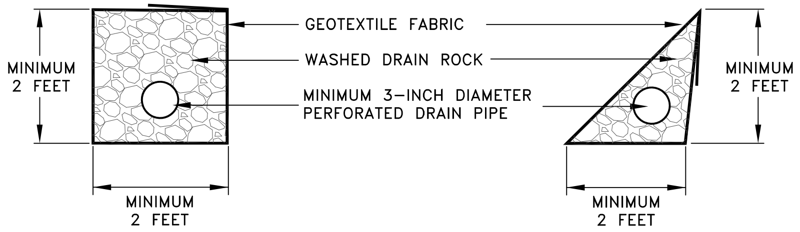




TYPICAL CUT AND FILL SLOPE CROSS-SECTION



TYPICAL DRAIN SECTION DETAIL



DRAIN SPECIFICATIONS

GEOTEXTILE FABRIC SHALL CONSIST OF MIRAFI 140N OR APPROVED EQUIVALENT WITH AOS BETWEEN No. 70 AND No. 100 SIEVE.

WASHED DRAIN ROCK SHALL BE OPEN-GRADED ANGULAR DRAIN ROCK WITH LESS THAN 2 PERCENT PASSING THE No. 200 SIEVE AND A MAXIMUM PARTICLE SIZE OF 3 INCHES.

NOTES:
1. DRAWING IS NOT TO SCALE.
2. SLOPES AND PROFILES SHOWN ARE APPROXIMATE.
3. DRAWING REPRESENTS TYPICAL FILL AND CUT SLOPE SECTION, AND MAY NOT BE SITE-SPECIFIC.

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Design:
Checked: ASR
Client: LCSD
Job No: 18084
CAD File: FIGURE 3
Scale: NONE

Drawn: HDG
Date: 10/2/18

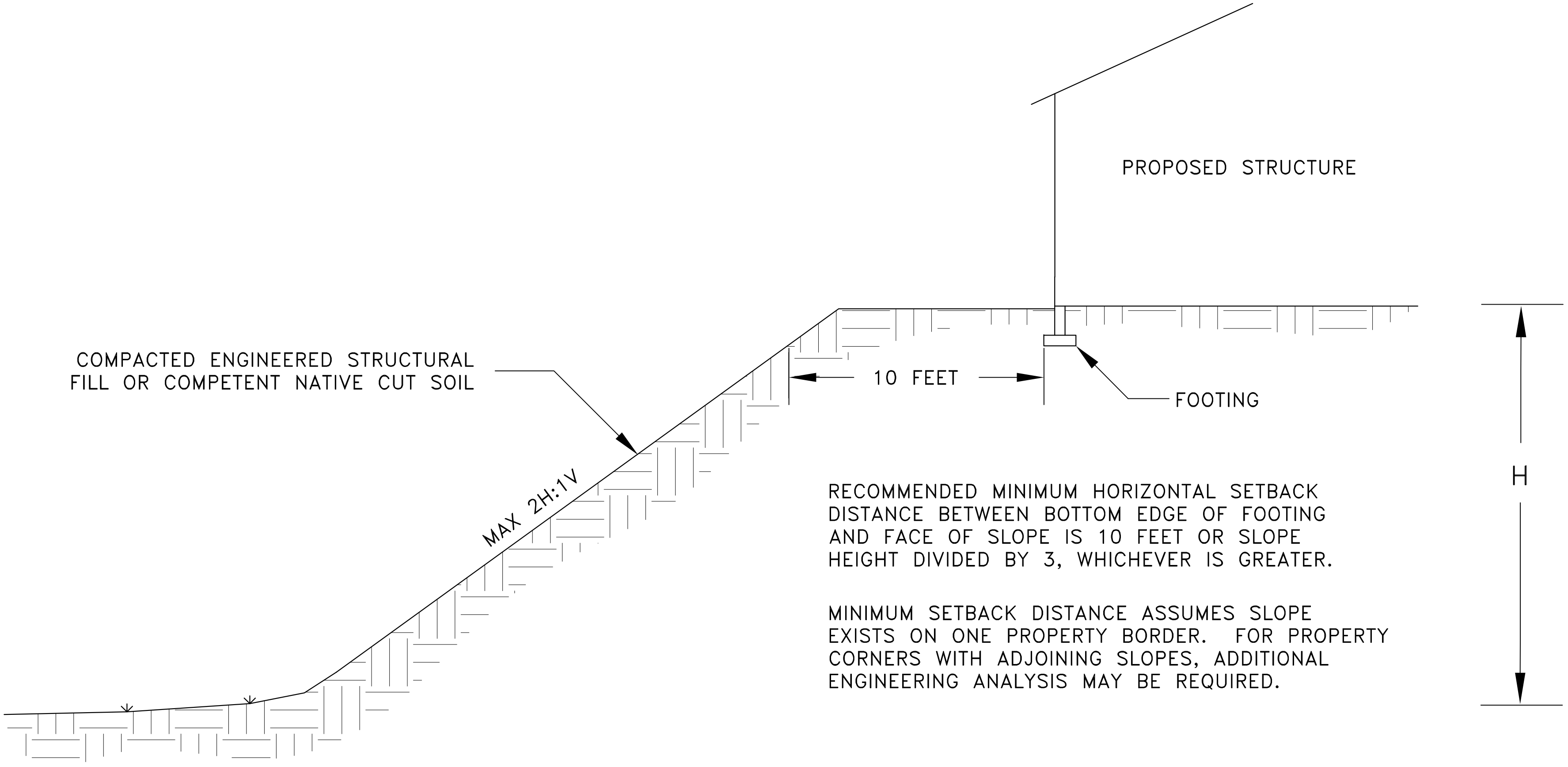
Rev	By	Date

TYPICAL CUT AND FILL SLOPE CROSS-SECTION

LA CENTER MIDDLE SCHOOL
LA CENTER, WASHINGTON

FIGURE 3

MINIMUM FOUNDATION SLOPE SETBACK DETAIL



RECOMMENDED MINIMUM HORIZONTAL SETBACK DISTANCE BETWEEN BOTTOM EDGE OF FOOTING AND FACE OF SLOPE IS 10 FEET OR SLOPE HEIGHT DIVIDED BY 3, WHICHEVER IS GREATER.

MINIMUM SETBACK DISTANCE ASSUMES SLOPE EXISTS ON ONE PROPERTY BORDER. FOR PROPERTY CORNERS WITH ADJOINING SLOPES, ADDITIONAL ENGINEERING ANALYSIS MAY BE REQUIRED.

NOTES:
1. DRAWING IS NOT TO SCALE.
2. SLOPES AND PROFILES SHOWN ARE APPROXIMATE.
3. DRAWING REPRESENTS TYPICAL FOUNDATION SETBACK DETAIL, AND MAY NOT BE SITE-SPECIFIC.

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Design:
Checked: ASR
Client: LCSD
Job No: 18084
CAD File: FIGURE 4
Scale: NONE

Drawn: HDG
Date: 10/2/18

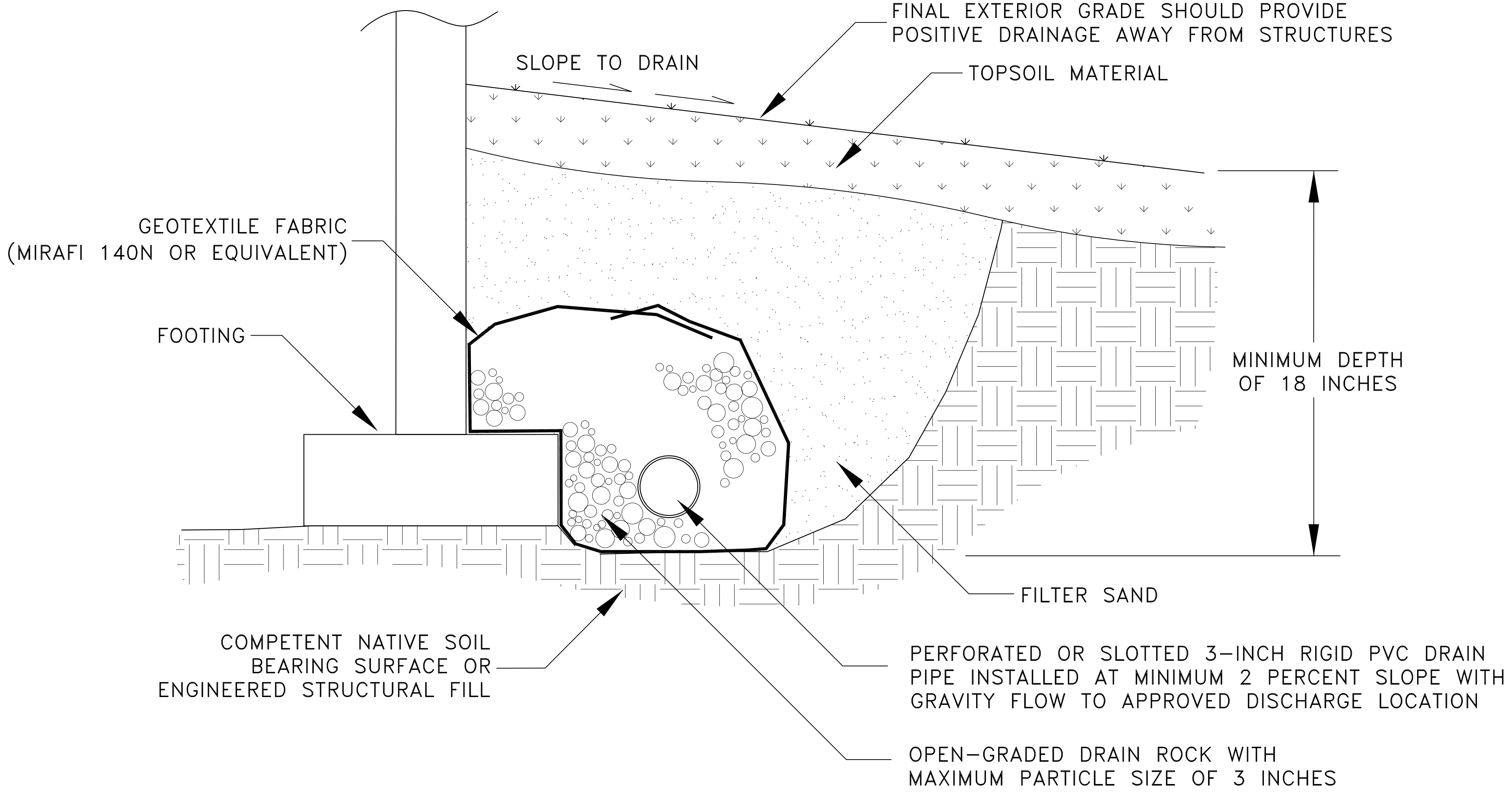
Rev	By	Date

TYPICAL MINIMUM SLOPE SETBACK DETAIL

LA CENTER MIDDLE SCHOOL
LA CENTER, WASHINGTON

FIGURE 4

TYPICAL PERIMETER FOOTING DRAIN DETAIL



NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL FOOTING DRAIN DETAIL AND MAY NOT BE SITE-SPECIFIC.

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Design:
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Client: LCSD
Job No: 18084
CAD File: FIGURE 5
Scale: NONE

Drawn: HDG
Date: 10/2/18

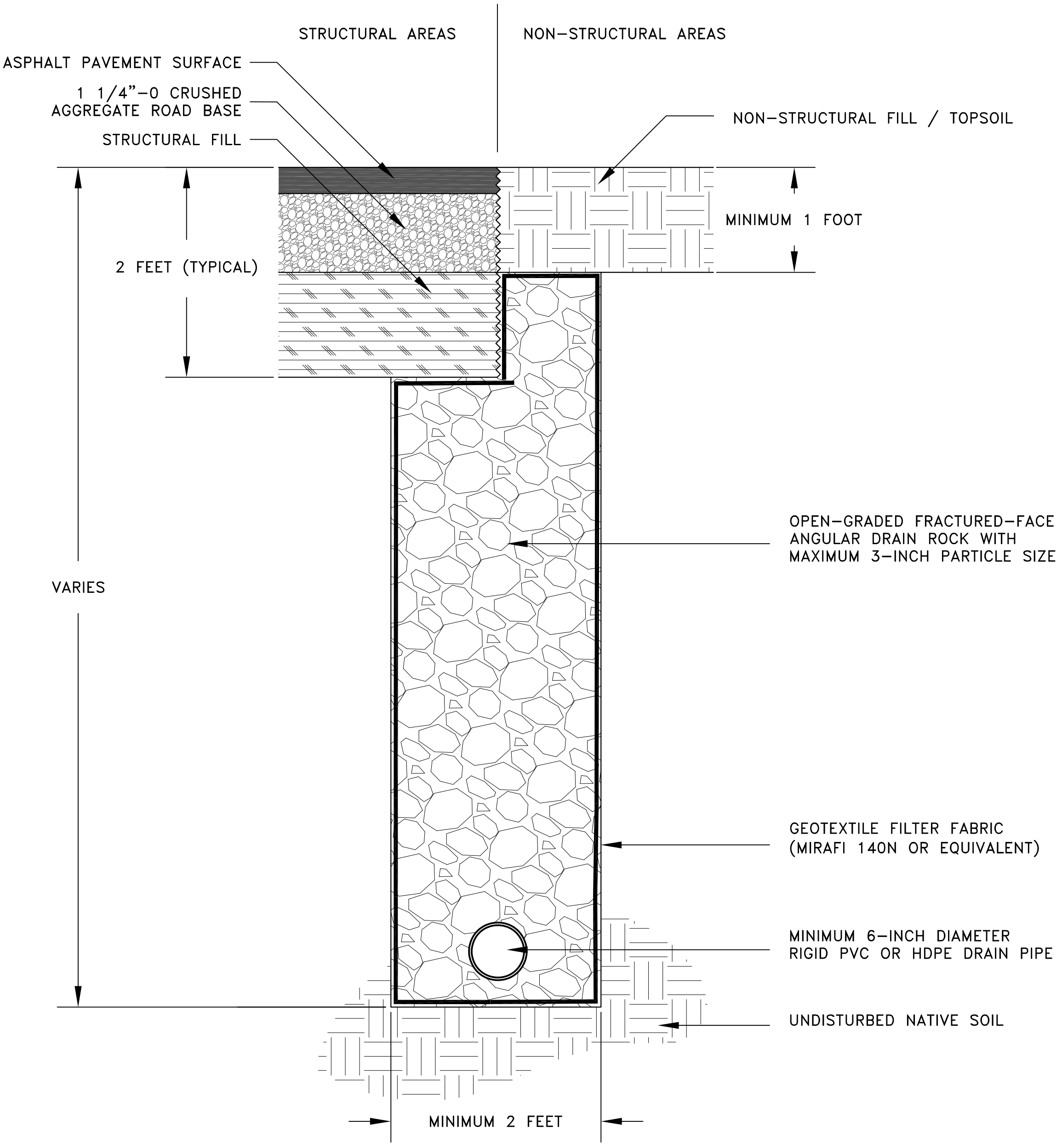
Rev	By	Date

TYPICAL PERIMETER FOOTING DRAIN DETAIL

LA CENTER MIDDLE SCHOOL
LA CENTER, WASHINGTON

FIGURE
5

TYPICAL PERFORATED DRAIN PIPE TRENCH DETAIL



NOTE: LOCATION, INVERT ELEVATION, DEPTH OF TRENCH, AND EXTENT OF PERFORATED PIPE REQUIRED MAY BE MODIFIED BY THE GEOTECHNICAL ENGINEER DURING CONSTRUCTION BASED UPON FIELD OBSERVATION AND SITE-SPECIFIC SOIL CONDITIONS.

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Design:
Checked: ASR
Client: LCSD
Job No: 18084
CAD File: FIGURE 6
Scale: NONE

Drawn: HDG
Date: 10/2/18

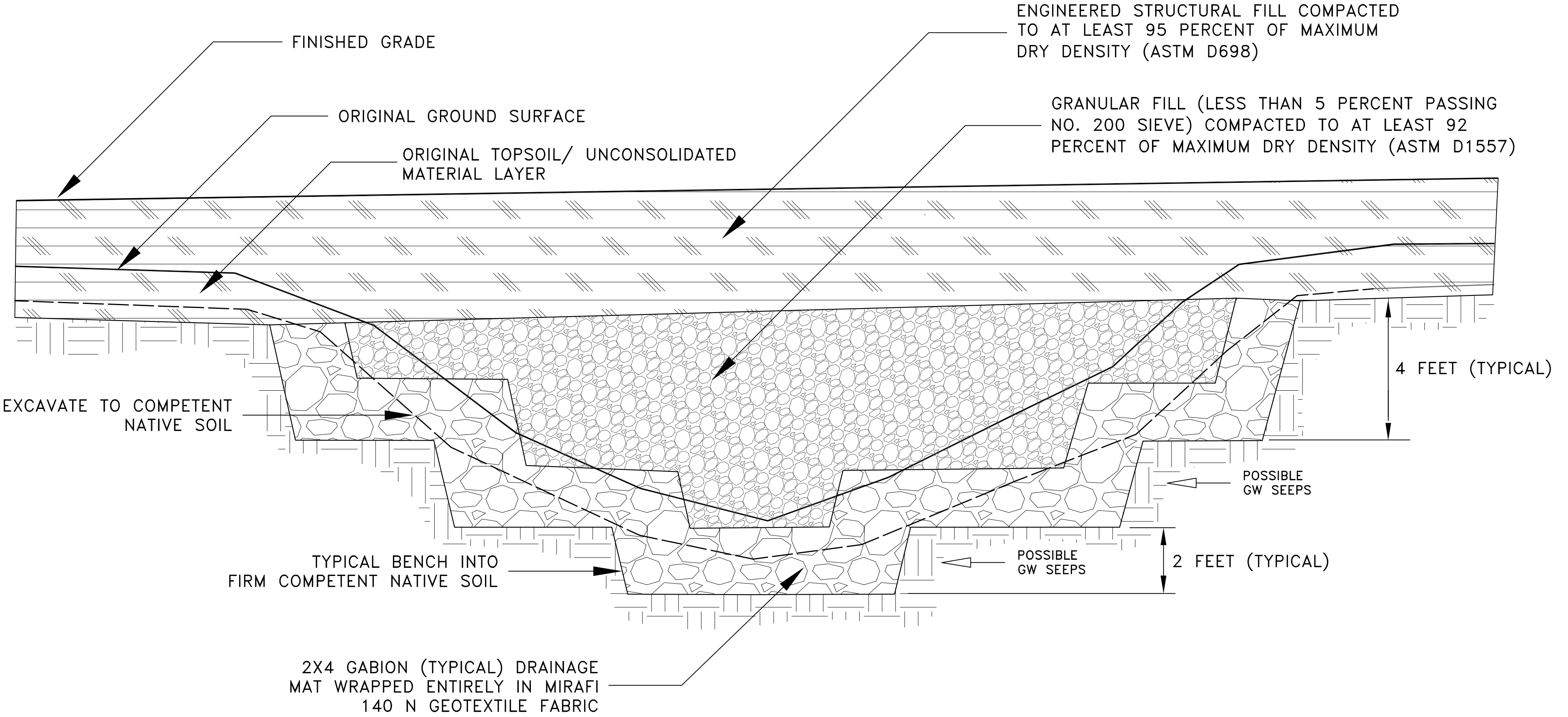
Rev	By	Date

TYPICAL PERFORATED
DRAIN PIPE TRENCH DETAIL

LA CENTER MIDDLE SCHOOL
LA CENTER, WASHINGTON

FIGURE
6

TYPICAL DRAINAGE MAT CROSS-SECTION



NOTES:
1. DRAWING IS NOT TO SCALE.
2. SLOPES AND PROFILES SHOWN ARE APPROXIMATE.
3. DRAWING REPRESENTS TYPICAL DRAINAGE MAT SECTION AND MAY NOT BE SITE–SPECIFIC.
4. DEPTH, LOCATION, EXTENT, AND THICKNESS OF GABION MAT AND GRANULAR FILL LAYER SHOULD BE DETERMINED IN THE FIELD BY COLUMBIA WEST.
5. DRAIN PIPE MAY BE NEEDED AT LOWEST GRADIENT POINT OF DRAINAGE MAT TO CONTROL AND DIRECT FLOW.

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Design:	Drawn: HDG			
Checked: ASR	Date: 10/2/18			
Client: LCSD	Rev	By	Date	
Job No: 18084				
CAD File: FIGURE 7				
Scale: NONE				

TYPICAL DRAINAGE MAT SECTION

LA CENTER MIDDLE SCHOOL
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FIGURE
7

APPENDIX A
LABORATORY TEST RESULTS

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT
La Center Middle School
La Center, Washington

CLIENT
Mr. Dave Holmes, Superintendent
La Center School District
725 NE Highland Avenue
La Center, Washington 98629

PROJECT NO.: 18084
LAB ID: S18-346
REPORT DATE: 04/27/18
FIELD ID: TP1.1
DATE SAMPLED: 04/18/18
SAMPLED BY: ASR

MATERIAL DATA

MATERIAL SAMPLED: Lean CLAY

MATERIAL SOURCE: Test Pit TP-01
depth = 2 feet

USCS SOIL TYPE: CL, Lean Clay

SPECIFICATIONS: none

AASHTO SOIL TYPE: A-7-6(19)

LABORATORY TEST DATA

LABORATORY EQUIPMENT: Rainhart "Mary Ann" Sifter 637

TEST PROCEDURE: ASTM D6913

ADDITIONAL DATA

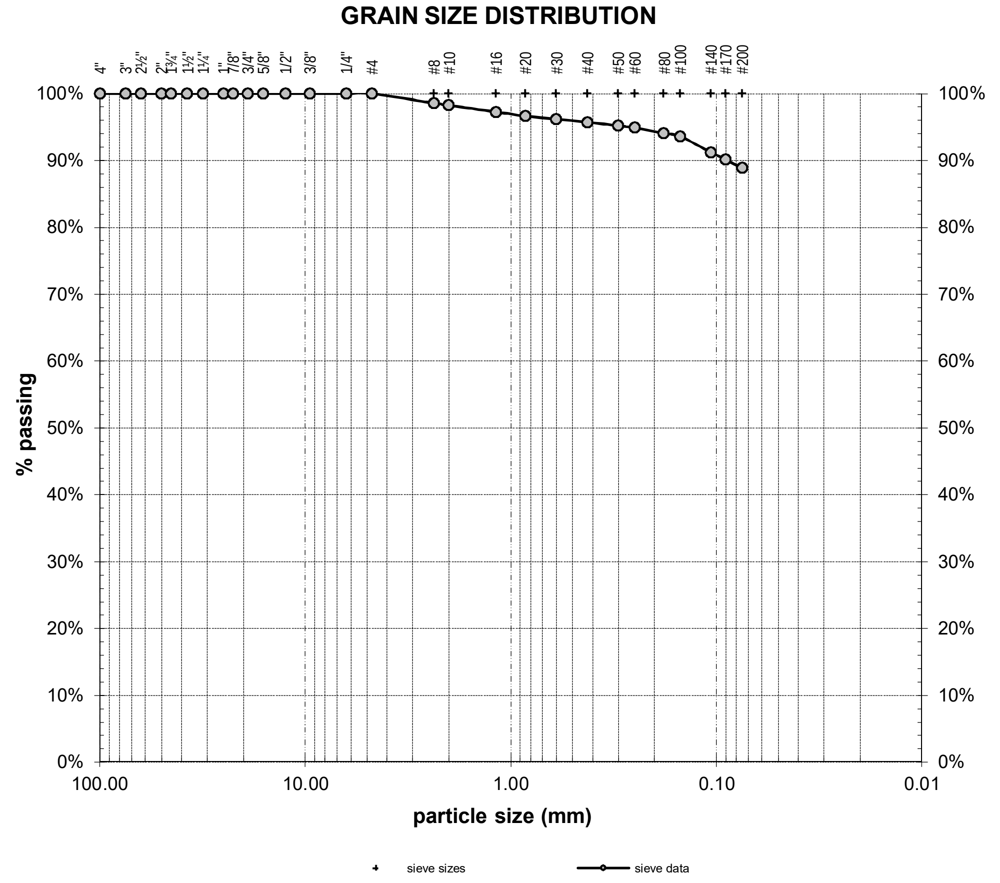
initial dry mass (g) = 113.49
as-received moisture content = 38.3%
liquid limit = 44
plastic limit = 25
plasticity index = 19
fineness modulus = n/a

coefficient of curvature, C_C = n/a
coefficient of uniformity, C_U = n/a
effective size, $D_{(10)}$ = n/a
$D_{(30)}$ = n/a
$D_{(60)}$ = n/a

SIEVE DATA

% gravel = 0.0%
% sand = 11.1%
% silt and clay = 88.9%

	SIEVE SIZE		PERCENT PASSING			
			SIEVE		SPECS	
	US	mm	act.	interp.	max	min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5		100%		
	1.25"	31.5		100%		
	1.00"	25.0		100%		
	7/8"	22.4		100%		
	3/4"	19.0		100%		
	5/8"	16.0		100%		
	1/2"	12.5		100%		
	3/8"	9.50		100%		
	1/4"	6.30		100%		
	#4	4.75	100%			
SAND	#8	2.36		99%		
	#10	2.00	98%			
	#16	1.18		97%		
	#20	0.850	97%			
	#30	0.600		96%		
	#40	0.425	96%			
	#50	0.300		95%		
	#60	0.250	95%			
	#80	0.180		94%		
	#100	0.150	94%			
	#140	0.106		91%		
	#170	0.090		90%		
	#200	0.075	89%			



DATE TESTED: 04/20/18
TESTED BY: RTT

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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
La Center Middle School La Center, Washington	Mr. Dave Holmes, Superintendent La Center School District 725 NE Highland Avenue La Center, Washington 98629	18084	S18-346
		REPORT DATE 04/27/18	FIELD ID TP1.1
		DATE SAMPLED 04/18/18	SAMPLED BY ASR

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Lean CLAY	Test Pit TP-01 depth = 2 feet	CL, Lean Clay

LABORATORY TEST DATA

LABORATORY EOUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318

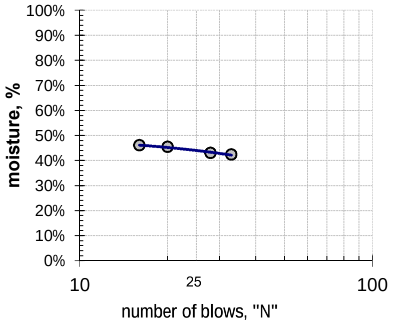
ATTERBERG LIMITS

liquid limit = 44
plastic limit = 25
plasticity index = 19

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	29.19	28.93	30.42	32.07
dry soil + pan weight, g =	26.68	26.53	27.43	28.46
pan weight, g =	20.75	20.94	20.85	20.62
N (blows) =	33	28	20	16
moisture, % =	42.3 %	42.9 %	45.4 %	46.1 %

LIQUID LIMIT



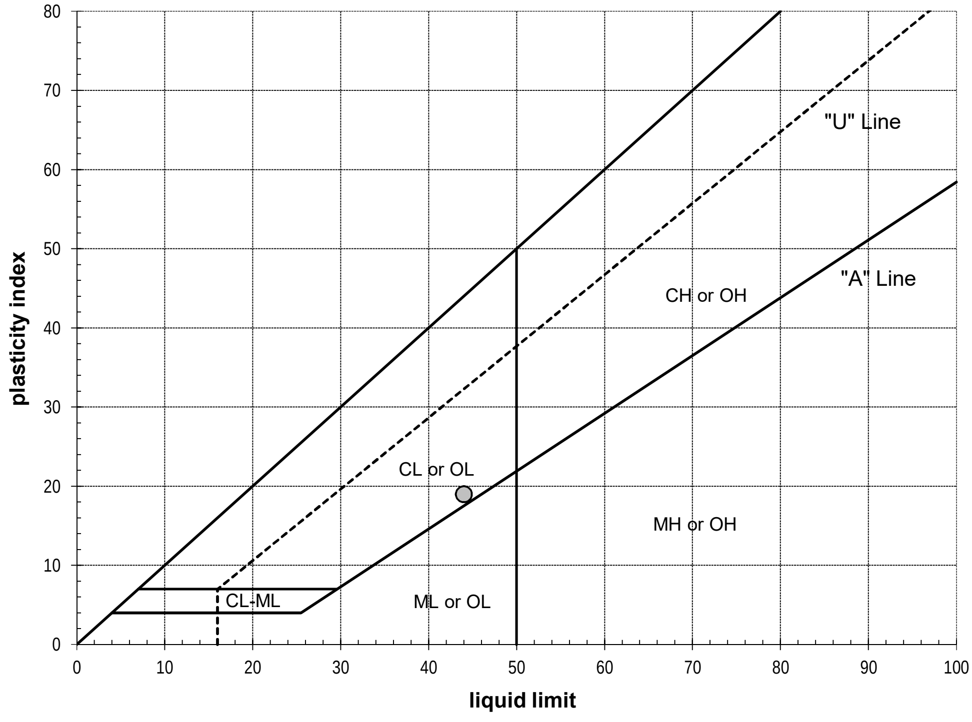
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	27.96	28.18		
dry soil + pan weight, g =	26.53	26.72		
pan weight, g =	20.83	20.86		
moisture, % =	25.1 %	24.9 %		

PLASTICITY CHART



ADDITIONAL DATA

% gravel = 0.0%
% sand = 11.1%
% silt and clay = 88.9%
% silt = n/a
% clay = n/a
moisture content = 38.3%

DATE TESTED	TESTED BY
04/24/18	JJC

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
La Center Middle School La Center, Washington	Mr. Dave Holmes, Superintendent La Center School District 725 NE Highland Avenue La Center, Washington 98629	18084	S18-347
		REPORT DATE 04/27/18	FIELD ID TP1.2
		DATE SAMPLED 04/18/18	SAMPLED BY ASR

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
SILT	Test Pit TP-01 depth = 6 feet	ML, Silt

SPECIFICATIONS	AASHTO SOIL TYPE
none	A-4(0)

LABORATORY TEST DATA

LABORATORY EOUIPMENT	TEST PROCEDURE
Rainhart "Mary Ann" Sifter 637	ASTM D6913

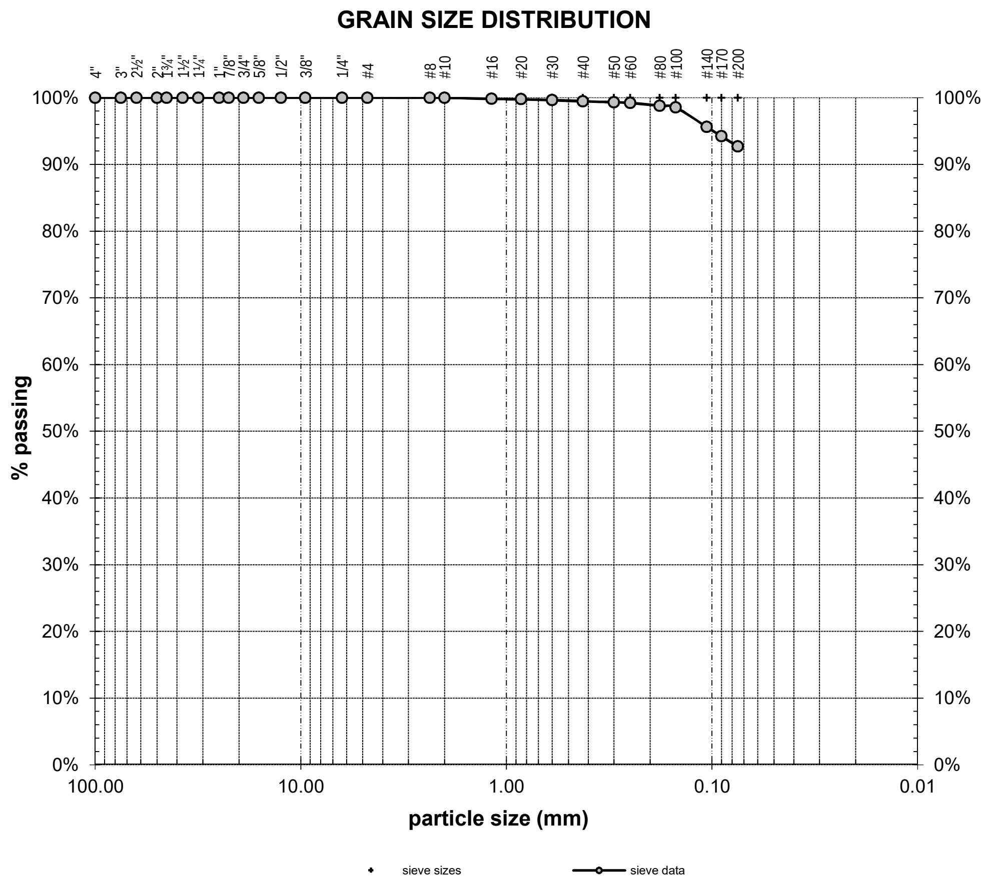
ADDITIONAL DATA

initial dry mass (g) =	120.14		
as-received moisture content =	39.1%	coefficient of curvature, C_C =	n/a
liquid limit =	-	coefficient of uniformity, C_U =	n/a
plastic limit =	-	effective size, $D_{(10)}$ =	n/a
plasticity index =	NP	$D_{(30)}$ =	n/a
fineness modulus =	n/a	$D_{(60)}$ =	n/a

SIEVE DATA

% gravel = 0.0%
% sand = 7.3%
% silt and clay = 92.7%

	SIEVE SIZE		PERCENT PASSING			
			SIEVE		SPECS	
	US	mm	act.	interp.	max	min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5		100%		
	1.25"	31.5		100%		
	1.00"	25.0		100%		
	7/8"	22.4		100%		
	3/4"	19.0		100%		
	5/8"	16.0		100%		
	1/2"	12.5		100%		
	3/8"	9.50		100%		
	1/4"	6.30		100%		
	#4	4.75	100%			
SAND	#8	2.36		100%		
	#10	2.00	100%			
	#16	1.18		100%		
	#20	0.850	100%			
	#30	0.600		100%		
	#40	0.425	99%			
	#50	0.300		99%		
	#60	0.250	99%			
	#80	0.180		99%		
	#100	0.150	99%			
	#140	0.106		96%		
	#170	0.090		94%		
	#200	0.075	93%			



DATE TESTED	TESTED BY
04/20/18	RTT

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT
La Center Middle School
La Center, Washington

CLIENT
Mr. Dave Holmes, Superintendent
La Center School District
725 NE Highland Avenue
La Center, Washington 98629

PROJECT NO.
18084

LAB ID
S18-348

REPORT DATE
04/27/18

FIELD ID
TP1.3

DATE SAMPLED
04/18/18

SAMPLED BY
ASR

MATERIAL DATA

MATERIAL SAMPLED
SILT with Sand

MATERIAL SOURCE
Test Pit TP-01
depth = 9 feet

USCS SOIL TYPE
ML, Silt with Sand

SPECIFICATIONS
none

AASHTO SOIL TYPE
A-4(5)

LABORATORY TEST DATA

LABORATORY EQUIPMENT
Rainhart "Mary Ann" Sifter 637

TEST PROCEDURE
ASTM D6913

ADDITIONAL DATA

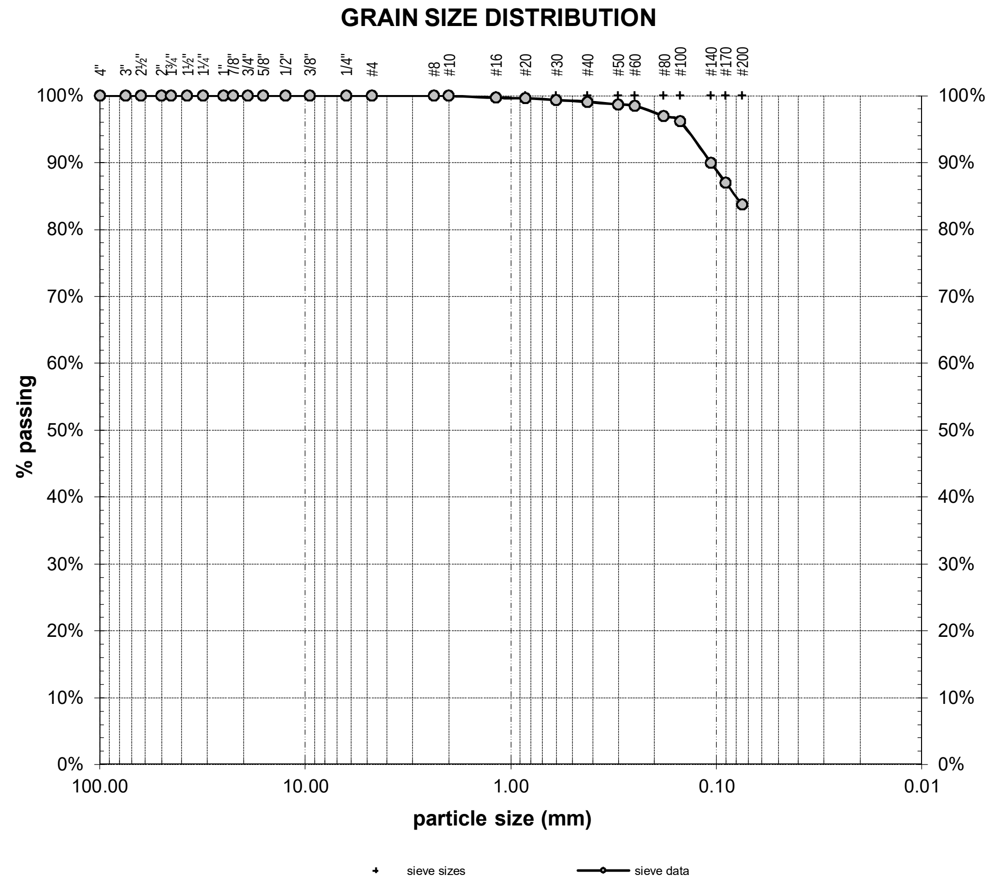
initial dry mass (g) = 124.30
as-received moisture content = 42.2%
liquid limit = 30
plastic limit = 23
plasticity index = 7
fineness modulus = n/a

coefficient of curvature, C_C = n/a
coefficient of uniformity, C_U = n/a
effective size, $D_{(10)}$ = n/a
$D_{(30)}$ = n/a
$D_{(60)}$ = n/a

SIEVE DATA

% gravel = 0.0%
% sand = 16.3%
% silt and clay = 83.7%

	SIEVE SIZE		PERCENT PASSING			
			SIEVE		SPECS	
	US	mm	act.	interp.	max	min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5		100%		
	1.25"	31.5		100%		
	1.00"	25.0		100%		
	7/8"	22.4		100%		
	3/4"	19.0		100%		
	5/8"	16.0		100%		
	1/2"	12.5		100%		
	3/8"	9.50		100%		
	1/4"	6.30		100%		
	#4	4.75	100%			
SAND	#8	2.36		100%		
	#10	2.00	100%			
	#16	1.18		100%		
	#20	0.850	100%			
	#30	0.600		99%		
	#40	0.425	99%			
	#50	0.300		99%		
	#60	0.250	98%			
	#80	0.180		97%		
	#100	0.150	96%			
	#140	0.106		90%		
	#170	0.090		87%		
	#200	0.075	84%			



DATE TESTED
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ATTERBERG LIMITS REPORT

PROJECT
La Center Middle School
La Center, Washington

CLIENT
Mr. Dave Holmes, Superintendent
La Center School District
725 NE Highland Avenue
La Center, Washington 98629

PROJECT NO.: 18084
LAB ID: S18-348
REPORT DATE: 04/27/18
FIELD ID: TP1.3
DATE SAMPLED: 04/18/18
SAMPLED BY: ASR

MATERIAL DATA

MATERIAL SAMPLED: SILT with Sand

MATERIAL SOURCE
Test Pit TP-01
depth = 9 feet

USCS SOIL TYPE: ML, Silt with Sand

LABORATORY TEST DATA

LABORATORY EOUIPMENT: Liquid Limit Machine, Hand Rolled

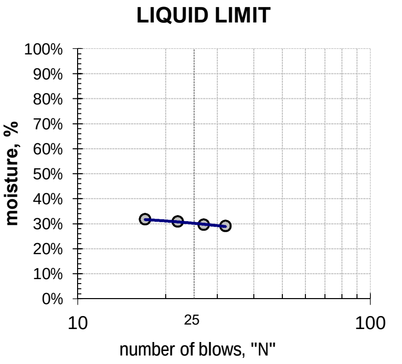
TEST PROCEDURE: ASTM D4318

ATTERBERG LIMITS

liquid limit = 30
plastic limit = 23
plasticity index = 7

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	34.64	32.30	30.82	31.28
dry soil + pan weight, g =	31.52	29.71	28.42	28.77
pan weight, g =	20.76	20.94	20.63	20.85
N (blows) =	32	27	22	17
moisture, % =	29.0 %	29.5 %	30.8 %	31.7 %

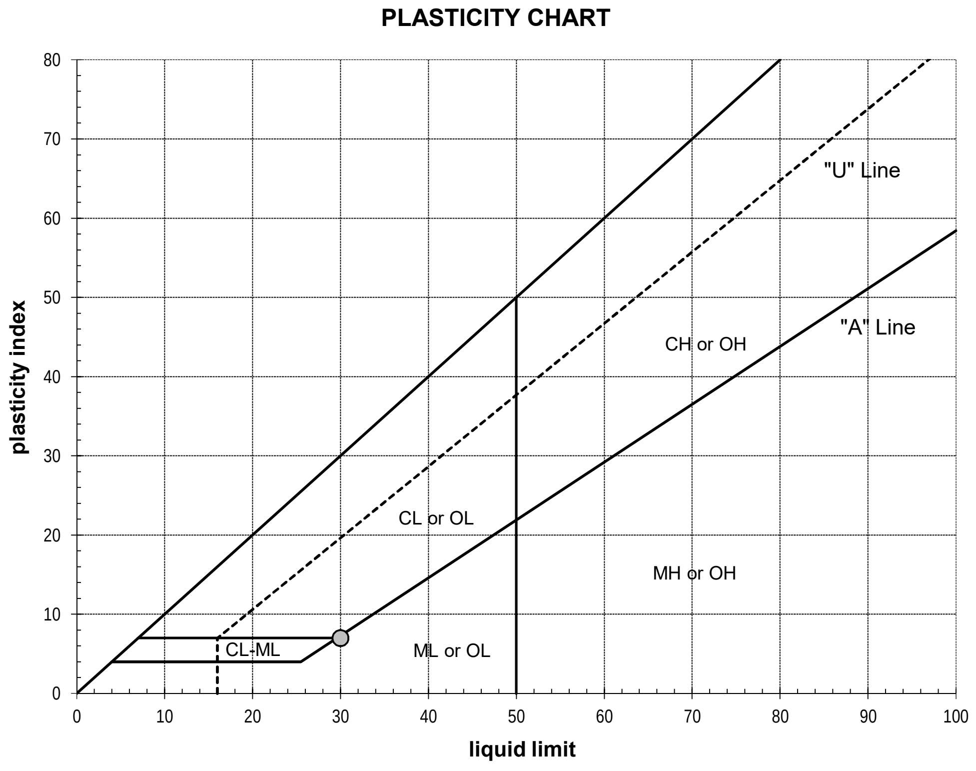


SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	28.02	29.09		
dry soil + pan weight, g =	26.66	27.52		
pan weight, g =	20.72	20.85		
moisture, % =	22.9 %	23.5 %		



ADDITIONAL DATA

% gravel = 0.0%
% sand = 16.3%
% silt and clay = 83.7%
% silt = n/a
% clay = n/a
moisture content = 42.2%

DATE TESTED: 04/25/18
TESTED BY: RTT

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT La Center Middle School La Center, Washington	CLIENT Mr. Dave Holmes, Superintendent La Center School District 725 NE Highland Avenue La Center, Washington 98629	PROJECT NO. 18084	LAB ID S18-349
		REPORT DATE 04/27/18	FIELD ID TP4.1
		DATE SAMPLED 04/18/18	SAMPLED BY ASR

MATERIAL DATA

MATERIAL SAMPLED SILT	MATERIAL SOURCE Test Pit TP-04 depth = 4.5 feet	USCS SOIL TYPE ML, Silt
SPECIFICATIONS none		AASHTO SOIL TYPE A-4(0)

LABORATORY TEST DATA

LABORATORY EOUIPMENT Rainhart "Mary Ann" Sifter 637	TEST PROCEDURE ASTM D6913

ADDITIONAL DATA

initial dry mass (g) = 108.10
as-received moisture content = 39.8%
liquid limit = -
plastic limit = -
plasticity index = NP
fineness modulus = n/a

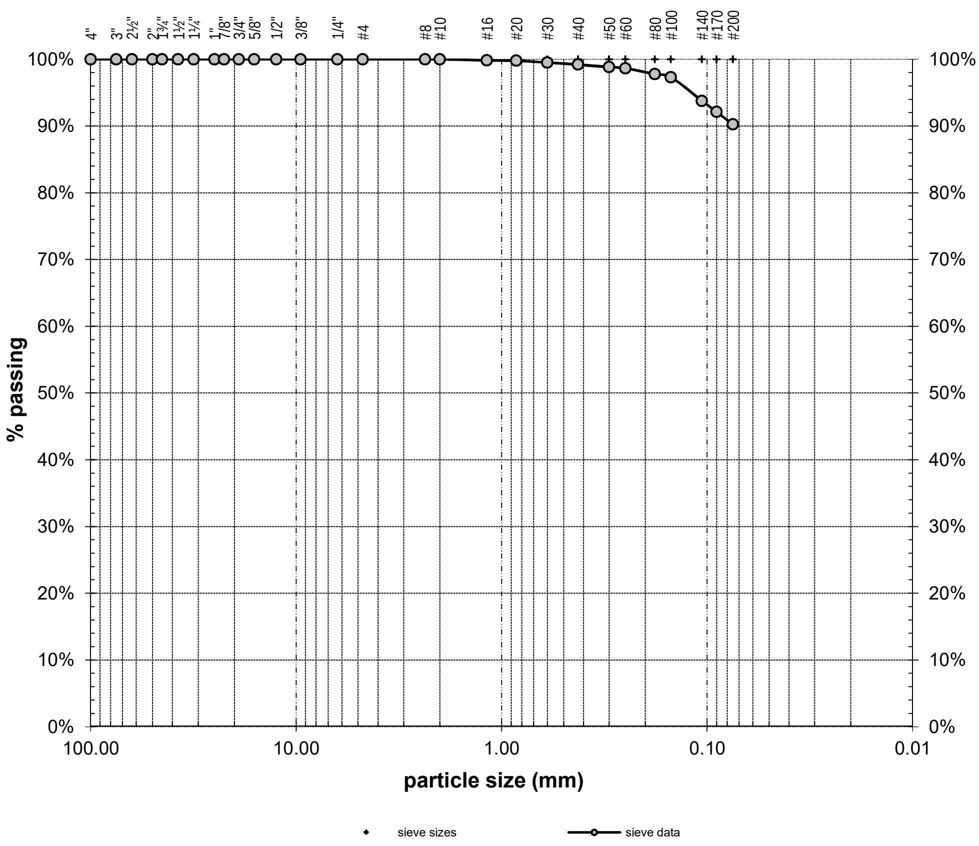
coefficient of curvature, C_C = n/a
coefficient of uniformity, C_U = n/a
effective size, $D_{(10)}$ = n/a
$D_{(30)}$ = n/a
$D_{(60)}$ = n/a

SIEVE DATA

% gravel = 0.0%
% sand = 9.8%
% silt and clay = 90.2%

	SIEVE SIZE		PERCENT PASSING			
			SIEVE		SPECS	
	US	mm	act.	interp.	max	min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5		100%		
	1.25"	31.5		100%		
	1.00"	25.0		100%		
	7/8"	22.4		100%		
	3/4"	19.0		100%		
	5/8"	16.0		100%		
	1/2"	12.5		100%		
	3/8"	9.50		100%		
	1/4"	6.30		100%		
	#4	4.75	100%			
SAND	#8	2.36		100%		
	#10	2.00	100%			
	#16	1.18		100%		
	#20	0.850	100%			
	#30	0.600		99%		
	#40	0.425	99%			
	#50	0.300		99%		
	#60	0.250	99%			
	#80	0.180		98%		
	#100	0.150	97%			
	#140	0.106		94%		
	#170	0.090		92%		
	#200	0.075	90%			

GRAIN SIZE DISTRIBUTION



DATE TESTED 04/20/18	TESTED BY RTT

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT
La Center Middle School
La Center, Washington

CLIENT
Mr. Dave Holmes, Superintendent
La Center School District
725 NE Highland Avenue
La Center, Washington 98629

PROJECT NO.: 18084
LAB ID: S18-350
REPORT DATE: 04/27/18
FIELD ID: TP5.1
DATE SAMPLED: 04/18/18
SAMPLED BY: ASR

MATERIAL DATA

MATERIAL SAMPLED: Silty SAND

MATERIAL SOURCE: Test Pit TP-05
depth = 14 feet

USCS SOIL TYPE: SM, Silty Sand

SPECIFICATIONS: none

AASHTO SOIL TYPE: A-4(0)

LABORATORY TEST DATA

LABORATORY EQUIPMENT: Rainhart "Mary Ann" Sifter 637

TEST PROCEDURE: ASTM D6913

ADDITIONAL DATA

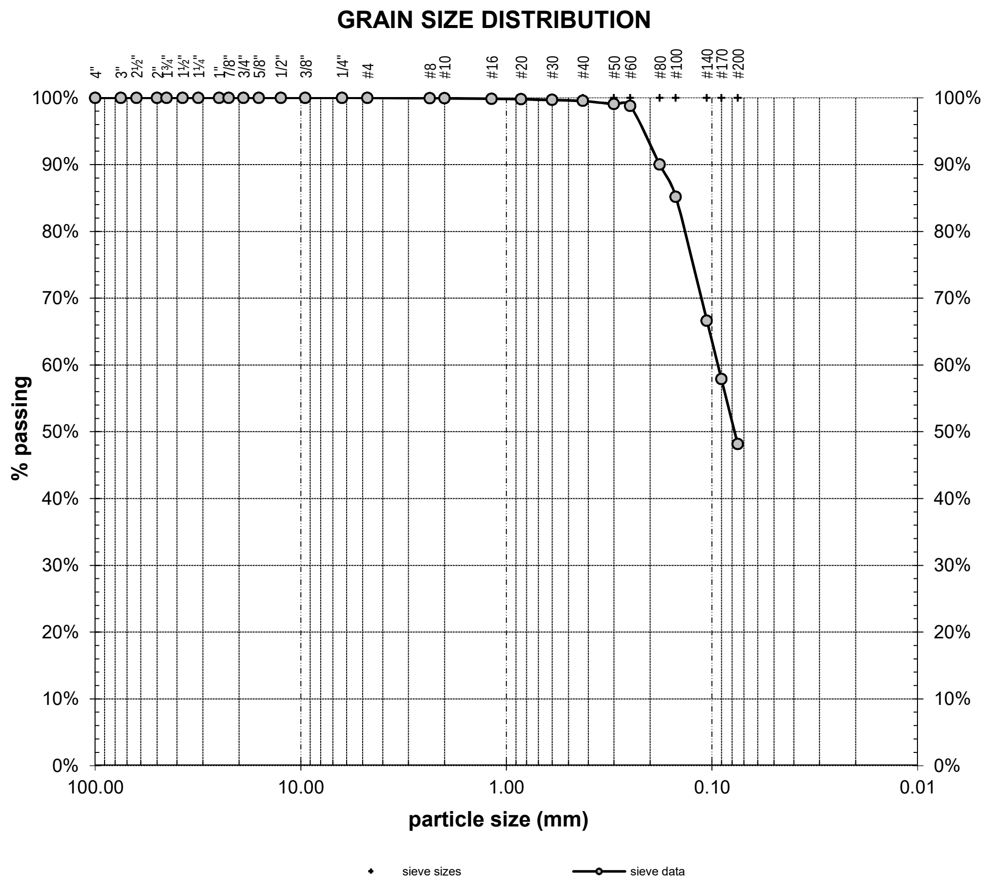
initial dry mass (g) = 172.53
as-received moisture content = 35.4%
liquid limit = -
plastic limit = -
plasticity index = NP
fineness modulus = n/a

coefficient of curvature, C_C = n/a
coefficient of uniformity, C_U = n/a
effective size, $D_{(10)}$ = n/a
$D_{(30)}$ = n/a
$D_{(60)}$ = 0.094 mm

SIEVE DATA

% gravel = 0.0%
% sand = 51.8%
% silt and clay = 48.2%

	SIEVE SIZE		PERCENT PASSING			
			SIEVE		SPECS	
	US	mm	act.	interp.	max	min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5		100%		
	1.25"	31.5		100%		
	1.00"	25.0		100%		
	7/8"	22.4		100%		
	3/4"	19.0		100%		
	5/8"	16.0		100%		
	1/2"	12.5		100%		
	3/8"	9.50		100%		
	1/4"	6.30		100%		
	#4	4.75	100%			
SAND	#8	2.36		100%		
	#10	2.00	100%			
	#16	1.18		100%		
	#20	0.850	100%			
	#30	0.600		100%		
	#40	0.425	100%			
	#50	0.300		99%		
	#60	0.250	99%			
	#80	0.180		90%		
	#100	0.150	85%			
	#140	0.106		67%		
	#170	0.090		58%		
	#200	0.075	48%			



DATE TESTED: 04/20/18
TESTED BY: RTT

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
La Center Middle School La Center, Washington	Mr. Dave Holmes, Superintendent La Center School District 725 NE Highland Avenue La Center, Washington 98629	18084	S18-888
		REPORT DATE	FIELD ID
		09/27/18	TP15.1
		DATE SAMPLED	SAMPLED BY
		08/31/18	ASR

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Lean CLAY with Sand	Test Pit TP-15, depth = 2 feet native subgrade soils	CL, Lean Clay with Sand

SPECIFICATIONS	AASHTO SOIL TYPE
none	A-6(9)

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Rainhart "Mary Ann" Sifter 637	ASTM D6913

ADDITIONAL DATA

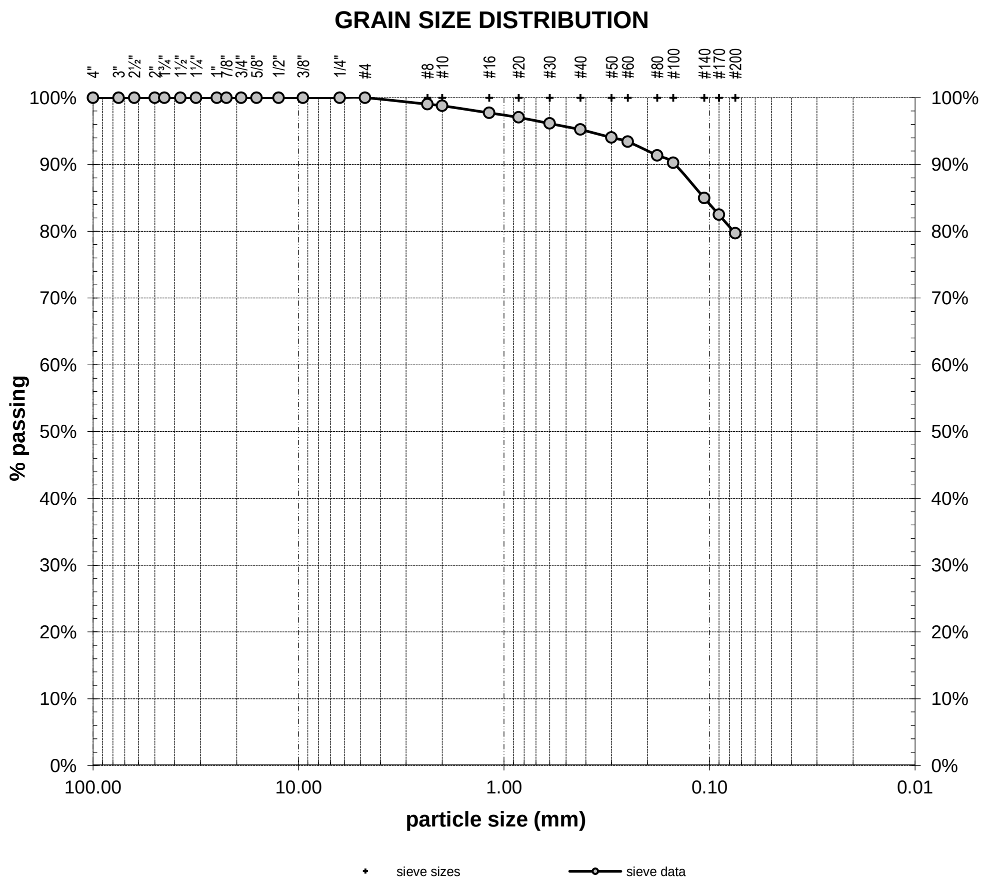
initial dry mass (g) = 222.55
as-received moisture content = 19.2%
liquid limit = 35
plastic limit = 23
plasticity index = 12
fineness modulus = n/a

coefficient of curvature, C_C = n/a
coefficient of uniformity, C_U = n/a
effective size, $D_{(10)}$ = n/a
$D_{(30)}$ = n/a
$D_{(60)}$ = n/a

SIEVE DATA

% gravel = 0.0%
% sand = 20.3%
% silt and clay = 79.7%

	SIEVE SIZE		PERCENT PASSING			
			SIEVE		SPECS	
	US	mm	act.	interp.	max	min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5		100%		
	1.25"	31.5		100%		
	1.00"	25.0		100%		
	7/8"	22.4		100%		
	3/4"	19.0		100%		
	5/8"	16.0		100%		
	1/2"	12.5		100%		
	3/8"	9.50		100%		
	1/4"	6.30		100%		
	#4	4.75	100%			
SAND	#8	2.36		99%		
	#10	2.00	99%			
	#16	1.18		98%		
	#20	0.850	97%			
	#30	0.600		96%		
	#40	0.425	95%			
	#50	0.300		94%		
	#60	0.250	93%			
	#80	0.180		91%		
	#100	0.150	90%			
	#140	0.106		85%		
	#170	0.090		82%		
	#200	0.075	80%			



DATE TESTED	TESTED BY
09/14/18	KMS

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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
La Center Middle School La Center, Washington	Mr. Dave Holmes, Superintendent La Center School District 725 NE Highland Avenue La Center, Washington 98629	18084	S18-888
		REPORT DATE 09/27/18	FIELD ID TP15.1
		DATE SAMPLED 08/31/18	SAMPLED BY ASR

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Lean CLAY with Sand	Test Pit TP-15, depth = 2 feet native subgrade soils	CL, Lean Clay with Sand

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318

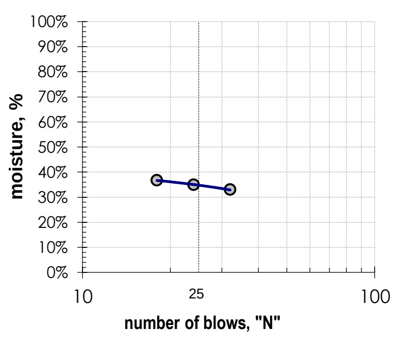
ATTERBERG LIMITS

liquid limit = 35
plastic limit = 23
plasticity index = 12

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	31.48	31.55	31.69	
dry soil + pan weight, g =	28.82	28.76	28.75	
pan weight, g =	20.75	20.76	20.75	
N (blows) =	32	24	18	
moisture, % =	33.0 %	34.9 %	36.8 %	

LIQUID LIMIT



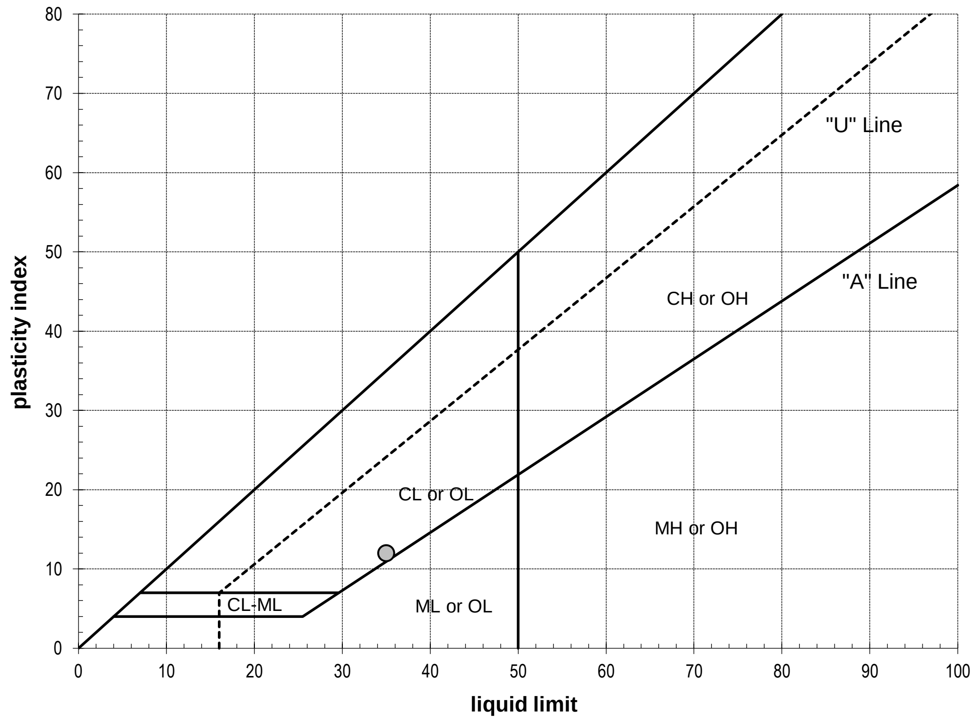
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	28.28	27.83		
dry soil + pan weight, g =	26.91	26.50		
pan weight, g =	20.84	20.64		
moisture, % =	22.6 %	22.7 %		

PLASTICITY CHART



ADDITIONAL DATA

% gravel = 0.0%
% sand = 20.3%
% silt and clay = 79.7%
% silt = n/a
% clay = n/a
moisture content = 19.2%

DATE TESTED	TESTED BY
09/19/18	KMS

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
La Center Middle School La Center, Washington	Mr. Dave Holmes, Superintendent La Center School District 725 NE Highland Avenue La Center, Washington 98629	18084	S18-356
		REPORT DATE 05/01/18	FIELD ID SB1.1
		DATE SAMPLED 04/19/18	SAMPLED BY ASR

MATERIAL DATA

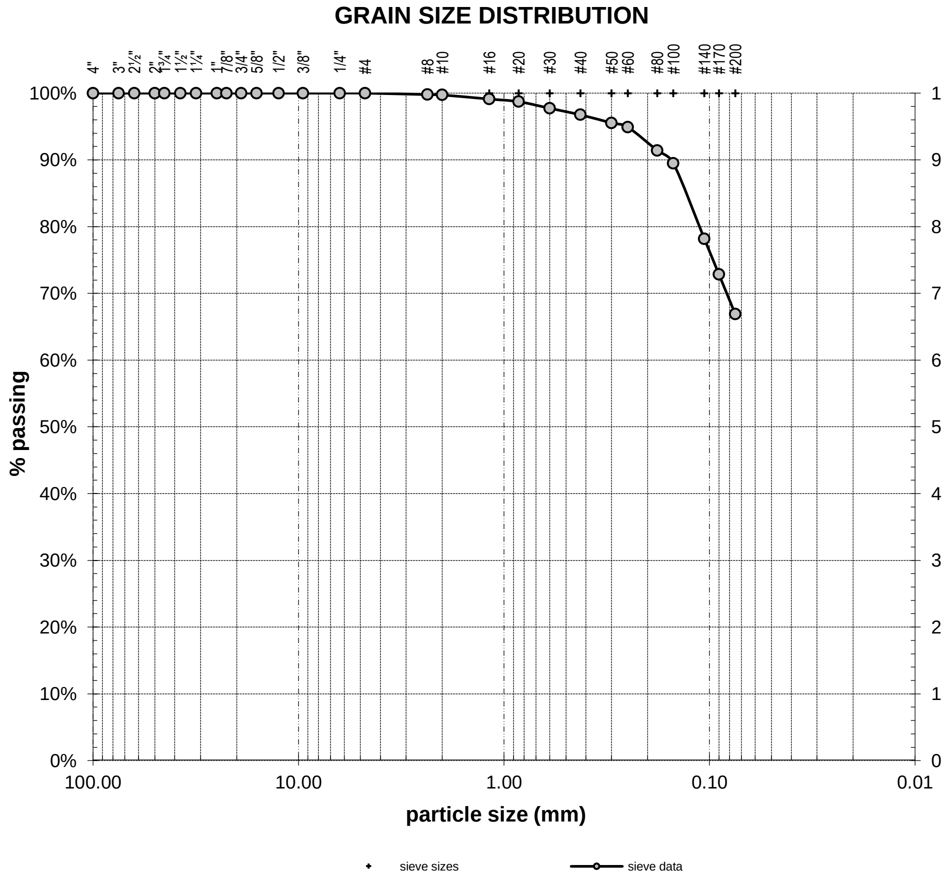
MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Sandy Lean CLAY	Soil Boring SB-01 depth = 2.5 feet	CL, Sandy Lean Clay
SPECIFICATIONS none		AASHTO SOIL TYPE A-7-6(14)

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Rainhart "Mary Ann" Sifter 637	ASTM D6913

ADDITIONAL DATA

initial dry mass (g) =	144.37		
as-received moisture content =	37.7%	coefficient of curvature, C_C =	n/a
liquid limit =	46	coefficient of uniformity, C_U =	n/a
plastic limit =	24	effective size, $D_{(10)}$ =	n/a
plasticity index =	22	$D_{(30)}$ =	n/a
fineness modulus =	n/a	$D_{(60)}$ =	n/a



SIEVE DATA

% gravel = 0.0%
% sand = 33.1%
% silt and clay = 66.9%

	SIEVE SIZE		PERCENT PASSING			
			SIEVE		SPECS	
	US	mm	act.	interp.	max	min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5		100%		
	1.25"	31.5		100%		
	1.00"	25.0		100%		
	7/8"	22.4		100%		
	3/4"	19.0		100%		
	5/8"	16.0		100%		
	1/2"	12.5		100%		
	3/8"	9.50		100%		
	1/4"	6.30		100%		
	#4	4.75	100%			
SAND	#8	2.36		100%		
	#10	2.00	100%			
	#16	1.18		99%		
	#20	0.850	99%			
	#30	0.600		98%		
	#40	0.425	97%			
	#50	0.300		96%		
	#60	0.250	95%			
	#80	0.180		91%		
	#100	0.150	89%			
	#140	0.106		78%		
	#170	0.090		73%		
	#200	0.075	67%			

DATE TESTED	TESTED BY
04/26/18	RTT

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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
La Center Middle School La Center, Washington	Mr. Dave Holmes, Superintendent La Center School District 725 NE Highland Avenue La Center, Washington 98629	18084	S18-356
		REPORT DATE	FIELD ID
		05/01/18	SB1.1
		DATE SAMPLED	SAMPLED BY
		04/19/18	ASR

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Sandy Lean CLAY	Soil Boring SB-01 depth = 2.5 feet	CL, Sandy Lean Clay

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318

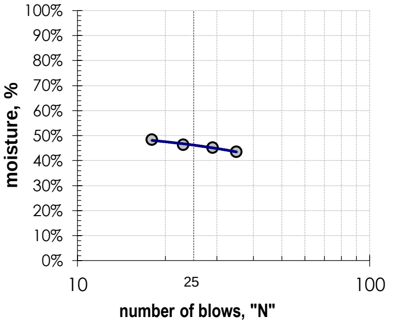
ATTERBERG LIMITS

liquid limit = 46
plastic limit = 24
plasticity index = 22

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	30.87	29.81	31.23	29.27
dry soil + pan weight, g =	27.80	27.05	27.87	26.53
pan weight, g =	20.75	20.94	20.62	20.86
N (blows) =	35	29	23	18
moisture, % =	43.6 %	45.2 %	46.3 %	48.3 %

LIQUID LIMIT



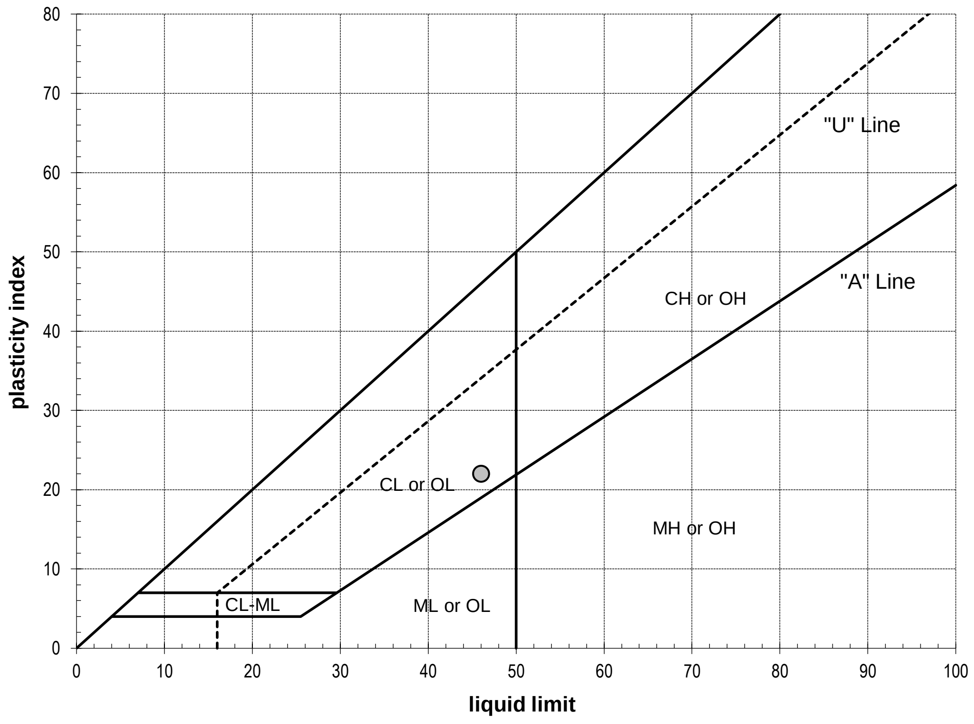
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	27.42	27.47		
dry soil + pan weight, g =	26.16	26.20		
pan weight, g =	20.83	20.88		
moisture, % =	23.6 %	23.9 %		

PLASTICITY CHART



ADDITIONAL DATA

% gravel = 0.0%
% sand = 33.1%
% silt and clay = 66.9%
% silt = n/a
% clay = n/a
moisture content = 37.7%

DATE TESTED	TESTED BY
04/30/18	RTT

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT
La Center Middle School
La Center, Washington

CLIENT
Mr. Dave Holmes, Superintendent
La Center School District
725 NE Highland Avenue
La Center, Washington 98629

PROJECT NO. 18084
LAB ID S18-357
REPORT DATE 05/01/18
FIELD ID SB1.4
DATE SAMPLED 04/19/18
SAMPLED BY ASR

MATERIAL DATA

MATERIAL SAMPLED
SILT with Sand

MATERIAL SOURCE
Soil Boring SB-01
depth = 9.5 feet

USCS SOIL TYPE
ML, Silt with Sand

SPECIFICATIONS
none

AASHTO SOIL TYPE
A-4(2)

LABORATORY TEST DATA

LABORATORY EQUIPMENT
Rainhart "Mary Ann" Sifter 637

TEST PROCEDURE
ASTM D6913

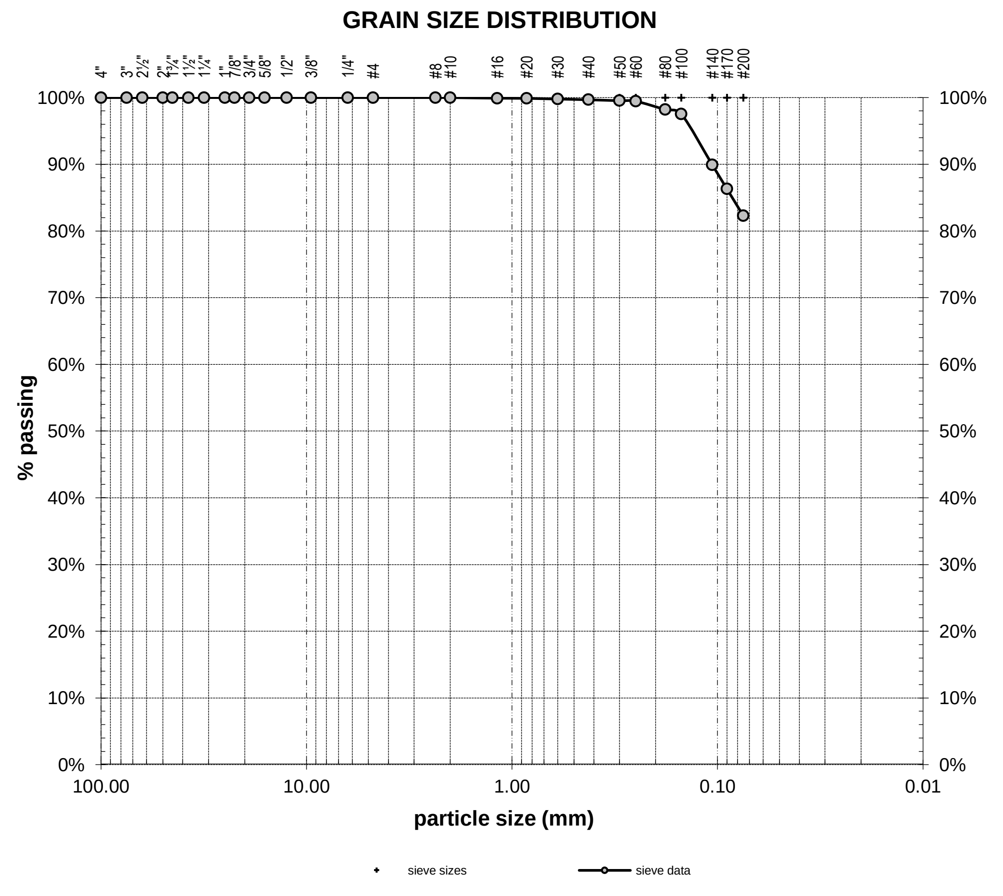
ADDITIONAL DATA

initial dry mass (g) = 138.12
as-received moisture content = 36.5%
liquid limit = 27
plastic limit = 24
plasticity index = 3
fineness modulus = n/a

coefficient of curvature, C_C = n/a
coefficient of uniformity, C_U = n/a
effective size, $D_{(10)}$ = n/a
$D_{(30)}$ = n/a
$D_{(60)}$ = n/a

SIEVE DATA

% gravel = 0.0%
% sand = 17.7%
% silt and clay = 82.3%



	SIEVE SIZE		PERCENT PASSING			
			SIEVE		SPECS	
	US	mm	act.	interp.	max	min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5		100%		
	1.25"	31.5		100%		
	1.00"	25.0		100%		
	7/8"	22.4		100%		
	3/4"	19.0		100%		
	5/8"	16.0		100%		
	1/2"	12.5		100%		
	3/8"	9.50		100%		
	1/4"	6.30		100%		
	#4	4.75	100%			
SAND	#8	2.36		100%		
	#10	2.00	100%			
	#16	1.18		100%		
	#20	0.850	100%			
	#30	0.600		100%		
	#40	0.425	100%			
	#50	0.300		100%		
	#60	0.250	99%			
	#80	0.180		98%		
	#100	0.150	98%			
	#140	0.106		90%		
	#170	0.090		86%		
	#200	0.075	82%			

DATE TESTED 04/26/18
TESTED BY RTT

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ATTERBERG LIMITS REPORT

PROJECT
La Center Middle School
La Center, Washington

CLIENT
Mr. Dave Holmes, Superintendent
La Center School District
725 NE Highland Avenue
La Center, Washington 98629

PROJECT NO. 18084	LAB ID S18-357
REPORT DATE 05/01/18	FIELD ID SB1.4
DATE SAMPLED 04/19/18	SAMPLED BY ASR

MATERIAL DATA

MATERIAL SAMPLED
SILT with Sand

MATERIAL SOURCE
Soil Boring SB-01
depth = 9.5 feet

USCS SOIL TYPE
ML, Silt with Sand

LABORATORY TEST DATA

LABORATORY EQUIPMENT
Liquid Limit Machine, Hand Rolled

TEST PROCEDURE
ASTM D4318

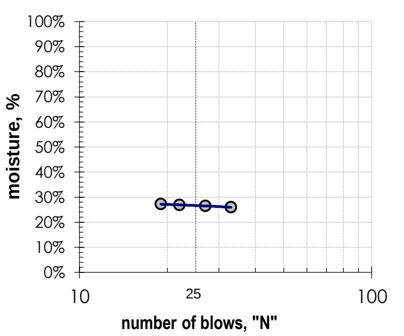
ATTERBERG LIMITS

liquid limit = 27
plastic limit = 24
plasticity index = 3

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	34.20	33.34	32.87	34.96
dry soil + pan weight, g =	31.43	30.74	30.28	31.94
pan weight, g =	20.76	20.94	20.63	20.85
N (blows) =	33	27	22	19
moisture, % =	26.0 %	26.5 %	26.8 %	27.2 %

LIQUID LIMIT



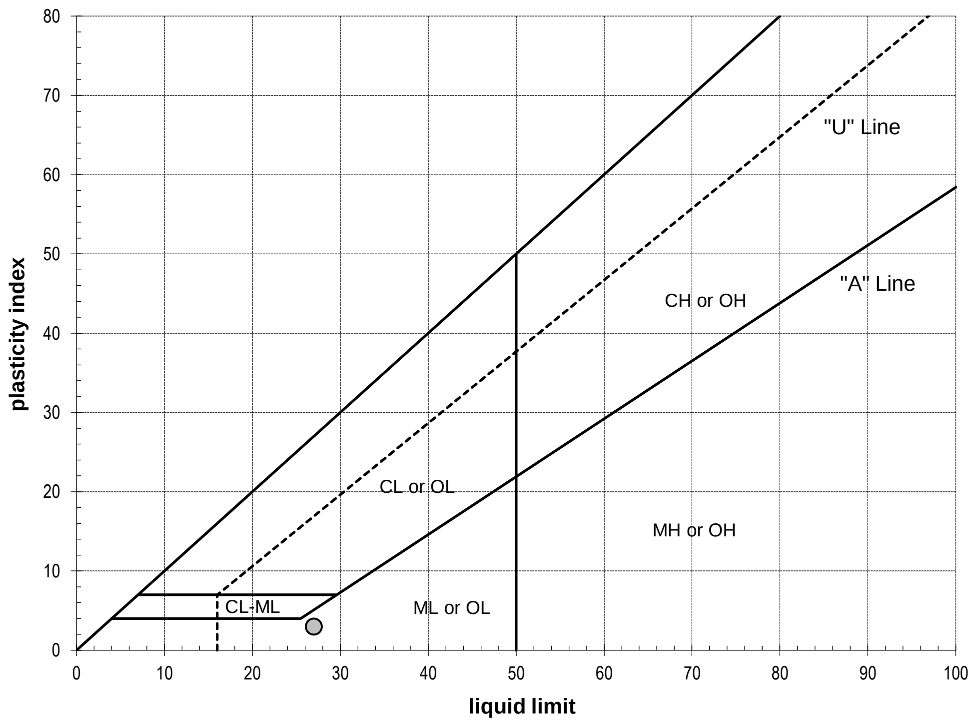
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	27.38	28.10		
dry soil + pan weight, g =	26.09	26.70		
pan weight, g =	20.72	20.85		
moisture, % =	24.0 %	23.9 %		

PLASTICITY CHART



ADDITIONAL DATA

% gravel =	0.0%
% sand =	17.7%
% silt and clay =	82.3%
% silt =	n/a
% clay =	n/a
moisture content =	36.5%

DATE TESTED 04/27/18	TESTED BY RTT

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT
La Center Middle School
La Center, Washington

CLIENT
Mr. Dave Holmes, Superintendent
La Center School District
725 NE Highland Avenue
La Center, Washington 98629

PROJECT NO. 18084	LAB ID S18-358
REPORT DATE 05/01/18	FIELD ID SB1.7
DATE SAMPLED 04/19/18	SAMPLED BY ASR

MATERIAL DATA

MATERIAL SAMPLED
Silty CLAY with Sand

MATERIAL SOURCE
Soil Boring SB-01
depth = 19.5 feet

USCS SOIL TYPE
CL-ML, Silty Clay with Sand

SPECIFICATIONS
none

AASHTO SOIL TYPE
A-4(2)

LABORATORY TEST DATA

LABORATORY EQUIPMENT
Rainhart "Mary Ann" Sifter 637

TEST PROCEDURE
ASTM D6913

ADDITIONAL DATA

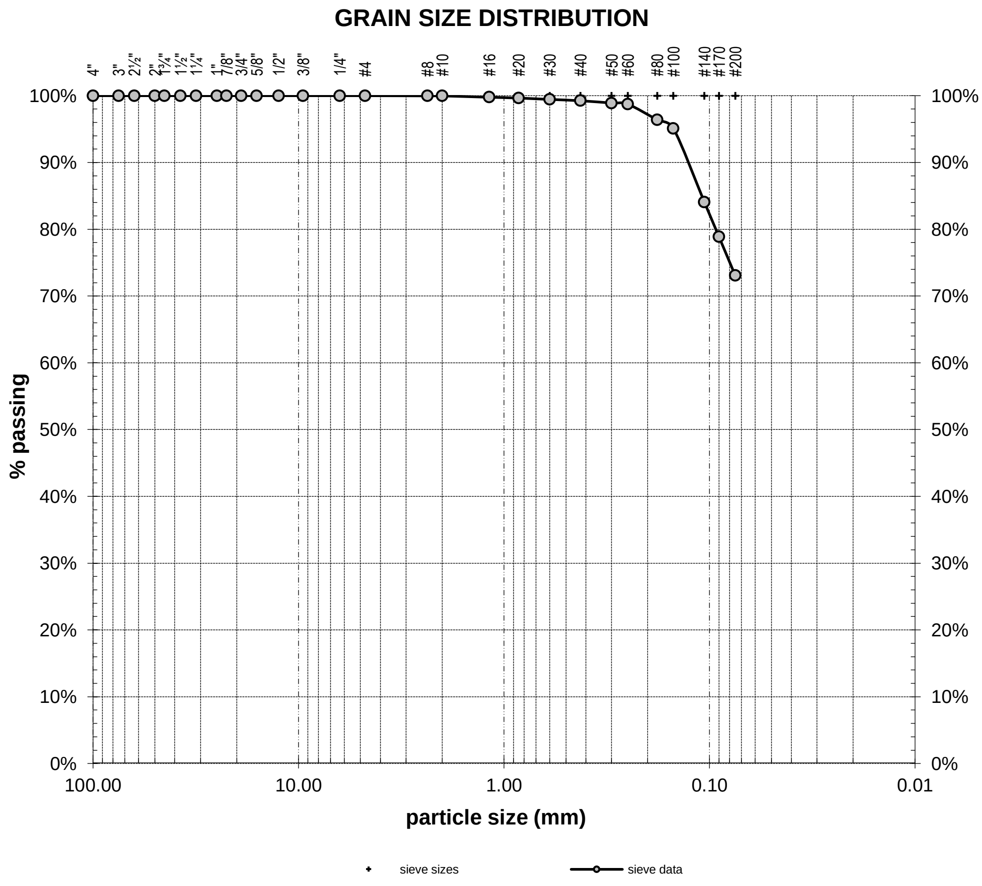
initial dry mass (g) = 151.73
as-received moisture content = 29.6%
liquid limit = 26
plastic limit = 21
plasticity index = 5
fineness modulus = n/a

coefficient of curvature, C_C = n/a
coefficient of uniformity, C_U = n/a
effective size, $D_{(10)}$ = n/a
$D_{(30)}$ = n/a
$D_{(60)}$ = n/a

SIEVE DATA

% gravel = 0.0%
% sand = 26.9%
% silt and clay = 73.1%

	SIEVE SIZE		PERCENT PASSING			
			SIEVE		SPECS	
	US	mm	act.	interp.	max	min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5		100%		
	1.25"	31.5		100%		
	1.00"	25.0		100%		
	7/8"	22.4		100%		
	3/4"	19.0		100%		
	5/8"	16.0		100%		
	1/2"	12.5		100%		
	3/8"	9.50		100%		
	1/4"	6.30		100%		
	#4	4.75	100%			
SAND	#8	2.36		100%		
	#10	2.00	100%			
	#16	1.18		100%		
	#20	0.850	100%			
	#30	0.600		99%		
	#40	0.425	99%			
	#50	0.300		99%		
	#60	0.250	99%			
	#80	0.180		96%		
	#100	0.150	95%			
	#140	0.106		84%		
	#170	0.090		79%		
	#200	0.075	73%			



DATE TESTED
04/26/18

TESTED BY
RTT

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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
La Center Middle School La Center, Washington	Mr. Dave Holmes, Superintendent La Center School District 725 NE Highland Avenue La Center, Washington 98629	18084	S18-358
		REPORT DATE 05/01/18	FIELD ID SB1.7
		DATE SAMPLED 04/19/18	SAMPLED BY ASR

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Silty CLAY with Sand	Soil Boring SB-01 depth = 19.5 feet	CL-ML, Silty Clay with Sand

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318

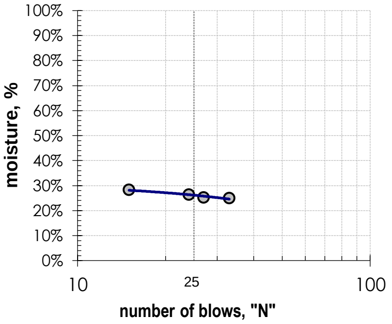
ATTERBERG LIMITS

liquid limit = 26
plastic limit = 21
plasticity index = 5

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	34.51	31.65	35.78	32.11
dry soil + pan weight, g =	31.80	29.43	32.68	29.61
pan weight, g =	20.94	20.64	20.90	20.78
N (blows) =	33	27	24	15
moisture, % =	25.0 %	25.3 %	26.3 %	28.3 %

LIQUID LIMIT



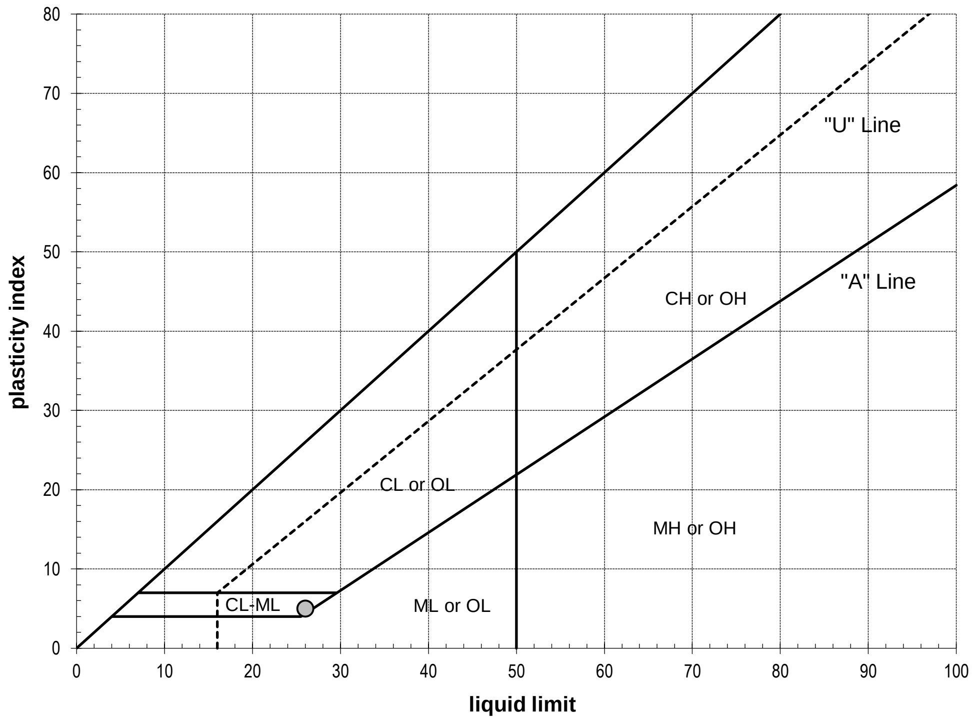
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	28.63	28.90		
dry soil + pan weight, g =	27.27	27.48		
pan weight, g =	20.84	20.87		
moisture, % =	21.2 %	21.5 %		

PLASTICITY CHART



ADDITIONAL DATA

% gravel = 0.0%
% sand = 26.9%
% silt and clay = 73.1%
% silt = n/a
% clay = n/a
moisture content = 29.6%

DATE TESTED	TESTED BY
04/30/18	RTT

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
La Center Middle School La Center, Washington	Mr. Dave Holmes, Superintendent La Center School District 725 NE Highland Avenue La Center, Washington 98629	18084	S18-359
		REPORT DATE 05/01/18	FIELD ID SB2.3
		DATE SAMPLED 04/19/18	SAMPLED BY ASR

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Lean CLAY with Sand	Soil Boring SB-02 depth = 7.5 feet	CL, Lean Clay with Sand

SPECIFICATIONS
none

AASHTO SOIL TYPE
A-4(5)

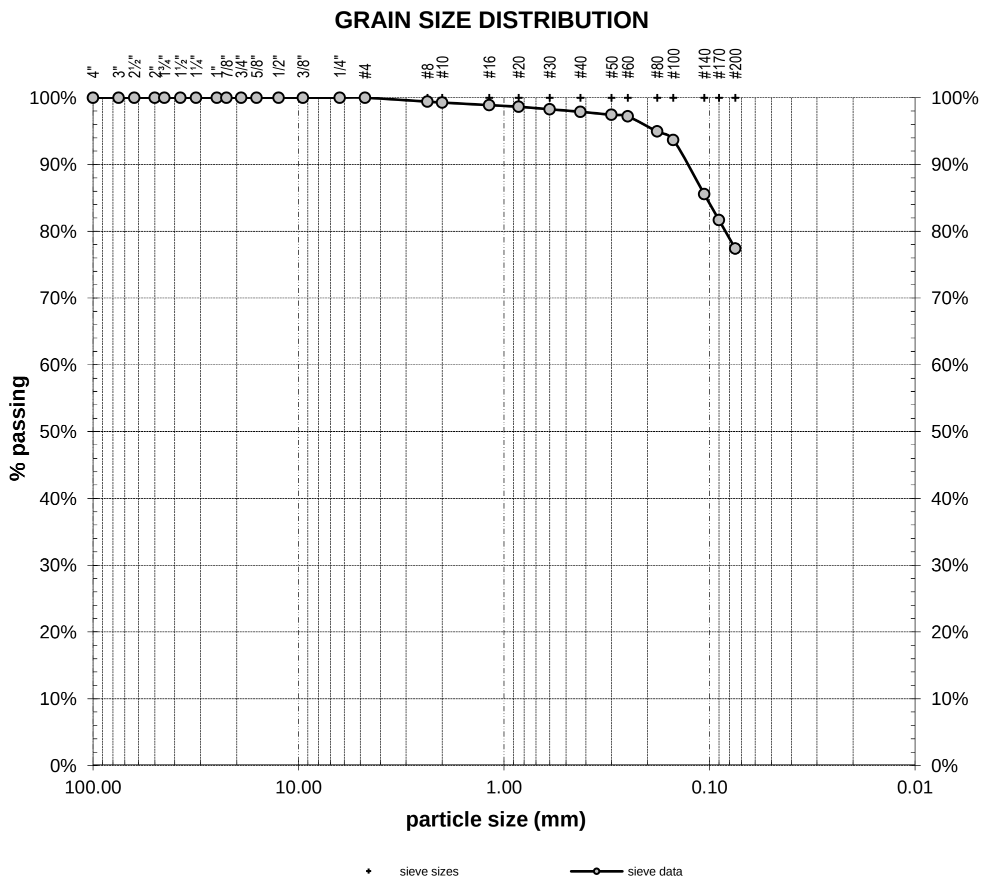
LABORATORY TEST DATA

LABORATORY EQUIPMENT
Rainhart "Mary Ann" Sifter 637

TEST PROCEDURE
ASTM D6913

ADDITIONAL DATA

initial dry mass (g) =	133.16		
as-received moisture content =	41.8%	coefficient of curvature, C_C =	n/a
liquid limit =	30	coefficient of uniformity, C_U =	n/a
plastic limit =	22	effective size, $D_{(10)}$ =	n/a
plasticity index =	8	$D_{(30)}$ =	n/a
fineness modulus =	n/a	$D_{(60)}$ =	n/a



SIEVE DATA

% gravel = 0.0%
% sand = 22.6%
% silt and clay = 77.4%

	SIEVE SIZE		PERCENT PASSING			
			SIEVE		SPECS	
	US	mm	act.	interp.	max	min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5		100%		
	1.25"	31.5		100%		
	1.00"	25.0		100%		
	7/8"	22.4		100%		
	3/4"	19.0		100%		
	5/8"	16.0		100%		
	1/2"	12.5		100%		
	3/8"	9.50		100%		
	1/4"	6.30		100%		
	#4	4.75	100%			
SAND	#8	2.36		99%		
	#10	2.00	99%			
	#16	1.18		99%		
	#20	0.850	99%			
	#30	0.600		98%		
	#40	0.425	98%			
	#50	0.300		97%		
	#60	0.250	97%			
	#80	0.180		95%		
	#100	0.150	94%			
	#140	0.106		86%		
	#170	0.090		82%		
	#200	0.075	77%			

DATE TESTED	TESTED BY
04/26/18	RTT

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ATTERBERG LIMITS REPORT

PROJECT
La Center Middle School
La Center, Washington

CLIENT
Mr. Dave Holmes, Superintendent
La Center School District
725 NE Highland Avenue
La Center, Washington 98629

PROJECT NO. 18084	LAB ID S18-359
REPORT DATE 05/01/18	FIELD ID SB2.3
DATE SAMPLED 04/19/18	SAMPLED BY ASR

MATERIAL DATA

MATERIAL SAMPLED
Lean CLAY with Sand

MATERIAL SOURCE
Soil Boring SB-02
depth = 7.5 feet

USCS SOIL TYPE
CL, Lean Clay with Sand

LABORATORY TEST DATA

LABORATORY EQUIPMENT
Liquid Limit Machine, Hand Rolled

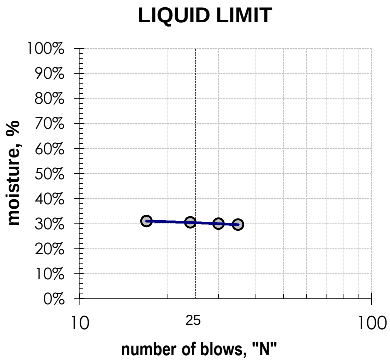
TEST PROCEDURE
ASTM D4318

ATTERBERG LIMITS

liquid limit = 30
plastic limit = 22
plasticity index = 8

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	33.20	32.68	29.24	32.55
dry soil + pan weight, g =	30.39	29.95	27.26	29.75
pan weight, g =	20.88	20.84	20.76	20.71
N (blows) =	35	30	24	17
moisture, % =	29.6 %	30.0 %	30.5 %	31.0 %



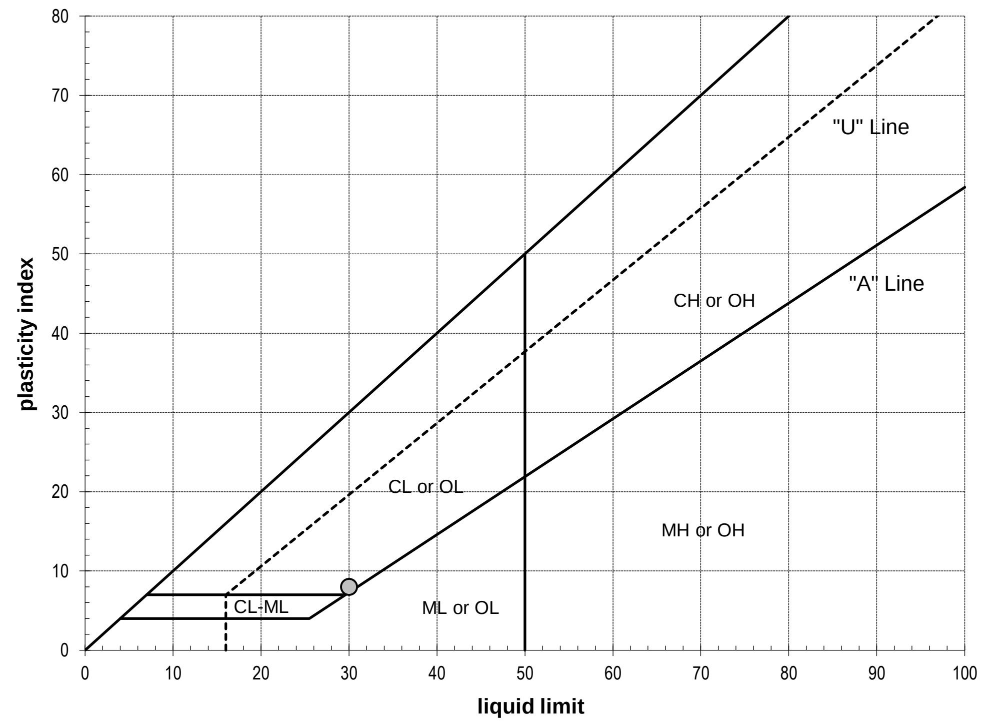
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	28.15	28.51		
dry soil + pan weight, g =	26.80	27.14		
pan weight, g =	20.72	20.85		
moisture, % =	22.2 %	21.8 %		

PLASTICITY CHART



ADDITIONAL DATA

% gravel = 0.0%
% sand = 22.6%
% silt and clay = 77.4%
% silt = n/a
% clay = n/a
moisture content = 41.8%

DATE TESTED 04/30/18	TESTED BY RTT

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
La Center Middle School La Center, Washington	Mr. Dave Holmes, Superintendent La Center School District 725 NE Highland Avenue La Center, Washington 98629	18084	S18-360
		REPORT DATE	FIELD ID
		05/01/18	SB2.8
		DATE SAMPLED	SAMPLED BY
		04/20/18	ASR

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Clayey SAND	Soil Boring SB-02 depth = 30 feet	SC, Clayey Sand
SPECIFICATIONS		AASHTO SOIL TYPE
none		A-2-6(0)

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Rainhart "Mary Ann" Sifter 637	ASTM D6913

ADDITIONAL DATA

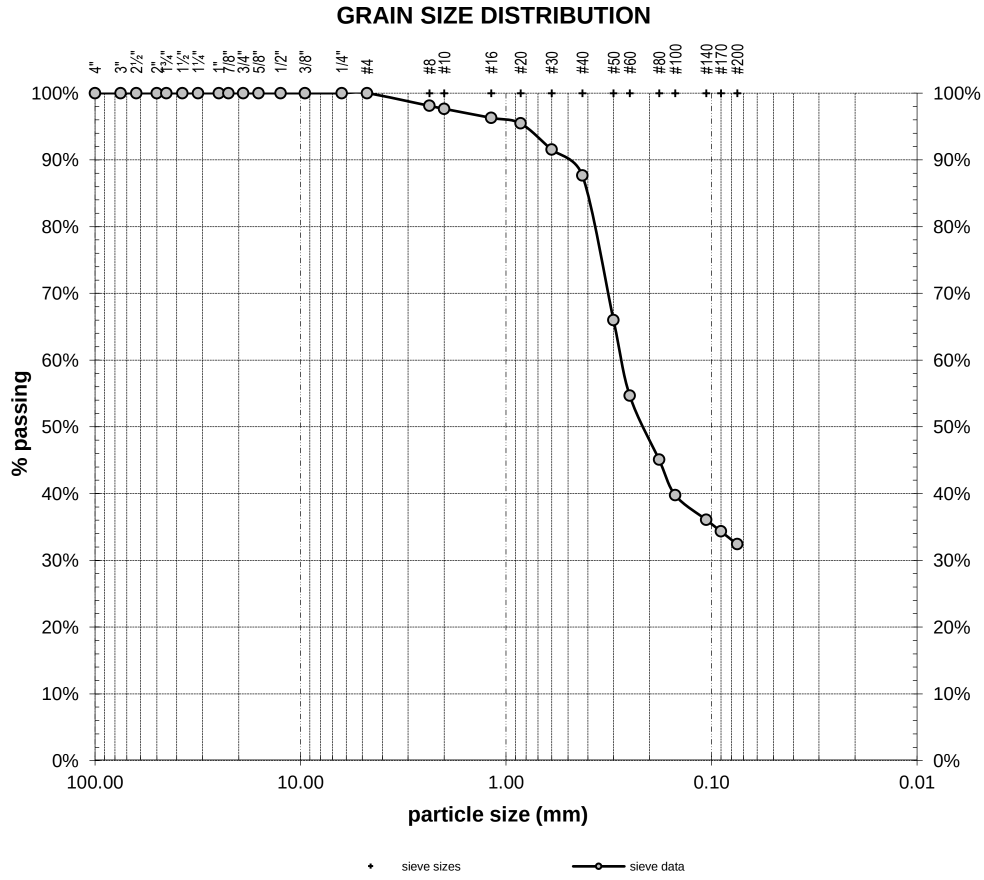
initial dry mass (g) = 148.33
as-received moisture content = 24.9%
liquid limit = 27
plastic limit = 15
plasticity index = 12
fineness modulus = n/a

coefficient of curvature, C_C = n/a
coefficient of uniformity, C_U = n/a
effective size, $D_{(10)}$ = n/a
$D_{(30)}$ = n/a
$D_{(60)}$ = 0.272 mm

SIEVE DATA

% gravel = 0.0%
% sand = 67.6%
% silt and clay = 32.4%

	SIEVE SIZE		PERCENT PASSING			
			SIEVE		SPECS	
	US	mm	act.	interp.	max	min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5		100%		
	1.25"	31.5		100%		
	1.00"	25.0		100%		
	7/8"	22.4		100%		
	3/4"	19.0		100%		
	5/8"	16.0		100%		
	1/2"	12.5		100%		
	3/8"	9.50		100%		
	1/4"	6.30		100%		
	#4	4.75	100%			
SAND	#8	2.36		98%		
	#10	2.00	98%			
	#16	1.18		96%		
	#20	0.850	95%			
	#30	0.600		92%		
	#40	0.425	88%			
	#50	0.300		66%		
	#60	0.250	55%			
	#80	0.180		45%		
	#100	0.150	40%			
	#140	0.106		36%		
	#170	0.090		34%		
	#200	0.075	32%			



DATE TESTED	TESTED BY
04/26/18	RTT

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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
La Center Middle School La Center, Washington	Mr. Dave Holmes, Superintendent La Center School District 725 NE Highland Avenue La Center, Washington 98629	18084	S18-360
		REPORT DATE 05/01/18	FIELD ID SB2.8
		DATE SAMPLED 04/20/18	SAMPLED BY ASR

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Clayey SAND	Soil Boring SB-02 depth = 30 feet	SC, Clayey Sand

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318

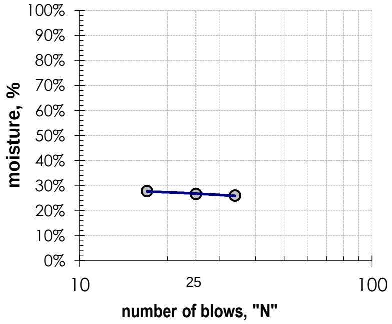
ATTERBERG LIMITS

liquid limit = 27
plastic limit = 15
plasticity index = 12

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	31.16	30.81	35.41	
dry soil + pan weight, g =	28.99	28.72	32.21	
pan weight, g =	20.65	20.85	20.70	
N (blows) =	34	25	17	
moisture, % =	26.0 %	26.6 %	27.8 %	

LIQUID LIMIT



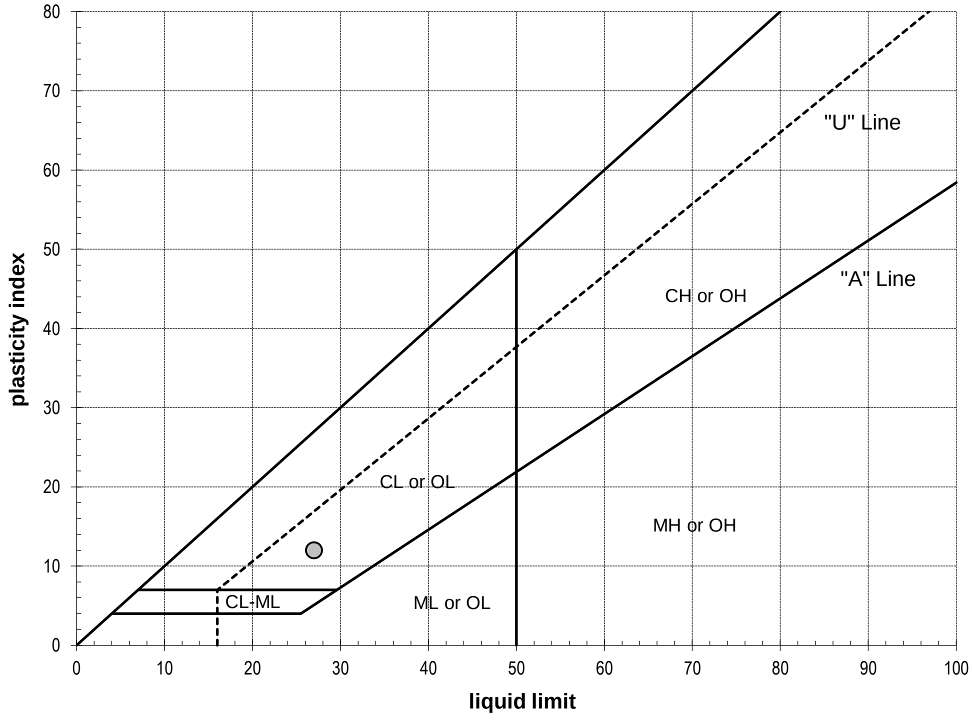
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	27.72	27.05		
dry soil + pan weight, g =	26.81	26.22		
pan weight, g =	20.74	20.59		
moisture, % =	15.0 %	14.7 %		

PLASTICITY CHART



ADDITIONAL DATA

% gravel = 0.0%
% sand = 67.6%
% silt and clay = 32.4%
% silt = n/a
% clay = n/a
moisture content = 24.9%

DATE TESTED	TESTED BY
04/30/18	RTT

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT
La Center Middle School
La Center, Washington

CLIENT
Mr. Dave Holmes, Superintendent
La Center School District
725 NE Highland Avenue
La Center, Washington 98629

PROJECT NO. 18084	LAB ID S18-889
REPORT DATE 09/26/18	FIELD ID SB3.3
DATE SAMPLED 08/22/18	SAMPLED BY HDG

MATERIAL DATA

MATERIAL SAMPLED
SILT with Sand

MATERIAL SOURCE
Soil Boring SB-03
depth = 7.5 feet

USCS SOIL TYPE
ML, Silt with Sand

SPECIFICATIONS
none

AASHTO SOIL TYPE
A-4(3)

LABORATORY TEST DATA

LABORATORY EQUIPMENT
Rainhart "Mary Ann" Sifter 637

TEST PROCEDURE
ASTM D6913

ADDITIONAL DATA

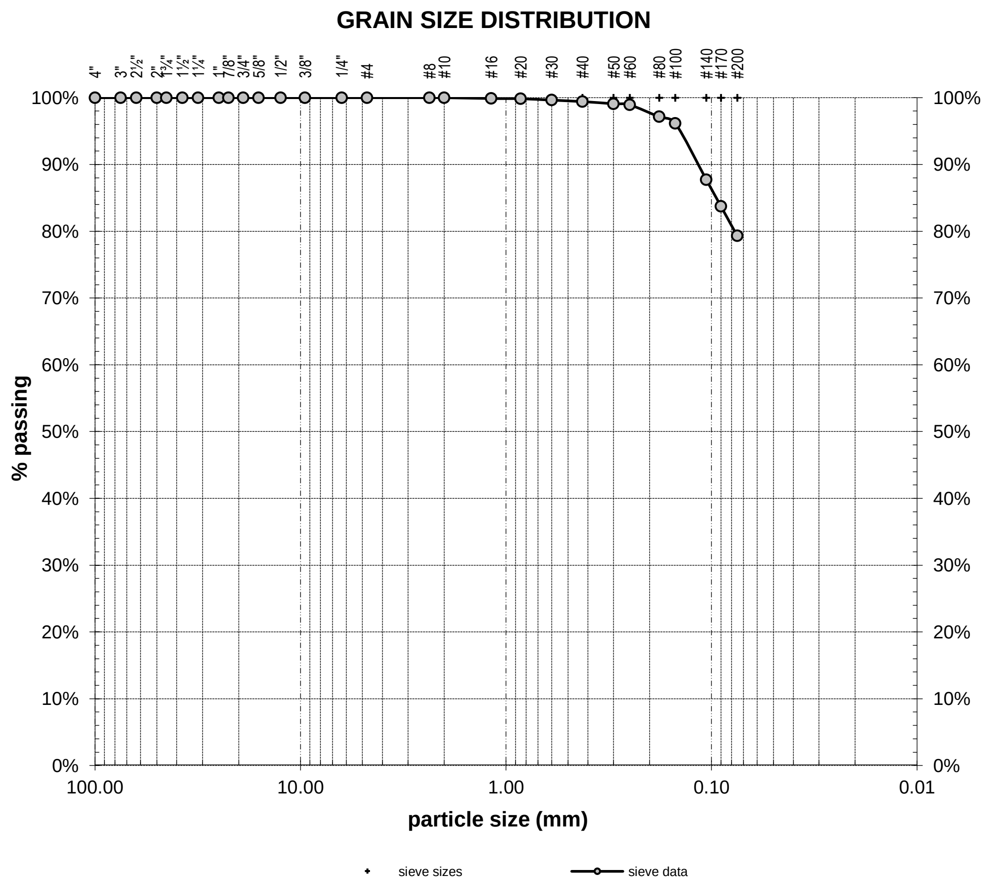
initial dry mass (g) = 171.45
as-received moisture content = 37.0%
liquid limit = 30
plastic limit = 25
plasticity index = 5
fineness modulus = n/a

coefficient of curvature, C_C = n/a
coefficient of uniformity, C_U = n/a
effective size, $D_{(10)}$ = n/a
$D_{(30)}$ = n/a
$D_{(60)}$ = n/a

SIEVE DATA

% gravel = 0.0%
% sand = 20.7%
% silt and clay = 79.3%

	SIEVE SIZE		PERCENT PASSING			
			SIEVE		SPECS	
	US	mm	act.	interp.	max	min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5		100%		
	1.25"	31.5		100%		
	1.00"	25.0		100%		
	7/8"	22.4		100%		
	3/4"	19.0		100%		
	5/8"	16.0		100%		
	1/2"	12.5		100%		
	3/8"	9.50		100%		
	1/4"	6.30		100%		
	#4	4.75	100%			
SAND	#8	2.36		100%		
	#10	2.00	100%			
	#16	1.18		100%		
	#20	0.850	100%			
	#30	0.600		100%		
	#40	0.425	99%			
	#50	0.300		99%		
	#60	0.250	99%			
	#80	0.180		97%		
	#100	0.150	96%			
	#140	0.106		88%		
	#170	0.090		84%		
	#200	0.075	79%			



DATE TESTED 09/19/18

TESTED BY KMS

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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
La Center Middle School La Center, Washington	Mr. Dave Holmes, Superintendent La Center School District 725 NE Highland Avenue La Center, Washington 98629	18084	S18-889
		REPORT DATE 09/26/18	FIELD ID SB3.3
		DATE SAMPLED 08/22/18	SAMPLED BY HDG

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
SILT with Sand	Soil Boring SB-03 depth = 7.5 feet	ML, Silt with Sand

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318

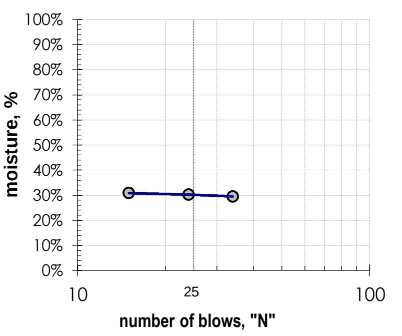
ATTERBERG LIMITS

liquid limit = 30
plastic limit = 25
plasticity index = 5

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	36.84	34.36	34.13	
dry soil + pan weight, g =	33.18	31.21	30.99	
pan weight, g =	20.77	20.76	20.80	
N (blows) =	34	24	15	
moisture, % =	29.5 %	30.1 %	30.8 %	

LIQUID LIMIT



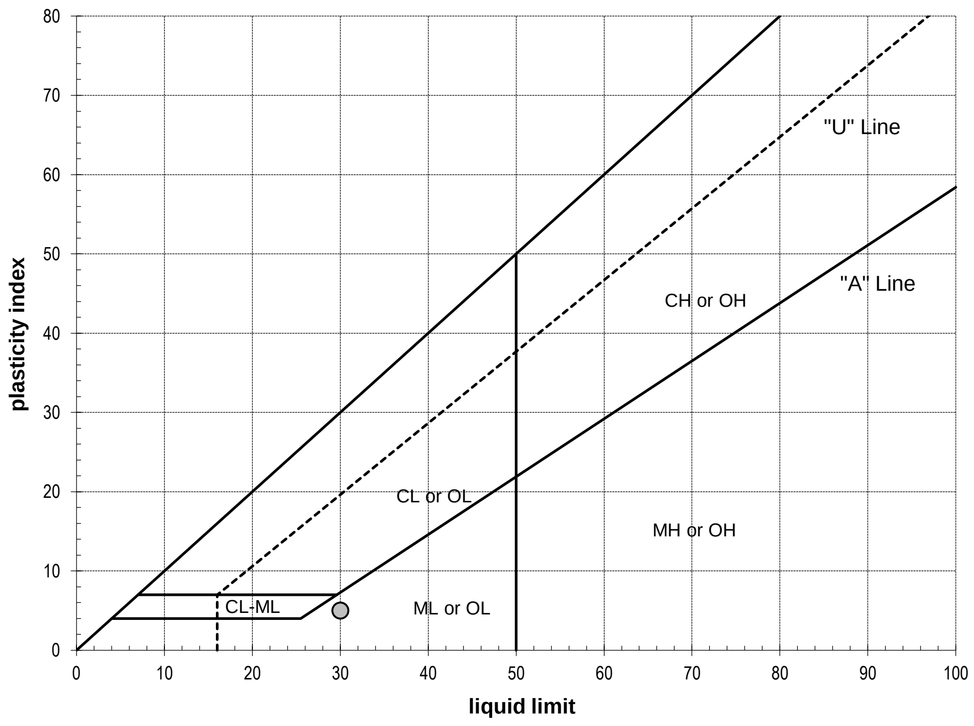
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	29.05	28.28		
dry soil + pan weight, g =	27.38	26.76		
pan weight, g =	20.84	20.64		
moisture, % =	25.5 %	24.8 %		

PLASTICITY CHART



ADDITIONAL DATA

% gravel = 0.0%
% sand = 20.7%
% silt and clay = 79.3%
% silt = n/a
% clay = n/a
moisture content = 37.0%

DATE TESTED	TESTED BY
09/24/18	RTT

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
La Center Middle School La Center, Washington	Mr. Dave Holmes, Superintendent La Center School District 725 NE Highland Avenue La Center, Washington 98629	18084	S18-890
		REPORT DATE	FIELD ID
		09/26/18	SB3.4
		DATE SAMPLED	SAMPLED BY
		08/22/18	HDG

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Lean CLAY with Sand	Soil Boring SB-03 depth = 10.5 feet	CL, Lean Clay with Sand

SPECIFICATIONS	AASHTO SOIL TYPE
none	A-4(8)

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Rainhart "Mary Ann" Sifter 637	ASTM D6913

ADDITIONAL DATA

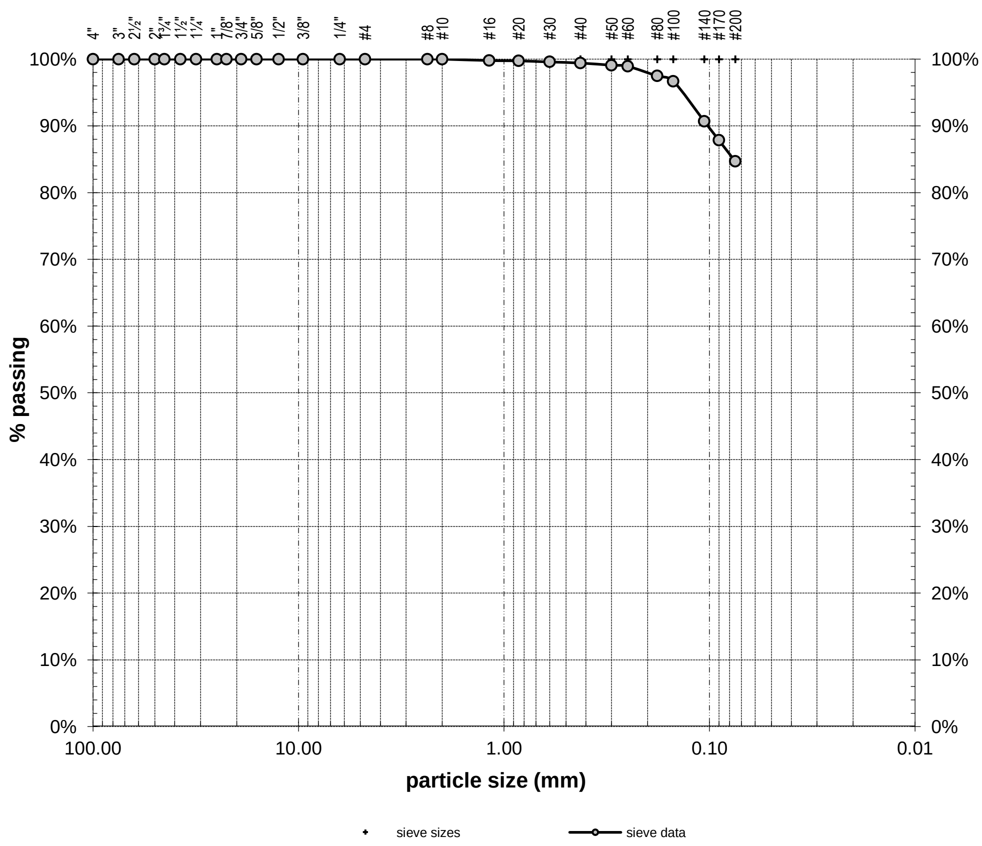
initial dry mass (g) =	88.83		
as-received moisture content =	39.8%	coefficient of curvature, C_C =	n/a
liquid limit =	33	coefficient of uniformity, C_U =	n/a
plastic limit =	23	effective size, $D_{(10)}$ =	n/a
plasticity index =	10	$D_{(30)}$ =	n/a
fineness modulus =	n/a	$D_{(60)}$ =	n/a

SIEVE DATA

% gravel = 0.0%
% sand = 15.3%
% silt and clay = 84.7%

	SIEVE SIZE		PERCENT PASSING			
			SIEVE		SPECS	
	US	mm	act.	interp.	max	min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5		100%		
	1.25"	31.5		100%		
	1.00"	25.0		100%		
	7/8"	22.4		100%		
	3/4"	19.0		100%		
	5/8"	16.0		100%		
	1/2"	12.5		100%		
	3/8"	9.50		100%		
	1/4"	6.30		100%		
	#4	4.75	100%			
SAND	#8	2.36		100%		
	#10	2.00	100%			
	#16	1.18		100%		
	#20	0.850	100%			
	#30	0.600		100%		
	#40	0.425	99%			
	#50	0.300		99%		
	#60	0.250	99%			
	#80	0.180		97%		
	#100	0.150	97%			
	#140	0.106		91%		
	#170	0.090		88%		
	#200	0.075	85%			

GRAIN SIZE DISTRIBUTION



DATE TESTED	TESTED BY
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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
La Center Middle School La Center, Washington	Mr. Dave Holmes, Superintendent La Center School District 725 NE Highland Avenue La Center, Washington 98629	18084	S18-890
		REPORT DATE 09/26/18	FIELD ID SB3.4
		DATE SAMPLED 08/22/18	SAMPLED BY HDG

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Lean CLAY with Sand	Soil Boring SB-03 depth = 10.5 feet	CL, Lean Clay with Sand

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318

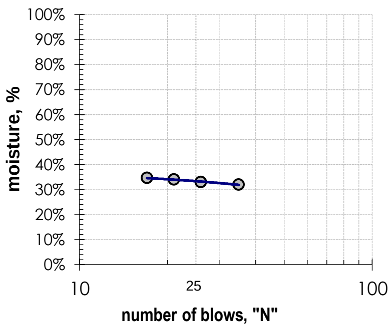
ATTERBERG LIMITS

liquid limit = 33
plastic limit = 23
plasticity index = 10

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	30.17	31.58	33.39	32.41
dry soil + pan weight, g =	27.89	28.89	30.14	29.45
pan weight, g =	20.76	20.73	20.59	20.91
N (blows) =	35	26	21	17
moisture, % =	32.0 %	33.0 %	34.0 %	34.7 %

LIQUID LIMIT



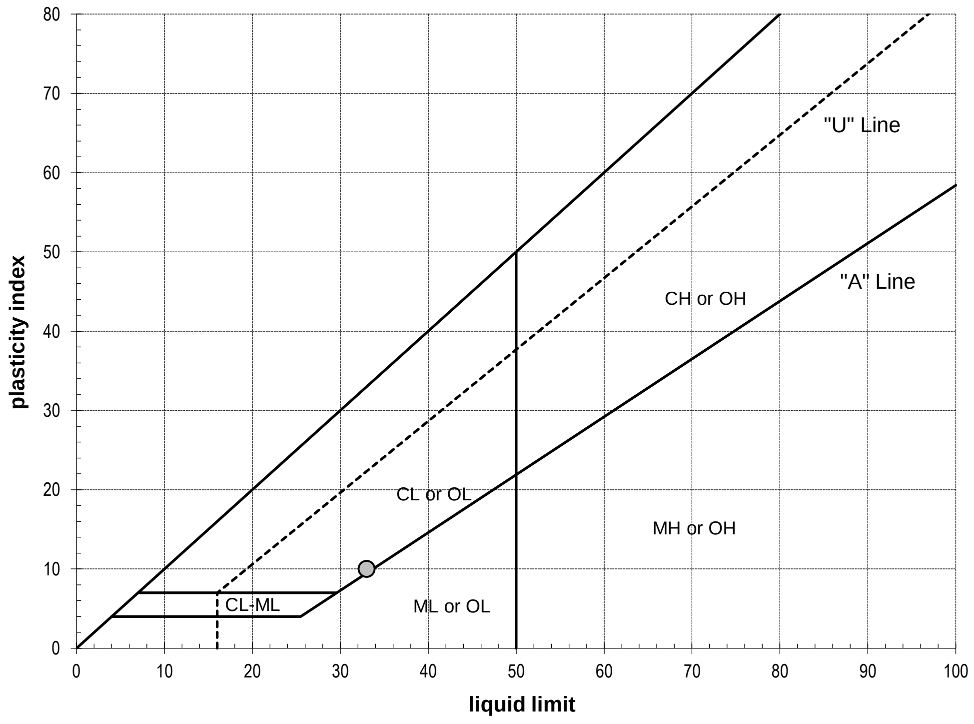
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	27.30	27.58		
dry soil + pan weight, g =	26.10	26.33		
pan weight, g =	20.73	20.86		
moisture, % =	22.4 %	22.9 %		

PLASTICITY CHART



ADDITIONAL DATA

% gravel = 0.0%
% sand = 15.3%
% silt and clay = 84.7%
% silt = n/a
% clay = n/a
moisture content = 39.8%

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
La Center Middle School La Center, Washington	Mr. Dave Holmes, Superintendent La Center School District 725 NE Highland Avenue La Center, Washington 98629	18084	S18-891
		REPORT DATE 09/26/18	FIELD ID SB4.4
		DATE SAMPLED 08/22/18	SAMPLED BY HDG

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
SILT	Soil Boring SB-04 depth = 10 feet	ML, Silt
SPECIFICATIONS none		AASHTO SOIL TYPE A-4(4)

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Rainhart "Mary Ann" Sifter 637	ASTM D6913

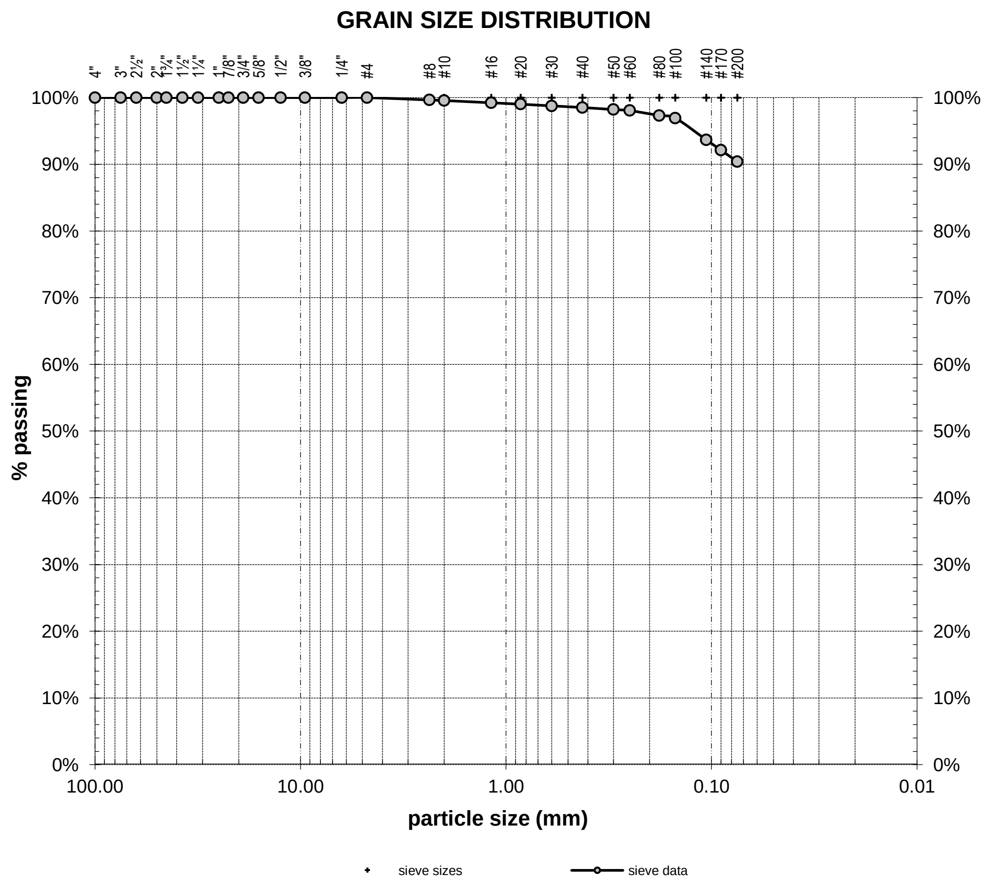
ADDITIONAL DATA

initial dry mass (g) =	158.17		
as-received moisture content =	41.7%	coefficient of curvature, C_C =	n/a
liquid limit =	30	coefficient of uniformity, C_U =	n/a
plastic limit =	26	effective size, $D_{(10)}$ =	n/a
plasticity index =	4	$D_{(30)}$ =	n/a
fineness modulus =	n/a	$D_{(60)}$ =	n/a

SIEVE DATA

% gravel = 0.0%
% sand = 9.6%
% silt and clay = 90.4%

	SIEVE SIZE		PERCENT PASSING			
			SIEVE		SPECS	
	US	mm	act.	interp.	max	min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5		100%		
	1.25"	31.5		100%		
	1.00"	25.0		100%		
	7/8"	22.4		100%		
	3/4"	19.0		100%		
	5/8"	16.0		100%		
	1/2"	12.5		100%		
	3/8"	9.50		100%		
	1/4"	6.30		100%		
	#4	4.75	100%			
SAND	#8	2.36		100%		
	#10	2.00	100%			
	#16	1.18		99%		
	#20	0.850	99%			
	#30	0.600		99%		
	#40	0.425	99%			
	#50	0.300		98%		
	#60	0.250	98%			
	#80	0.180		97%		
	#100	0.150	97%			
	#140	0.106		94%		
	#170	0.090		92%		
	#200	0.075	90%			



DATE TESTED	TESTED BY
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ATTERBERG LIMITS REPORT

PROJECT
La Center Middle School
La Center, Washington

CLIENT
Mr. Dave Holmes, Superintendent
La Center School District
725 NE Highland Avenue
La Center, Washington 98629

PROJECT NO. 18084	LAB ID S18-891
REPORT DATE 09/26/18	FIELD ID SB4.4
DATE SAMPLED 08/22/18	SAMPLED BY HDG

MATERIAL DATA

MATERIAL SAMPLED
SILT

MATERIAL SOURCE
Soil Boring SB-04
depth = 10 feet

USCS SOIL TYPE
ML, Silt

LABORATORY TEST DATA

LABORATORY EQUIPMENT
Liquid Limit Machine, Hand Rolled

TEST PROCEDURE
ASTM D4318

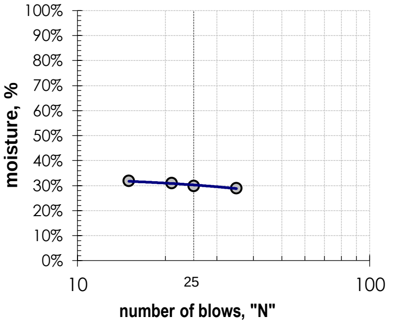
ATTERBERG LIMITS

liquid limit = 30
plastic limit = 26
plasticity index = 4

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	32.37	33.33	33.92	32.24
dry soil + pan weight, g =	29.77	30.47	30.82	29.47
pan weight, g =	20.79	20.89	20.82	20.76
N (blows) =	35	25	21	15
moisture, % =	29.0 %	29.9 %	31.0 %	31.8 %

LIQUID LIMIT



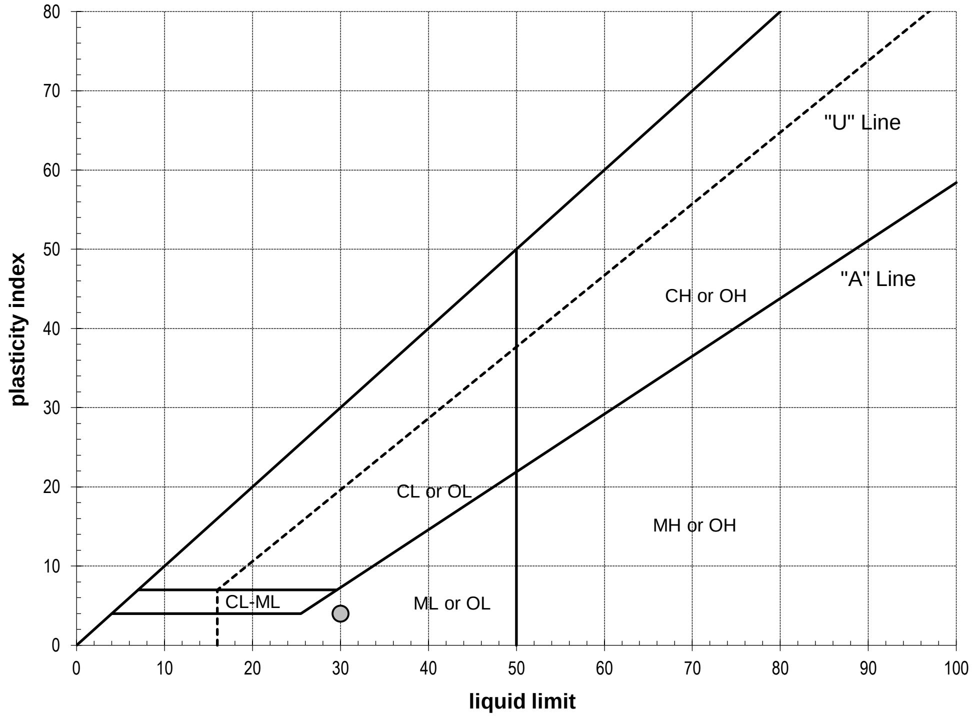
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	27.33	27.21		
dry soil + pan weight, g =	25.99	25.86		
pan weight, g =	20.75	20.59		
moisture, % =	25.6 %	25.6 %		

PLASTICITY CHART



ADDITIONAL DATA

% gravel = 0.0%
% sand = 9.6%
% silt and clay = 90.4%
% silt = n/a
% clay = n/a
moisture content = 41.7%

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT
La Center Middle School
La Center, Washington

CLIENT
Mr. Dave Holmes, Superintendent
La Center School District
725 NE Highland Avenue
La Center, Washington 98629

PROJECT NO. 18084
LAB ID S18-892
REPORT DATE 09/26/18
FIELD ID SB4.7
DATE SAMPLED 08/22/18
SAMPLED BY HDG

MATERIAL DATA

MATERIAL SAMPLED
SILT with Sand

MATERIAL SOURCE
Soil Boring SB-04
depth = 20 feet

USCS SOIL TYPE
ML, Silt with Sand

SPECIFICATIONS
none

AASHTO SOIL TYPE
A-4(2)

LABORATORY TEST DATA

LABORATORY EQUIPMENT
Rainhart "Mary Ann" Sifter 637

TEST PROCEDURE
ASTM D6913

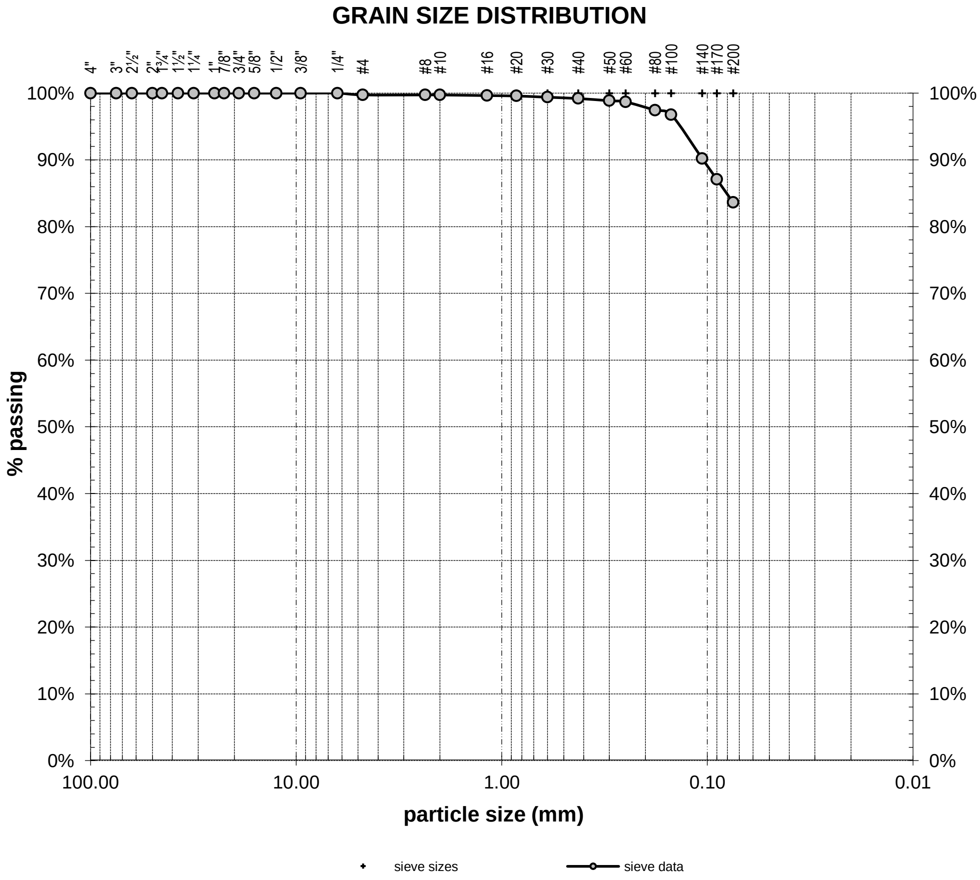
ADDITIONAL DATA

initial dry mass (g) = 199.95
as-received moisture content = 28.4%
liquid limit = 26
plastic limit = 22
plasticity index = 4
fineness modulus = n/a

coefficient of curvature, C_C = n/a
coefficient of uniformity, C_U = n/a
effective size, $D_{(10)}$ = n/a
$D_{(30)}$ = n/a
$D_{(60)}$ = n/a

SIEVE DATA

% gravel = 0.3%
% sand = 16.1%
% silt and clay = 83.6%


GRAIN SIZE DISTRIBUTION

	SIEVE SIZE		PERCENT PASSING			
			SIEVE		SPECS	
	US	mm	act.	interp.	max	min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5		100%		
	1.25"	31.5		100%		
	1.00"	25.0		100%		
	7/8"	22.4		100%		
	3/4"	19.0		100%		
	5/8"	16.0		100%		
	1/2"	12.5		100%		
	3/8"	9.50		100%		
	1/4"	6.30	100%			
	#4	4.75	100%			
SAND	#8	2.36		100%		
	#10	2.00	100%			
	#16	1.18		100%		
	#20	0.850	100%			
	#30	0.600		99%		
	#40	0.425	99%			
	#50	0.300		99%		
	#60	0.250	99%			
	#80	0.180		97%		
	#100	0.150	97%			
	#140	0.106		90%		
	#170	0.090		87%		
	#200	0.075	84%			

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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
La Center Middle School La Center, Washington	Mr. Dave Holmes, Superintendent La Center School District 725 NE Highland Avenue La Center, Washington 98629	18084	S18-892
		REPORT DATE 09/26/18	FIELD ID SB4.7
		DATE SAMPLED 08/22/18	SAMPLED BY HDG

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
SILT with Sand	Soil Boring SB-04 depth = 20 feet	ML, Silt with Sand

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318

ATTERBERG LIMITS

liquid limit = 26
plastic limit = 22
plasticity index = 4

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	36.11	33.92	32.29	33.47
dry soil + pan weight, g =	33.06	31.27	29.87	30.73
pan weight, g =	20.70	20.74	20.47	20.83
N (blows) =	34	27	23	19
moisture, % =	24.7 %	25.2 %	25.7 %	27.7 %

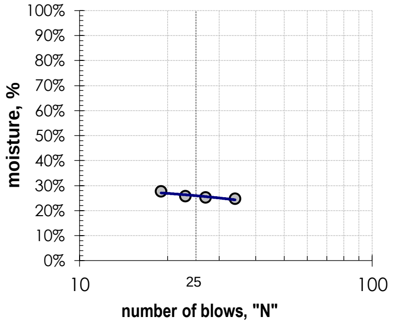
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

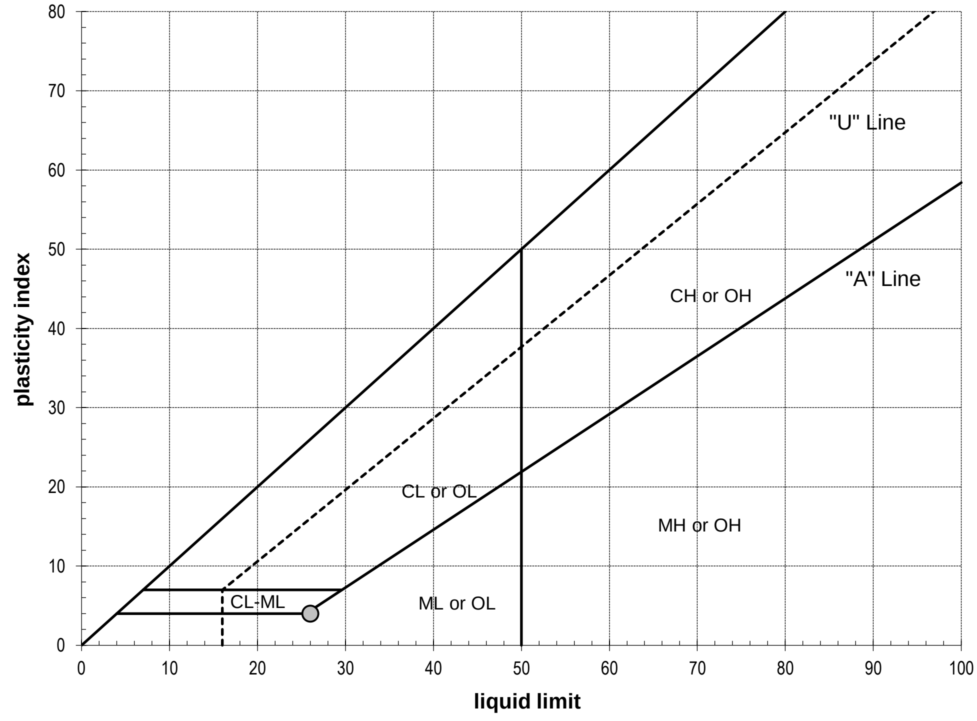
PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	28.09	28.46		
dry soil + pan weight, g =	26.80	27.06		
pan weight, g =	20.79	20.60		
moisture, % =	21.5 %	21.7 %		

LIQUID LIMIT



PLASTICITY CHART



ADDITIONAL DATA

% gravel = 0.3%
% sand = 16.1%
% silt and clay = 83.6%
% silt = n/a
% clay = n/a
moisture content = 28.4%

DATE TESTED	TESTED BY
09/24/18	RTT

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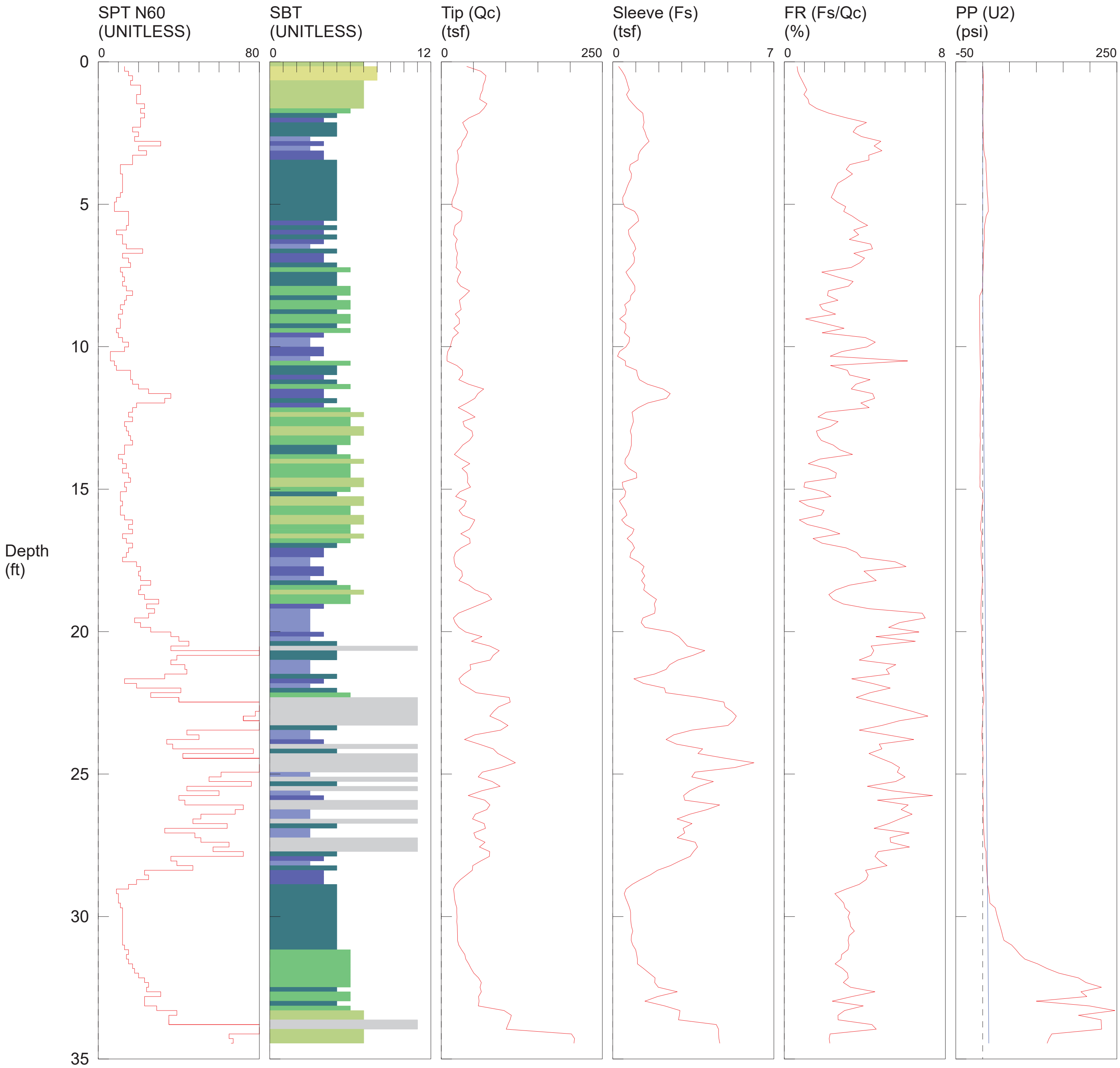
APPENDIX B
SUBSURFACE EXPLORATION LOGS

Columbia West / CPT-1 / 2313 NE Lockwood Creek Rd La Center

OPERATOR: OGE DMM
CONE ID: DDG1452
HOLE NUMBER: CPT-1
TEST DATE: 8/8/2018 8:50:57 AM
TOTAL DEPTH: 34.449 ft

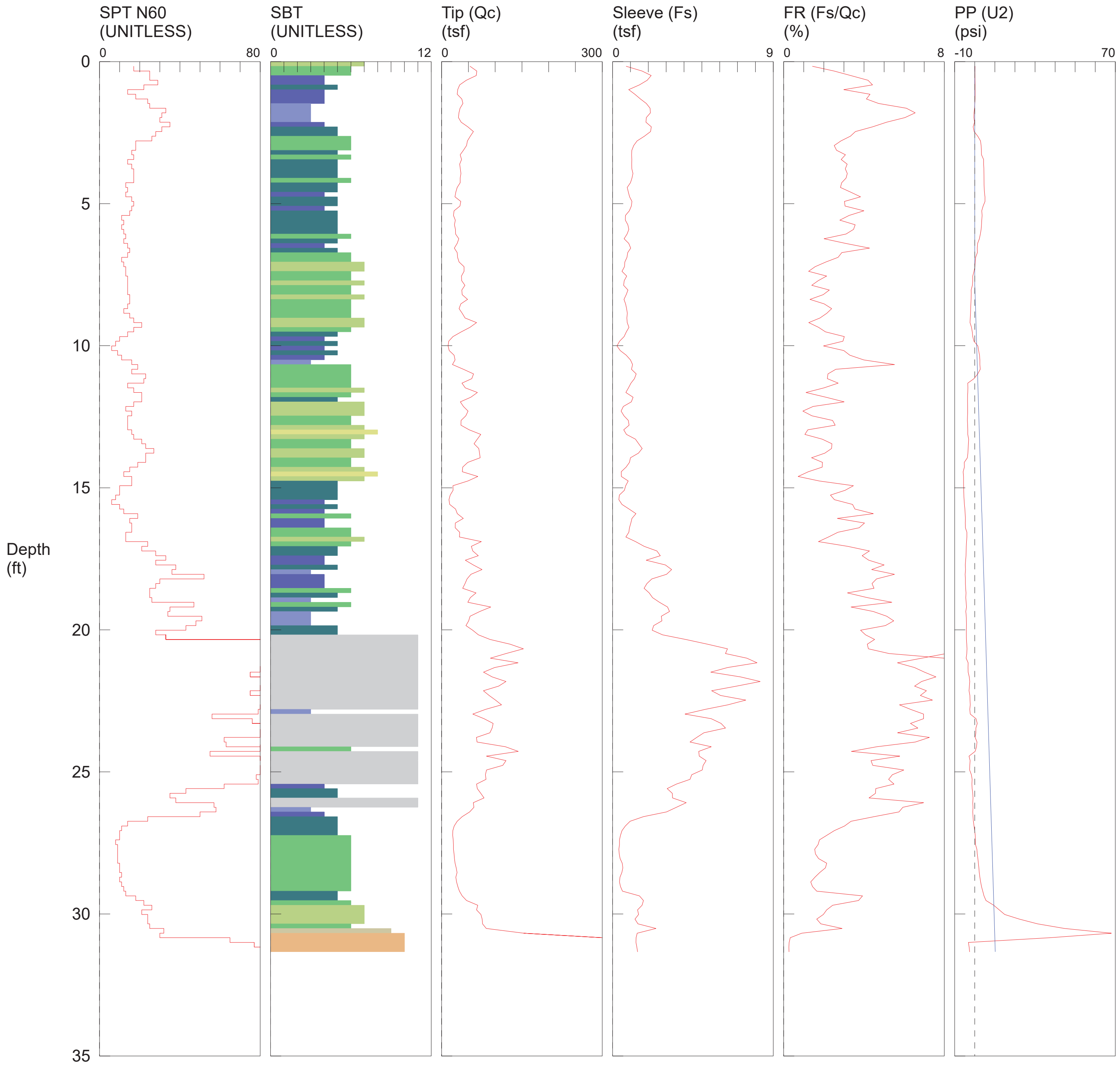


- 🟥 1 sensitive fine grained
- 🟥 2 organic material
- 🟦 3 clay
- 🟪 4 silty clay to clay
- 🟦 5 clayey silt to silty clay
- 🟩 6 sandy silt to clayey silt
- 🟩 7 silty sand to sandy silt
- 🟨 8 sand to silty sand
- 🟫 9 sand
- 🟧 10 gravelly sand to sand
- ⬜ 11 very stiff fine grained (*)
- ⬛ 12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Columbia West / CPT-2 / 2313 NE Lockwood Creek Rd La Center

OPERATOR: OGE DMM
CONE ID: DDG1452
HOLE NUMBER: CPT-2
TEST DATE: 8/8/2018 10:39:31 AM
TOTAL DEPTH: 31.332 ft

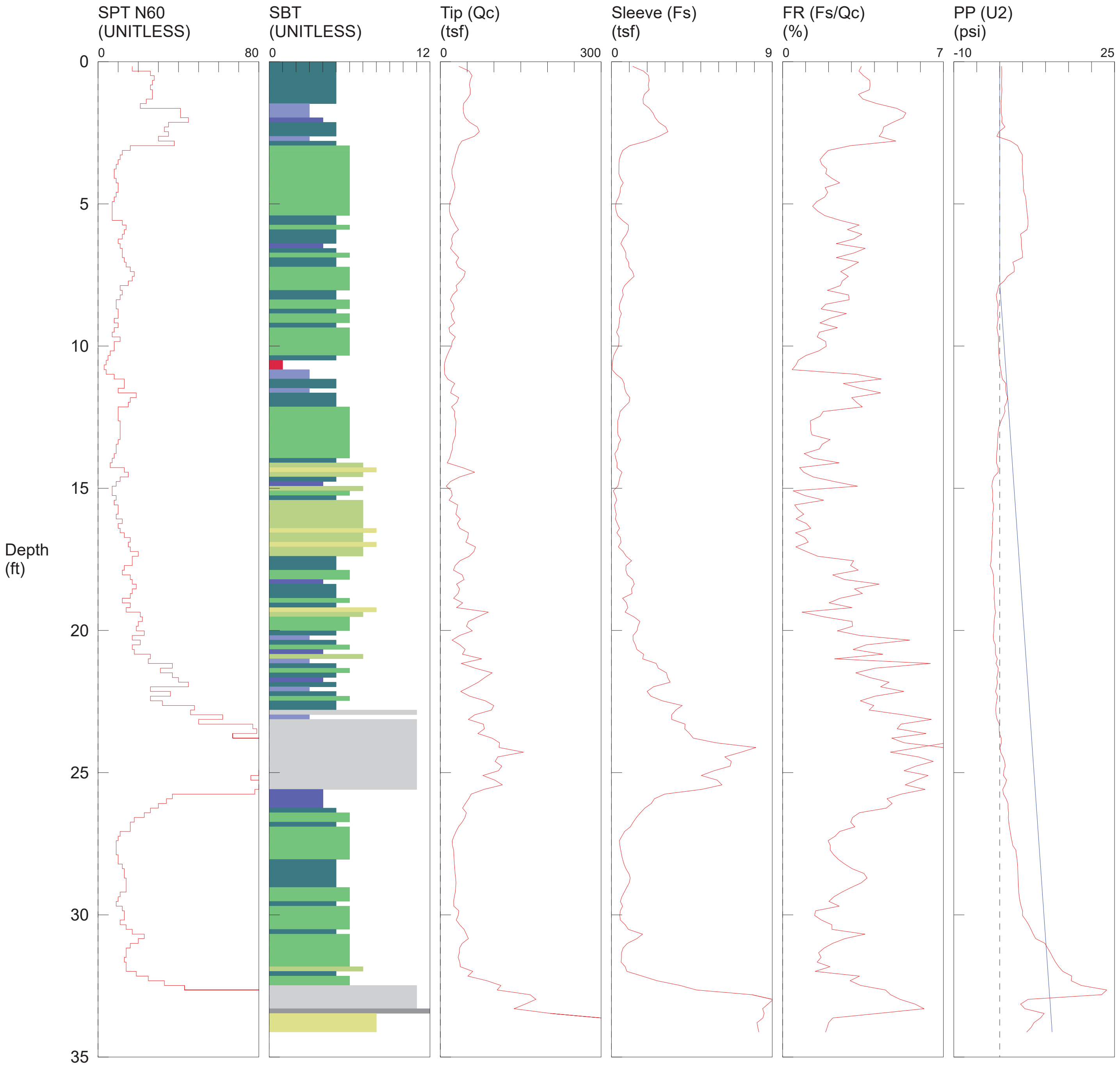


🟥 1 sensitive fine grained
🟥 2 organic material
🟦 3 clay
🟦 4 silty clay to clay
🟩 5 clayey silt to silty clay
🟩 6 sandy silt to clayey silt
🟩 7 silty sand to sandy silt
🟨 8 sand to silty sand
🟫 9 sand
🟧 10 gravelly sand to sand
⬜ 11 very stiff fine grained (*)
⬛ 12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Columbia West / CPT-3 / 2313 NE Lockwood Creek Rd La Center

OPERATOR: OGE DMM
CONE ID: DDG1452
HOLE NUMBER: CPT-3
TEST DATE: 8/8/2018 11:15:11 AM
TOTAL DEPTH: 34.121 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

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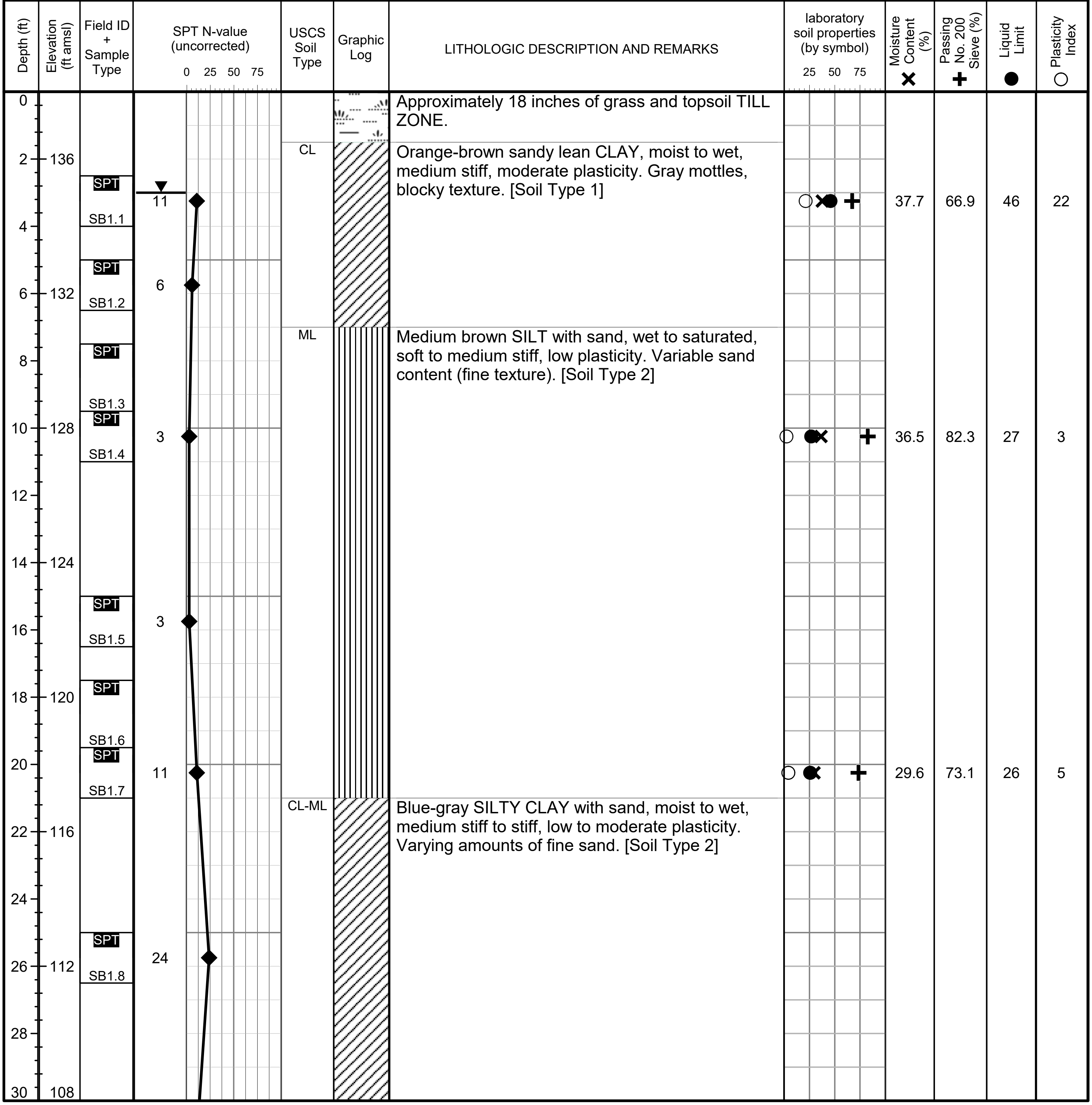
SOIL BORING LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	BORING NO. SB-1
PROJECT LOCATION La Center, Washington	DRILLING CONTRACTOR Western States	DRILL RIG CME-55	ENGINEER/GEOLOGIST ASR	PAGE NO. 1 of 2
BORING LOCATION See Figure 2	DRILLING METHOD Mud-Rotary	SAMPLING METHOD SPT	START DATE 4/19/2018	START TIME 0800
REMARKS None	APPROX. SURFACE ELEVATION 138 ft amsl	GROUNDWATER DEPTH 3 feet bgs	FINISH DATE 4/19/2018	FINISH TIME 1400



USCS Soil Type	LITHOLOGIC DESCRIPTION AND REMARKS	Field ID + Sample Type	SPT N-value	Moisture Content (%) ×	Passing No. 200 Sieve (%) +	Liquid Limit ●	Plasticity Index ○
	Approximately 18 inches of grass and topsoil TILL ZONE.						
CL	Orange-brown sandy lean CLAY, moist to wet, medium stiff, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]	SPT SB1.1	11	37.7	66.9	46	22
		SPT SB1.2	6				
ML	Medium brown SILT with sand, wet to saturated, soft to medium stiff, low plasticity. Variable sand content (fine texture). [Soil Type 2]	SPT SB1.3					
		SPT SB1.4	3	36.5	82.3	27	3
		SPT SB1.5	3				
		SPT SB1.6					
		SPT SB1.7	11	29.6	73.1	26	5
CL-ML	Blue-gray SILTY CLAY with sand, moist to wet, medium stiff to stiff, low to moderate plasticity. Varying amounts of fine sand. [Soil Type 2]	SPT SB1.8	24				

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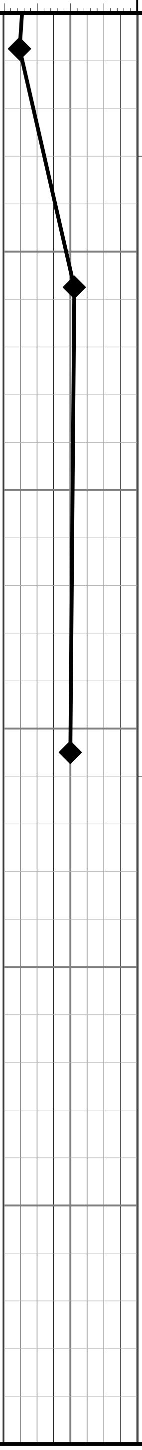
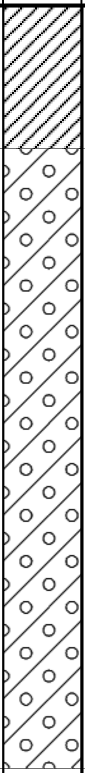
SOIL BORING LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	BORING NO. SB-1
PROJECT LOCATION La Center, Washington	DRILLING CONTRACTOR Western States	DRILL RIG CME-55	ENGINEER/GEOLOGIST ASR	PAGE NO. 2 of 2
BORING LOCATION See Figure 2	DRILLING METHOD Mud-Rotary	SAMPLING METHOD SPT	START DATE 4/19/2018	START TIME 0800
REMARKS None	APPROX. SURFACE ELEVATION 138 ft amsl	GROUNDWATER DEPTH 3 feet bgs	FINISH DATE 4/19/2018	FINISH TIME 1400





Depth (ft)	Elevation (ft amsl)	Field ID + Sample Type	SPT N-value (uncorrected)	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	laboratory soil properties (by symbol)	Moisture Content (%) ✕	Passing No. 200 Sieve (%) ✚	Liquid Limit ●	Plasticity Index ○
30	108	SPT SB1.9	12			Blue-gray SILTY CLAY with sand, moist to wet, medium stiff to stiff, low to moderate plasticity. Varying amounts of fine sand. [Soil Type 2]					
32											
						WEATHERED CONGLOMERATE - Orange-brown to varicolored CONGLOMERATE, partially to fully cemented sub-angular to sub-rounded pebbles and gravels in sand, silt, and clay matrix. Moist, very hard, moderate plasticity. [Soil Type 3]					
34	104										
		SPT SB1.10	53								
36											
38	100										
40											
42	96										
44											
		SPT SB1.11	REFUSAL 50 FOR 5"								
46	92					Soil boring terminated at 46 feet due to practical refusal. Groundwater encountered at 3.0 feet. Piezometer installed to 28 feet. Screened interval from 18 to 28 feet BGS.					
48											
50	88										
52											
54	84										
56											
58	80										
60											

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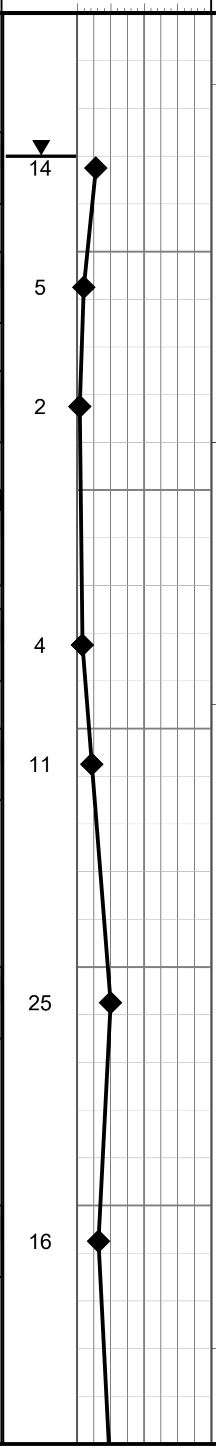
SOIL BORING LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	BORING NO. SB-2
PROJECT LOCATION La Center, Washington	DRILLING CONTRACTOR Western States	DRILL RIG CME-55	ENGINEER/GEOLOGIST ASR	PAGE NO. 1 of 2
BORING LOCATION See Figure 2	DRILLING METHOD Mud-Rotary	SAMPLING METHOD SPT	START DATE 4/19/2018	START TIME 1445
REMARKS None	APPROX. SURFACE ELEVATION 134 ft amsl	GROUNDWATER DEPTH 3 feet bgs	FINISH DATE 4/20/2018	FINISH TIME 1300



Depth (ft)	Elevation (ft amsl)	Field ID + Sample Type	SPT N-value (uncorrected)	USCS Soil Type	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%) ✕	Passing No. 200 Sieve (%) ✚	Liquid Limit ●	Plasticity Index ○
0					Approximately 18 inches of grass and topsoil TILL ZONE.				
2	132			CL	Orange-brown LEAN CLAY with sand, moist to wet, medium dense, low to moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]				
		SPT SB2.1	14						
4									
		SPT SB2.2	5						
6	128								
8		SPT SB2.3	2			41.8	77.4	30	8
				ML	Medium brown SILT with sand, wet to saturated, soft to medium stiff, low plasticity. Variable sand content (fine texture). [Soil Type 2]				
10	124	SHELBY							
12									
		SPT SB2.4	4						
14	120			CL-ML	Blue-gray SILTY CLAY with sand, moist to wet, medium stiff to stiff, low to moderate plasticity. Varying amounts of fine sand. [Soil Type 2]				
		SPT SB2.5	11						
16									
18	116								
20									
		SPT SB2.6	25						
22	112								
24									
		SPT SB2.7	16						
26	108								
28				SC	Blue-gray clayey SAND, moist to wet, medium dense, moderate plasticity. Medium-textured sand. [Soil Type 2]				
30	104								

laboratory soil properties (by symbol): 25 50 75

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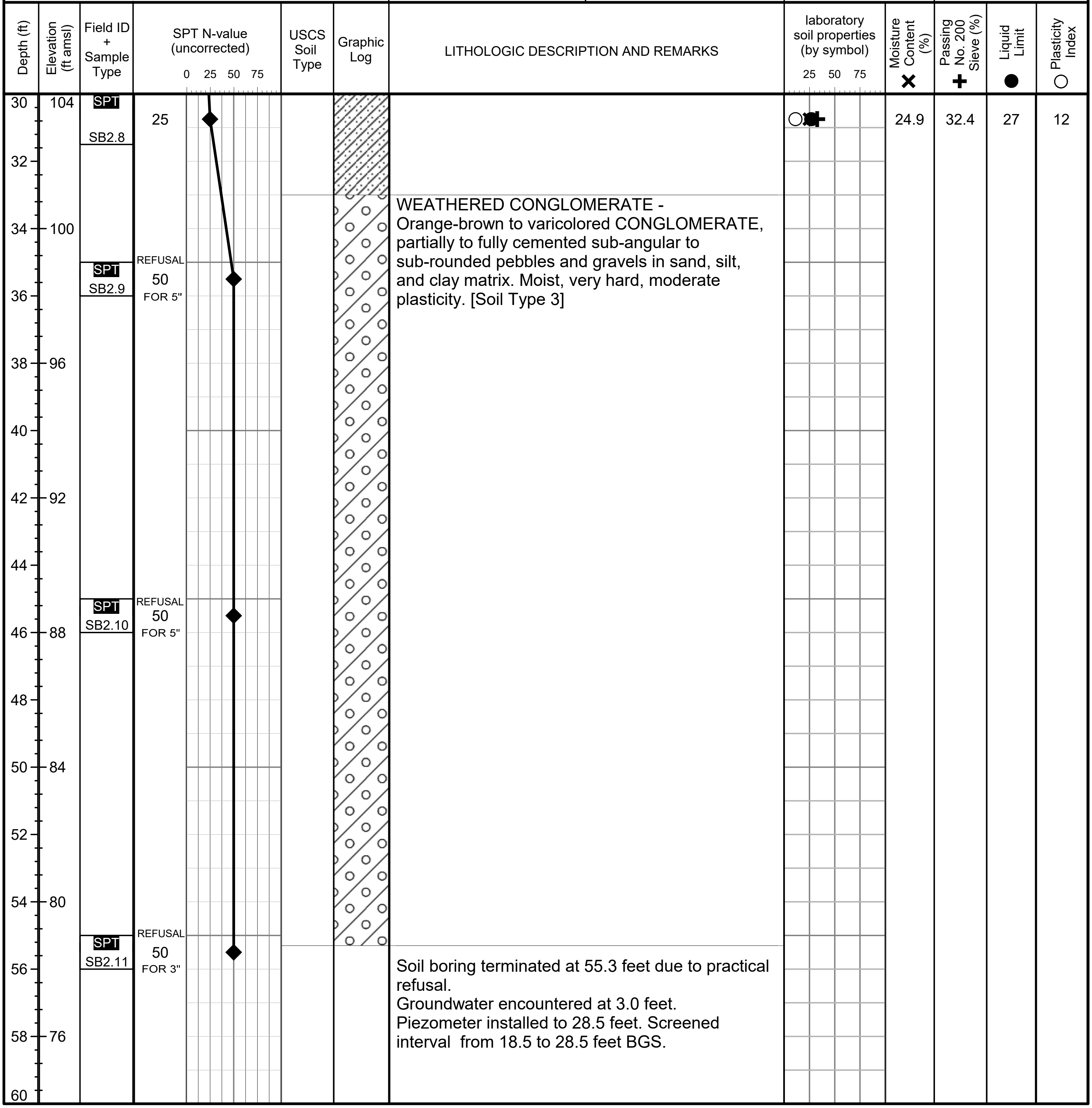
SOIL BORING LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	BORING NO. SB-2
PROJECT LOCATION La Center, Washington	DRILLING CONTRACTOR Western States	DRILL RIG CME-55	ENGINEER/GEOLOGIST ASR	PAGE NO. 2 of 2
BORING LOCATION See Figure 2	DRILLING METHOD Mud-Rotary	SAMPLING METHOD SPT	START DATE 4/19/2018	START TIME 1445
REMARKS None	APPROX. SURFACE ELEVATION 134 ft amsl	GROUNDWATER DEPTH 3 feet bgs	FINISH DATE 4/20/2018	FINISH TIME 1300



Field ID + Sample Type	SPT N-value (uncorrected)	USCS Soil Type	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
SPT SB2.8	25			24.9	32.4	27	12
			WEATHERED CONGLOMERATE - Orange-brown to varicolored CONGLOMERATE, partially to fully cemented sub-angular to sub-rounded pebbles and gravels in sand, silt, and clay matrix. Moist, very hard, moderate plasticity. [Soil Type 3]				
SPT SB2.9	REFUSAL 50 FOR 5"						
SPT SB2.10	REFUSAL 50 FOR 5"						
SPT SB2.11	REFUSAL 50 FOR 3"						

Soil boring terminated at 55.3 feet due to practical refusal.
Groundwater encountered at 3.0 feet.
Piezometer installed to 28.5 feet. Screened interval from 18.5 to 28.5 feet BGS.

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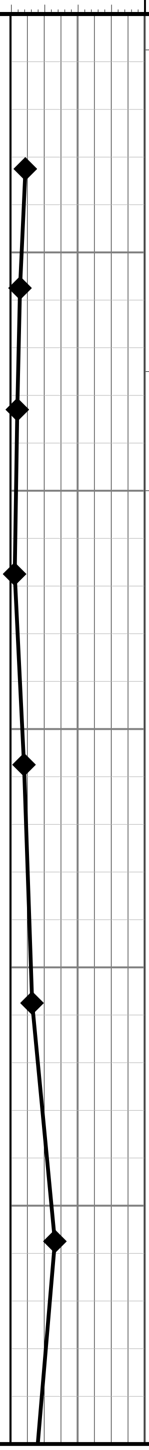
SOIL BORING LOG

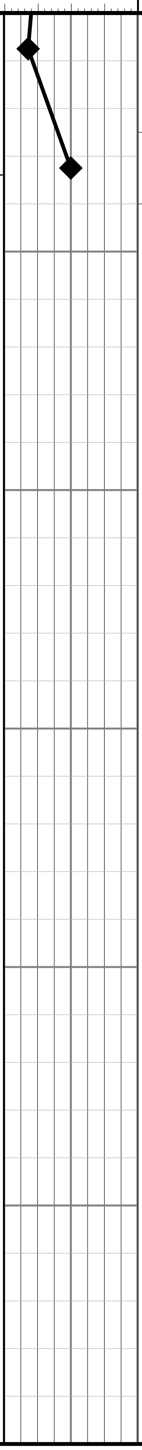
PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	BORING NO. SB-3
PROJECT LOCATION La Center, Washington	DRILLING CONTRACTOR Dan Fischer Excavating	DRILL RIG Trailer-mount	ENGINEER HDG	PAGE NO. 1 of 2
BORING LOCATION See Figure 2	DRILLING METHOD Solid-stem	SAMPLING METHOD SPT	START DATE 08/22/18	START TIME 0815
REMARKS None	APPROX. SURFACE ELEVATION 133 ft amsl	GROUNDWATER DEPTH Not observed	FINISH DATE 08/22/18	FINISH TIME 1035



Depth (ft)	Elevation (ft amsl)	Field ID + Sample Type	SPT N-value (uncorrected)	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0							Approximately 6 to 8 inches of topsoil and grass.					
2 4 6	132 128	SPT SB3.1 SPT SB3.2	11 7	CL	A-7	▨	Orange-brown sandy lean CLAY, moist to wet, medium stiff to stiff, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]					
8	124	SPT SB3.3	5	ML	A-4(3)	▥	Brown to tan SILT with sand, wet to saturated, soft to medium stiff, low plasticity. Variable sand content (fine texture). [Soil Type 2]		37.0	79.3	30	5
10 12 14 16 18 20 22 24 26 28 30	120 116 112 108 104	SHELBY SB3.4 SPT SB3.5 SPT SB3.6 SPT SB3.7 SPT SB3.8	 3 10 16 33	CL	A-4(8)	▨	Brown to blue-gray lean CLAY with sand, moist to wet, soft to hard. [Soil Type 2]		39.8	84.7	33	10

SOIL BORING LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	BORING NO. SB-3
PROJECT LOCATION La Center, Washington	DRILLING CONTRACTOR Dan Fischer Excavating	DRILL RIG Trailer-mount	ENGINEER HDG	PAGE NO. 2 of 2
BORING LOCATION See Figure 2	DRILLING METHOD Solid-stem	SAMPLING METHOD SPT	START DATE 08/22/18	START TIME 0815
REMARKS None	APPROX. SURFACE ELEVATION 133 ft amsl	GROUNDWATER DEPTH Not observed	FINISH DATE 08/22/18	FINISH TIME 1035



Depth (ft)	Elevation (ft amsl)	Field ID + Sample Type	SPT N-value (uncorrected)	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
30		SPT SB3.8	18		A-4	▨	Brown to blue-gray lean CLAY with sand, moist to wet, soft to hard. [Soil Type 2]					
32	100	SPT SB3.10	50 REFUSAL FOR 4"			○	WEATHERED CONGLOMERATE - Orange-brown to varicolored CONGLOMERATE, partially to fully cemented sub-angular to sub-rounded pebbles and gravels in sand, silt, and clay matrix. Moist, very hard, moderate plasticity. [Soil Type 3]					
34							Soil boring terminated at 32.9 ft bgs. Groundwater not observed.					

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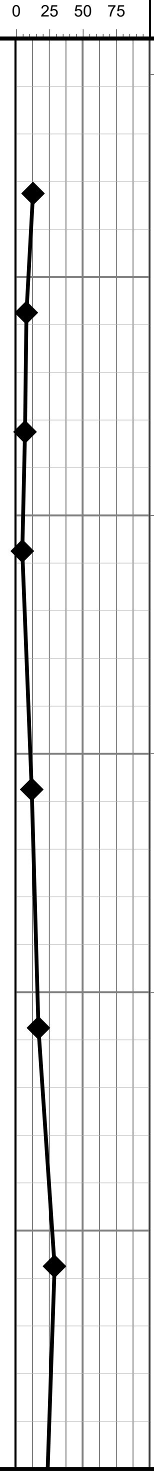
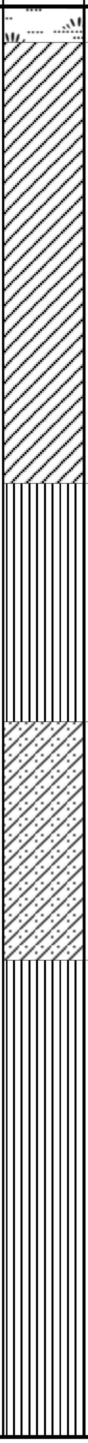
SOIL BORING LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	BORING NO. SB-4
PROJECT LOCATION La Center, Washington	DRILLING CONTRACTOR Dan Fischer Excavating	DRILL RIG Trailer-mount	ENGINEER HDG	PAGE NO. 1 of 2
BORING LOCATION See Figure 2	DRILLING METHOD Solid-stem	SAMPLING METHOD SPT	START DATE 08/22/18	START TIME 1055
REMARKS None	APPROX. SURFACE ELEVATION 136 ft amsl	GROUNDWATER DEPTH Not observed	FINISH DATE 08/22/18	FINISH TIME 1310

Depth (ft)	Elevation (ft amsl)	Field ID + Sample Type	SPT N-value (uncorrected)	USCS Soil Type	AASHTO Soil Type	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0	136					Approximately 6 to 8 inches of topsoil and grass.					
				CL	A-7	Orange-brown sandy lean CLAY, moist to wet, medium dense, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]					
2											
		SPT SB4.1	13								
4	132										
		SPT SB4.2	8								
6											
8	128	SPT SB4.3	7								
10		SPT SB4.4	5	ML	A-4(4)	Brown to tan SILT, wet to saturated, medium stiff, low plasticity. Variable sand content (fine texture). [Soil Type 2]		41.7	90.4	30	4
12	124										
14											
		SPT SB4.5	12	SC	A-4	Blue-gray clayey SAND, moist to wet, medium dense, moderate plasticity. Medium-textured sand. [Soil Type 2]					
16	120										
18											
20	116	SPT SB4.6	17	ML	A-4(2)	Blue-gray SILT with sand, moist to wet, stiff to hard. [Soil Type 2]		28.4	83.6	26	4
22											
24	112										
		SPT SB4.7	29								
26											
28	108										
30											





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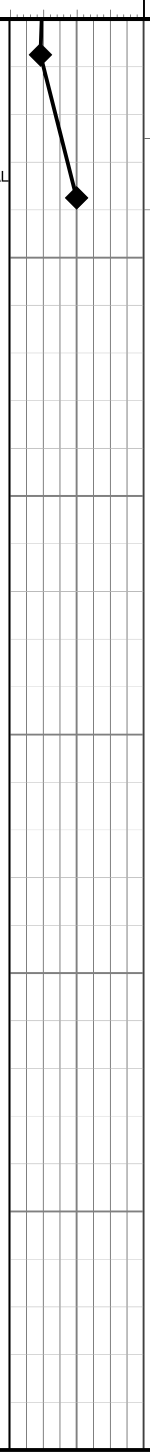
SOIL BORING LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	BORING NO. SB-4
PROJECT LOCATION La Center, Washington	DRILLING CONTRACTOR Dan Fischer Excavating	DRILL RIG Trailer-mount	ENGINEER HDG	PAGE NO. 2 of 2
BORING LOCATION See Figure 2	DRILLING METHOD Solid-stem	SAMPLING METHOD SPT	START DATE 08/22/18	START TIME 1055
REMARKS None	APPROX. SURFACE ELEVATION 136 ft amsl	GROUNDWATER DEPTH Not observed	FINISH DATE 08/22/18	FINISH TIME 1310



Depth (ft)	Elevation (ft amsl)	Field ID + Sample Type	SPT N-value (uncorrected)	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
30		SPT SB4.8	23		A-4	▥	Blue-gray SILT with sand, moist to wet, stiff to hard. [Soil Type 2]					
32	104	SPT SB4.9	REFUSAL 50 FOR 4"			▨	WEATHERED CONGLOMERATE - Orange-brown to varicolored CONGLOMERATE, partially to fully cemented sub-angular to sub-rounded pebbles and gravels in sand, silt, and clay matrix. Moist, very hard, moderate plasticity. [Soil Type 3]					
34												
36	100						Soil boring terminated at 33.4 ft bgs. Groundwater not observed.					
38												
40	96											
42												
44	92											
46												
48	88											
50												
52	84											
54												
56	80											
58												
60	76											

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TEST PIT LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	TEST PIT NO. TP-1
PROJECT LOCATION La Center, Washington	CONTRACTOR L&S Contractors	EQUIPMENT CAT 307E	GEOLOGIST/ENGINEER ASR	DATE 4/18/18
APPROXIMATE TEST PIT LOCATION See Figure 2	APPROX. SURFACE ELEVATION 138 ft amsl	GROUNDWATER DEPTH Seeps at 1 feet bgs	START TIME 0815	FINISH TIME 0850

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0 ▼					▒	Approximately 18 inches of grass and topsoil TILL ZONE.					
	TP-1.1	Gee silt loam	A-7-6(19)	CL	▨	Orange-brown lean CLAY to lean CLAY with sand, moist to wet, medium dense, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]	38.3	88.9	44	19	
5					▨						
	TP1.2		A-4(0)	ML	▥	Medium brown SILT to SILT with sand, wet to saturated, soft to medium stiff, low plasticity to non-plastic. Variable sand and clay content (fine texture). [Soil Type 2]	39.1	92.7	NP	NP	
	TP1.3		A-4(5)		▥		42.2	83.7	30	7	
10					▥						
15						Bottom of test pit at 14 feet bgs. Groundwater seeps encountered at 1 feet bgs. Heavy flow.					

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TEST PIT LOG

PROJECT NAME: La Center Middle School
CLIENT: La Center School District
PROJECT NO.: 18084
TEST PIT NO.: TP-2
PROJECT LOCATION: La Center, Washington
CONTRACTOR: L&S Contractors
EQUIPMENT: CAT 307E
GEOLOGIST/ENGINEER: ASR
DATE: 4/18/18
APPROXIMATE TEST PIT LOCATION: See Figure 2
APPROX. SURFACE ELEVATION: 142 ft amsl
GROUNDWATER DEPTH: Seeps at 3 feet bgs
START TIME: 0855
FINISH TIME: 0915

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 18 inches of grass and topsoil TILL ZONE.					
		Gee silt loam	A-7	CL	▨	Orange-brown lean CLAY to lean CLAY with sand, moist to wet, medium dense, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]					
			A-4	ML	▥	Medium brown SILT to SILT with sand, wet to saturated, soft to medium stiff, low plasticity to non-plastic. Variable sand and clay content (fine texture). [Soil Type 2]					
15						Bottom of test pit at 15 feet bgs. Groundwater seeps encountered at 3 feet bgs. Moderate flow.					

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TEST PIT LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District	PROJECT NO. 18084	TEST PIT NO. TP-3
PROJECT LOCATION La Center, Washington	CONTRACTOR L&S Contractors	EQUIPMENT CAT 307E	GEOLOGIST/ENGINEER ASR	DATE 4/18/18
APPROXIMATE TEST PIT LOCATION See Figure 2	APPROX. SURFACE ELEVATION 136 ft amsl	GROUNDWATER DEPTH Seeps at 3 feet bgs	START TIME 0920	FINISH TIME 0950

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 18 inches of grass and topsoil TILL ZONE.					
▼ 5		Odne silt loam	A-7	CL		Orange-brown lean CLAY to lean CLAY with sand, moist to wet, medium dense, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]					
10			A-4	ML		Medium brown SILT to SILT with sand, wet to saturated, soft to medium stiff, low plasticity to non-plastic. Variable sand and clay content (fine texture). [Soil Type 2]					
15						Bottom of test pit at 14.5 feet bgs. Groundwater seeps encountered at 3 feet bgs. Moderate flow.					

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TEST PIT LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	TEST PIT NO. TP-4
PROJECT LOCATION La Center, Washington	CONTRACTOR L&S Contractors	EQUIPMENT CAT 307E	GEOLOGIST/ENGINEER ASR	DATE 4/18/18
APPROXIMATE TEST PIT LOCATION See Figure 2	APPROX. SURFACE ELEVATION 137 ft amsl	GROUNDWATER DEPTH Seeps at 3 feet bgs	START TIME 1000	FINISH TIME 1050

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 18 inches of grass and topsoil TILL ZONE.					
▼		Gee silt loam	A-7	CL	▨	Orange-brown lean CLAY to lean CLAY with sand, moist to wet, medium dense, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]					
5 10	TP4.1		A-4(0)	ML	▥	Medium brown SILT to SILT with sand, wet to saturated, soft to medium stiff, low plasticity to non-plastic. Variable sand and clay content (fine texture). [Soil Type 2]	39.8	90.2	NP	NP	
15						Bottom of test pit at 14 feet bgs. Groundwater seeps encountered at 3 feet bgs. Heavy flow.					

TEST PIT LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	TEST PIT NO. TP-5
PROJECT LOCATION La Center, Washington	CONTRACTOR L&S Contractors	EQUIPMENT CAT 307E	GEOLOGIST/ENGINEER ASR	DATE 4/18/18
APPROXIMATE TEST PIT LOCATION See Figure 2	APPROX. SURFACE ELEVATION 135 ft amsl	GROUNDWATER DEPTH Seeps at 3 feet bgs	START TIME 1100	FINISH TIME 1155

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 18 inches of grass and topsoil TILL ZONE.					
▼ 5		Odne silt loam	A-7	CL	▨	Orange-brown lean CLAY to lean CLAY with sand, moist to wet, medium dense, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]					
10			A-4	ML	▥	Medium brown SILT to SILT with sand, wet to saturated, soft to medium stiff, low plasticity to non-plastic. Variable sand and clay content (fine texture). [Soil Type 2]					
	TP5.1		A-4(0)	ML-CL	▨	Blue-gray silty SAND, wet, loose, low plasticity to non-plastic, variable silt/clay content. [Soil Type 2]	35.4	48.2	NP	NP	
15						Bottom of test pit at 15 feet bgs. Groundwater seeps encountered at 3 feet bgs. Moderate flow.					

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TEST PIT LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District	PROJECT NO. 18084	TEST PIT NO. TP-6
PROJECT LOCATION La Center, Washington	CONTRACTOR L&S Contractors EQUIPMENT CAT 307E	GEOLOGIST/ENGINEER ASR	DATE 4/18/18
APPROXIMATE TEST PIT LOCATION See Figure 2	APPROX. SURFACE ELEVATION 132 ft amsl GROUNDWATER DEPTH Seeps at 2 feet bgs	START TIME 1200	FINISH TIME 1240

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 18 inches of grass and topsoil TILL ZONE.					
▼ 5		Odne silt loam	A-7	CL		Orange-brown lean CLAY to lean CLAY with sand, moist to wet, medium dense, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]					
10			A-4	ML		Medium brown SILT to SILT with sand, wet to saturated, soft to medium stiff, low plasticity to non-plastic. Variable sand and clay content (fine texture). [Soil Type 2]					
15						Bottom of test pit at 14 feet bgs. Groundwater seeps encountered at 2 feet bgs. Moderate flow.					

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TEST PIT LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	TEST PIT NO. TP-7
PROJECT LOCATION La Center, Washington	CONTRACTOR L&S Contractors	EQUIPMENT CAT 307E	GEOLOGIST/ENGINEER ASR	DATE 4/18/18
APPROXIMATE TEST PIT LOCATION See Figure 2	APPROX. SURFACE ELEVATION 136 ft amsl	GROUNDWATER DEPTH Seeps at 1 feet bgs	START TIME 1245	FINISH TIME 1315

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0 ▼						Approximately 18 inches of grass and topsoil TILL ZONE.					
5		Odne silt loam	A-7	CL	▨	Orange-brown lean CLAY to lean CLAY with sand, moist to wet, medium dense, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1] Interbedded sand and silt lenses.					
10			A-4	ML	▥	Medium brown SILT to SILT with sand, wet to saturated, soft to medium stiff, low plasticity to non-plastic. Variable sand and clay content (fine texture). [Soil Type 2]					
15						Bottom of test pit at 13 feet bgs. Groundwater seeps encountered at 1 feet bgs. Heavy flow.					

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TEST PIT LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	TEST PIT NO. TP-8
PROJECT LOCATION La Center, Washington	CONTRACTOR L&S Contractors	EQUIPMENT CAT 307E	GEOLOGIST/ENGINEER ASR	DATE 4/18/18
APPROXIMATE TEST PIT LOCATION See Figure 2	APPROX. SURFACE ELEVATION 134 ft amsl	GROUNDWATER DEPTH Seeps at 2 feet bgs	START TIME 1320	FINISH TIME 1345

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 18 inches of grass and topsoil TILL ZONE.					
▼ 5		Gee silt loam	A-7	CL		Orange-brown lean CLAY to lean CLAY with sand, moist to wet, medium dense, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]					
10			A-4	ML		Medium brown SILT to SILT with sand, wet to saturated, soft to medium stiff, low plasticity to non-plastic. Variable sand and clay content (fine texture). [Soil Type 2]					
15						Bottom of test pit at 14 feet bgs. Groundwater seeps encountered at 2 feet bgs. Moderate flow.					

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TEST PIT LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	TEST PIT NO. TP-9
PROJECT LOCATION La Center, Washington	CONTRACTOR L&S Contractors	EQUIPMENT CAT 307E	GEOLOGIST/ENGINEER ASR	DATE 4/18/18
APPROXIMATE TEST PIT LOCATION See Figure 2	APPROX. SURFACE ELEVATION 132 ft amsl	GROUNDWATER DEPTH Seeps at 4 feet bgs	START TIME 1350	FINISH TIME 1415

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0				CL	▩	Minor topsoil, disturbed clay FILL, evidence of previous grading.					
▼ 5		Gee silt loam	A-7	CL	▨	Orange-brown lean CLAY to lean CLAY with sand, moist to wet, medium dense, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]					
10			A-4	ML	▥	Medium brown SILT to SILT with sand, wet to saturated, soft to medium stiff, low plasticity to non-plastic. Variable sand and clay content (fine texture). [Soil Type 2]					
15						Bottom of test pit at 14 feet bgs. Groundwater seeps encountered at 4 feet bgs. Moderate flow.					

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TEST PIT LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District	PROJECT NO. 18084	TEST PIT NO. TP-10
PROJECT LOCATION La Center, Washington	CONTRACTOR L&S Contractors EQUIPMENT CAT 307E	GEOLOGIST/ENGINEER ASR	DATE 4/18/18
APPROXIMATE TEST PIT LOCATION See Figure 2	APPROX. SURFACE ELEVATION 132 ft amsl GROUNDWATER DEPTH Seeps at 4 feet bgs	START TIME 1420	FINISH TIME 1500

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0 ▼				CL	▩	Minor topsoil, disturbed clay FILL, evidence of previous grading. Concrete debris encountered at 4 feet.					
5		Odne silt loam	A-7	CL	▨	Orange-brown lean CLAY to lean CLAY with sand, moist to wet, medium dense, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]					
10			A-4	ML	▥	Medium brown SILT to SILT with sand, wet to saturated, soft to medium stiff, low plasticity to non-plastic. Variable sand and clay content (fine texture). [Soil Type 2]					
15						Bottom of test pit at 14 feet bgs. Groundwater seeps encountered at 4 feet bgs. Moderate flow.					

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TEST PIT LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	TEST PIT NO. TP-11
PROJECT LOCATION La Center, Washington	CONTRACTOR L&S Contractors	EQUIPMENT CAT 307E	GEOLOGIST/ENGINEER ASR	DATE 8/31/18
APPROXIMATE TEST PIT LOCATION See Figure 2	APPROX. SURFACE ELEVATION 136 ft amsl	GROUNDWATER DEPTH Not encountered	START TIME 0820	FINISH TIME 0830

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 18 inches of grass and topsoil TILL ZONE.					
		Gee silt loam	A-7	CL	▨	Orange-brown lean CLAY, moist, medium stiff, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]					IT-1 Depth = 2.0 ft k = 0.2 in/hr
						Bottom of test pit at 2.0 feet. Groundwater not encountered.					
5											
10											
15											

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TEST PIT LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	TEST PIT NO. TP-12
PROJECT LOCATION La Center, Washington	CONTRACTOR L&S Contractors	EQUIPMENT CAT 307E	GEOLOGIST/ENGINEER ASR	DATE 8/31/18
APPROXIMATE TEST PIT LOCATION See Figure 2	APPROX. SURFACE ELEVATION 133 ft amsl	GROUNDWATER DEPTH Not encountered	START TIME 0836	FINISH TIME 0840

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 18 inches of grass and topsoil TILL ZONE.					
		Gee silt loam	A-7	CL	▨	Orange-brown lean CLAY, moist, medium stiff, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]					IT-2 Depth = 2.0 ft k = 0.05 in/hr
						Bottom of test pit at 2.0 feet. Groundwater not encountered.					
5											
10											
15											

TEST PIT LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	TEST PIT NO. TP-13
PROJECT LOCATION La Center, Washington	CONTRACTOR L&S Contractors	EQUIPMENT CAT 307E	GEOLOGIST/ENGINEER ASR	DATE 8/31/18
APPROXIMATE TEST PIT LOCATION See Figure 2	APPROX. SURFACE ELEVATION 133 ft amsl	GROUNDWATER DEPTH Not encountered	START TIME 0845	FINISH TIME 0910

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0					░	Approximately 18 inches of grass and topsoil TILL ZONE.					
		Odne silt loam	A-7	CL	▨	Orange-brown lean CLAY, moist, medium stiff, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]					IT-3 ⊓ Depth = 2.0 ft k = 0.01 in/hr
						Bottom of test pit at 2.0 feet. Groundwater not encountered.					
5											
10											
15											

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TEST PIT LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District		PROJECT NO. 18084	TEST PIT NO. TP-14
PROJECT LOCATION La Center, Washington	CONTRACTOR L&S Contractors	EQUIPMENT CAT 307E	GEOLOGIST/ENGINEER ASR	DATE 8/31/18
APPROXIMATE TEST PIT LOCATION See Figure 2	APPROX. SURFACE ELEVATION 135 ft amsl	GROUNDWATER DEPTH Not encountered	START TIME 0914	FINISH TIME 0925

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 18 inches of grass and topsoil TILL ZONE.					
5		Gee silt loam	A-7	CL	▨	Orange-brown lean CLAY, moist, medium stiff, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]					IT-4 Depth = 2.0 ft k = 0.02 in/hr
10			A-4	ML	▥	Brownish grey SILT with sand, wet, medium stiff, low plasticity to non-plastic, variable silt/clay content. [Soil Type 2]					
15						Bottom of test pit at 14 feet. Groundwater not encountered.					

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TEST PIT LOG

PROJECT NAME La Center Middle School	CLIENT La Center School District	PROJECT NO. 18084	TEST PIT NO. TP-15
PROJECT LOCATION La Center, Washington	CONTRACTOR L&S Contractors EQUIPMENT CAT 307E	GEOLOGIST/ENGINEER ASR	DATE 8/31/18
APPROXIMATE TEST PIT LOCATION See Figure 2	APPROX. SURFACE ELEVATION 138 ft amsl GROUNDWATER DEPTH Not encountered	START TIME 0930	FINISH TIME 1000

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 18 inches of grass and topsoil TILL ZONE.					
	TP15.1	Gee silt loam	A-6(9)	CL	▨	Orange-brown lean CLAY to lean CLAY with sand, moist to wet, medium dense, moderate plasticity. Gray mottles, blocky texture. [Soil Type 1]	19.2	79.7	35	12	
5					▨						
			A-4	ML	▥	Medium brown to brownish grey SILT with sand, wet, soft to medium stiff, low plasticity to non-plastic. Variable sand and clay content (fine texture). [Soil Type 2]					
10					▥						
15						Bottom of test pit at 15 feet. Groundwater not encountered.					

APPENDIX C
SOIL CLASSIFICATION INFORMATION

SOIL DESCRIPTION AND CLASSIFICATION GUIDELINES

Particle-Size Classification

COMPONENT	ASTM/USCS		AASHTO	
	size range	sieve size range	size range	sieve size range
Cobbles	> 75 mm	greater than 3 inches	> 75 mm	greater than 3 inches
Gravel	75 mm – 4.75 mm	3 inches to No. 4 sieve	75 mm – 2.00 mm	3 inches to No. 10 sieve
Coarse	75 mm – 19.0 mm	3 inches to 3/4-inch sieve	-	-
Fine	19.0 mm – 4.75 mm	3/4-inch to No. 4 sieve	-	-
Sand	4.75 mm – 0.075 mm	No. 4 to No. 200 sieve	2.00 mm – 0.075 mm	No. 10 to No. 200 sieve
Coarse	4.75 mm – 2.00 mm	No. 4 to No. 10 sieve	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve
Medium	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve	-	-
Fine	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve
Fines (Silt and Clay)	< 0.075 mm	Passing No. 200 sieve	< 0.075 mm	Passing No. 200 sieve

Consistency for Cohesive Soil

CONSISTENCY	SPT N-VALUE (BLOWS PER FOOT)	POCKET PENETROMETER (UNCONFINED COMPRESSIVE STRENGTH, tsf)
Very Soft	2	less than 0.25
Soft	2 to 4	0.25 to 0.50
Medium Stiff	4 to 8	0.50 to 1.0
Stiff	8 to 15	1.0 to 2.0
Very Stiff	15 to 30	2.0 to 4.0
Hard	30 to 60	greater than 4.0
Very Hard	greater than 60	-

Relative Density for Granular Soil

RELATIVE DENSITY	SPT N-VALUE (BLOWS PER FOOT)
Very Loose	0 to 4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	more than 50

Moisture Designations

TERM	FIELD IDENTIFICATION
Dry	No moisture. Dusty or dry.
Damp	Some moisture. Cohesive soils are usually below plastic limit and are moldable.
Moist	Grains appear darkened, but no visible water is present. Cohesive soils will clump. Sand will bulk. Soils are often at or near plastic limit.
Wet	Visible water on larger grains. Sand and silt exhibit dilatancy. Cohesive soil can be readily remolded. Soil leaves wetness on the hand when squeezed. Soil is much wetter than optimum moisture content and is above plastic limit.

AASHTO SOIL CLASSIFICATION SYSTEM

TABLE 1. Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35 Percent or Less Passing .075 mm)			Silt-Clay Materials (More than 35 Percent Passing 0.075)			
Group Classification	A-1	A-3	A-2	A-4	A-5	A-6	A-7
Sieve analysis, percent passing:							
2.00 mm (No. 10)	-	-	-				
0.425 mm (No. 40)	50 max	51 min	-	-	-	-	-
0.075 mm (No. 200)	25 max	10 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)							
Liquid limit				40 max	41 min	40 max	41 min
Plasticity index	6 max	N.P.		10 max	10 max	11 min	11 min
General rating as subgrade	Excellent to good			Fair to poor			

Note: The placing of A-3 before A-2 is necessary in the "left to right elimination process" and does not indicate superiority of A-3 over A-2.

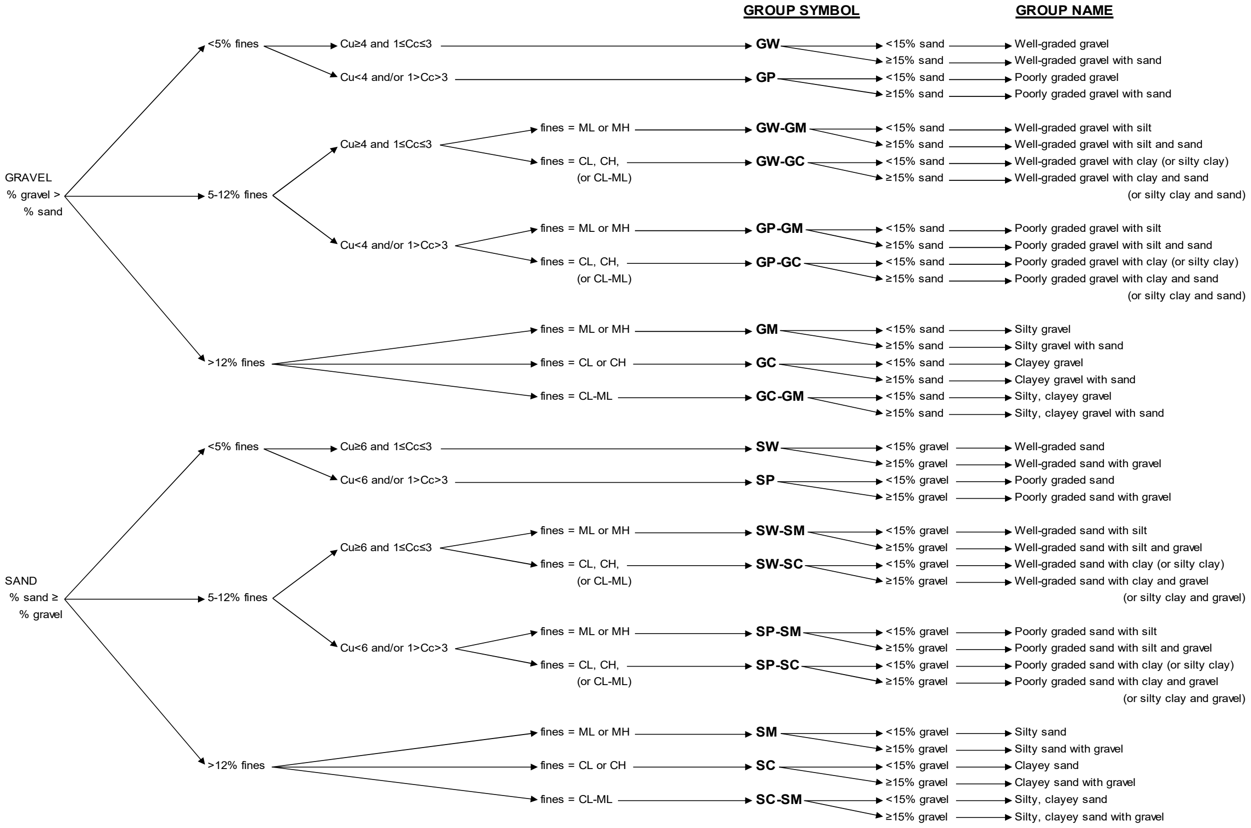
TABLE 2. Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35 Percent or Less Passing 0.075 mm)							Silt-Clay Materials (More than 35 Percent Passing 0.075 mm)			
	A-1			A-2							A-7
Group Classification	A-1-a	A-1-b	A-3	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7-5, A-7-6
Sieve analysis, percent passing:											
2.00 mm (No. 10)	50 max	-	-	-	-	-	-	-	-	-	-
0.425 mm (No. 40)	30 max	50 max	51 min	-	-	-	-	-	-	-	-
0.075 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)											
Liquid limit				40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11min
Usual types of significant constituent materials	Stone fragments, gravel and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
General ratings as subgrade	Excellent to Good							Fair to poor			

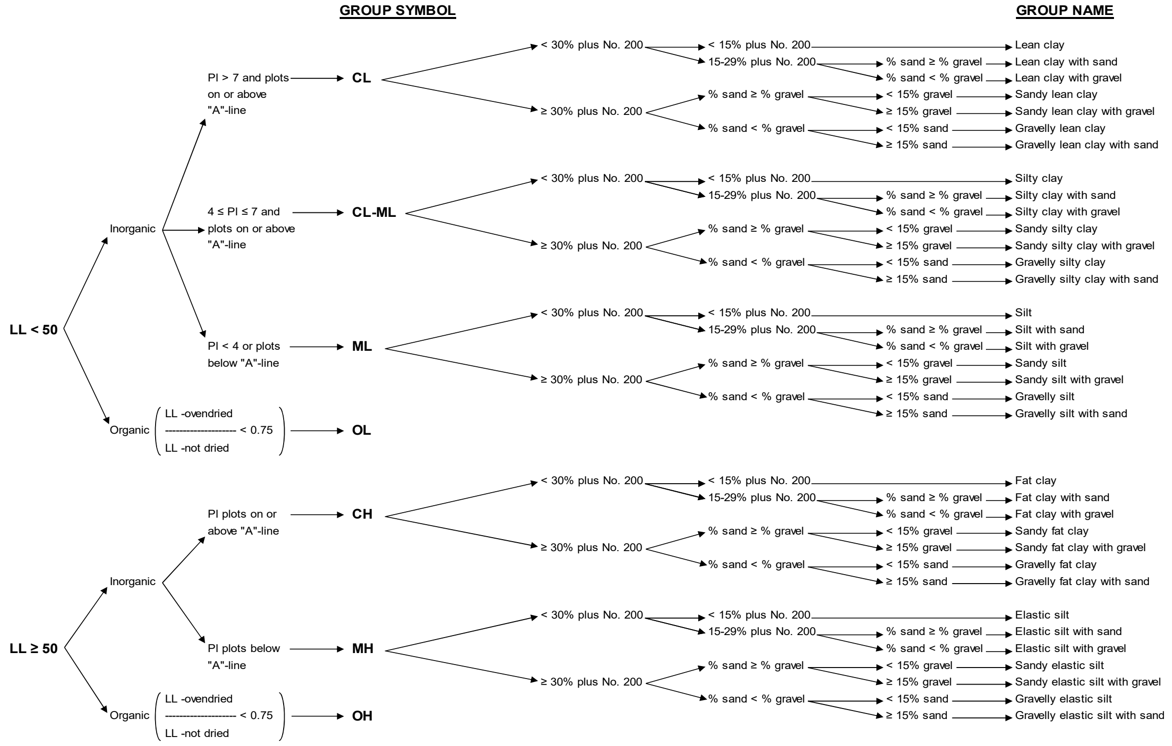
Note: Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30 (see Figure 2).

AASHTO = American Association of State Highway and Transportation Officials

USCS SOIL CLASSIFICATION SYSTEM



Flow Chart for Classifying Coarse-Grained Soils (More Than 50% Retained on No. 200 Sieve)



Flow Chart for Classifying Fine-Grained Soil (50% or More Passes No. 200 Sieve)

APPENDIX D
PHOTO LOG

LA CENTER MIDDLE SCHOOL
LA CENTER, WASHINGTON
PHOTO LOG

Site Overview, Facing South

Typical Observed Sod and Topsoil Depth

LA CENTER MIDDLE SCHOOL
LA CENTER, WASHINGTON
PHOTO LOG

Test Pit Profile, Test Pit TP-5

LA CENTER MIDDLE SCHOOL
LA CENTER, WASHINGTON
PHOTO LOG

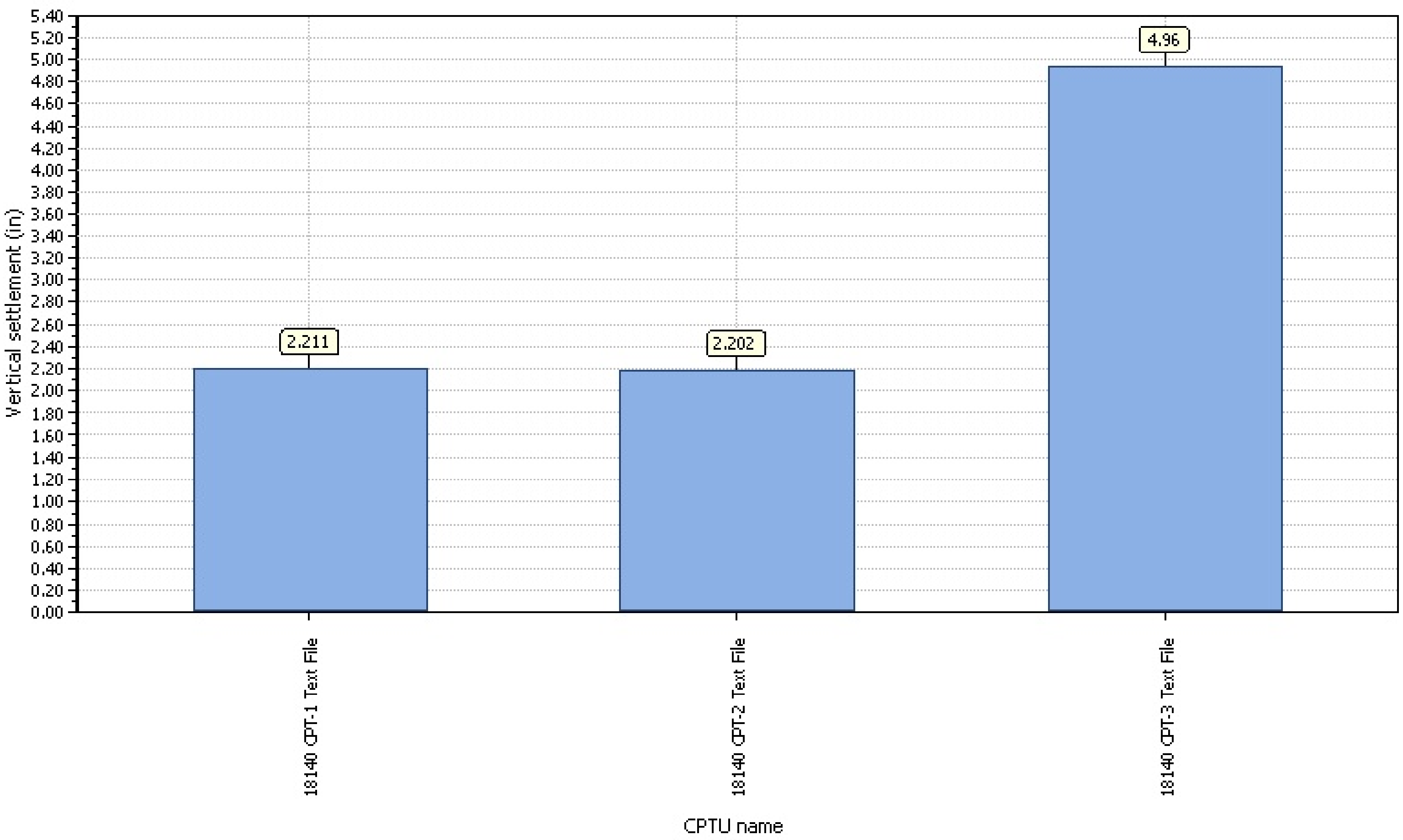
Subsurface Exploration Activity, Soil Boring SB-1

APPENDIX E
LIQUEFACTION EVALUATION

Project title : LCMS

Location : La Center

Overall vertical settlements report



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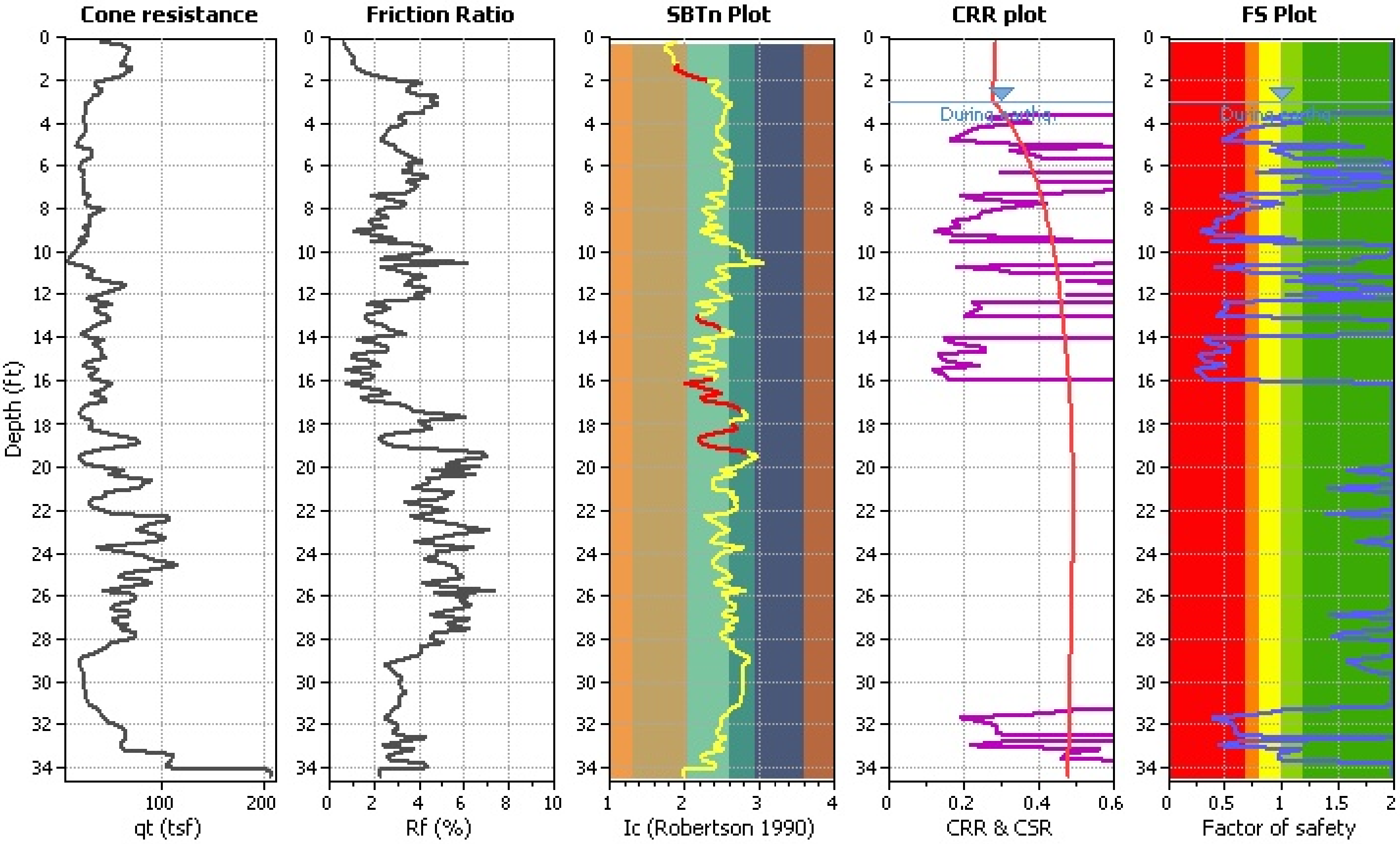
LIQUEFACTION ANALYSIS REPORT

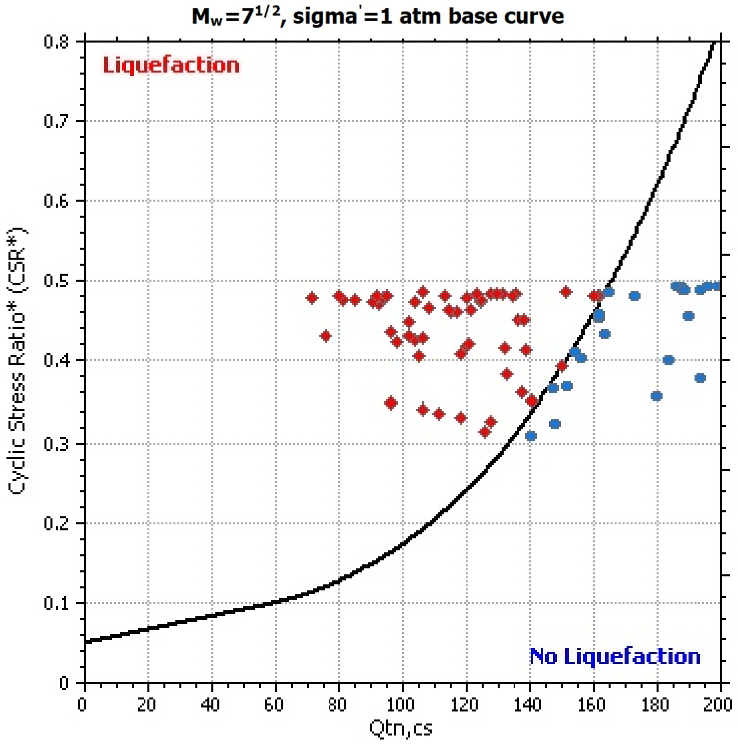
Project title : LCMS **Location : La Center**

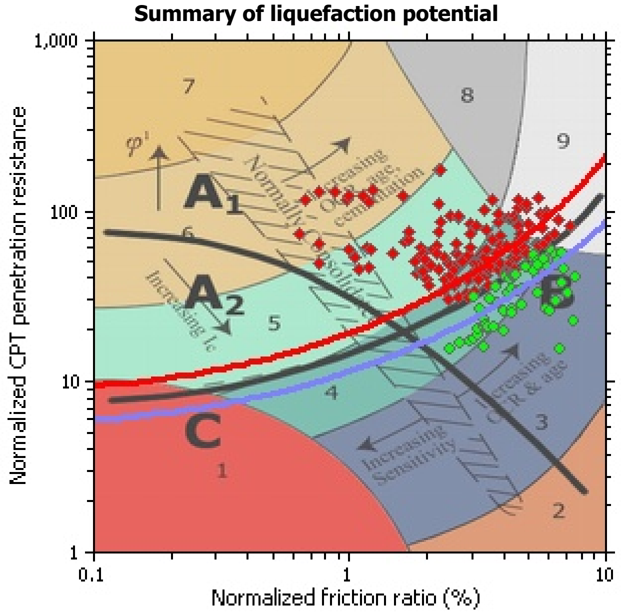
CPT file : 18140 CPT-1 Text File

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	7.50 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	3.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.82	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.39	Unit weight calculation:	Based on SBT	K_σ applied:	No		

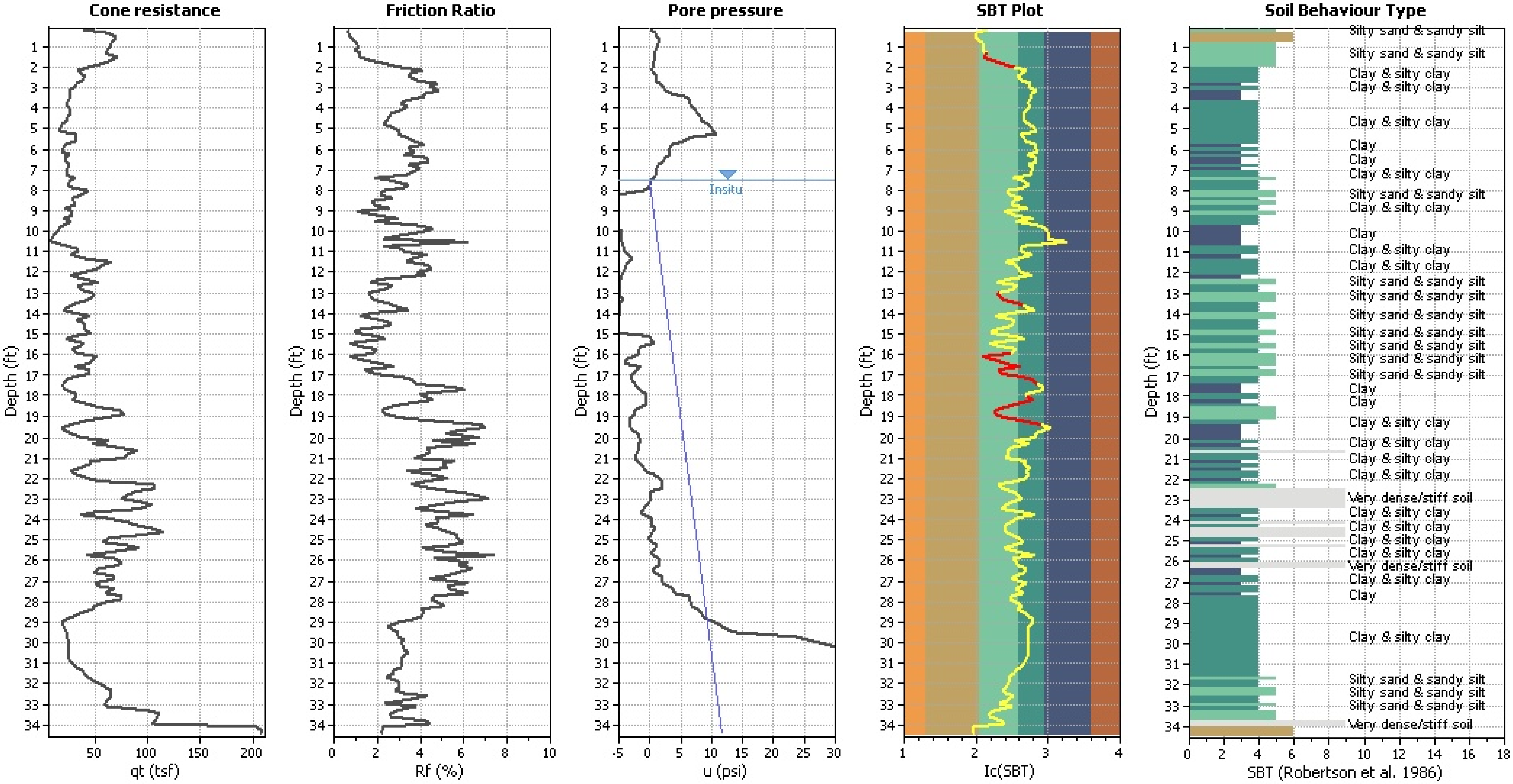






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plo



Input parameters and analysis data

Analysis method: Robertson (2009)
Fines correction method: Robertson (2009)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.82
Peak ground acceleration: 0.39
Depth to water table (insitu): 7.50 ft

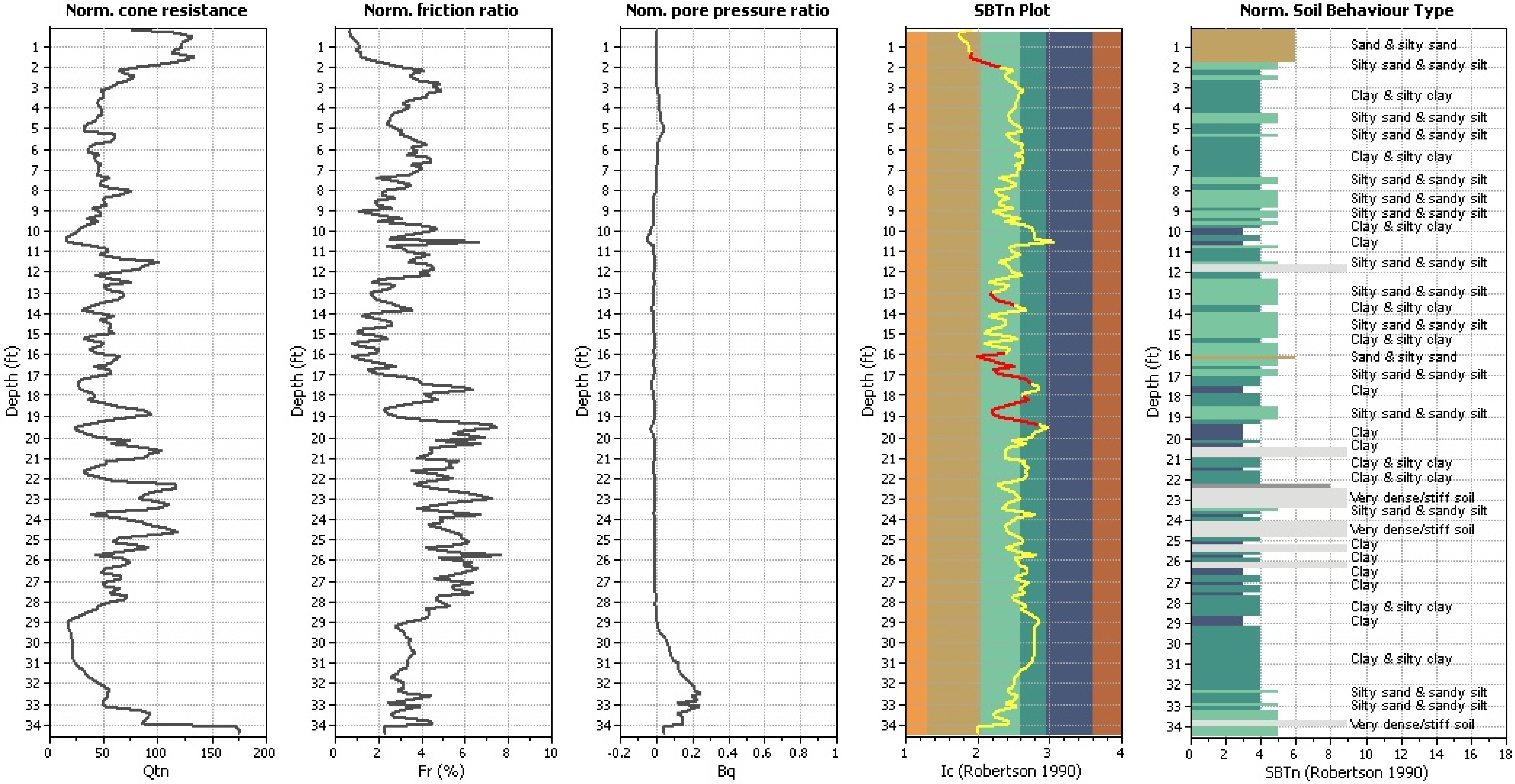
Depth to water table (erthq.): 3.00 ft
Average results interval: 1
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: Yes
K_σ applied: No
Clay like behavior applied: All soils
Limit depth applied: No
Limit depth: N/A

SBT legend

🟥 1. Sensitive fine grained	🟩 4. Clayey silt to silty	🟧 7. Gravely sand to sand
🟫 2. Organic material	🟩 5. Silty sand to sandy silt	⬛ 8. Very stiff sand to
🟦 3. Clay to silty clay	🟨 6. Clean sand to silty sand	⬜ 9. Very stiff fine grained

CPT basic interpretation plots (normaliz



Input parameters and analysis data

Analysis method: Robertson (2009)
Fines correction method: Robertson (2009)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.82
Peak ground acceleration: 0.39
Depth to water table (insitu): 7.50 ft

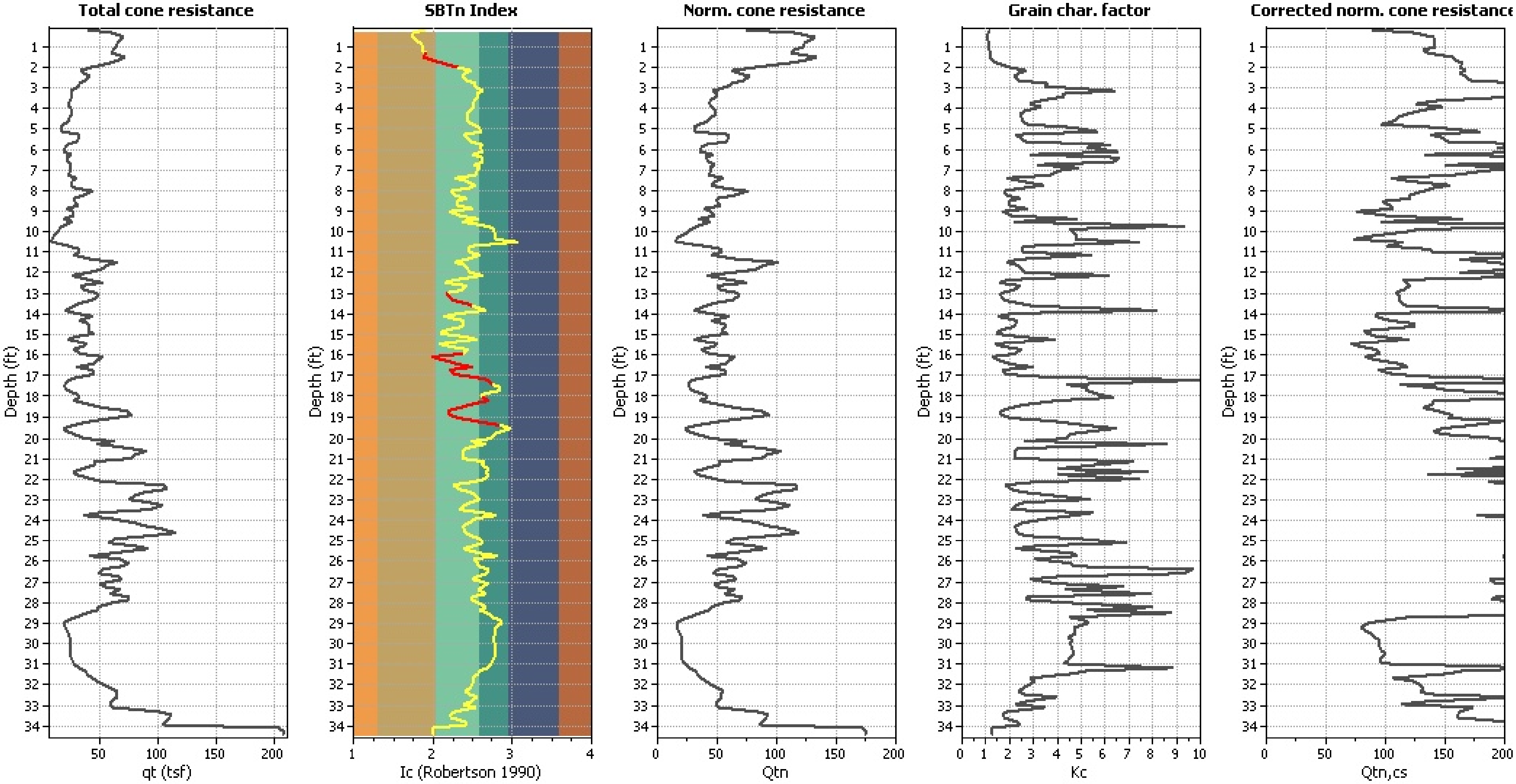
Depth to water table (erthq.): 3.00 ft
Average results interval: 1
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: Yes
K_{σ} applied: No
Clay like behavior applied: All soils
Limit depth applied: No
Limit depth: N/A

SBTn legend

🟥 1. Sensitive fine grained	🟩 4. Clayey silt to silty	🟧 7. Gravely sand to sand
🟫 2. Organic material	🟩 5. Silty sand to sandy silt	⬛ 8. Very stiff sand to
🟦 3. Clay to silty clay	🟨 6. Clean sand to silty sand	⬜ 9. Very stiff fine grained

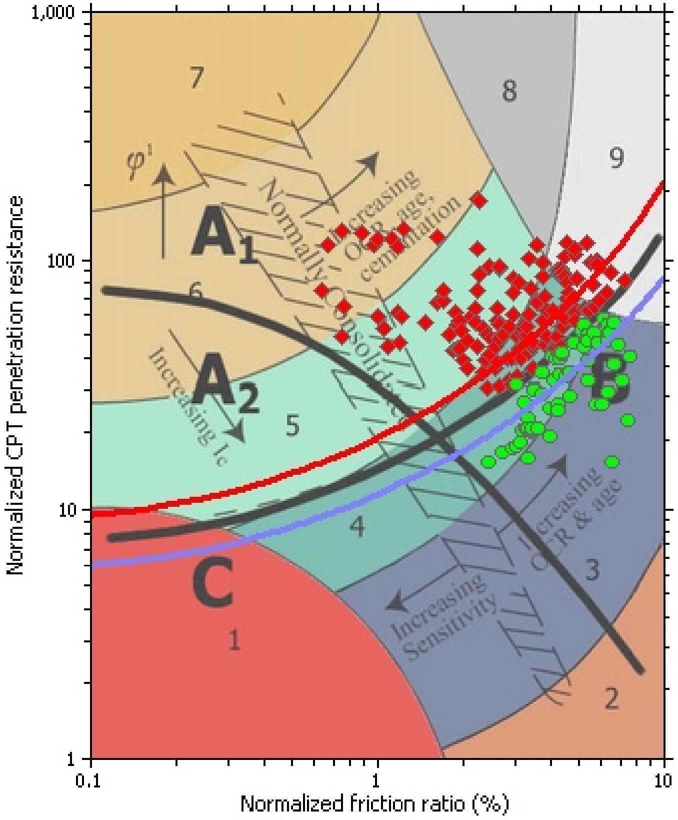
Liquefaction analysis overall plots (intermediate resu

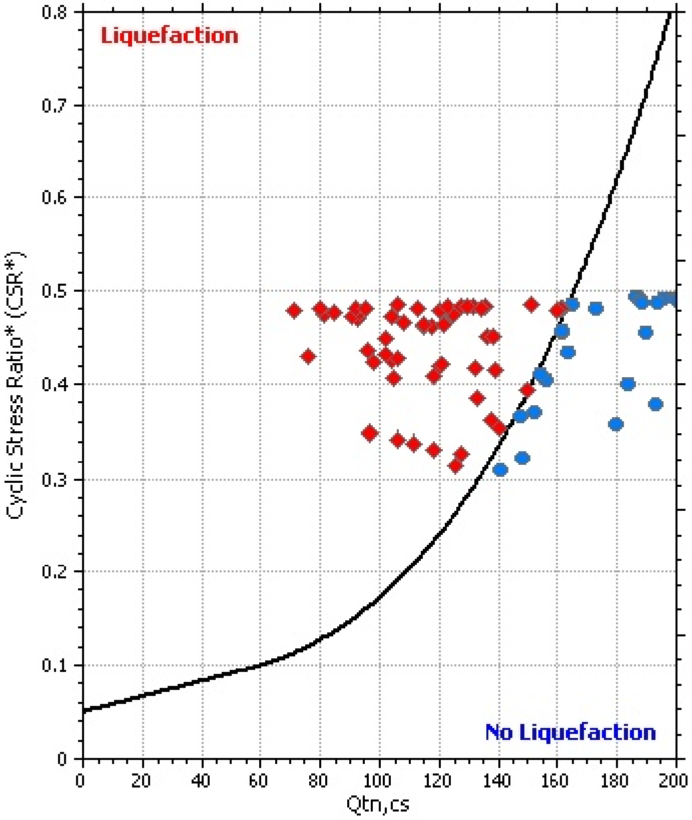


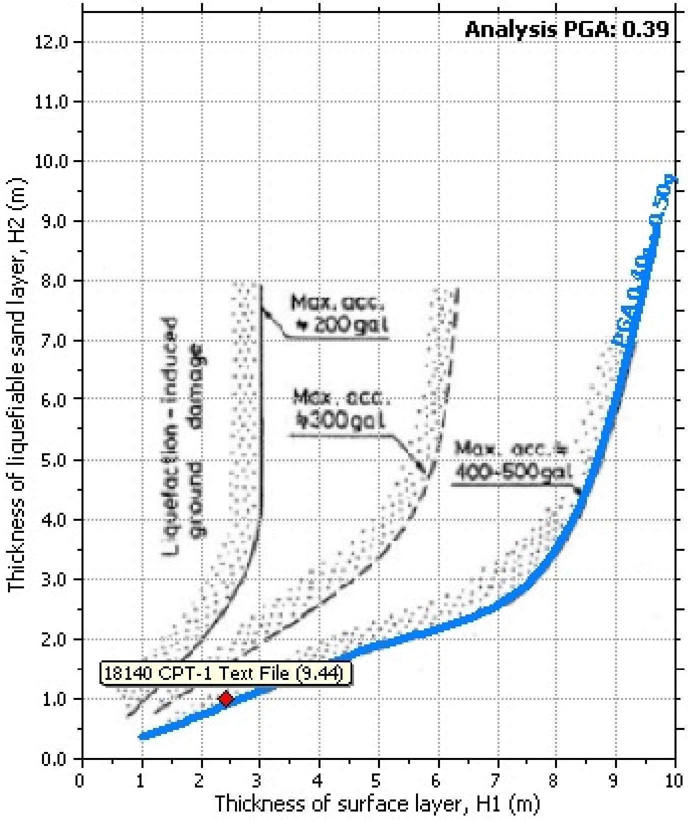
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	3.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_{σ} applied:	No
Earthquake magnitude M_w:	7.82	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.39	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.50 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis summary plo



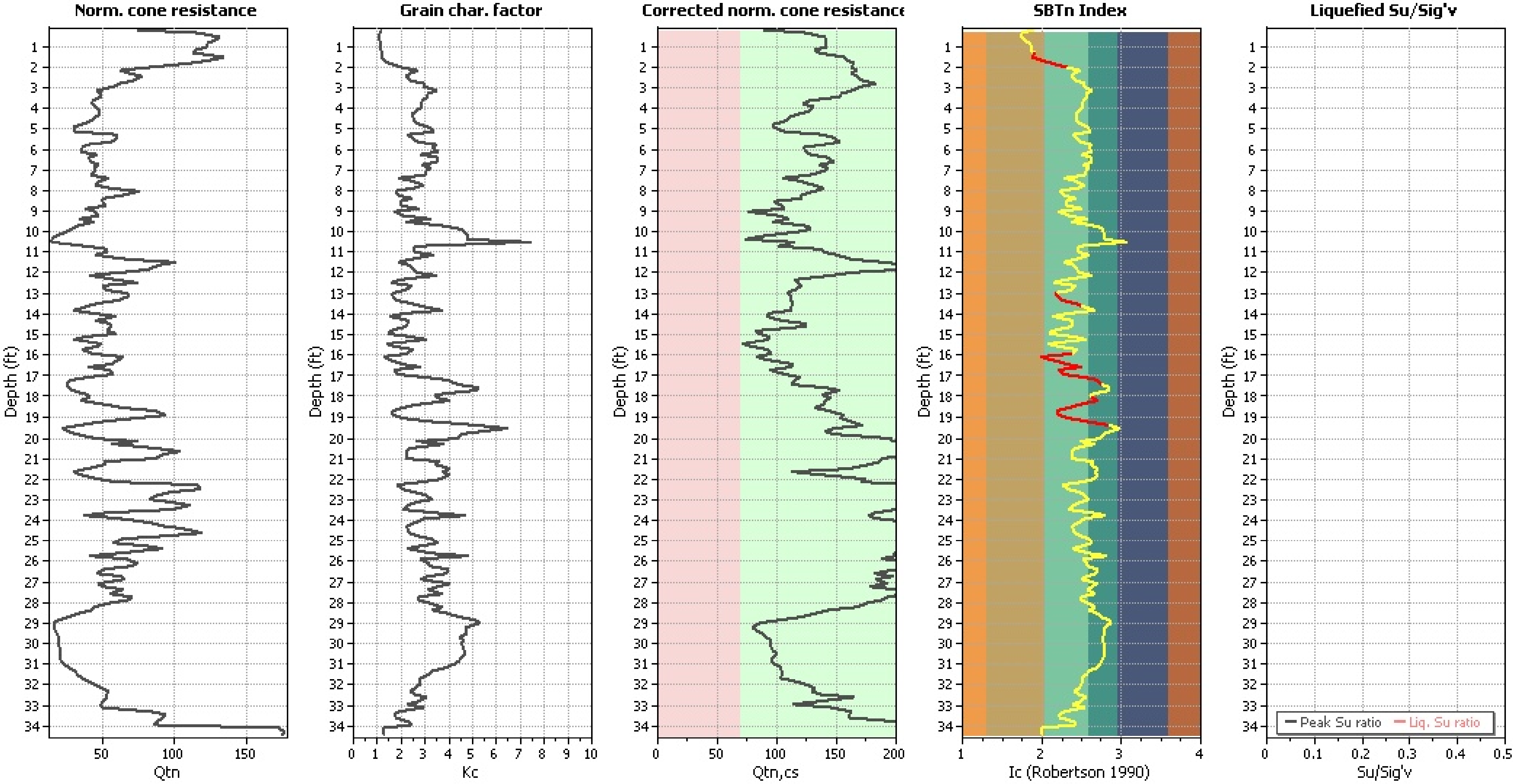




Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	3.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.82	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.39	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.50 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

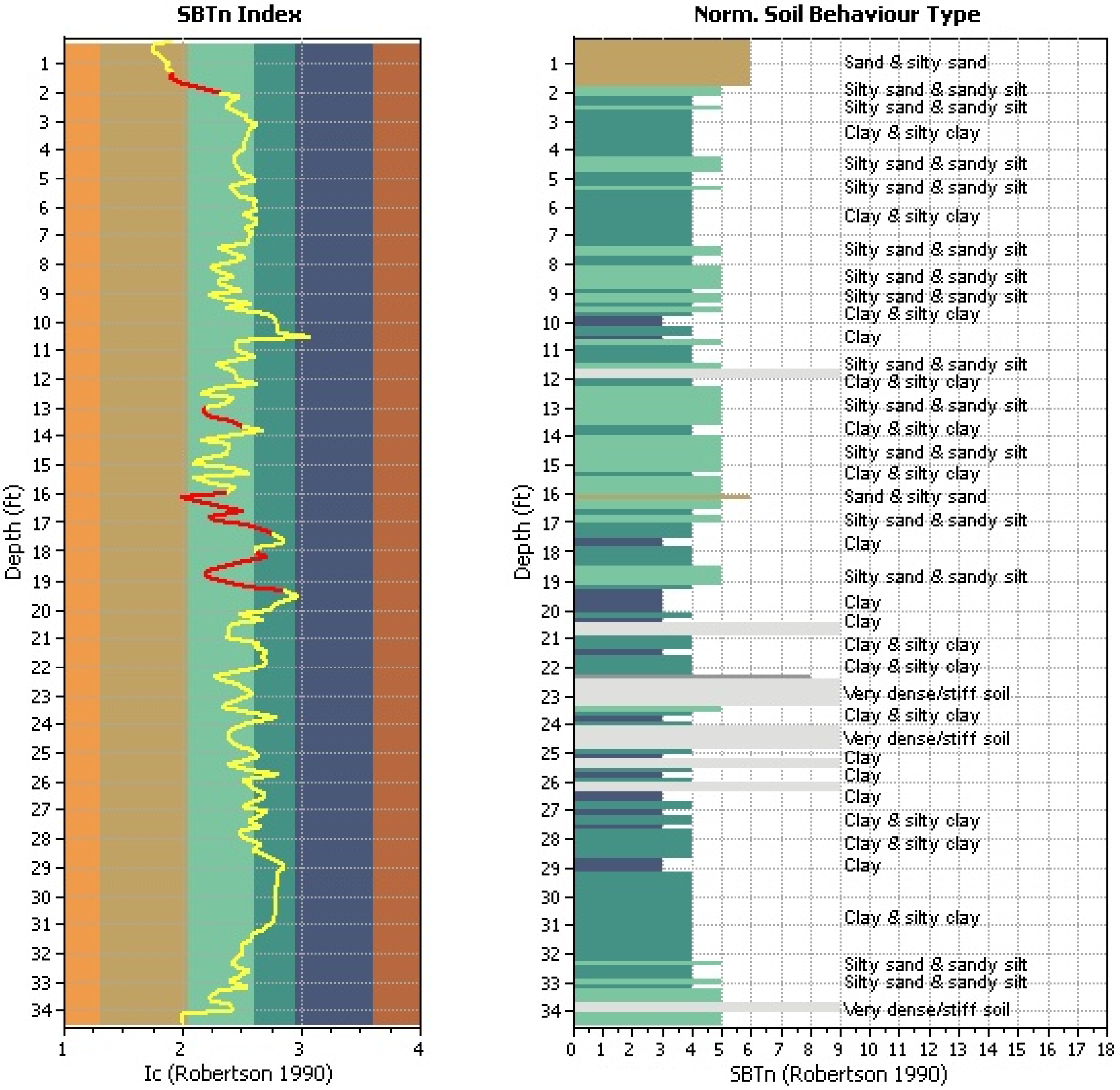
Analysis method:	Robertson (2009)	Depth to water table (erthq.):	3.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.82	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.39	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.50 ft	Fill height:	N/A	Limit depth:	N/A

TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between $1.80 < I_c < 3.0$) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.



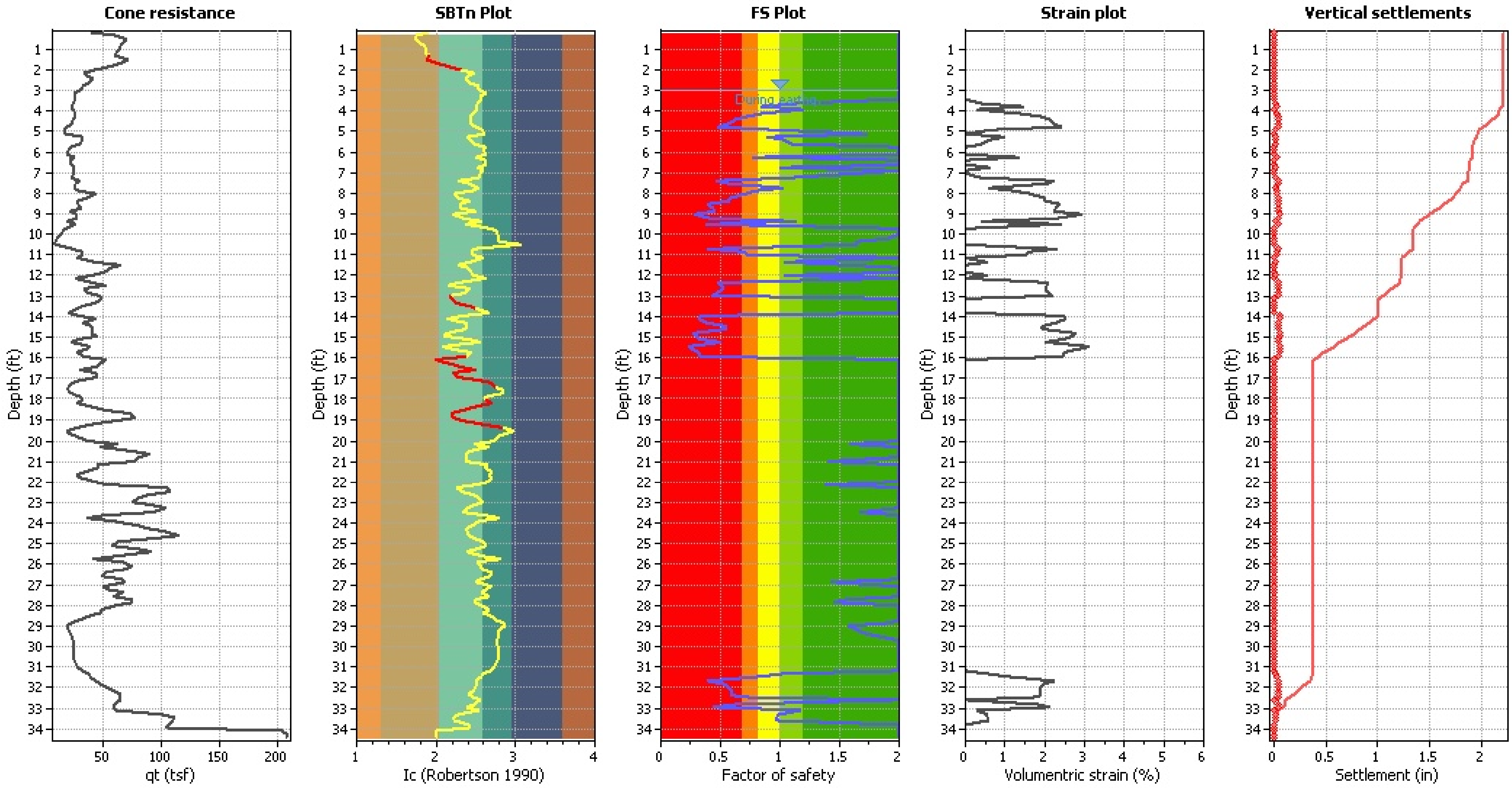
Transition layer algorithm properties

I_c minimum check value:	1.70
I_c maximum check value:	3.00
I_c change ratio value:	0.0250
Minimum number of points in layer:	4

General statistics

Total points in CPT file:	210
Total points excluded:	29
Exclusion percentage:	13.81%
Number of layers detected:	6

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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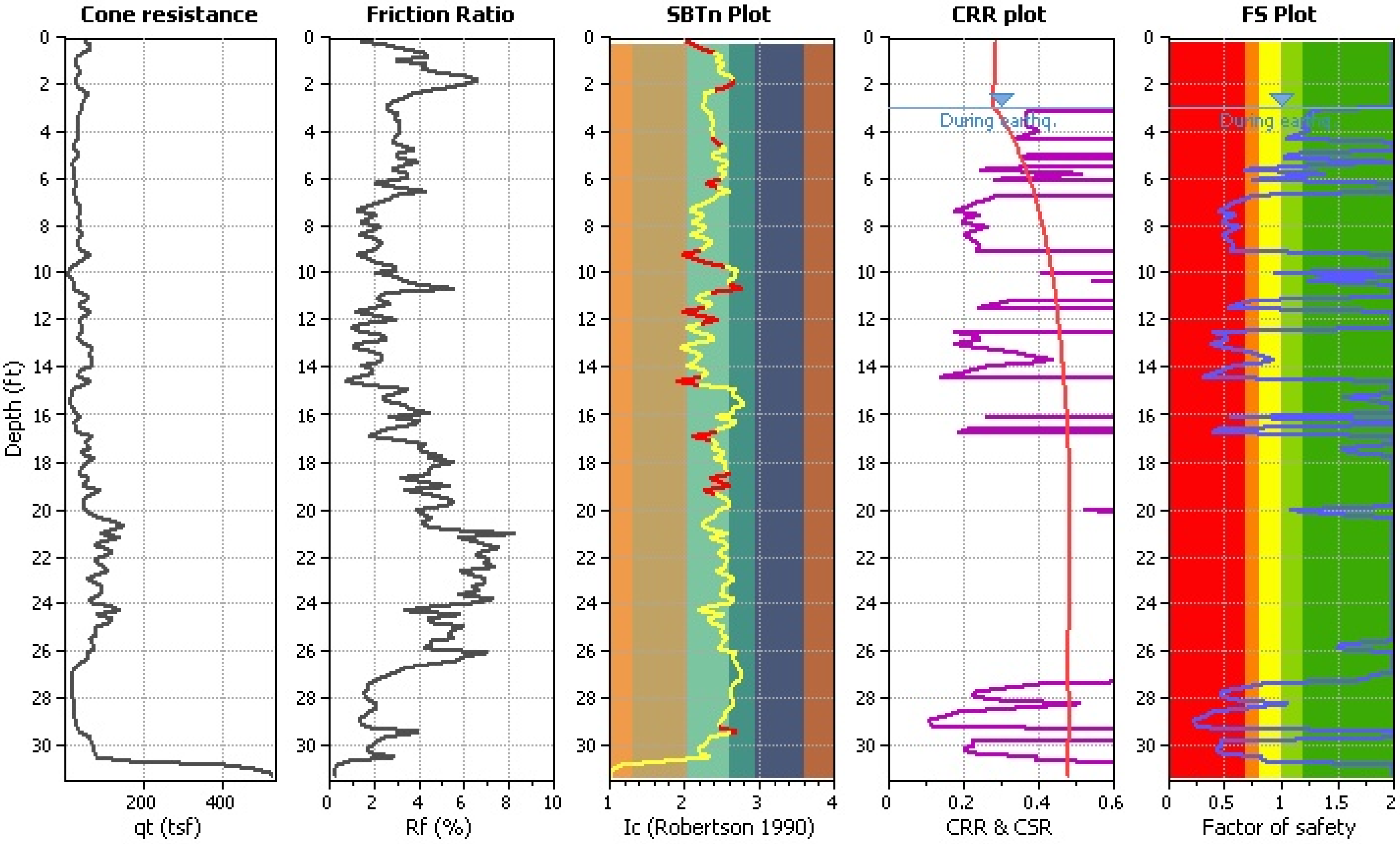
LIQUEFACTION ANALYSIS REPORT

Project title : LCMS **Location : La Center**

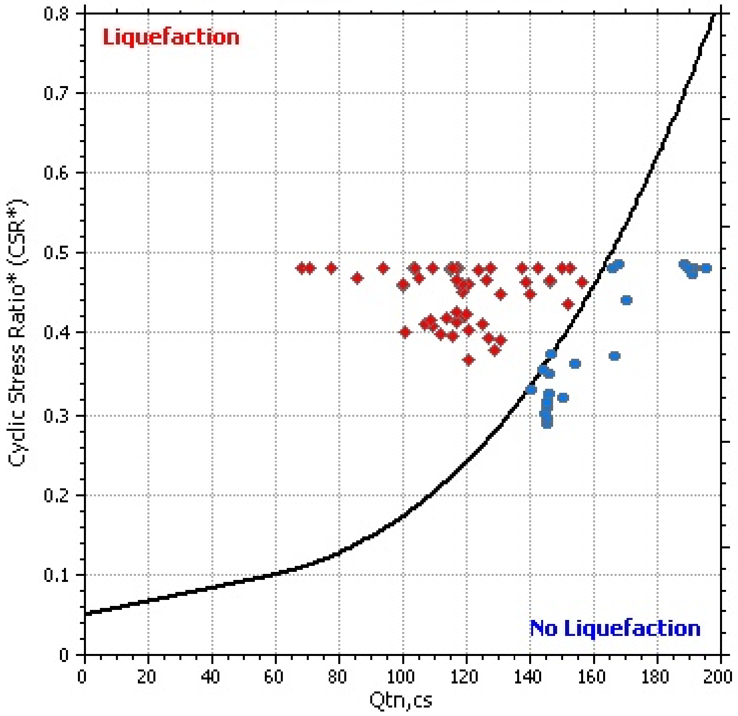
CPT file : 18140 CPT-2 Text File

Input parameters and analysis data

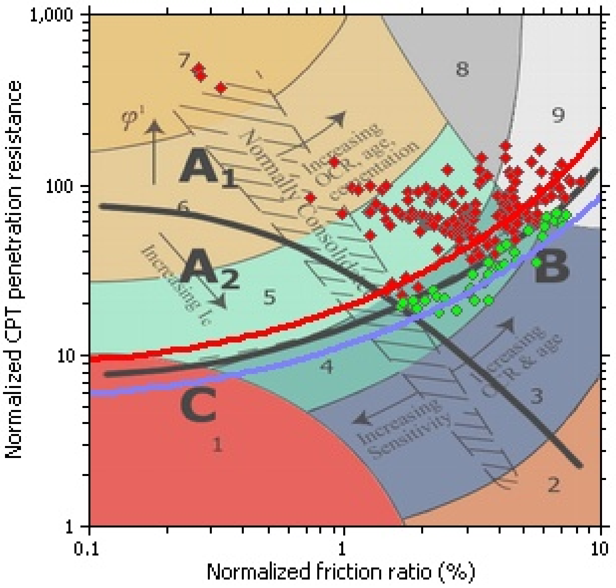
Analysis method:	Robertson (2009)	G.W.T. (in-situ):	7.50 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	3.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.82	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.39	Unit weight calculation:	Based on SBT	K_σ applied:	No		



$M_w=7^{1/2}$, sigma'=1 atm base curve

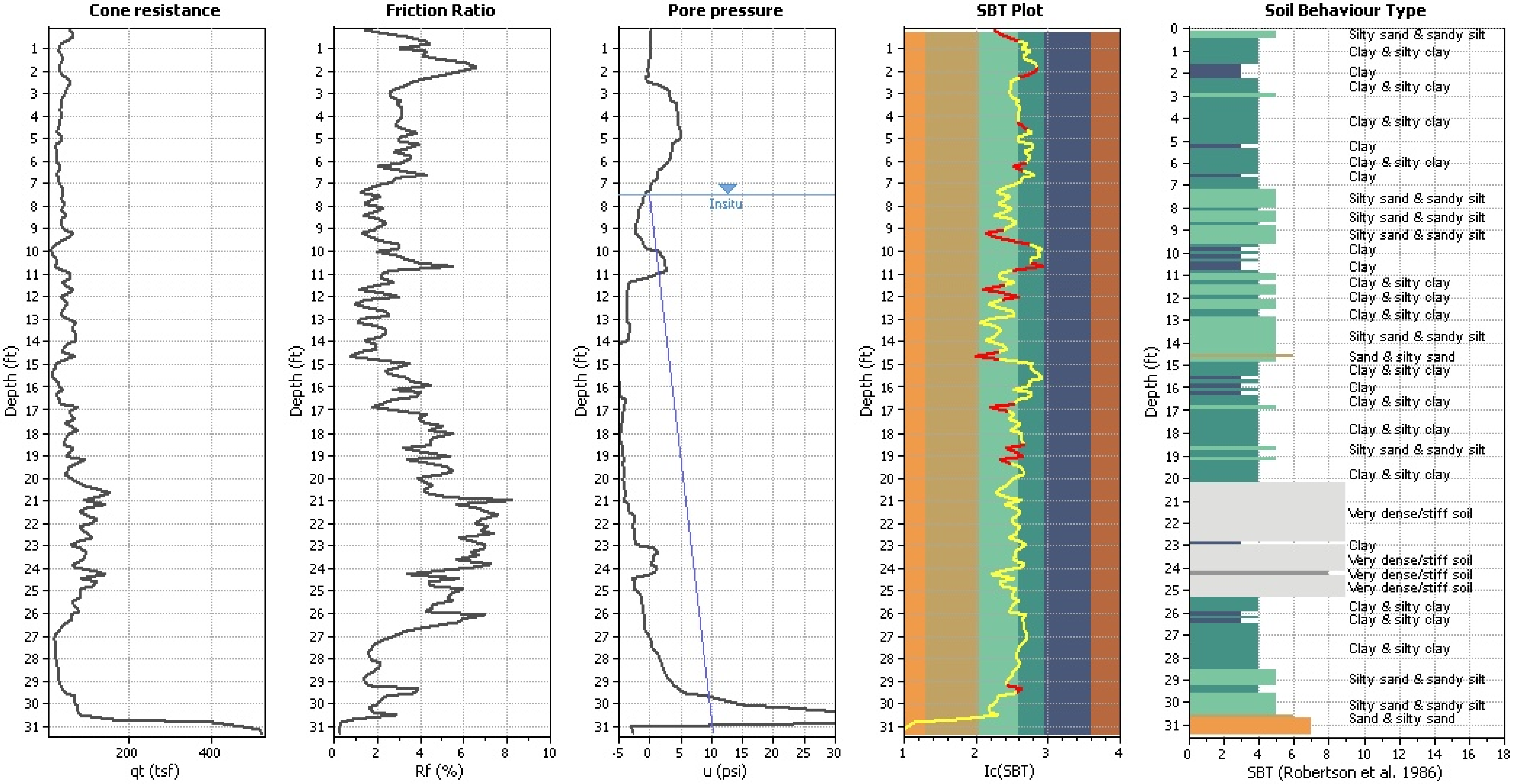


Summary of liquefaction potential



Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plo



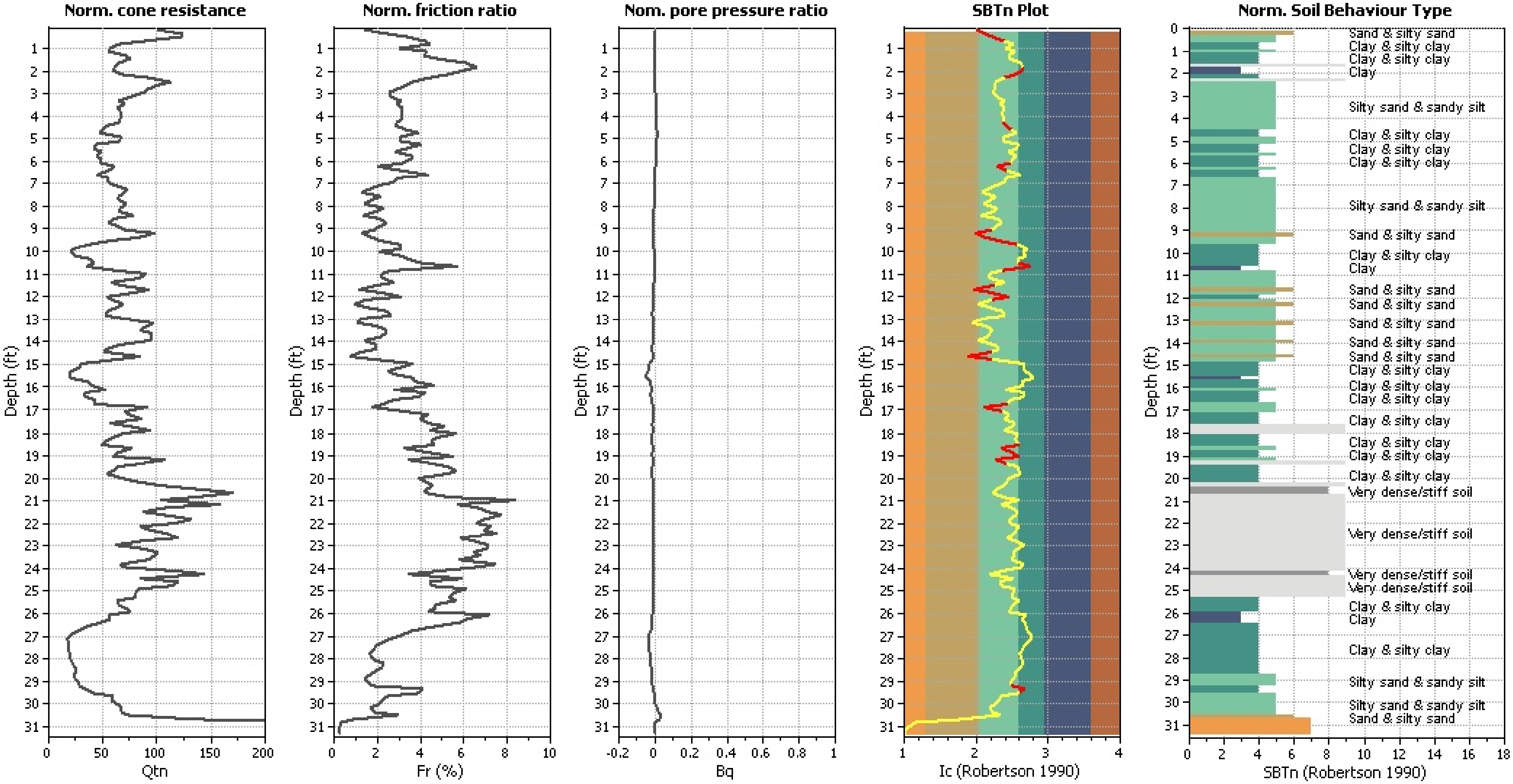
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	3.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.82	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.39	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.50 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty
🟩 5. Silty sand to sandy silt
🟨 6. Clean sand to silty sand
🟧 7. Gravely sand to sand
⬛ 8. Very stiff sand to
⬜ 9. Very stiff fine grained

CPT basic interpretation plots (normaliz



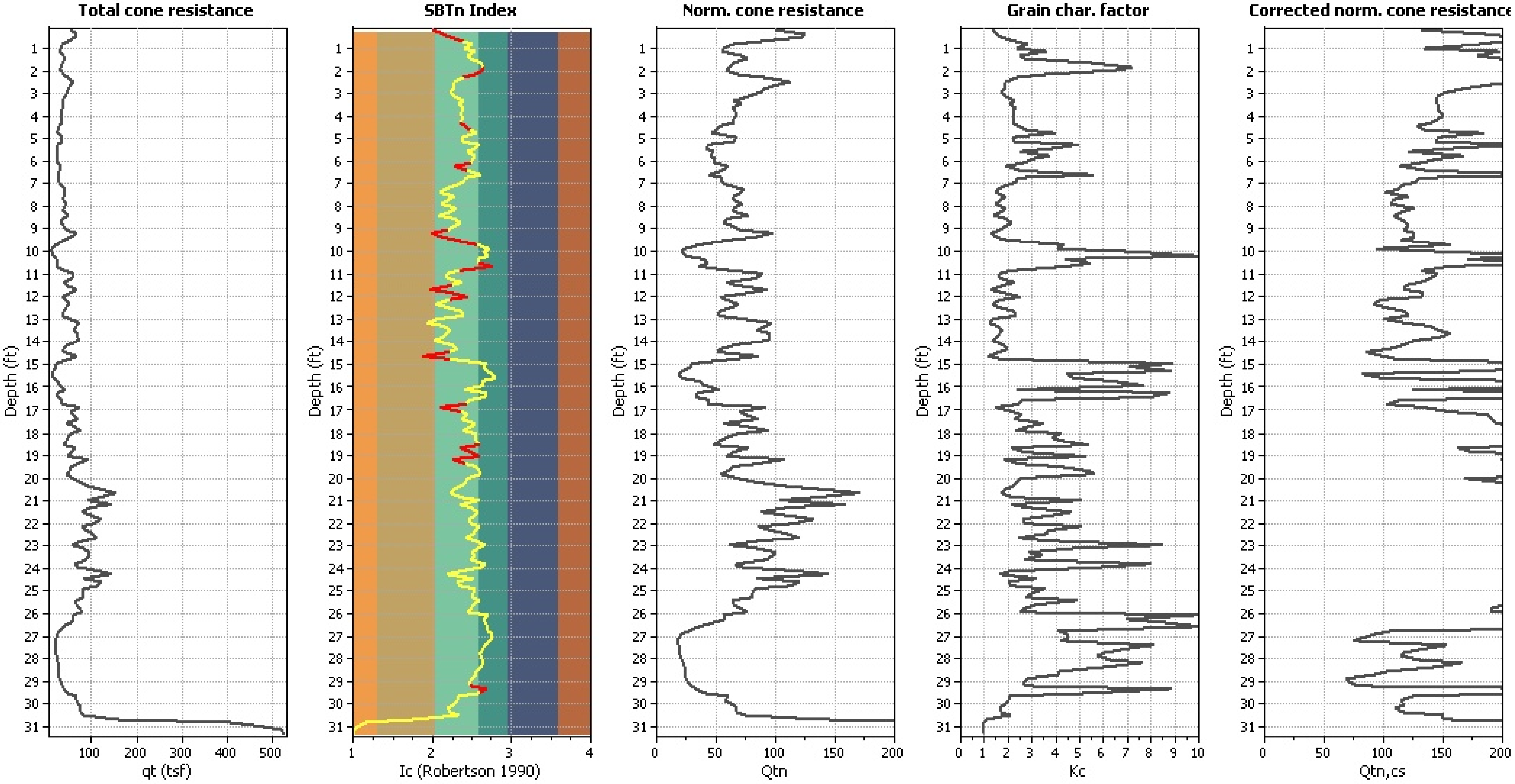
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	3.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.82	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.39	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.50 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

🟥 1. Sensitive fine grained	🟩 4. Clayey silt to silty	🟧 7. Gravely sand to sand
🟫 2. Organic material	🟩 5. Silty sand to sandy silt	⬛ 8. Very stiff sand to
🟦 3. Clay to silty clay	🟨 6. Clean sand to silty sand	⬜ 9. Very stiff fine grained

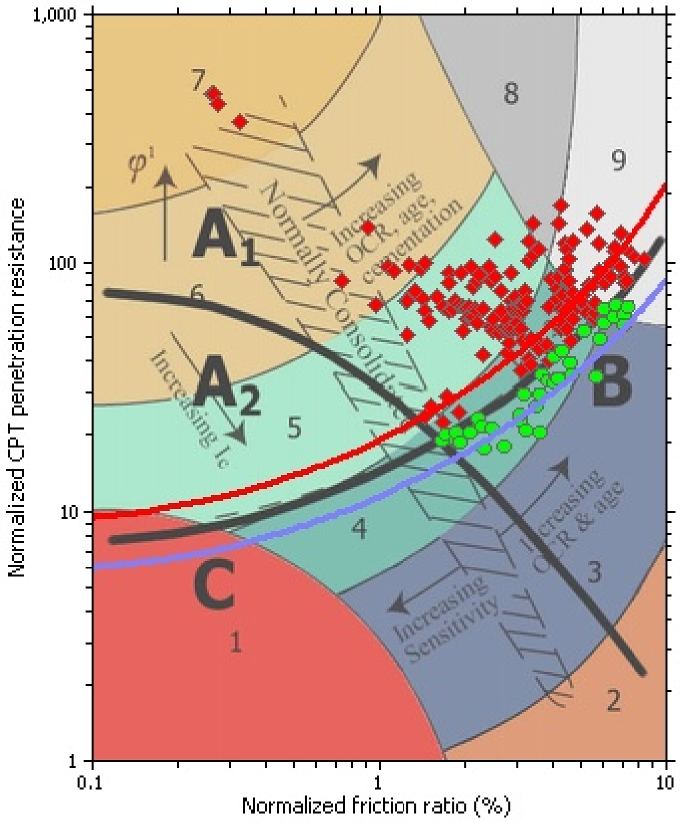
Liquefaction analysis overall plots (intermediate resu

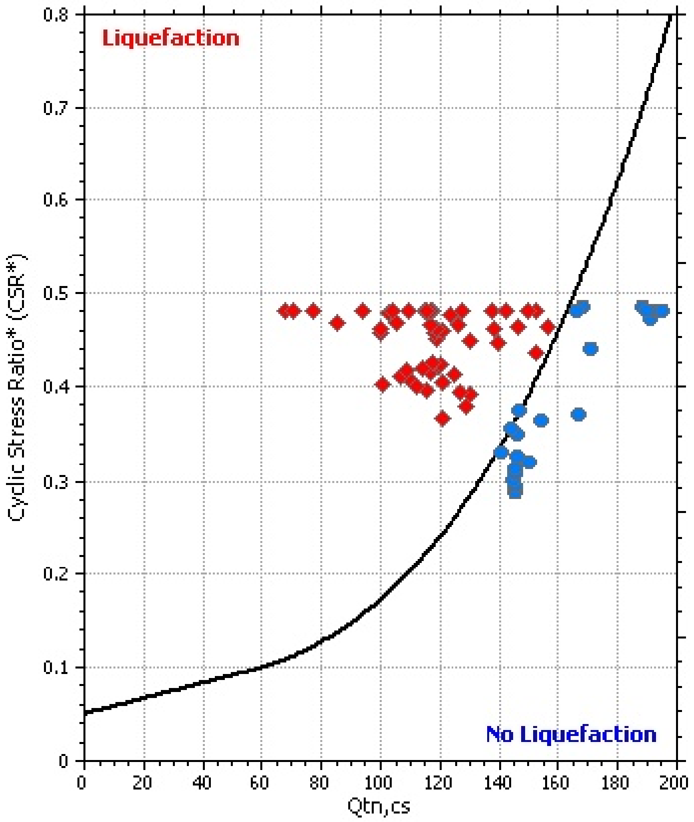


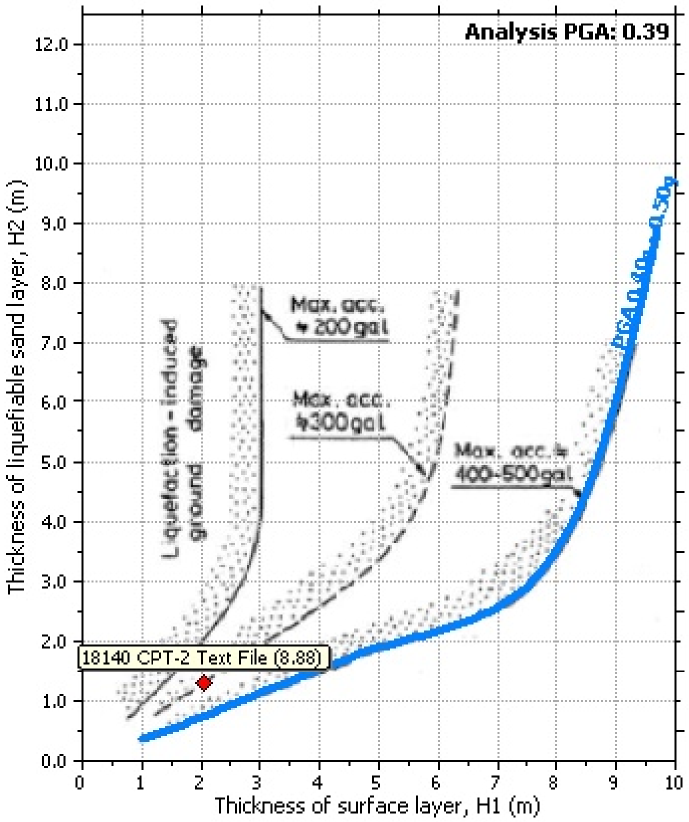
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	3.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.82	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.39	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.50 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis summary plo



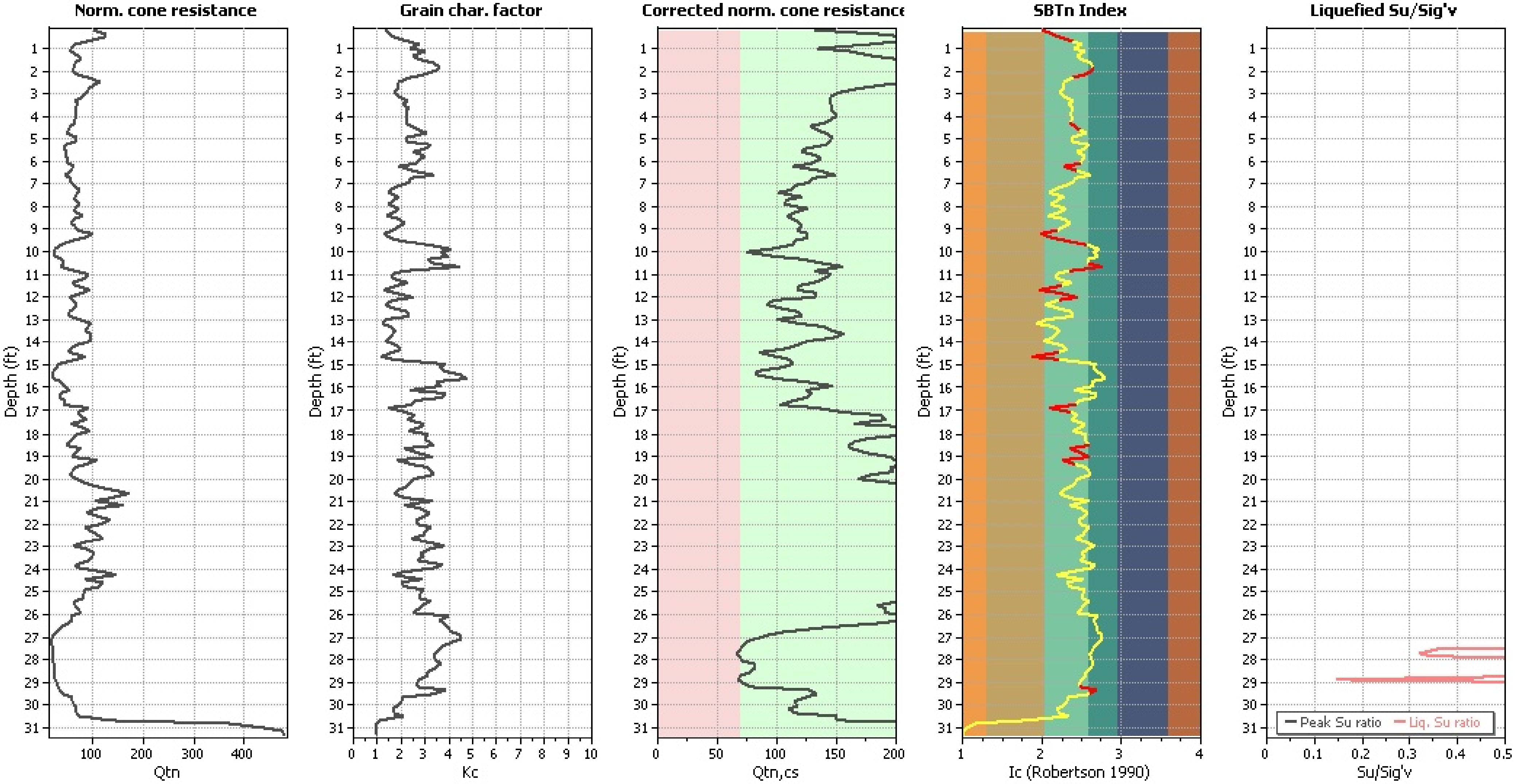




Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	3.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.82	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.39	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.50 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	3.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.82	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.39	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.50 ft	Fill height:	N/A	Limit depth:	N/A

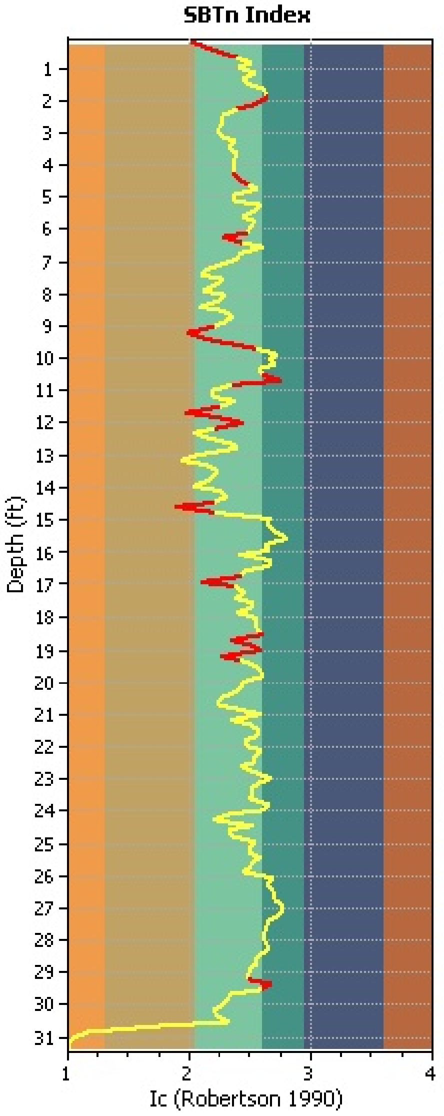
TRANSITION LAYER DETECTION ALGORITHM REPORT

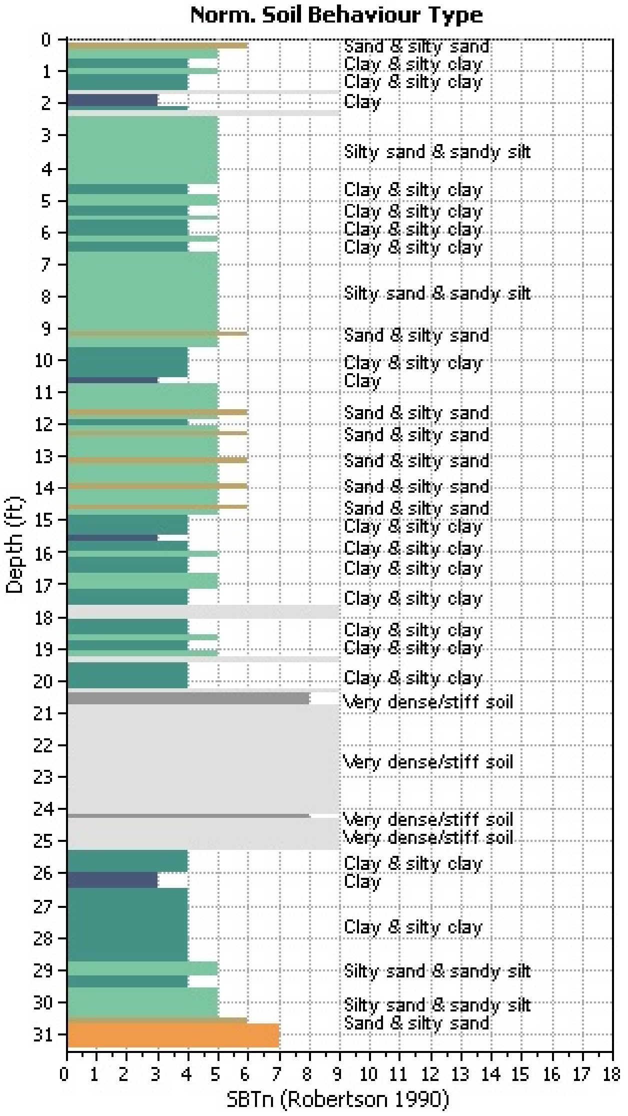
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between $1.80 < I_c < 3.0$) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.





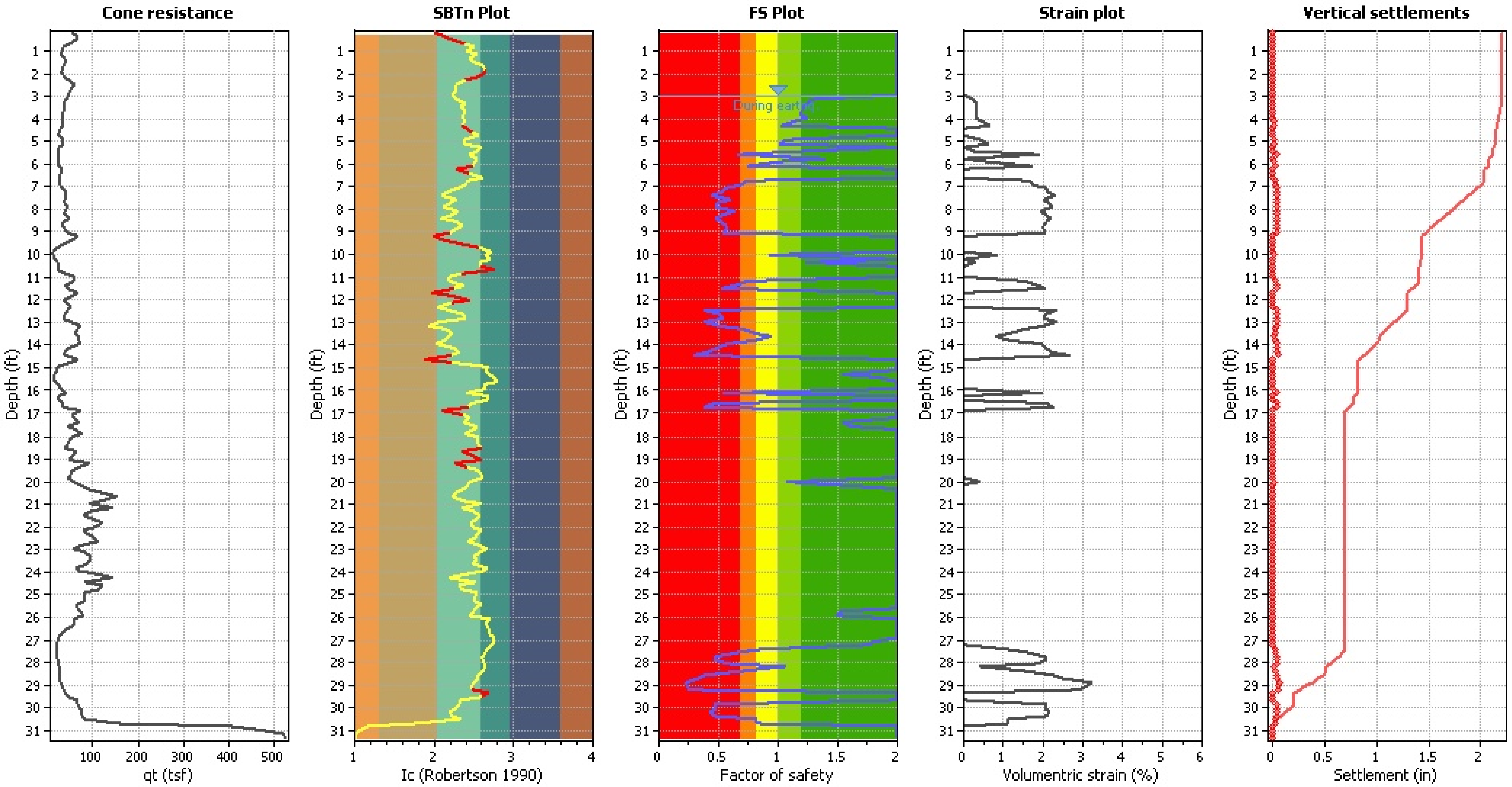
Transition layer algorithm properties

I_c minimum check value:	1.70
I_c maximum check value:	3.00
I_c change ratio value:	0.0250
Minimum number of points in layer:	3

General statistics

Total points in CPT file:	191
Total points excluded:	44
Exclusion percentage:	23.04%
Number of layers detected:	13

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Columbia West Engineering, Inc.
11917 NE 95th Avenue
Vancouver, WA 98682
http://www.columbiawestengineering.com

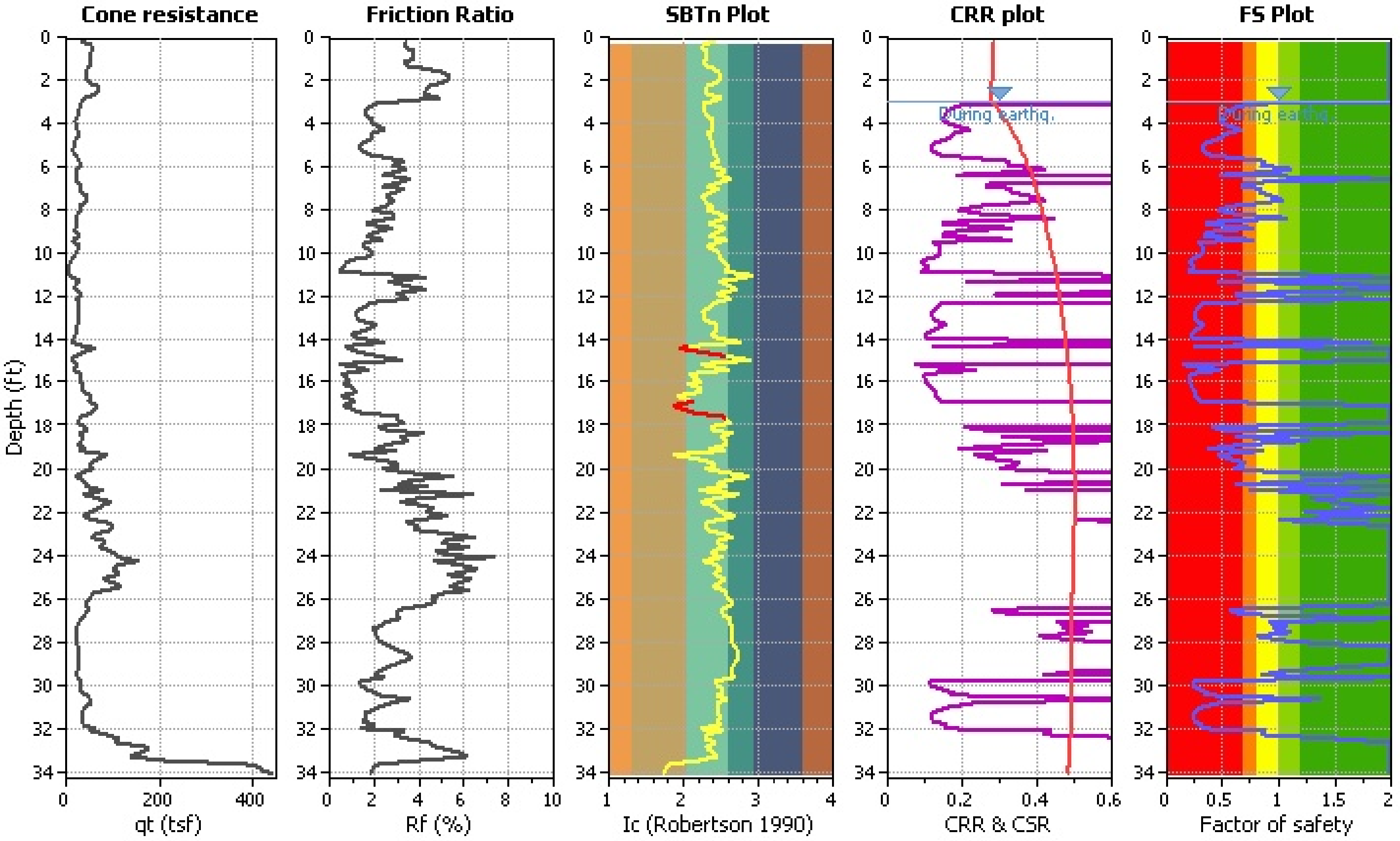
LIQUEFACTION ANALYSIS REPORT

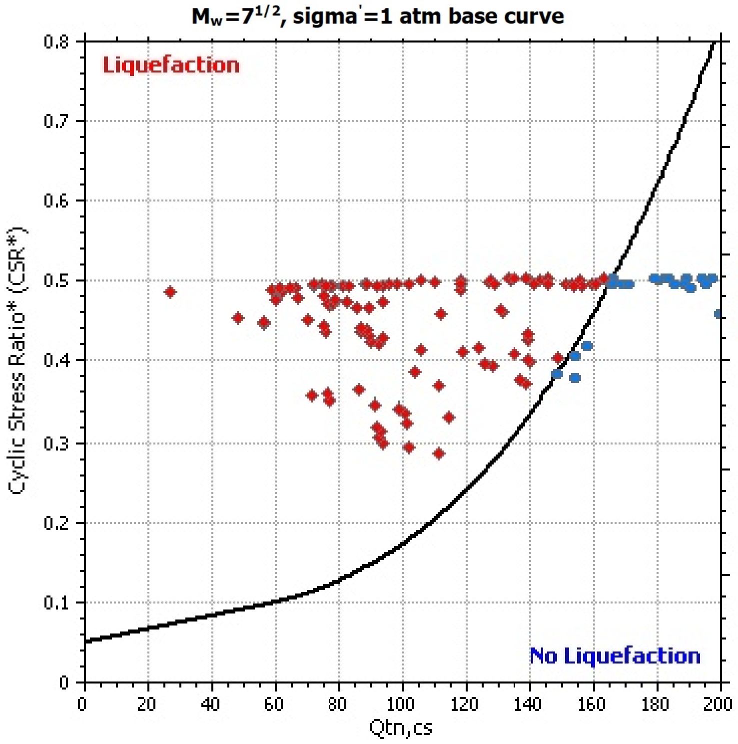
Project title : LCMS **Location : La Center**

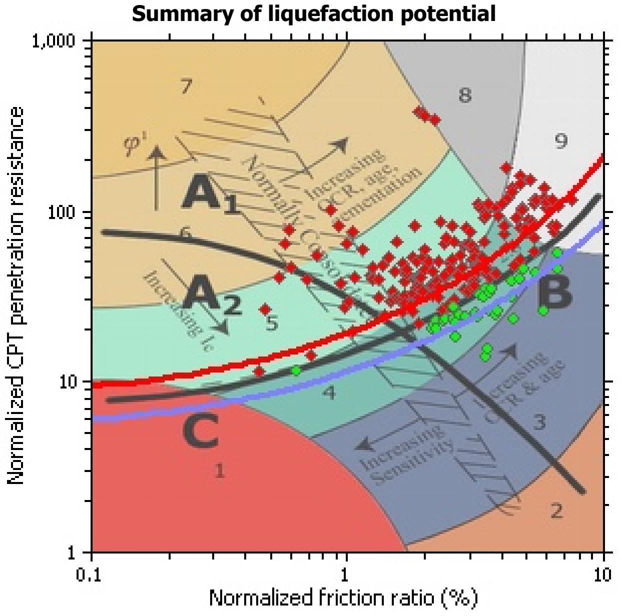
CPT file : 18140 CPT-3 Text File

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	8.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	3.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.82	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.39	Unit weight calculation:	Based on SBT	K_σ applied:	No		

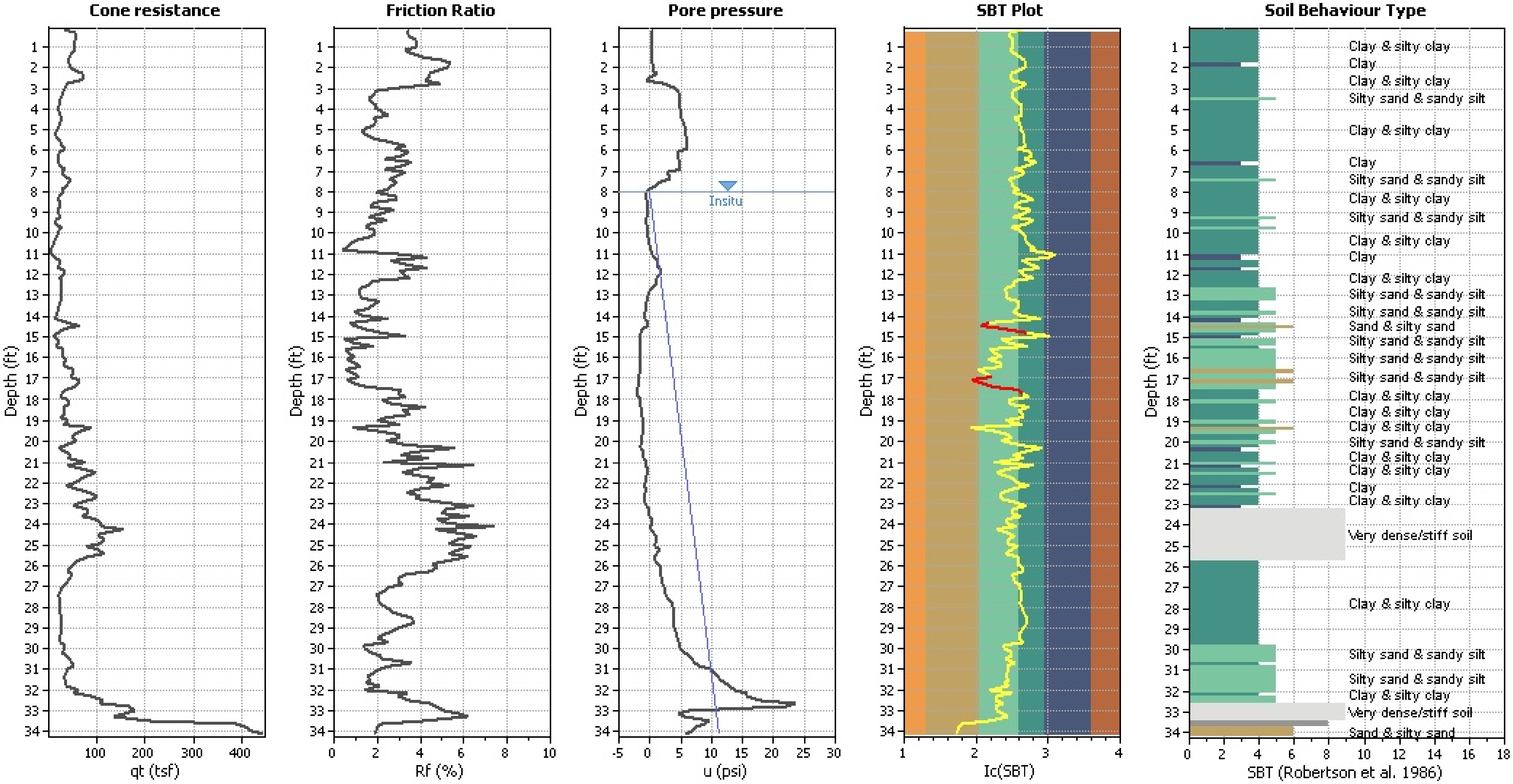






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plo



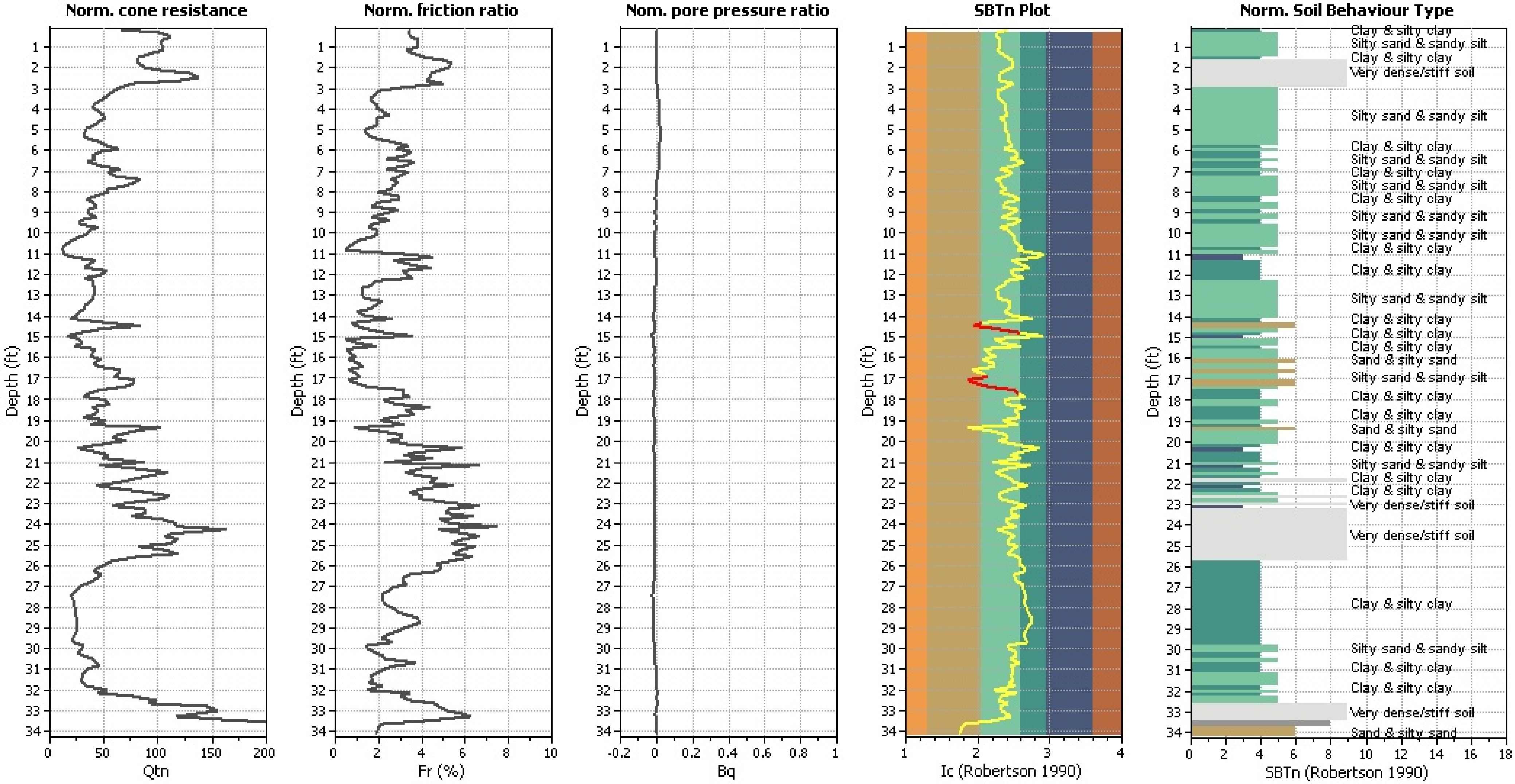
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	3.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.82	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.39	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty
- 🟩 5. Silty sand to sandy silt
- 🟫 6. Clean sand to silty sand
- 🟧 7. Gravely sand to sand
- ⬛ 8. Very stiff sand to
- ⬜ 9. Very stiff fine grained

CPT basic interpretation plots (normaliz



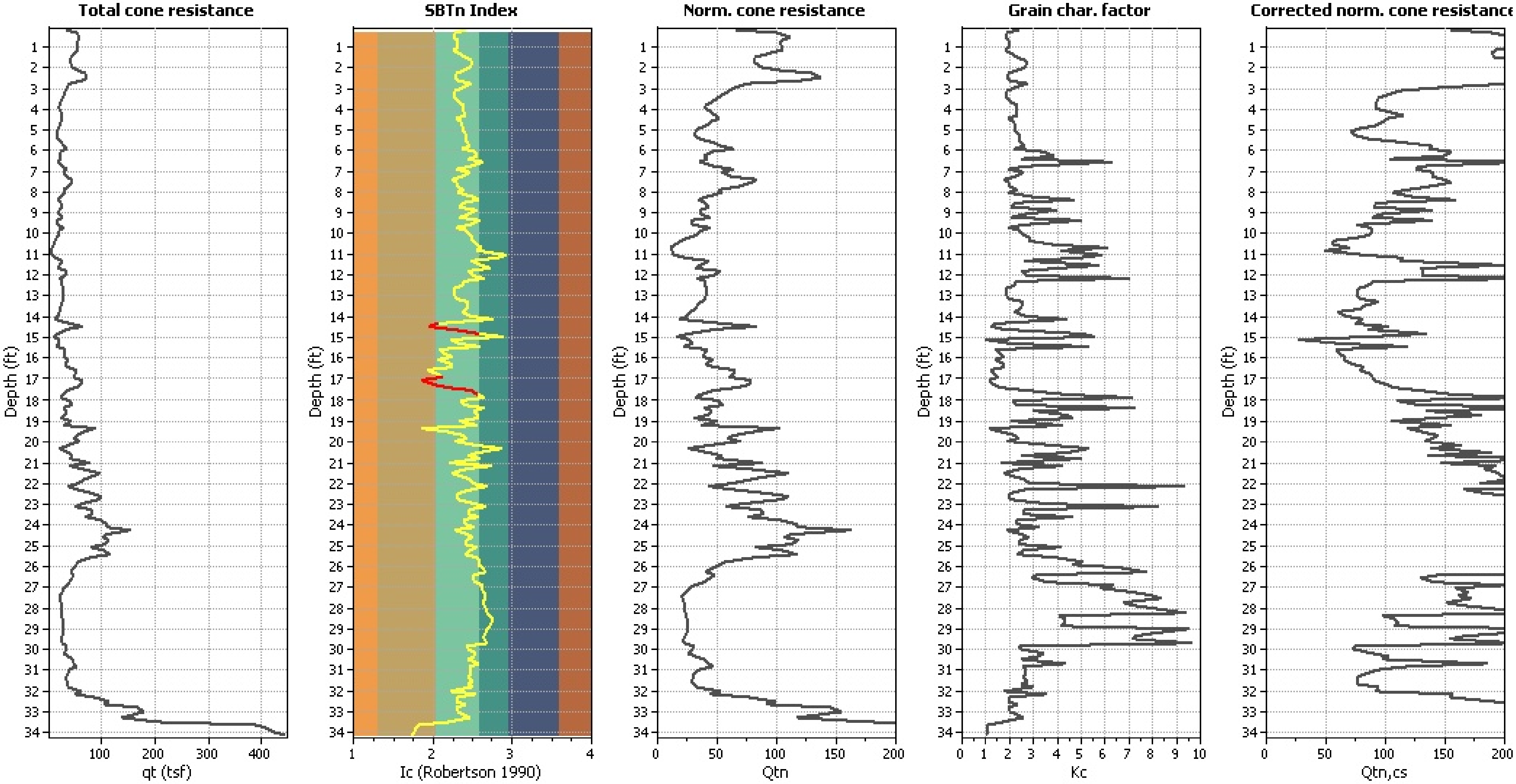
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	3.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.82	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.39	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty
- 🟩 5. Silty sand to sandy silt
- 🟨 6. Clean sand to silty sand
- 🟧 7. Gravely sand to sand
- ⬛ 8. Very stiff sand to
- ⬜ 9. Very stiff fine grained

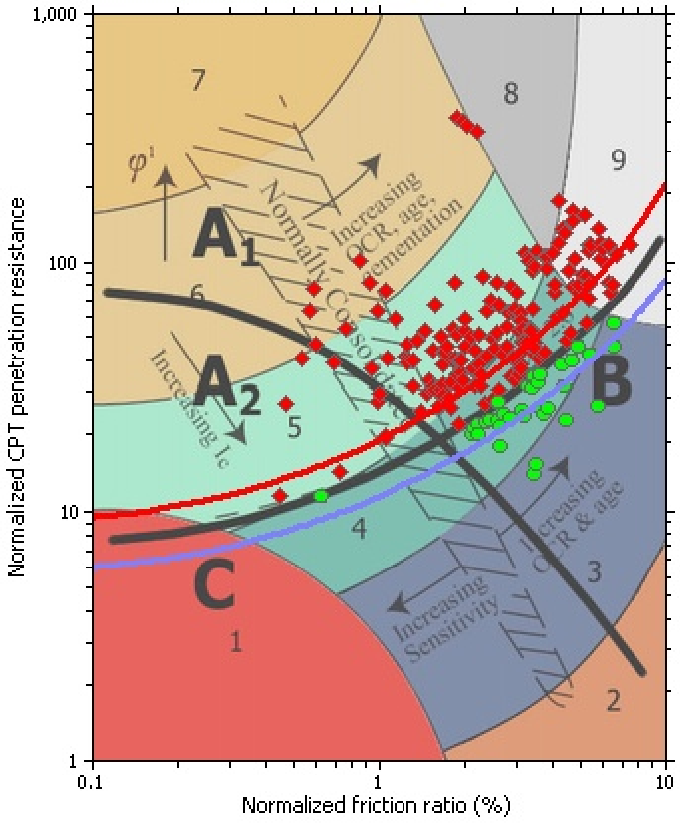
Liquefaction analysis overall plots (intermediate resu

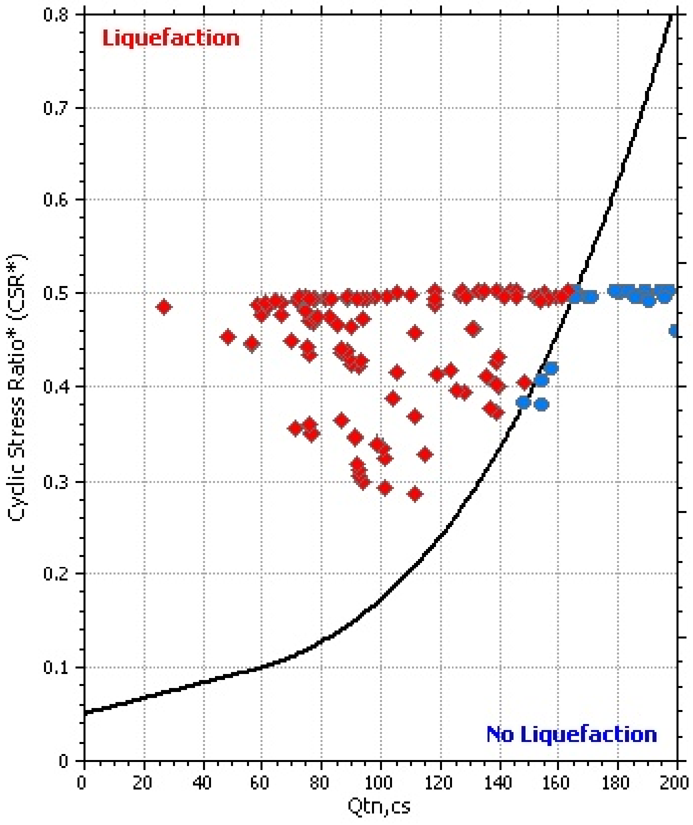


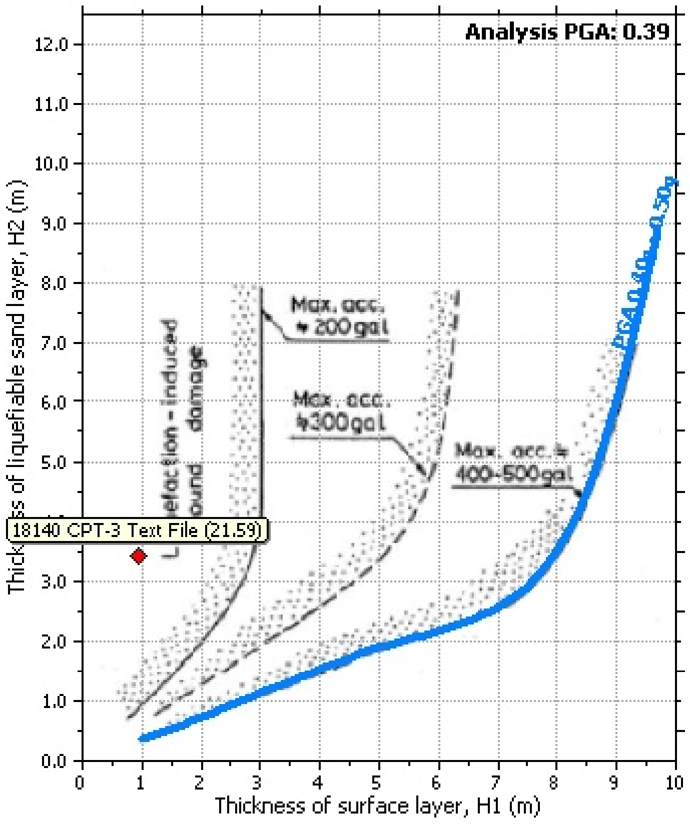
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	3.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.82	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.39	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis summary plo



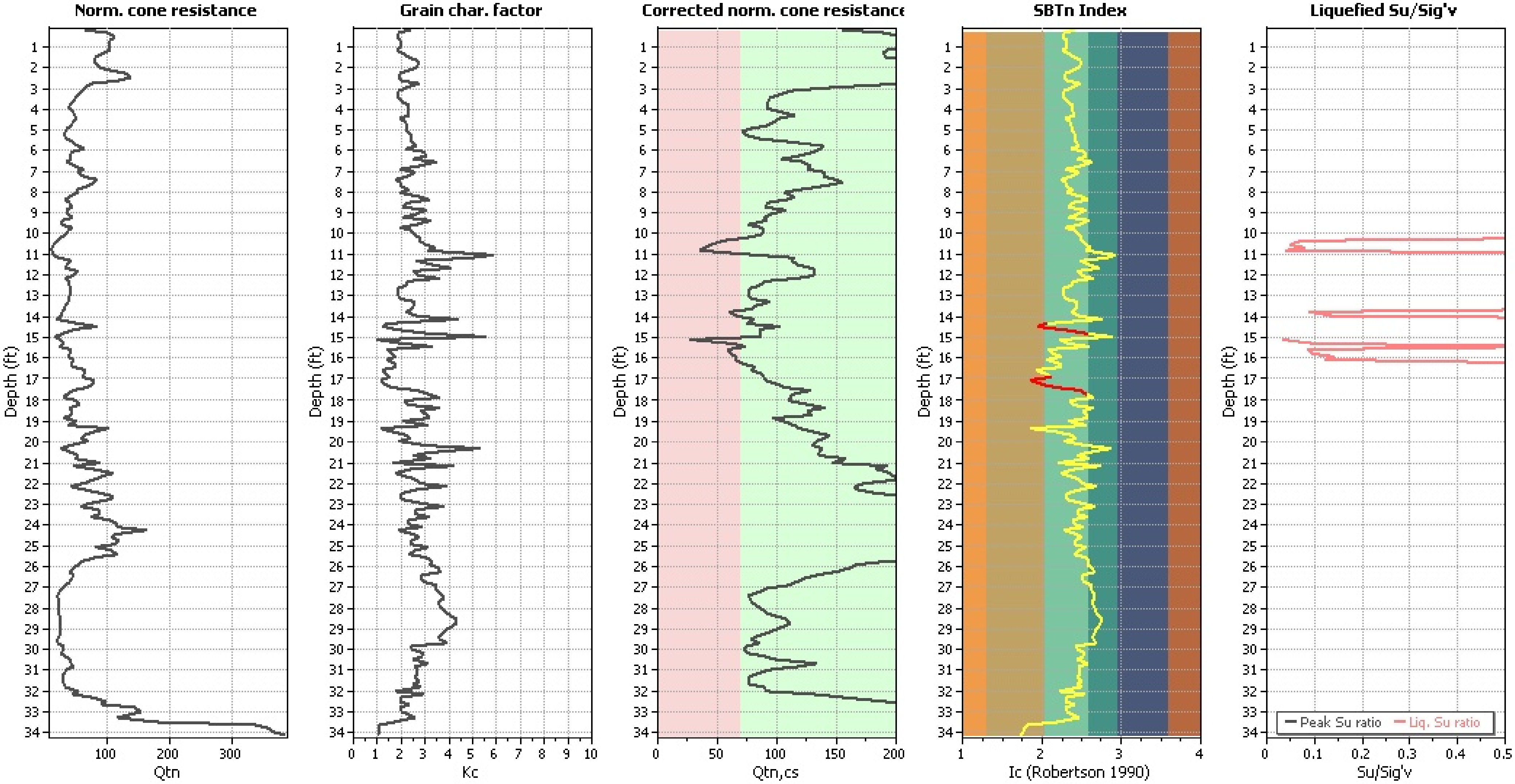




Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	3.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.82	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.39	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	3.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.82	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.39	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

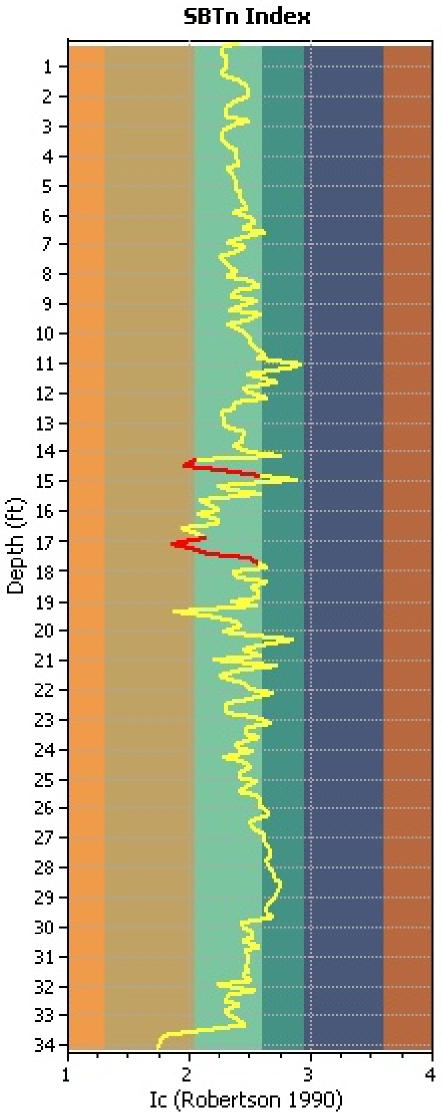
TRANSITION LAYER DETECTION ALGORITHM REPORT

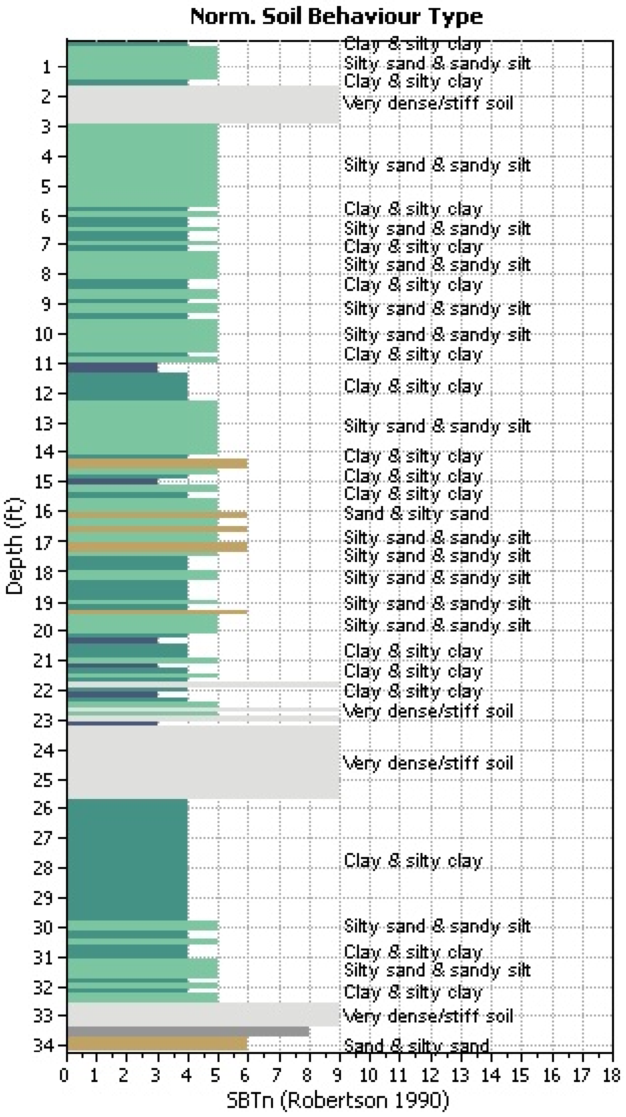
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between $1.80 < I_c < 3.0$) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.





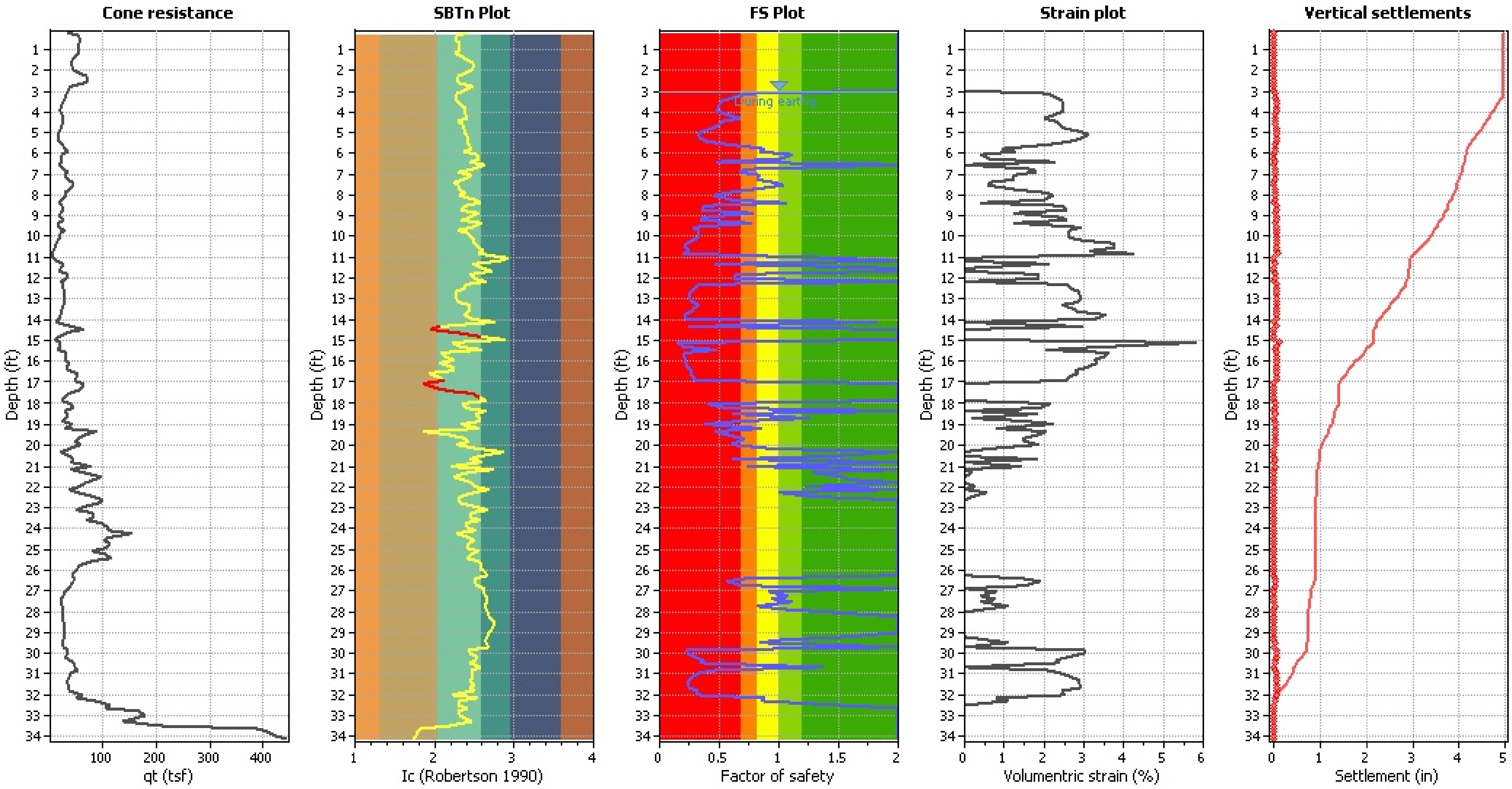
Transition layer algorithm properties

I_c minimum check value:	1.76
I_c maximum check value:	3.32
I_c change ratio value:	0.0250
Minimum number of points in layer:	4

General statistics

Total points in CPT file:	208
Total points excluded:	10
Exclusion percentage:	4.81%
Number of layers detected:	2

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

APPENDIX F
REPORT LIMITATIONS AND IMPORTANT INFORMATION

Date: October 3, 2018
Project: La Center Middle School
Vancouver, Washington

Geotechnical and Environmental Report Limitations and Important Information

Report Purpose, Use, and Standard of Care

This report has been prepared in accordance with standard fundamental principles and practices of geotechnical engineering and/or environmental consulting, and in a manner consistent with the level of care and skill typical of currently practicing local engineers and consultants. This report has been prepared to meet the specific needs of specific individuals for the indicated site. It may not be adequate for use by other consultants, contractors, or engineers, or if change in project ownership has occurred. It should not be used for any other reason than its stated purpose without prior consultation with Columbia West Engineering, Inc. (Columbia West). It is a unique report and not applicable for any other site or project. If site conditions are altered, or if modifications to the project description or proposed plans are made after the date of this report, it may not be valid. Columbia West cannot accept responsibility for use of this report by other individuals for unauthorized purposes, or if problems occur resulting from changes in site conditions for which Columbia West was not aware or informed.

Report Conclusions and Preliminary Nature

This geotechnical or environmental report should be considered preliminary and summary in nature. The recommendations contained herein have been established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. The exploration and associated laboratory analysis of collected representative samples identifies soil conditions at specific discreet locations. It is assumed that these conditions are indicative of actual conditions throughout the subject property. However, soil conditions may differ between tested locations at different seasonal times of the year, either by natural causes or human activity. Distinction between soil types may be more abrupt or gradual than indicated on the soil logs. This report is not intended to stand alone without understanding of concomitant instructions, correspondence, communication, or potential supplemental reports that may have been provided to the client.

Because this report is based upon observations obtained at the time of exploration, its adequacy may be compromised with time. This is particularly relevant in the case of natural disasters, earthquakes, floods, or other significant events. Report conclusions or interpretations may also be subject to revision if significant development or other manmade impacts occur within or in proximity to the subject property. Groundwater conditions, if presented in this report, reflect observed conditions at the time of investigation. These conditions may change annually, seasonally or as a result of adjacent development.

Additional Investigation and Construction QA/QC

Columbia West should be consulted prior to construction to assess whether additional investigation above and beyond that presented in this report is necessary. Even slight variations in soil or site conditions may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent QA/QC construction observation and testing to verify soil conditions do not differ materially or significantly from the interpreted conditions utilized for preparation of this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Actual subsurface conditions are more readily observed and discerned during the earthwork phase of construction when soils are exposed. Columbia West cannot accept responsibility for deviations from recommendations described in this report or future performance of structural facilities if another consultant is retained during the construction phase or Columbia West is not engaged to provide construction observation to the full extent recommended.

Collected Samples

Uncontaminated samples of soil or rock collected in connection with this report will be retained for thirty days. Retention of such samples beyond thirty days will occur only at client's request and in return for payment of storage charges incurred. All contaminated or environmentally impacted materials or samples are the sole property of the client. Client maintains responsibility for proper disposal.

Report Contents

This geotechnical or environmental report should not be copied or duplicated unless in full, and even then only under prior written consent by Columbia West, as indicated in further detail in the following text section entitled *Report Ownership*. The recommendations, interpretations, and suggestions presented in this report are only understandable in context of reference to the whole report. Under no circumstances should the soil boring or test pit excavation logs, monitor well logs, or laboratory analytical reports be separated from the remainder of the report. The logs or reports should not be redrawn or summarized by other entities for inclusion in architectural or civil drawings, or other relevant applications.

Report Limitations for Contractors

Geotechnical or environmental reports, unless otherwise specifically noted, are not prepared for the purpose of developing cost estimates or bids by contractors. The extent of exploration or investigation conducted as part of this report is usually less than that necessary for contractor's needs. Contractors should be advised of these report limitations, particularly as they relate to development of cost estimates. Contractors may gain valuable information from this report, but should rely upon their own interpretations as to how subsurface conditions may affect cost, feasibility, accessibility and other components of the project work. If believed necessary or relevant, contractors should conduct additional exploratory investigation to obtain satisfactory data for the purposes of developing adequate cost estimates. Clients or developers cannot insulate themselves from attendant liability by disclaiming accuracy for subsurface ground conditions without advising contractors appropriately and providing the best information possible to limit potential for cost overruns, construction problems, or misunderstandings.

Report Ownership

Columbia West retains the ownership and copyright property rights to this entire report and its contents, which may include, but may not be limited to, figures, text, logs, electronic media, drawings, laboratory reports, and appendices. This report was prepared solely for the client, and other relevant approved users or parties, and its distribution must be contingent upon prior express written consent by Columbia West. Furthermore, client or approved users may not use, lend, sell, copy, or distribute this document without express written consent by Columbia West. Client does not own nor have rights to electronic media files that constitute this report, and under no circumstances should said electronic files be distributed or copied. Electronic media is susceptible to unauthorized manipulation or modification, and may not be reliable.

Consultant Responsibility

Geotechnical and environmental engineering and consulting is much less exact than other scientific or engineering disciplines, and relies heavily upon experience, judgment, interpretation, and opinion often based upon media (soils) that are variable, anisotropic, and non-homogenous. This often results in unrealistic expectations, unwarranted claims, and uninformed disputes against a geotechnical or environmental consultant. To reduce potential for these problems and assist relevant parties in better understanding of risk, liability, and responsibility, geotechnical and environmental reports often provide definitive statements or clauses defining and outlining consultant responsibility. The client is encouraged to read these statements carefully and request additional information from Columbia West if necessary.