Addendum 1 [July 17, 2025]: Community Solar Site Reports (Basis of Design, ESA 1, Geotech)

RFP No. 32003560-01
Added July 17, 2025

May 2, 2024

Oregon Department of Environmental Quality
700 NE Multnomah Street, Suite 600
Portland, OR 97232

Attention: Ryan Lewis

Basis of Design and Engineering Approach
2800 NE 82nd Avenue
Portland, Oregon
Project: SOJ-7-05

INTRODUCTION

This basis of design and engineering approach outlines measures that Bird Alliance of Oregon Inc. and Bird Alliance of Oregon Nature and Wildlife Care Center, LLC (together, Bird Alliance) agree to perform under the prospective purchaser agreement (PPA) with the Oregon Department of Environmental Quality (DEQ) for the property located at 2800 NE 82nd Avenue in Portland, Oregon (subject property). The 12.49-acre property consists of Tax Lot 400 of Multnomah County Tax Map 1N2E28BC and occupies the approximately west half of the approximately 26-acre former H.G. LaVelle Landfill (Landfill). The subject property is currently owned by Skidmore Limited Partnership, an Oregon limited partnership (“Owner”) and is occupied by a former golf driving range, including covered tee boxes and a vacant building, a cell tower, and a portion of a landfill gas control system (LGCS).

Bird Alliance intends to construct a state-of-the-art wildlife care center at the subject property using sustainable and wildlife-friendly building practices. The new facility may include an approximately 5,000-square-foot wildlife care center and up to 34 open-air animal enclosures that will total approximately 19,000 square feet. Subject property redevelopment is anticipated to occur in separate construction phases, a schedule for which has not yet been established.

We anticipate that this basis of design and engineering approach will be included with the PPA as an attachment.

BACKGROUND

The following sections describe the subject property's historical use, historical regulatory interaction, and previous environmental studies.

HISTORICAL USE

The subject property was first developed with a gravel quarry operated by Rose City Sand & Gravel Co. with associated structures and access roads from at least 1936 through 1972. In 1957, a structure was constructed on the west portion of the subject property. Between 1972 and 1982, the former gravel quarry, which was present on a majority of the subject property, on the adjacent property north of the subject property (currently occupied by the Asian American Plaza), and on the adjacent property north and east of the subject property (currently occupied by Dharma Rain Zen Center [Dharma Rain]), functioned as the Landfill and was backfilled with soil and construction and demolition debris. The debris included inert material such as brick, metal, and concrete; appliances; and organic material, including plants and wood. In addition, a limited amount of household waste was disposed of at the Landfill, contrary to DEQ permit requirements. By 1975, the structures associated with the former Landfill operations at the subject property had been removed, except for the 1957 structure. In 1979, the LGCS was installed at the subject property. In 1982, the Landfill ceased operation and was capped with fill soil. By 1990, a golf driving range was constructed on the subject property. By 2000, a radio tower was present on the southwest portion of the subject property. By 2005, the golf driving range was no longer operating, but the structures associated with the driving range (including covered tee boxes and the 1957 structure) remained on the subject property. In 2007, the existing radio tower was converted to a cell tower. In 2009, the LGCS was expanded, including two new extraction wells along the south subject property boundary.

HISTORICAL REGULATORY INTERACTION

Post-closure maintenance of the subject property is managed under a Solid Waste Disposal Site Closure Permit, Construction and Demolition Landfill, Permit No. 211, issued to Mike Hashem and PSFM Limited Partnership, an Oregon limited partnership (together, "Hashem"), effective November 14, 2011, to August 31, 2021 ("Closure Permit"). The Closure Permit has been administratively extended by DEQ. The DEQ-issued Closure Permit authorizes the permittee to conduct operation and maintenance of the LGCS, landfill gas monitoring, maintenance of the soil cap (covering the landfill portion of the subject property), surface-water controls, and inspections, among other measures to ensure the subject property is protective of human health, ecological receptors, and the environment. The Owner and Hashem have not been and, as of the date of this basis of design and engineering approach, are not in compliance with the Closure Permit. DEQ has previously brought enforcement actions against Hashem. As a result of the Owner's and Hashem's non-compliance, the LGCS does not currently meet the requirements of the Closure Permit and DEQ's laws and regulations. Moreover, the owner/operator of the subject property shut down the LGCS without approval from DEQ, in violation of the Closure Permit.

It is our understanding that, upon acquiring the subject property, Bird Alliance will become the permittee for the new solid waste landfill Closure Permit and assume responsibility for operating, inspecting, monitoring, and maintaining the LGCS. The requirements of the Closure Permit are separate from the requirements under the PPA. It is our understanding that DEQ will provide

Exhibit D
Page 3 of 11

public notice and opportunity to comment on a proposed certification decision once Bird Alliance has completed the work outlined in this basis of design and engineering approach regardless of whether the Closure Permit is still in effect. Within 90 days after receiving Bird Alliance's closeout report and consideration of public comment, DEQ will issue a final Certificate of Completion.

PREVIOUS ENVIRONMENTAL STUDIES

In connection with Bird Alliance's environmental due diligence, NV5 conducted the following environmental studies: 1) a Phase I environmental site assessment (ESA) dated October 11, 2023, and 2) a Phase II ESA and landfill gas extraction system assessment dated April 26, 2024. The Phase II ESA and landfill gas extraction system assessment was conducted in accordance with a DEQ-approved work plan dated December 14, 2023.

Extensive sampling of soil and soil gas at the subject property during the Phase II ESA indicates that the primary concern of impacts to human health and the environment is the potential for methane migration. Soil gas sampling activities in the interior of the subject property identified methane in soil gas at concentrations up to 6.80 percent by volume (pbv) and identified gasoline-range hydrocarbons and benzene in soil gas at concentrations greater than the DEQ Vapor Intrusion into Buildings—Chronic risk-based concentration (RBC) for commercial receptors.

Environmental characterization of subsurface conditions also identified limited impacts to the soil cap material and shallow and deeper solid waste at the subject property from petroleum hydrocarbons, volatile organic compounds (VOCs), metals, polycyclic aromatic hydrocarbons (PAHs), and/or pesticides. Contaminants present in the soil cap and shallow solid waste throughout the subject property (the upper 5 feet of soil) do not exceed applicable DEQ RBCs for human health but do exceed DEQ clean fill screening levels (CFSLs). Additionally, contaminants present in the upper 5 feet of soil throughout the subject property exceed DEQ Ecological RBCs that may be applicable to birds and mammals that may occupy future open-air enclosures.

Groundwater results from samples collected in March 2001 from two down-gradient monitoring wells (GWMW-1 and GWMW-2) north of the subject property on the adjoining Dharma Rain site and Asian American Plaza site did not indicate the presence of VOCs or semi-volatile organic compounds (including PAHs), except for Bis(2-ethylhexyl) phthalate. Several total metals were detected at concentrations greater than the current DEQ Ingestion & Inhalation from Tapwater RBCs. The groundwater results of leachate parameters were not indicative of leachate impact to groundwater. The depths to groundwater measured in monitoring wells GWMW-1 and GWMW-2 in March 2001 were approximately 191 and 202 feet below ground surface, respectively, indicating a significant vertical buffer of presumed clean soil between the bottom of the Landfill and the water table. A beneficial water use determination did not identify water supply wells at the subject property, or within 0.25 mile of the subject property. Potable water is supplied to the surrounding properties by the Portland Water Bureau, which sources water from the Bull Run watershed and the Columbia South Shore Wellfield. Groundwater in the subject property vicinity is neither currently nor reasonably likely in the future to be developed for municipal or community consumptive use. Consequently, the DEQ Leaching to Groundwater exposure pathway is considered incomplete.

Exhibit D
Page 4 of 11

BASIS OF DESIGN

OBJECTIVES

With respect to methane mitigation and mitigation of other volatile contaminants in soil gas at the subject property, the primary objectives for the basis of design will be as follows:

- Mitigate potential for methane to accumulate in a confined space or structure at concentrations exceeding 25 percent of the lower explosive limit (i.e., 1.25 pbv).
- Mitigate potential for gasoline-range hydrocarbons and VOCs to migrate into a structure at concentrations greater than acute and chronic air RBCs for commercial receptors.
- Ensure that the proposed improvements do not exacerbate existing conditions on the subject property; for example, resulting in or increasing off-site methane/vapor migration through utility corridors or by accumulation beneath paved areas on the subject property.
- Ensure that any disturbances to the current LGCS are minimal and/or temporary.

Soil cap material contains contaminants exceeding DEQ Ecological RBCs and/or CFSLs, but not DEQ human health RBCs. Therefore, soil cap material can be reused on site without restriction. With respect to the soil cap on the subject property, the primary objectives of the basis of design will be as follows:

- Mitigate future facility wildlife exposure to contaminated soil exceeding ecological RBCs within the open-air enclosures.
- Mitigate human health exposure to solid waste within the Landfill at the subject property.
- Maintain the soil cap’s integrity after construction is complete.

MITIGATION AND OTHER MEASURES

The landfill gas mitigation measures that Bird Alliance agrees to perform under the PPA to meet the above objectives include the following:

1. Implement engineering controls in the form of active or passive ventilation mitigation systems incorporated into the development plans that will address the potential for unacceptable methane accumulation within the interiors of future enclosed spaces.
2. Implement engineering controls in the form of trench dams within utility corridors to prevent migration of methane off site through utility trench backfill materials.

Other measures that Bird Alliance agrees to perform under the PPA are as follows:

3. Implement an institutional control in the form of an Easement and Equitable Servitudes (EES) to be recorded with Multnomah County, restricting the use of groundwater and restricting activities that would compromise the engineering controls.
4. Mitigate human health exposure to the solid waste within the landfill by maintaining the soil cap’s integrity after all phases of development are complete. Mitigate exposure of future facility wildlife that will inhabit the open-air enclosures to contaminated soil exceeding ecological RBCs by placing at least three feet of imported substrate material at

the bottoms of the enclosures or, if the substrate material is less than three feet thick, placing a substrate barrier between the substrate material and the contaminated soil exceeding ecological RBCs.

5. Submit the following documents to DEQ during various phases of the redevelopment activities:
   - Soil and Solid Waste Management Plan (SSWMP)
   - Health and Safety Plan (HSP)
   - Methane mitigation engineering plans and specifications
   - Inspection and progress reports

In addition, Bird Alliance will submit a final closure report after all phases of construction are complete.

DESIGN CONCEPTS

NV5 will assist the development team by preparing methane mitigation engineering plans and specifications that will be submitted to DEQ for approval and may also be used for bidding and construction purposes. The plans will define the extent of the methane mitigation design elements, locate the trench dams, and provide engineering details. Specifications will describe the required materials, installation procedures, and testing requirements for the design elements.

At this time, conceptual design elements have been developed for measures 1 and 2 described above. Preliminary design recommendations for measures 1 and 2 are described below. In addition, details pertaining to measures 3 through 5 are described below.

Measure 1

Based on our understanding of the subject property's conditions, methane is present in the subsurface at the Landfill. The proposed development includes structures on the subject property in areas over the Landfill. The LGCS present around the perimeter of the landfill has historically demonstrated that it successfully mitigates off-site migration of methane to adjoining parcels.

The landfill material has been in place for at least 30 years. While methane generation has apparently decreased over time, the possibility of methane migrating into future enclosed spaces and accumulating at concentrations greater than 1.25 pbv (25 percent of methane's lower explosive limit) and thus becoming an explosion hazard cannot be ruled out. Therefore, engineering controls in the form of active or passive ventilation mitigation systems should be incorporated into the development plans and specifications that will address the potential for unacceptable methane accumulation under structures and confined spaces during and after development of the subject property.

Various foundation and structural design concepts are currently being evaluated. Preliminary designs for the development include a 5,000-square-foot wildlife care center with deep pile foundations and 34 open-air animal enclosures with deep pile foundations. The wildlife enclosures may be grouped together to minimize the number of piles needed. To ensure that future building occupants and wildlife will not be exposed to unacceptable risk due to methane, we recommend the enclosed structures include one of the following design options: 1) maintain a clear height above grade of at least 12 inches to girder, 18 inches to floor joist, and 24 inches to structural floors with ventilation openings of the under-floor crawl space of either 1 percent of the under-floor area or openings of not less than 1.5 square feet per 25 linear feet of exterior wall; 2) include active mechanical ventilation of the building crawl spaces, possibly controlled with a methane detector; or 3) install sub-slab passive venting systems and low permeable membranes beneath the floor slabs. The low permeable membrane should consist of a 60-mil, spray-applied membrane or high-density polyethylene membrane. Either membrane type should be installed and inspected by qualified personnel. The vent systems should consist of flat vent piping or perforated PVC piping beneath the low-permeable membrane that would then be vented vertically through the structure’s roof. Since the project is still in the early stages of planning, with only conceptual designs underway, the methane mitigation design elements cannot be presented until other discipline designs (primarily architectural and structural) are further developed.

The current soil cap allows some level of atmospheric venting of methane. During development, construction of less permeable surfaces such as pavement or concrete could exacerbate current conditions and allow methane to accumulate to unacceptable levels. Therefore, landscaped areas should be incorporated into the less permeable areas to facilitate continued atmospheric venting from beneath newly paved or hardscaped covered areas (including structures). If paved areas exceed 5,000 contiguous square feet and are within 15 feet of the exterior wall of the wildlife care center, landscaped areas that are at least two feet wide will be installed immediately adjacent to the building’s exterior walls, covering at least 80 percent of the building’s perimeter as recommended in the Los Angeles Department of Building and Safety Methane Mitigation Standard Plan. Additional enhancements that may be warranted beneath these areas could include installation of passive vent piping in a grid array beneath the pavement to enhance venting beneath the less permeable areas.

Measure 2

As part of the development, utility corridors for storm sewer, sanitary sewer, and other utilities will likely extend off site to existing trunk systems in the city right-of-way. To mitigate potential for uncontrolled migration of methane through relatively permeable trench backfill and potentially off site, trench dams typically consisting of cement-bentonite, other concrete mixes, or compacted native soil are recommended at all locations where utilities extend off site and also immediately adjacent to building footings such that methane/vapors do not migrate beneath planned structures. In addition, utility vaults should be equipped with vented covers and penetrations should be sealed. In the event electrical power will be installed underground, underground electrical conduits should be sealed where they daylight before entering electrical panels or junction boxes, where potential ignition sources could be present. We also recommend that electrical devices/equipment within enclosed structures be intrinsically safe such that they are incapable of producing heat or spark sufficient to ignite an explosive atmosphere.

Since current development plans are not final, it is possible that future buildings may be constructed at locations that may require slight modification of the extraction system layout, such as removal and replacement of extraction wells, monitoring probes, vents, or some combination of these. Modifications to the extraction system layout should be conducted by

Exhibit D
Page 7 of 11

qualified personnel and verification testing (confirming vacuums and flow are present, as expected) should be conducted after modification to ensure proper operation.

Measure 3

Bird Alliance will record with Multnomah County Clerk an EES and will provide DEQ a file-stamped copy of the EES within five working days of recording. The EES will stipulate restrictions for property use, engineering controls to be implemented and maintained, and expected inspection and reporting requirements. It is likely the EES will restrict groundwater use, restrict land use, and restrict penetration of the soil cap and vapor barriers (if present). Each restriction and engineering control contained in the EES will run with the land until such time as the restriction and engineering control can be removed by written certification from DEQ (Certificate of Completion) and recorded in the deed records of Multnomah County, certifying that restrictions or engineering controls are no longer required to ensure the subject property is protective of human health, ecological receptors, and the environment.

Measure 4

Bird Alliance has assumed that the owner will conduct all work necessary to bring the soil cap and stormwater control features into compliance with the permit before the closing date of the property's sales transaction, including (1) removing all fire hazards and overgrown vegetation, (2) removing debris and litter, (3) removing ponded water (to deter leachate production), (4) grading the soil cover surface to achieve contours of at least 2 percent (to minimize leachate generation), and (5) repairing the stormwater controls used to divert stormwater away or around the perimeter of the landfill (such as surface water diversion ditches) so that they function correctly and do not result in wells associated with the LGCS to be buried in sediment. In addition, Bird Alliance has assumed that the owner will repair the perimeter fencing to control public access and prevent unauthorized entry, as also stipulated in the permit, prior to the closing date.

If any of the above permit-compliant stipulations are compromised during redevelopment activities, Bird Alliance will repair and restore the compromised stipulation(s) to pre-disturbed conditions. As noted above, Bird Alliance assumes that the pre-disturbed conditions will have been in compliance with the permit before potential disturbance and/or compromise during redevelopment activities.

Bird Alliance will mitigate exposure of future facility wildlife that will inhabit the open-air enclosures to contaminated soil exceeding ecological RBCs by placing at least three feet of imported substrate material at the bottoms of the enclosures or, if substrate material is less than 3 feet thick, by placing a substrate barrier such as fiberglass mesh or pervious concrete between the substrate material and the underlying contaminated soil exceeding ecological RBCs.

NV5 also recommends that, to the extent practical, efforts be made to avoid or limit excavations through the existing soil cap cover during installation of catch basins, storm sewer piping, or other required improvements. Excavation work within the soil cap or that will extend through the soil cap into the solid waste should be conducted by personnel with the appropriate health and safety training in accordance with the pending SSWMP. All excavations should be properly backfilled and compacted in accordance with geotechnical recommendations to adequately restore covered conditions.

Measure 5

If DEQ determines modifications to the work specified in this document are necessary, Bird Alliance anticipates preparing a written revision to this basis of design and engineering approach and submitting the additional following documents to DEQ during various phases of the redevelopment activities: SSWMP, HSP, methane mitigation engineering plans and specifications, inspection and progress reports, and final closure report.

Soil and Solid Waste Management Plan

An SSWMP will be prepared and submitted to DEQ for review within 60 days before the initial phase of redevelopment. The SSWMP will summarize methods to be employed for the management (handling and disposal) of soil and solid waste that may be encountered during earthwork activities and describe soil cap restoration measures to be implemented upon completion of earthwork and final grading activities. In addition, the SSWMP will (1) outline standard procedures for the evaluation of imported and exported fill soil; (2) outline procedures for the identification and management of unforeseen waste material that may be encountered during portions of site earthwork; (3) provide the earthwork subcontractor with guidance related to the identification, notification, and handling of potential unforeseen waste; (4) establish a decision structure supporting the management of potential unforeseen waste; and (5) present contractor reporting requirements.

Health and Safety Plan

NV5 will prepare a site-specific HSP for its employees and employees of subcontractors contractually bound to NV5 for their site activities. Other consultants, agencies, and contractors not under the direction of NV5 will be responsible for developing and implementing their own HSP. The site-specific HSP will present a description of existing site conditions and responsibilities of project personnel and will describe the criteria for hazard and risk evaluation, levels of personal protection, air monitoring procedures, decontamination procedures, safety rules, emergency response procedures, training requirements, and standards for routine healthcare monitoring.

Methane Mitigation Engineering Plans and Specifications

NV5 will prepare engineering plans (drawings) and specifications to help mitigate the hazards posed by methane and development on the former landfill. The engineering plans and specifications will incorporate the design concepts described in this basis of design and engineering approach and will mitigate potentially unacceptable concentrations of methane to levels protective of receptors occupying proposed future enclosed structures. The plans and specifications will be submitted to DEQ for review and approval and can also be used for bidding and construction purposes. The plans will define the extent of the methane mitigation design elements, location of trench dams, and provide engineering details. The specifications will describe the required materials, installation procedures, and testing requirements for the design elements. The engineering design recommendations for the proposed development will be

Exhibit D
Page 9 of 11

sufficiently conservative and protective of human health and, in our professional opinion, will mitigate potential for methane to accumulate under an enclosed structure at concentrations exceeding 1.25 pbv regardless of future operation of the LGCS.

Inspection and Progress Reports

Periodic inspection and progress reports will be submitted to DEQ to document the results of all activities conducted during the redevelopment phases related to methane mitigation and soil cap and stormwater control features restoration and maintenance activities. At this time, we propose submitting progress reports on a quarterly basis. More frequent reporting may be necessary if monitoring activities during construction show upward-trending methane concentrations or if changed site conditions cause increased risk to public health and safety.

Final Closure Report

Within 90 days after Bird Alliance's obligations under the PPA have been met, a final closure report will be submitted to DEQ for review. The final closure report will summarize all of the monitoring, maintenance, and operation activities completed during the redevelopment activities and will rationalize why a Certificate of Completion is warranted for the subject property. The final closure report will also document the final methane screening results before occupancy of confined spaces and indoor air and vent systems (if applicable) sample results, to confirm that the enclosed structures and subject property are safe for occupancy and that the installed engineering controls are working effectively and as designed. As described above, if DEQ agrees that the measures described in this basis of design and engineering approach are no longer required to ensure the subject property is protective of human health, ecological receptors, and the environment, DEQ will provide public notice and opportunity to comment on a proposed certification decision. Within 90 days after receiving Bird Alliance's closeout report and consideration of public comment, DEQ will issue a final Certificate of Completion.

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Exhibit D
Page 10 of 11

We appreciate your continued assistance and support on this project. Please call if you have questions regarding this submittal or if we may be of assistance in any regard.

Sincerely,

NV5

Caroline B. Siegel
Environmental Staff

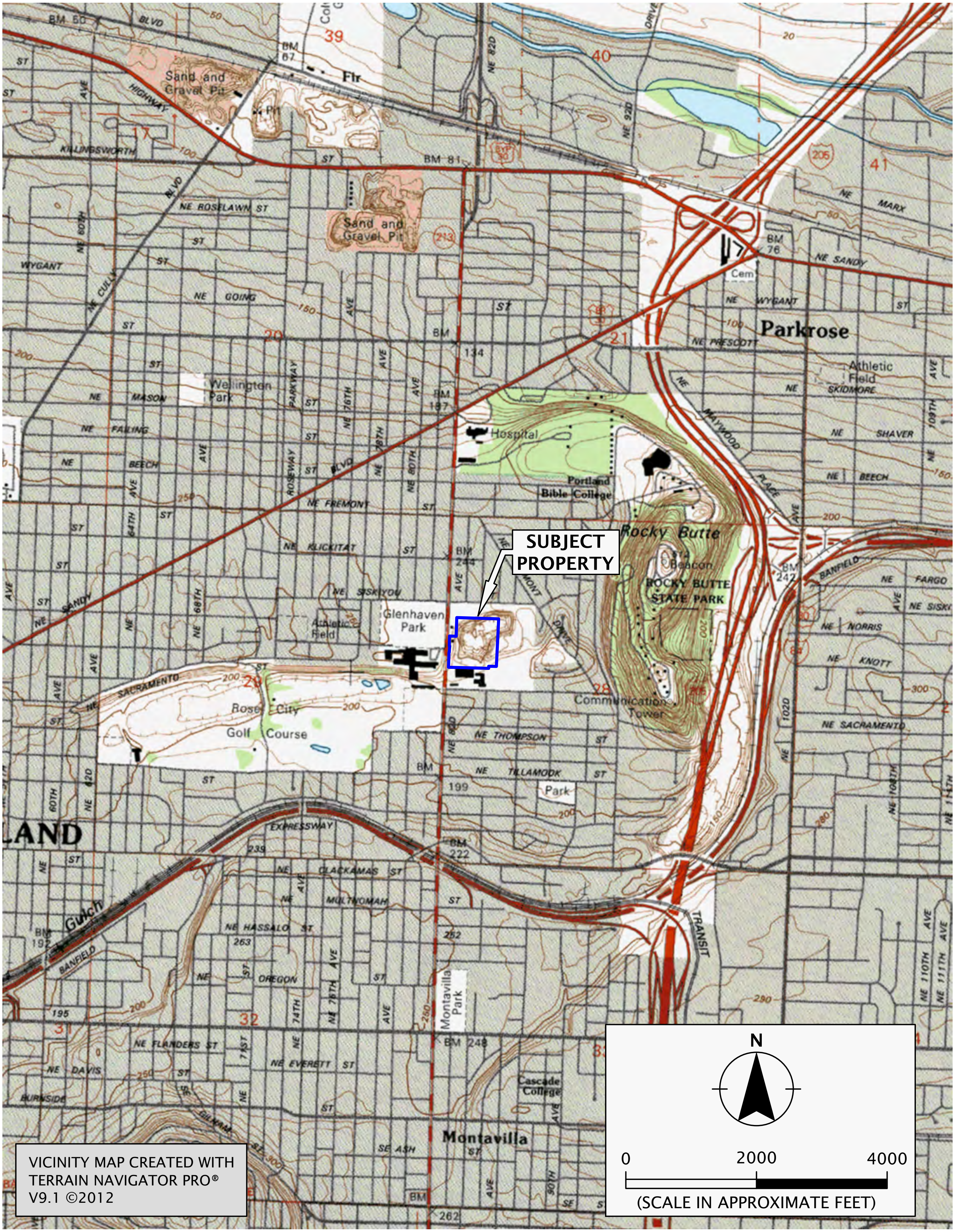
Kyle R. Sattler, L.G. (Washington)
Principal Geologist

Mike F. Coenen, P.E.
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
62771PE
OREGON
July 11, 2000
MICHAEL F. COENEN
EXPIRES: 12/31/25

cc: Stuart Wells, Bird Alliance
Jeanette Schuster, Tonkon Torp LLP
Amy Copeland, Shiels Obletz Johnsen

CBS:MFC:KRS:sn
One copy submitted
Document ID: SOJ-7-05-050224-envlr.docx



VICINITY MAP CREATED WITH TERRAIN NAVIGATOR PRO®
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NV5

SOJ-7-02

OCTOBER 2023

VICINITY MAP

2800 NE 82ND AVENUE
PORTLAND, OR

FIGURE 1

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FIGURE 2

SITE PLAN

2800 NE 82ND AVENUE
PORTLAND, OR

SOJ-7-02

OCTOBER 2023

NV5

SITE PLAN BASED ON AERIAL PHOTOGRAPH DATED JUNE 14, 2022, OBTAINED FROM GOOGLE EARTH PRO.

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LEGEND:

— — —	SUBJECT PROPERTY BOUNDARY
MW-1 ●	METHANE MONITORING PROBE
PV-1 ●	PASSIVE VENT
EW-1 ●	METHANE EXTRACTION WELL
GWMW-1 ●	GROUNDWATER MONITORING WELL

N

0 150 300

(SCALE IN FEET)

NOTES:

1. SITE PLAN BASED ON PDF DRAWING NO. G1.01 OF PROPOSED WELL LOCATIONS, REVISED DATE AUGUST 4, 2009, PREPARED BY ENERGYNEERING SOLUTIONS, INC.
2. AERIAL PHOTOGRAPH DATED JUNE 14, 2022, OBTAINED FROM GOOGLE EARTH PRO.

FIGURE 3

LANDFILL GAS EXTRACTION AND MONITORING SYSTEM

2800 NE 82ND AVENUE
PORTLAND, OR

SOJ-7-02

OCTOBER 2023

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REPORT OF GEOTECHNICAL ENGINEERING SERVICES

2800 NE 82nd Avenue Development
2800 NE 82nd Avenue
Portland, Oregon

For
Audubon Society of Portland, Oregon
Portland Audubon Wildlife Care Center LLC
October 27, 2023

Project: SOJ-7-01

October 27, 2023

Audubon Society of Portland, Oregon
Portland Audubon Wildlife Care Center LLC
5151 NW Cornell Road
Portland, OR 97210

Attention: Stuart Wells, Executive Director

Report of Geotechnical Engineering Services
2800 NE 82nd Development
2800 NE 82nd Avenue
Portland, Oregon
Project: SOJ-7-01

NV5 is pleased to present this report of geotechnical engineering services for the proposed development located at 2800 NE 82nd Avenue in Portland, Oregon. The site includes Tax Lot 400 of Multnomah County Tax Map 1N2E28BS and encompasses 12.49 acres of the former H.G. LaVelle Landfill. Our services for this project were conducted in accordance with our proposal dated July 20, 2023, and the Environmental Services Agreement between Audubon Society of Portland, Oregon / Portland Audubon Wildlife Care Center LLC and GeoDesign, Inc. dba NV5, dated October 12, 2023.

We appreciate the opportunity to be of service to you. Please contact us if you have questions regarding this report.

Sincerely,

NV5

Jeffery D. Tucker, P.E., G.E.
Principal Engineer

cc: Amy Copeland, Shiels Obletz Johnsen

JJP:JDT:kt
Attachments
Document ID: SOJ-7-01-102723-geor.docx

9450 SW Commerce Circle, Suite 300 | Wilsonville, OR 97070 | www.NV5.com | Office 503.968.8787

EXECUTIVE SUMMARY

We understand that proposed development plans include construction of a 5,000-square-foot wildlife care center with bird cages and associated hardscapes. The following provides a summary of pertinent geotechnical considerations. The main body of the report should be referenced for a thorough description of the subsurface conditions and geotechnical recommendations. The following factors will have an impact on design and construction of the proposed project. Our specific recommendations for site development are provided in this report.

- It is likely that the majority of primary settlement has occurred in the landfill, but we anticipate the landfill will continue to settle due to long-term settlement that is generally caused by biological and chemical breakdown of the debris.

- To prevent excessive settlement and long-term differential settlement, foundations should not bear on fill. The buildings' footings and floor slabs should be supported on a deep foundation system bearing on the dense sand and gravel soil encountered at depth.

- There is a risk of long-term excessive differential settlement of the pavement and associated maintenance given the variable conditions of the fill. We recommend that site mass grading (cut and fill) be minimized in order to reduce the risk of pavement differential settlement between cut and fill areas. We anticipate periodic maintenance and re-surfacing of the pavement will be required throughout the life of the project.

- The fill contains cobbles, boulders, large debris (i.e., wood, metal, brick, concrete, and AC), and dense gravel. One boring encountered refusal on metal debris at a depth of 48.5 BGS. Refusal on obstructions might be encountered during the installation of the deep foundation system. Excavation volumes for utility trenches may be greater than anticipated due to sloughing and the need to remove oversized material.

- The planned development may require the demolition of structures. Demolition should include complete removal of floor slabs and buried foundation elements within planned improvement areas. Excavations should be backfilled with compacted structural fill.

- The fines-rich soil in the landfill cap present at the ground surface is easily disturbed during the wet season. If not carefully executed, site earthwork can create extensive soft areas and significant repair costs can result. Subgrade protection will be required when the subgrade is wet.

- The proposed development may require modifications to the existing methane gas collection systems (i.e., extraction wells, passive venting wells, and monitoring wells). We recommend that the modifications are completed by qualified personnel and that verification monitoring is conducted after reconnection to evaluate system performance.

TABLE OF CONTENTS

TABLE OF CONTENTS

APPENDIX

ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
AC	asphalt concrete
ACP	asphalt concrete pavement
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
BGS	below ground surface
CAPWAP	case pile wave analysis program
CTB	cement-treated base
ESAL	equivalent single-axle load
g	gravitational acceleration (32.2 feet/second^2)
H:V	horizontal to vertical
in/hr	inch(es) per hour
MCE	maximum considered earthquake
OSHA	Occupational Safety and Health Administration
OSSC	2021 Oregon Standard Specifications for Construction
pcf	pounds per cubic foot
PDA	Pile Driving Analyzer®
PG	performance grade
psi	pounds per square inch

1.0 INTRODUCTION

NV5 is pleased to submit this report of geotechnical engineering services for the proposed development located at 2800 NE 82nd Avenue in Portland, Oregon. The site includes Tax Lot 400 of Multnomah County Tax Map 1N2E28BS and encompasses 12.49 acres of the former H.G. LaVelle Landfill. Figure 1 shows the site vicinity relative to surrounding features. Figure 2 shows the proposed development area and our approximate exploration locations. Acronyms and abbreviations used herein are defined above, immediately following the Table of Contents.

We understand the proposed development includes construction of a 5,000-square-foot wildlife care center with bird cages and associated hardscapes. Foundation loads for the buildings were unknown at the time of this report; however, based on our experience with similar structures, we have assumed maximum column and wall loads of 80 kips and 5 kips per foot, respectively. Based on topography, cuts and fills are expected to be less than a few feet each. If building loads or grading plans vary from our assumptions, NV5 should be contacted to determine if revisions to this report are necessary.

2.0 BACKGROUND

GeoDesign, Inc. (now NV5) previously prepared a geotechnical executive summary memorandum for the site in 2017 for a previous property owner (GeoDesign, Inc., 2017). Subsurface explorations were completed to a maximum depth of 126.5 feet BGS, with infiltration testing conducted in 6 borings at depths between 15 and 35 feet BGS for 11 total infiltration tests.

The overall 12.5-acre site was originally a portion of property consisting of 35 acres owned by Rose City Sand and Gravel Company and was developed and operated as a sand and gravel mining pit. The quarry was mined to depths of up to approximately 80 feet below surrounding street grades. In 1972, the site was leased to LaVelle and Yett, Inc., which operated a landfill at the site under a permit issued by the Oregon Department of Environmental Quality to Rose City Sand and Gravel Company. The landfill was permitted to receive building and demolition debris, wood products, metals, heavy industrial debris, and similar materials. Approximately 2 million cubic yards of waste fill were deposited into the landfill. In 1982, the landfill was closed and covered with a soil cap. Rose City Sand Gravel Company became the permittee for Landfill Closure Permit #211. The property was then developed into a golf driving range. The landfill office building was converted to an office.

3.0 PURPOSE AND SCOPE

The purpose of our services was to provide geotechnical engineering recommendations for the proposed development. The specific scope of our services is summarized as follows:

- Reviewed readily available, published geologic data and our in-house files for existing information on subsurface conditions in the site vicinity.
- Performed analyses to assess liquefaction and lateral spreading potential.
- Provided foundation support recommendations for the proposed buildings. We assume deep foundation systems will be required to support the buildings.

- Provided recommendations for site preparation, including grading and drainage, stripping depths, fill type for imported material, compaction criteria, trench excavation and backfill, use of on-site soil, and wet/dry weather earthwork.
- Provided recommendations for use in design of conventional retaining walls, including backfill and drainage requirements and lateral earth pressures.
- Provided recommendations for construction of AC pavement for on-site access roads and parking areas, including subbase, base course, and AC paving thickness.
- Evaluated groundwater conditions at the site and provided general recommendations for dewatering during construction and subsurface drainage, if required.
- Provided recommendations for the preparation of subgrade for concrete floor slabs, including an anticipated value for subgrade modulus.
- Provided seismic parameters in accordance with ASCE 7-16. We have assumed a seismic site-specific seismic hazard analysis is not required.
- Prepared this geotechnical engineering report that presents our findings, conclusions, and recommendations.

4.0 SITE CONDITIONS

4.1 GEOLOGIC SETTING

The site is located in the Portland Basin, part of the larger Willamette Valley physiographic province. Starting in the early Eocene, approximately 56 million years ago, subduction of the Farallon Plate beneath the North American Plate accreted volcanic arcs and seafloor sediments to the western edge of the North American Plate and resulted in the creation of the Cascade Volcanic Arc. Continued subduction resulted in the creation of the Coast Range and a forearc basin west of the Cascades starting in the early Miocene, approximately 20 million years ago (Evarts et al., 2009). This geometry has continued to present day, with subduction of the Juan de Fuca Plate (a remnant of the Farallon Plate) creating localized uplift along the coast range, a forearc basin within the present-day Willamette Valley, and continuing weak arc volcanism within the Cascade Arc further east (Orr and Orr, 2012).

During the Miocene, approximately 16 million to 14.5 million years ago, flood basalts originating from present-day northeast Oregon and southeast Washington flowed down the ancestral Columbia River and repeatedly filled low-lying areas of the Willamette Valley, leaving thick flow sequences of basalt across the Portland Basin, immediately followed by varied sedimentary deposits resulting from erosion of the nearby Cascade Arc, collectively known as the Troutdale Formation (Orr and Orr, 2012). Deposition of the Troutdale Formation continued until approximately 2 million years ago (Evarts et al., 2009), with sporadic deposition of terrace gravels and re-working of the Troutdale Formation deposits continuing up to the time of the Missoula floods.

Starting approximately 16,000 years ago, cataclysmic floods originating in northwest Montana, and caused by ice-dam rupture of a lobe of the Cordilleran Ice sheet, repeatedly flooded the Portland Basin and backfilled the Willamette Valley. The floods resulted in significant downcutting and deposition of sedimentary units locally, with large gravel bars and delta deposits in higher energy areas and thick deposits of clay and silt in lower energy environments, including the floor of the Willamette Valley (Evarts et al., 2009).

Locally, the site is underlain by coarse-grained facies of the Missoula floods (Wells et al., 2020), part of a larger gravel bar that comprises the uplands of north and northeast Portland. These deposits consist of massive deposits of unconsolidated sand and gravel, with some zones of cobbles and boulders. The thickness of these deposits is variable, but prior mining of aggregate and explorations on site indicate that these deposits extended from the surface to at least 100 feet BGS.

Underlying the flood deposits, the Troutdale Formation is present to an unknown depth, with the deepest nearby water wells immediately south of the site recording the formation to a depth of at least 220 feet BGS. Basalts of the Columbia River Basalt Group are present at an unknown depth below the Troutdale Formation and constitute bedrock for the purpose and scope of this project (Hogenson and Foxworthy, 1965).

4.2 SURFACE CONDITIONS

The west side of the site is currently occupied by a vacant, one-story building; a parking lot, and an old, covered golf driving range structure. Two ponds are also located on site, and the rest of the site is vegetated with grass. Based on an existing conditions survey provided to us by Shiels Obletz Johnsen, the site generally slopes west to east from an elevation of 250 to 240 feet. The south side of the site slopes down to the adjacent tax lots from an elevation of 245 to 220 feet.

4.3 SUBSURFACE CONDITIONS

4.3.1 General

We explored subsurface conditions at the site in 2016 by drilling 13 borings (B-1 through B-13) to depths of up to 126.5 feet BGS and excavating 21 test pits (TP-1 through TP-21) to depths of up to 5.5 feet BGS. The approximate exploration locations are shown on Figure 2. The exploration log and laboratory testing results are presented in the Appendix. The following sections provide detailed descriptions of the materials encountered.

4.3.2 Cap Fill

Our explorations encountered 0 to 21.5 feet of cap fill. At the west and south site boundaries, the cap fill is approximately 3 to 21.5 feet thick at the locations explored. Within the landfill area, the cap fill is approximately 0 to 6 feet (generally 3 to 4 feet) thick at the locations explored. The composition and consistency of the cap fill is variable and includes loose to very dense sand and gravel and medium stiff to very stiff silt and clay with varying amounts of cobbles and boulders, trace to minor organics, and occasional construction debris. Laboratory testing on select samples of the cap fill indicates moisture contents ranged from 11 to 20 percent at the time of our explorations.

4.3.3 Landfill Debris

Within the landfill area, the cap fill is underlain by landfill debris to depths between 33.5 and 82 feet BGS at the locations explored. Landfill debris includes wood, concrete, AC, brick, metal, rubber, plastic, paper, cardboard, glass, carpet, fabric, and organic debris. Layers of stiff to very stiff silt and medium dense to very dense gravel and sand with variable construction debris were encountered within the landfill debris. Based on the explorations and laboratory testing, the landfill debris is high in organic content (13.5 to 29.2 percent) that is mostly comprised of wood debris. Select samples of the landfill debris indicate moisture contents ranged from 29 to 105 percent at the time of our explorations.

4.3.4 Lower Soil Fill

Five borings within the landfill area encountered medium dense to dense gravel and sand and stiff to very stiff clay and silt fill with occasional construction debris below the landfill debris to depths between 50 and 89 feet BGS at the locations explored.

4.3.5 Native Soil

Native soil comprised of loose to very dense gravel and sand with possible cobbles and boulders and very stiff to hard silt and clay was encountered below the cap fill, landfill debris, and lower soil fill to the maximum explored depth of 126.5 feet BGS. At the west and south site boundaries, the native soil was encountered below the cap fill at depths between 7.5 and 21.5 feet BGS. Within the landfill area, the native soil was encountered at depths between 33.5 and 89 feet BGS. Laboratory testing on select samples indicates moisture contents ranged from 8 to 26 percent, with fines content ranging from 7 to 81 percent.

4.3.6 Groundwater

Six borings were drilled to depths between 26.5 and 50.5 feet BGS using hollow-stem augers. Groundwater was not encountered in these explorations. The deeper borings were drilled using mud rotary drilling methods and the use of drilling fluid did not allow direct measurement of groundwater. Based on our review of water well logs on file with the Oregon Water Resources Department, the estimated depth to groundwater in the site vicinity is greater than approximately 190 feet BGS. Perched groundwater may be present within the fill after prolonged periods of heavy rainfall. The depth to groundwater is expected to fluctuate in response to seasonal changes, changes in surface topography, and other factors not observed in the site vicinity.

4.4 INFILTRATION TESTING

Infiltration testing was conducted to evaluate the feasibility and assist in design of on-site stormwater disposal facilities. Infiltration testing was conducted in hollow-stem auger borings B-7 and B-9 through B-13 at the depths indicated in Table 1. Infiltration testing was conducted using the encased falling head method in the 6-inch-inside diameter augers. A representative soil sample was collected below the infiltration test depths for fines content analysis.

Table 1 summarizes the infiltration testing results and fines content determination. The exploration logs and results of fines content analysis are presented in the Appendix.

Table 1. Infiltration Testing Results

Exploration	Depth (feet BGS)	Soil Description	Fines Content[1] (percent)	Observed Infiltration Rate[2] (in/hr)
B-7	15	SAND with silt, minor gravel	5	200
B-7	25	GRAVEL with silt and sand	5	266
B-9	25.3	SAND, trace gravel and silt	Not tested	~0
B-9	27.5	SAND with silt, minor gravel	9	12
B-9	35	SAND with silt, minor gravel	13	6
B-10	20	SAND with silt, trace gravel	12	14
B-10	26.5	GRAVEL with silt and sand	7	100
B-11	34	SAND with silt, minor gravel	8	100
B-12	19	Silty SAND FILL, trace clay	Not tested	~0
B-12	34	SAND with silt, trace gravel	9	4
B-13	29	GRAVEL with cobbles, sand, and silt	5	392

1. Fines content – material passing the U.S. Standard No. 200 sieve
2. In-situ infiltration rate observed in the field in 2006

Based on the results of the infiltration testing at the west site margin and due to the short period of the testing and the uncertainty associated with high volume tests, we recommend a maximum unfactored field infiltration rate of 200 in/hr.

The infiltration rates presented in Table 1 are unfactored. Correction factors should be applied to the measured infiltration rates to account for soil variations and the potential for long-term clogging due to siltation and buildup of organic material.

4.5 SEISMIC HAZARDS

4.5.1 Liquefaction

Liquefaction is a phenomenon caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. The excessive buildup of pore water pressure results in the sudden loss of shear strength in a soil. Granular soil, which relies on interparticle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. Sand boils and flows observed at the ground surface after an earthquake are the result of excess pore pressures dissipating upwards, carrying soil particles with the draining water. In general, loose, saturated sand soil with low silt and clay content is the most susceptible to liquefaction. Low plasticity, silty sand and silt may be moderately susceptible to liquefaction under relatively higher levels of ground shaking. Liquefaction can cause seismically induced densification of subsurface soil, which can result in settlement at the ground surface. If the ground surface is sloped or if there is an open face such as a ravine, the liquefied soil can also move horizontally in a process that is called lateral spreading.

Based on the depth to groundwater, it is our opinion that the soil at the site is not susceptible to liquefaction.

4.5.2 Lateral Spreading

Lateral spreading is a liquefaction-related seismic hazard. Areas subject to lateral spreading are typically gently sloping or flat sites underlain by liquefiable sediment adjacent to an open face, such as a riverbank. Based on the soil encountered at the site and distance from an open face, lateral spreading is not considered a hazard at the site.

5.0 DESIGN

5.1 GENERAL

The following sections provide our design recommendations for the development. All site preparation and structural fill should be prepared as recommended in the "Construction" section.

5.2 FOUNDATION SUPPORT

5.2.1 General

We recommend that all proposed buildings, floor slabs, and other settlement-sensitive structures be supported on deep foundations. Shallow foundations should not be used because they could experience excessive settlement as the landfill construction debris gradually decomposes. Steel pipe piles and driven grout piles are two common pile types in the Portland metropolitan area. We recommend pile-supported slabs extend approximately 10 feet beyond the exterior of the building to prevent these areas from settling differentially and making building access difficult.

5.2.2 Downward Axial Capacity

Figures 3 through 8 present our estimated allowable compressive capacity of the piles for various landfill debris thicknesses. The downdrag loads in Tables 2 through 4 assume the piles are spaced at least 3 pile diameters on-center. A safety factor of 3 should be used for pile design, although this value can be reduced to 2 if PDA testing or a pile load testing program is implemented.

Piles will develop the majority of their capacity in the dense sand and gravel unit encountered in our borings. The sand and gravel units were encountered at depths between approximately 33.5 and 89 feet BGS. We recommend 10 percent of production piles are evaluated by PDA. The building code requires full-time monitoring of pile installation to confirm the piles are driven in accordance with the recommendations in this geotechnical report and the approved plans and specifications.

Table 2. Downdrag Loads for 33.5 Feet of Landfill Debris

Deep Foundation Type	Downdrag Load[1] (kips)
12-inch-diameter, steel pipe pile	10.7
18-inch-diameter, steel pipe pile	16.1
24-inch-diameter, steel pipe pile	21.4
16-inch-diameter, driven grout pile	68.6
18-inch-diameter, driven grout pile	77.1

1. Downdrag loads should be applied as a structural load.

Table 3. Downdrag Loads for 65 Feet of Landfill Debris

Deep Foundation Type	Downdrag Load[1] (kips)
12-inch-diameter, steel pipe pile	52.0
18-inch-diameter, steel pipe pile	78.0
24-inch-diameter, steel pipe pile	104.0
16-inch-diameter, driven grout pile	94.7
18-inch-diameter, driven grout pile	107.0

1. Downdrag loads should be applied as a structural load.

Table 4. Downdrag Loads for 89 Feet of Landfill Debris

Deep Foundation Type	Downdrag Load[1] (kips)
12-inch-diameter, steel pipe pile	88.4
18-inch-diameter, steel pipe pile	132.6
24-inch-diameter, steel pipe pile	176.8
16-inch-diameter, driven grout pile	160.2
18-inch-diameter, driven grout pile	180.2

1. Downdrag loads should be applied as a structural load.

5.2.3 Uplift Resistance

Uplift capacity of the piles will be mobilized through skin friction between the pile and the surrounding soil. Figures 3 through 8 show our computed allowable uplift capacity for each deep foundation type.

5.2.4 Lateral Resistance

Resistance to lateral loads can be developed by passive pressure on the face of pile caps, grade beams, tie beams, and other buried foundation elements. Sliding friction on the base of pile-supported foundation elements should be ignored. Adjacent floor slabs, pavement, or the upper 12-inch depth of unpaved areas should not be considered when calculating passive resistance.

Pile lateral resistance will depend on the specific pile type, size material, reinforcing, and condition of the pile head. We can complete lateral pile analysis once the pile type has been selected.

5.2.5 Other Considerations

If driven piles are used, the terminal blow counts will depend on the pile type and driving equipment. The structural integrity of the steel pipe pile or the mandrel should be evaluated to confirm that it will withstand the stresses induced by pile driving. NV5 should be consulted to select the appropriate hammer energy to develop the required capacity while avoiding excessive driving stresses. Terminial blow criteria should be based on CAPWAP analysis considering the pile type, required capacity, and the selected driving equipment. Our analysis should be verified in the field using a PDA.

The piles should be installed with suitable alignment tolerances. Vertical alignment should be within 3 percent of plumb or as determined by the structural engineer, considering the pile cap design. Settlement of piles supported on the dense sand will be negligible beyond the elastic compression of the pile.

If buried obstructions are encountered during pile installation, the foundation installation equipment should be extracted and the obstruction removed. If the buried obstruction cannot be removed, the structural engineer should be consulted to select a new foundation location. Each pile should be carefully inspected for damage caused by impacting buried obstructions during driving. We also note the landfill debris might be corrosive to concrete and steel piles. Consequently, corrosion additives or protection may be required.

We recommend full-time observation of pile installation to confirm that the foundations are installed in accordance with the recommendations in this report and with the project specifications.

5.3 FLOOR SLABS

The pile cap material that is underlain by landfill debris will not provide adequate floor slab support. We recommend that a structural floor slab be used that is supported on deep foundations. The structural engineer should determine if the floor slabs can span the distance between the buildings' deep foundations or if additional floor slab deep foundations are necessary. We recommend that a working pad be placed beneath the floor slabs.

5.4 SEISMIC DESIGN PARAMETERS

The soil profile over the majority of the site is consistent with Site Class E in accordance with ASCE 7-16. While parts of the site may be classified as Site Class D, it is our opinion that it will be more efficient to assume Site Class E for all structures. The seismic design parameters presented in Table 5 can be used to compute design levels of ground shaking. ASCE 7-16 Section 11.4.8 requires a ground motion hazard study in accordance with Section 21.2 for structures on Site Class E sites with S_1 greater than or equal to 0.2 g (S_1 at the site is 0.381 g). Exception 3 of ASCE 7-16 Section 11.4.8 indicates a ground motion hazard study is not required for structures on Site Class E sites with S_1 greater than or equal to 0.2, provided that T (the fundamental period of the structure) is less than or equal to T_S and the equivalent static force procedure is used for design. The structural engineer should evaluate code requirements and exceptions to verify that these parameters can be used for design. If a site response analysis is needed, we can perform this additional analysis.

Table 5. Seismic Design Parameters

Seismic Design Parameter	Short Period (T_s)	1 Second Period (T_1)
MCE Spectral Acceleration	S_s = 0.885 g	S_1 = 0.381 g
Site Class	E	
Site Coefficient	F_a = 1.3	F_v = 2.476
Adjusted Spectral Acceleration	S_{MS} = 1.151 g	S_{M1} = 0.943 g
Design Spectral Response Acceleration Parameters	S_{DS} = 0.767 g	S_{D1} = 0.629 g

5.5 POST-CONSTRUCTION SETTLEMENT

Based on our explorations and laboratory testing, the landfill debris is high in organic content (13.5 to 29.2 percent) that is mostly composed of wood debris. It is likely that the majority of primary settlement has occurred in the landfill, but we anticipate the landfill will continue to settle due to long-term settlement that is generally caused by biological and chemical breakdown of the debris. Long-term settlement of the fill material is a major consideration when constructing facilities on the surface of any former landfill. The magnitude of the post-construction settlement will depend on the following factors:

- The amount of cutting or filling required to achieve site grades relative to current site elevations
- The time elapsed since the landfill debris and capping material was placed
- The thickness of the cap and landfill debris
- The compositions of the landfill debris

Special design and construction methods are required to reduce the effects of settlement. There is a risk of long-term excessive differential settlement of the pavement and associated maintenance given the variable conditions (thickness and composition) of the fill. Based on our analysis and experience with similar soil, total post-construction consolidation-induced settlement under static conditions will be on the order of 12 inches, with differential settlement of approximately 6 inches over a distance of approximately 50 feet.

We recommend that site mass grading (cut and fill) be minimized in order to reduce the risk of pavement differential settlement between cut and fill areas. We anticipate that periodic maintenance and re-surfacing of the pavement will be required throughout the life of the project. In addition, hinged slabs should be used to provide a safe transition for pedestrians between pile-supported and unsupported hard surfaces.

Utility pipes should include flexible joints and should not be installed through deeper fill areas (such as existing ponds) to reduce the risk of pipes distortion.

5.6 RETAINING STRUCTURES

5.6.1 Assumptions

Our retaining wall design recommendations are based on the following assumptions: (1) the walls consist of conventional, cantilevered retaining walls; (2) the walls are less than 10 feet in height; (3) the backfill is drained and consists of imported granular materials; and (4) the backfill has a slope flatter than 4H:1V. Re-evaluation of our recommendations will be required if the retaining wall design criteria for the project varies from these assumptions.

5.6.2 Wall Design Parameters

For unrestrained retaining walls, an active equivalent fluid pressure of 35 pcf should be used for design. Where retaining walls are restrained from rotation (such as basement walls), an at-rest equivalent fluid pressure of 55 pcf should be used for design. A superimposed seismic lateral force should be calculated based on a dynamic force of $7H^2$ pounds per lineal foot of wall, where H is the height of the wall in feet, and applied as a distributed load with the centroid located at a distance of 0.6H from the base of the wall.

If surcharges (e.g., retained slopes, structure foundations, vehicles, steep slopes, terraced walls, etc.) are located within a horizontal distance from the back of a wall equal to the height of the wall, additional pressures will need to be accounted for in the wall design. Our office should be contacted for appropriate wall surcharges based on the actual magnitude and configuration of the applied loads. The base of the wall footing excavations should extend a minimum of 12 inches below the lowest adjacent grade. The wall footings should be designed in accordance with the “Foundation Support” section.

We note that retaining walls will likely settle over time with the surrounding ground surface. This settlement should be accounted for in the retaining wall design. Concrete retaining walls can also be constructed with additional batter. Other types of retaining walls or reinforced slopes that can better tolerate settlement can also be used on this project instead of concrete walls.

5.6.3 Wall Drainage and Backfill

The above design parameters have been provided assuming back-of-wall drains will be installed to prevent buildup of hydrostatic pressures behind all walls. If a drainage system is not installed, our office should be contacted for revised design forces.

Backfill material placed behind retaining walls and extending a horizontal distance of ½H, where H is the height of the retaining wall, should consist of select granular wall backfill meeting the requirements described in the “Structural Fill” section. Alternatively, the native soil can be used as backfill material, provided a minimum 1-foot-wide column of angular drain rock wrapped in a geotextile is placed against the wall and the native soil can be adequately moisture conditioned for compaction. The rock column should extend from the perforated drainpipe to within approximately 1 foot of the ground surface. The angular drain rock should meet the requirements provided in the “Structural Fill” section. All wall backfill should be placed and compacted as recommended for select granular wall backfill in the “Structural Fill” section.

Perforated collector pipes should be placed at the base of the granular backfill behind the walls. The pipe should be embedded in a minimum 1-foot-wide zone of angular drain rock. The drain rock should meet specifications provided in the "Structural Fill" section. The drain rock should be wrapped in a drainage geotextile fabric meeting the requirements in the "Geotextile Fabric" section. The collector pipes should discharge at an appropriate location away from the base of the wall. The discharge pipe should not be tied directly into stormwater drain systems, unless measures are taken to prevent backflow into the drainage system of the wall.

Settlement of up to 1 percent of the wall height commonly occurs immediately adjacent to the wall as the wall rotates and develops active lateral earth pressures. Consequently, we recommend that construction of flatwork adjacent to retaining walls be postponed at least four weeks after backfilling of the wall, unless survey data indicates that settlement is complete prior to that time.

5.7 METHANE MITIGATION

The organic material in the landfill will generate methane gas as it decomposes. If not properly mitigated, the methane gas can accumulate and present a hazard. Typical methane gas mitigation measures include installing impermeable barriers to prevent gas migration, active or passive gas ventilation systems, gas detection systems, and performing routing monitoring. The proposed development may require modifications to the existing methane gas collection systems (i.e., extraction wells, passive venting wells, and monitoring wells). We recommend that an environmental consultant be hired to evaluate methane conditions at the sire, modifications are completed by qualified personnel, and verification monitoring is conducted after reconnection to evaluate system performance.

5.8 PAVEMENT

Pavement should be prepared in accordance with the "Site Preparation" and "Materials" sections. Subgrade improvement may be necessary in some areas where soft undocumented fill is present. The design pavement sections are for design traffic loads and are not intended for heavy construction traffic. Construction traffic should not be allowed on newly installed pavement or NV5 can be contacted to provide alternate pavement sections to account for anticipated construction traffic.

5.8.1 AC Pavement

Our pavement recommendations are based on the following assumptions:

- The top 12 inches of soil subgrade below the pavement section are compacted to at least 92 percent of the maximum dry density, as determined by ASTM D1557, or observations indicate that it is in a firm and unyielding condition.
- Resilient moduli of 20,000 psi and 4,500 psi were assumed for the aggregate base and improved subgrade, respectively.
- Initial and terminal serviceability indices of 4.2 and 2.5, respectively.
- Reliability of 85 percent and standard deviation of 0.45.
- Structural coefficients of 0.42 and 0.10 for the AC and aggregate base, respectively.
- A 20-year design life with no growth.

- Heavy traffic consists of an even distribution of two- and three-axle trucks, such as garbage and delivery vehicles.
- Fire access will consist of an imposed fire apparatus load of 80,000 pounds on an infrequent basis.

Traffic design loading was not available at the time of this report. We performed pavement analysis for several speculative loading scenarios. The results are provided in Table 6. The design team can select the appropriate pavement section for different areas of the site based on the final anticipated traffic levels. The recommended pavement sections are suitable to support an occasional 80,000-pound fire truck.

Table 6. Pavement Section Thickness[1]

Traffic Levels (ESALs)	Pavement Thicknesses without CTB (inches)		Pavement Thicknesses with CTB[2] (inches)	
	AC	Aggregate Base	AC	Aggregate Base
Automobile parking – 25,000	3.0	9.0	3.0	4.0
Truck areas – 150,000	4.0	12.0	4.0	4.0

1. All thicknesses are intended to be the minimum acceptable values.
2. CTB layer is assumed to be a minimum 12 inches thick and has a minimum seven-day compressive strength of 100 psi.

Table 6 includes the option for cement amending the subgrade. If the soil subgrade is cement amended to a minimum depth of 12 inches, the pavement thicknesses "with CTB" may be used. There sections assume the subgrade is cement amended and has a minimum seven-day compressive strength of 100 psi. In addition, to prevent strength loss during curing, cement-amended soil should be allowed to cure for at least four days prior to construction traffic or placing the aggregate base. Lastly, the amended subgrade should be protected with a minimum of 4 inches of aggregate base prior to construction traffic access.

5.9 DRAINAGE CONSIDERATIONS

5.9.1 Temporary

During earthwork at the site, the contractor should be made responsible for temporary drainage of surface water as necessary to prevent standing water and/or erosion at the working surface.

5.9.2 Surface

We recommend the finished ground surface around buildings slope away from the structures at a minimum 2 percent gradient for a distance of at least 5 feet. Pavement surfaces and open space areas should be sloped such that surface water runoff is collected and routed to suitable discharge points. We recommend pavement be sloped at greater inclination than normal to reduce the risk of puddles forming in paved areas due to long-term differential settlement.

Downspouts or roof scuppers should discharge into a storm drain system that carries the collected water to an appropriate stormwater system. Trapped planter areas should not be created adjacent to the buildings without providing means for positive drainage (e.g., swales or catch basins). Embedded walls should include drainage, as discussed in the "Retaining Structures" section.

5.9.3 Subsurface

Pending final grading plans, foundation drains around the perimeter of the buildings may be needed. Perimeter foundation drains should be installed in all areas where the finished floor grade will be at or below existing grades. Foundation drains should be constructed at a minimum slope of approximately ½ percent and pumped or drained by gravity to a suitable discharge. The perforated drainpipe should not be tied to a stormwater drainage system without backflow provisions. Foundation drains should consist of 4-inch-diameter, perforated drainpipe embedded in a minimum 2-foot-wide zone of crushed drain rock that extends to the ground surface. The invert elevation of the drainpipe should be installed at least 18 inches below the elevation of the floor slab.

Groundwater at the site is expected to be deeper than 190 feet BGS. Perched shallow water might be present within the fill after prolonged periods of heavy rainfall. If the site is graded to slope away from the buildings at a minimum 2 percent gradient for a distance of at least 5 feet, foundation drains should not be necessary. However, we recommend that perimeter drains be installed around buried or partially buried structures.

5.10 STORMWATER INFILTRATION SYSTEMS

The results of our infiltration testing indicate that disposal of stormwater on site via infiltration is feasible in the native gravel and sand soil. The infiltration rates shown in Table 1 are applicable at the locations and depths of the tests. It is important that infiltration systems be located as close to these locations and depths as possible and that infiltration occur in the native gravel or sand. The field infiltration rates are short-term field rates and factors of safety have not been applied for the type of infiltration system being considered. Appropriate correction factors should be applied by the project civil engineer to determine long-term infiltration parameters. Without additional testing, from a geotechnical perspective, we recommend a minimum factor of safety of at least 2 be applied to the field infiltration values presented above to account for soil variability with depth. The infiltration system design engineer should determine and apply appropriate remaining correction factor values or factors of safety to account for degree of in-system filtration, system maintenance, vegetation, potential for siltation, etc.

The infiltration flow rate of a disposal system will diminish over time as suspended solids and precipitates in the stormwater slowly clog the void spaces between the soil particles. Eventually, the system may fail and need to be replaced. We recommend the system include an overflow that is connected to a suitable discharge point such as the storm sewer. Finally, stormwater infiltration systems will cause localized high groundwater levels; therefore, they should not be located near basement walls, retaining walls, or other embedded structures, unless these are specifically designed to account for the resulting hydrostatic pressure. The stormwater system should not be located on sloping ground, unless it is approved by a geotechnical engineer.

It is possible that isolated pockets of low-permeable soil or perched groundwater exist within the design infiltration zone. Therefore, we recommend that drywells be field tested to confirm the design infiltration capacity has been achieved.

5.11 PERMANENT SLOPES

Permanent cut and fill slopes should not exceed 2H:1V. Slopes that will be maintained by mowing should not be constructed steeper than 3H:1V. Access roads and pavement should be located at least 5 feet from the top of cut and fill slopes. The setback should be increased to 10 feet for buildings. The slopes should be planted with appropriate vegetation to provide protection against erosion as soon as possible after grading. Surface water runoff should be collected and directed away from slopes to prevent water from running down the face of the slope.

6.0 CONSTRUCTION

6.1 SITE PREPARATION

6.1.1 Demolition

Demolition should include complete removal of existing structures, buried foundations, and pavement within 5 feet of areas to receive new pavement, buildings, retaining walls, or engineered fills. Underground utility lines, vaults, or tanks encountered in areas of new improvements should be completely removed or grouted full if left in place. Old basement/crawl space areas or voids resulting from removal of improvements or loose soil in utility lines should be backfilled with compacted structural fill, as discussed in the “Structural Fill” and “Fill Placement and Compaction” sections. The bottoms of such excavations should be excavated to expose a firm subgrade before filling and their sides sloped at a minimum of 1H:1V to allow for more uniform compaction at the edges of the excavations. Material generated during demolition should be transported off site for disposal or stockpiled in areas designated by the owner. It may be possible to use on-site AC and concrete as structural fill in accordance with the “Structural Fill” section.

6.1.2 Grubbing and Stripping

Trees and shrubs (in existing landscaped areas) should be removed from fill areas. In addition, root balls should be grubbed out to the depth of the roots, which could exceed 3 feet BGS. Depending on the methods used to remove root balls, considerable disturbance and loosening of the subgrade could occur during site grubbing. We recommend that soil disturbed during grubbing operations be removed to expose firm, undisturbed subgrade. The resulting excavations should be backfilled with structural fill.

The existing root zone in landscaped areas should be stripped and removed from all fill areas. The actual stripping depth should be based on field observations at the time of construction. Stripped material should be transported off site for disposal or used in landscaped areas.

6.1.3 Subgrade Evaluation

A member of our staff should observe the exposed subgrade for floor slabs, pavement areas, and foundation excavations after stripping and site cutting have been completed to determine if there are areas of unsuitable or unstable soil. Our representative should observe a proof roll of structural fill, pavement, and slab subgrade with a fully loaded dump truck or similar heavy, rubber tire construction equipment to identify soft, loose, or unsuitable areas. During wet weather or in areas not accessible to proof rolling equipment, the subgrade should be evaluated by probing.

Areas containing soft undocumented fill should be improved by scarifying and re-compacting (dry weather only), replacing with imported granular material in accordance with the "Structural Fill" and "Fill Placement and Compaction" sections, or by cement amending the soil in accordance with the "Cement Amendment" section. Scarifying and re-compacting the surficial soil may require that the soil be dried, which is only possible in the dry summer months.

6.2 SUBGRADE PROTECTION

The fine-rich soil in the landfill cap can be sensitive to small changes in moisture content and may be disturbed when the moisture content is above optimum. If not carefully executed, site preparation, utility trench work, and roadway excavation can create extensive soft areas and significant repair costs can result. Earthwork planning, regardless of the time of year, should include considerations for minimizing subgrade disturbance.

If construction occurs during the wet season or if the moisture content of the surficial soil is more than a couple percentage points above optimum, demolition, site stripping, and cutting may need to be accomplished using track-mounted equipment. Likewise, the use of granular haul roads and staging areas will be necessary for support of construction traffic during the rainy season or when the moisture content of the surficial soil is more than a few percentage points above optimum. The recommended aggregate base section for pavement areas is intended to support post-construction design traffic loads and may not support construction traffic or paving equipment when the subgrade soil is wet. Accordingly, if construction is planned for periods when the subgrade soil is wet, staging and haul roads with increased thicknesses of base rock will be required.

The size of staging and haul road areas, as well as the required thickness of granular material, will vary with the contractor's sequencing of a project and exposure to construction equipment. Based on our experience, between 12 and 18 inches of imported granular material is generally required in staging areas and between 18 and 24 inches in haul roads areas. Stabilization material may be used as a substitute, provided the top 4 inches of material consists of imported granular material. The actual thickness will depend on the contractor's means and methods and, accordingly, should be the contractor's responsibility. In addition, a geotextile fabric can be placed as a barrier between fine-grained subgrade and imported granular material in areas of repeated construction traffic, such as site entrances. The imported granular material, stabilization material, and geotextile fabric should meet the specifications in the "Materials" section.

As an alternative to thickened crushed rock sections, the subgrade can be cement amended to provide wet weather protection from construction traffic. The cement-amended subgrade should be covered by at least 4 inches of granular fill material. This recommendation is based on an assumed minimum unconfined compressive strength of 100 psi for subgrade amended to a depth of 12 to 16 inches. The actual thickness of the amended material and imported granular material will depend on the contractor's means and methods and, accordingly, should be the contractor's responsibility. Cement amendment is discussed in the "Materials" section.

6.3 EXCAVATION

6.3.1 General

The fill contains cobbles, boulders, large debris (i.e., wood, metal, brick, concrete, and AC), and dense gravel. The native soil includes dense gravel with possible cobbles and boulders. One test pit (TP-18) encountered refusal on cobbles at a depth of 4 feet BGS. Due to the presence of debris, oversized material, and dense gravel, excavations can become difficult if not impossible with conventional equipment and excavation volumes for utility trenches may be greater than anticipated due to sloughing and the need to remove oversized material.

Temporary excavation sidewalls in the landfill cap soil should stand vertical to a depth of approximately 4 feet, provided groundwater seepage is not observed in the sidewalls. Excavation sidewalls consisting of sand or gravel may experience caving at depths of less than 4 feet. Open excavation techniques may be used to excavate trenches with depths between 4 and 8 feet, provided the walls of the excavation are cut at a slope of 1H:1V and groundwater seepage is not present. At this inclination, the slopes may ravel and require some ongoing repair. Excavations should be flattened if excessive sloughing or raveling occurs. In lieu of large and open cuts, approved temporary shoring may be used for excavation support. A wide variety of shoring and dewatering systems are available. Consequently, we recommend the contractor be responsible for selecting the appropriate shoring and dewatering systems.

If box shoring is used, it should be understood that box shoring is a safety feature used to protect workers and does not prevent caving. If the excavations are left open for extended periods of time, caving of the sidewalls will likely occur. The presence of caved material will limit the ability to properly backfill and compact the trenches. The contractor should be prepared to fill voids between the box shoring and the sidewalls of the trenches with sand or gravel before caving occurs.

If shoring is used, we recommend that the type and design of the shoring system be the responsibility of the contractor, who is in the best position to choose a system that fits the overall plan of operation.

6.3.2 Temporary Dewatering

The regional groundwater table was not encountered in our explorations and is not expected to be encountered in project excavations. Perched water may be encountered during periods of persistent wet weather. The contractor should be made responsible for temporary drainage of surface water and perched water as necessary to prevent standing water and/or erosion at the working surface.

If perched groundwater is present, dewatering may be required to maintain dry working conditions. Pumping from sumps will likely be effective in removing water resulting from seepage.

We note that these recommendations are for guidance only. Dewatering of excavations is the sole responsibility of the contractor, as the contractor is in the best position to select these systems based on their means and methods.

6.3.3 Safety

All excavations should be made in accordance with applicable OSHA requirements and regulations of the state, county, and local jurisdiction. While this report describes certain approaches to excavation and dewatering, the contract documents should specify that the contractor is responsible for selecting the excavation and dewatering methods, monitoring the excavations for safety, and providing shoring (as required) to protect personnel and adjacent structural elements.

6.4 MATERIALS

6.4.1 Structural Fill

6.4.1.1 General

Fill should be placed on subgrade that has been prepared in conformance with the “Site Preparation” section. A variety of material may be used as structural fill at the site. However, all material used as structural fill should be free of organic material or other unsuitable material and should meet the specifications provided in OSSC 00330 (Earthwork), OSSC 00400 (Drainage and Sewers), and OSSC 02600 (Aggregates), depending on the application. A brief characterization of some of the acceptable materials and our recommendations for their use as structural fill are provided below. Fill should be compacted as described in the “Fill Placement and Compaction” section.

6.4.1.2 On-Site Soil

The on-site material should generally be suitable for use as general structural fill, provided it is properly moisture conditioned; free of debris, organic material, and particles over 6 inches in diameter; and meets the specifications provided in OSSC 00330.12 (Borrow Material). Oversized material, organic material, and debris are not suitable for structural fill. All such deleterious material must be removed prior to being used as structural fill. Laboratory testing indicates that the on-site silt soil was generally above optimum moisture content at the time of exploration. Moisture conditioning (drying) will be required to use on-site fines-rich soil for structural fill. Accordingly, extended dry weather will be required to adequately condition and place the silty soil as structural fill. It will be difficult, if not impossible, to adequately compact silt soil during the rainy season or during prolonged periods of rainfall, unless it is cement amended. In general, silt soil should only be used as structural fill during the dry summer months.

6.4.1.3 Imported Granular Material

Imported granular material used as structural fill should be pit- or quarry-run rock, crushed rock, or crushed gravel and sand and should meet the specifications provided in OSSC 00330.14 (Selected Granular Backfill) or OSSC 00330.15 (Selected Stone Backfill). The imported granular material should also be angular, should be fairly well graded between coarse and fine material, should have less than 6 percent by dry weight passing the U.S. Standard No. 200 sieve, and should have at least two fractured faces.

6.4.1.4 Stabilization Material

Stabilization material used in staging or haul road areas, in trenches, or for other applications should consist of 4- or 6-inch-minus pit- or quarry-run rock, crushed rock, or crushed gravel and sand and should meet the specifications provided in OSSC 00330.15 (Selected Stone Backfill). The material should have a maximum particle size of 6 inches, should have less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve, and should have at least two mechanically fractured faces. The material should be free of organic material and other deleterious material. Stabilization material should be placed in lifts between 12 and 24 inches thick and compacted to a firm condition.

6.4.1.5 Trench Backfill

Trench backfill placed beneath, adjacent to, and for at least 12 inches above utility lines (i.e., the pipe zone) should consist of well-graded granular material with a maximum particle size of 1½ inches and less than 10 percent by dry weight passing the U.S. Standard No. 200 sieve and should meet the specifications provided in OSSC 00405.13 (Pipe Zone Material). Within roadway alignments, the remainder of the trench backfill up to the subgrade elevation should consist of well-graded granular material with a maximum particle size of 2½ inches and less than 10 percent by dry weight passing the U.S. Standard No. 200 sieve and should meet the specifications provided in OSSC 00405.14 (Trench Backfill; Class B, C, or D).

Outside of structural improvement areas (e.g., roadway alignments or building pads), trench backfill placed above the pipe zone may consist of general fill material that is free of organic material and material over 6 inches in diameter and meets the specifications provided in OSSC 00405.14 (Trench Backfill; Class A, B, C, or D).

6.4.1.6 Drain Rock

Drain rock should consist of angular, granular material with a maximum particle size of 2 inches and should meet the specifications provided in OSSC 00430.11 (Granular Drain Backfill Material). The material should be free of roots, organic material, and other unsuitable material; should have less than 2 percent by dry weight passing the U.S. Standard No. 200 sieve (washed analysis); and should have at least two mechanically fractured faces. Drain rock should be compacted to a well-keyed, firm condition.

6.4.1.7 Aggregate Base Rock

Imported granular material used as base rock for building floor slabs and pavement should consist of ¾- or 1½-inch-minus material (depending on the application) and meet the requirements in OSSC 00641 (Aggregate Subbase, Base, and Shoulders). The aggregate should have at least two mechanically fractured faces. In addition, the aggregate should have less than 6 percent by dry weight passing the U.S. Standard No. 200 sieve.

6.4.1.8 Retaining Wall Select Backfill

Backfill material placed behind retaining walls and extending a horizontal distance of ½H, where H is the height of the retaining wall, should consist of select granular material that meets the specifications provided in OSSC 00510.12 (Granular Wall Backfill) or OSSC 00510.13 (Granular

Structure Backfill). We recommend the select granular wall backfill be separated from general fill, native soil, and/or topsoil using a geotextile fabric that meets the specifications provided below for drainage geotextiles.

The backfill should be placed and compacted as recommended for structural fill, with the exception of backfill placed immediately adjacent to walls. Backfill adjacent to walls should be compacted to a lesser standard to reduce the potential for generation of excessive pressure on the walls.

6.4.1.9 Recycled On-Site Material

AC and conventional concrete from demolished on-site structures may be used as fill if it is processed to meet the requirements for its intended use. Processing includes crushing and screening, grinding in place, or other methods to meet the requirements for structural fill as described above. The processed material should be fairly well graded and not contain metal, organic material, or other deleterious material. The processed material may be mixed with on-site soil or imported fill to assist in achieving the gradation requirements. We recommend that processed recycled fill have the maximum particles size as listed in Table 7.

Table 7. Processed Fill Maximum Particle Size

Depth of Placement[1]	Maximum Particle Size
0 feet to 1 foot	Not recommended
1 foot to 2 feet	2 inches
2 to 6 feet	4 inches
6 to 10 feet	8 inches
deeper than 10 feet	12 inches

1. Below subgrade of structural element

Recycled on-site fill material should not be used within a depth of 1 foot from foundations, floor slabs, pavement, or other subsurface elements. We also caution that excavation through recycled material that is placed as structural fill may be difficult if it has a significant fraction of oversized particles. In addition, these excavations may also be prone to raveling and caving.

6.4.2 Geotextile Fabric

6.4.2.1 Subgrade Geotextile

Subgrade geotextile should conform to OSSC Table 02320-4 and OSSC 00350 (Geosynthetic Installation). A minimum initial aggregate base lift of 6 inches is required over geotextiles.

6.4.2.2 Drainage Geotextile

Drainage geotextile should conform to Type 2 material of OSSC Table 02320-1 and OSSC 00350 (Geosynthetic Installation). A minimum initial aggregate base lift of 6 inches is required over geotextiles.

6.4.3 AC

6.4.3.1 ACP

On-site AC should be Level 2, ½-inch, dense ACP according to OSSC 00744 (Asphalt Concrete Pavement) and compacted to 91 percent of the maximum specific gravity of the mix, as determined by AASHTO T 209. The minimum and maximum lift thicknesses are 2.0 and 3.5 inches, respectively, for ½-inch ACP. Asphalt binder should be performance graded and conform to PG 64-22 or better.

6.4.3.2 Cold Weather Paving Considerations

In general, AC paving is not recommended during cold weather (temperatures less than 40 degrees Fahrenheit). Compacting under these conditions can result in low compaction and premature pavement distress.

Each AC mix design has a recommended compaction temperature range that is specific for the particular AC binder used. In colder temperatures, it is more difficult to maintain the temperature of the AC mix as it can lose heat while stored in the delivery truck, as it is placed, and in the time between placement and compaction. In Oregon, the AC surface temperature during paving should be at least 40 degrees Fahrenheit for lift thickness greater than 2.5 inches and at least 50 degrees Fahrenheit for lift thickness between 2.0 and 2.5 inches.

If paving activities must take place during cold weather construction as defined above, the project team should be consulted and a site meeting should be held to discuss ways to lessen low compaction risks.

6.4.4 Cement Amendment

6.4.4.1 General

As an alternative to the use of imported granular material for subgrade improvement, an experienced contractor may be able to amend the on-site soil with portland cement to obtain suitable support properties. Successful use of soil amendment depends on the use of correct mixing techniques, soil moisture content, and amendment quantities. Cement amendment should not be used if runoff during construction cannot be directed away from adjacent wetlands.

One test pit (TP-18) encountered refusal on cobbles at a depth of 4 feet BGS. Cement amending of the cap fill material will likely require some preliminary work to remove oversize material prior to amendment to remove oversize material that could damage equipment.

6.4.4.2 Subbase Stabilization

We recommend a target strength for cement-amended subgrade for building and pavement subbase (below aggregate base) soil of 100 psi. Successful use of soil amendment depends on use of correct techniques and equipment, soil moisture content, and the amount of cement added to the soil. The recommended percentage of cement is based on soil moisture contents at the time of placing the structural fill. Based on our experience, 6 percent cement by weight of dry soil is generally satisfactory when the soil moisture content does not exceed approximately 25 percent. If the soil moisture content is in the range of 25 to 35 percent, 7 to 9 percent by weight of dry soil is recommended. It is difficult to accurately predict field performance due to the variability in soil response to cement amendment. The amount of cement added to the soil may need to be adjusted based on field observations and performance. Moreover, depending on the time of year and moisture content levels during amendment, water may need to be applied during tilling to appropriately condition the soil moisture content. The amount of cement used during amendment should be based on an assumed soil dry unit weight of 110 pcf. For preliminary design purposes, we recommend a minimum of 6 percent cement. It is not possible to amend soil during heavy or continuous rainfall. Work should be completed during suitable conditions.

We recommend cement-spreading equipment be equipped with balloon tires to reduce rutting and disturbance of the fine-grained soil. A static sheepsfoot or segmented pad roller with a minimum static weight of 40,000 pounds should be used for initial compaction of the fine-grained soil. A smooth-drum roller with a minimum applied linear force of 700 pounds per inch should be used for final compaction.

A minimum curing time of four days is required between amendment and construction traffic access. Construction traffic should not be allowed on unprotected, cement-amended subgrade. To protect the cement-amended surfaces from abrasion or damage, the finished surface should be covered with 4 to 6 inches of imported granular material.

Amendment depths for building/pavement, haul roads, and staging areas are typically on the order of 12, 16, and 12 inches, respectively. The crushed rock typically becomes contaminated with soil during construction. Contaminated base rock should be removed and replaced with clean rock in pavement areas. The actual thickness of the amended material and imported granular material for haul roads and staging areas will depend on the anticipated traffic, as well as the contractor's means and methods and, accordingly, should be the contractor's responsibility. Cement amendment should not be attempted when the air temperature is below 40 degrees Fahrenheit or during moderate to heavy precipitation. Cement should not be placed when the ground surface is saturated or standing water exists.

6.4.4.3 Cement-Amended Structural Fill

On-site silt soil that is not suitable for structural fill due to high moisture content may be amended and placed as fill over a subgrade prepared in conformance with the "Site Preparation" section. Cement-amended fill lift thicknesses should be limited to 12 inches. The cement ratio for general cement-amended fill can generally be reduced by 1 percent (by dry weight). Typically, a minimum curing time of four days is required between amendment and construction traffic access. Consecutive lifts of fill may be amended immediately after the previous lift has been amended and compacted (e.g., the four-day wait period does not apply). However, where the final lift of fill is a building or roadway subgrade, the four-day wait period is in effect for the final lift of cement-amended soil.

6.4.4.4 Other Considerations

Portland cement-amended soil is hard and has low permeability. This soil does not drain well and it is not suitable for planting. Future planted areas should not be cement amended, if practical, or accommodations should be made for drainage and planting. Moreover, cement amending soil within building areas must be done carefully to avoid trapping water under floor slabs. We should be contacted if this approach is considered. Cement amendment should not be used if runoff during construction cannot be directed away from adjacent wetlands (if any). Cement amendment runoff should be collected, monitored, and treated in accordance with Oregon Department of Environmental Quality requirements prior to being discharged.

Gravel and cobbles were encountered in some of the explorations in the cap fill. Oversized particles in the gravel may cause damage to cement amendment mixing equipment.

6.4.4.5 Specification Recommendations

We recommend that the following comments be included in the specifications for the project:

- In general, cement amendment is not recommended during cold weather (temperatures less than 40 degrees Fahrenheit) or during rainfall.
- Mixing Equipment
  - Use a pulverizer/mixer capable of uniformly mixing the cement into the soil to the design depth. Blade mixing will not be allowed.
  - Pulverize the soil-cement mixture such that 100 percent by dry weight passes a 1-inch sieve and a minimum of 70 percent passes a No. 4 sieve, exclusive of gravel or stone retained on these sieves. If water is required, the pulverizer should be equipped to inject water to a tolerance of ¼ gallon per square foot of surface area.
  - Use machinery that will not disturb the subgrade, such as using low-pressure “balloon” tires on the pulverizer/mixer vehicle. If subgrade is disturbed, the tilling/amendment depth shall extend the full depth of the disturbance.
  - Multiple “passes” of the tiller may be required to adequately blend the cement and soil mixture.
- Spreading Equipment
  - Use a spreader capable of distributing the cement uniformly on the ground to within 5 percent variance of the specified application rate.
  - Use machinery that will not disturb the subgrade, such as using low-pressure “balloon” tires on the spreader vehicle. If subgrade is disturbed, the tilling/amendment depth shall extend the full depth of the disturbance.
- Compaction Equipment
  - Use a static, sheepsfoot or segmented pad roller with a minimum static weight of 40,000 pounds for initial compaction of fine-grained soil (silt and clay) or an alternate approved by the geotechnical engineer.

6.5 FILL PLACEMENT AND COMPACTION

Fill soil should be compacted at a moisture content that is within 3 percent of optimum. The maximum allowable moisture content varies with the soil gradation and should be evaluated during construction. Fill and backfill material should be placed in uniform, horizontal lifts and compacted with appropriate equipment. The maximum lift thickness will vary depending on the material and compaction equipment used but should generally not exceed the loose thicknesses provided in Table 8. Fill material should be compacted in accordance with the compaction criteria provided in Table 9.

Table 8. Recommended Uncompacted Lift Thickness

Compaction Equipment	Recommended Uncompacted Lift Thickness (inches)		
	Silty/Clayey Soil	Granular and Crushed Rock Maximum Particle Size ≤ 1½ Inches	Crushed Rock Maximum Particle Size > 1½ Inches
Hand tools: Plate compactor and jumping jack	4 to 8	4 to 8	Not recommended
Rubber tire equipment	6 to 8	10 to 12	6 to 8
Light roller	8 to 10	10 to 12	8 to 10
Heavy roller	10 to 12	12 to 18	12 to 16
Hoe pack equipment	12 to 16	18 to 24	18 to 24

The table above is based on our experience and is intended to serve only as a guideline. The information provided in this table should not be included in the project specifications.

Table 9. Compaction Criteria

Fill Type	Compaction Requirements in Structural Zones		
	Percent Maximum Dry Density Determined by ASTM D1557		
	0 to 2 Feet Below Subgrade (percent)	Greater Than 2 Feet Below Subgrade (percent)	Pipe Zone (percent)
Area fill (granular)	95	95	-----
Area fill (fine grained)	92	92	-----
Aggregate base	95	95	----
Trench backfill[1,2]	95	92	90[1,2]
Retaining wall backfill	95[3]	92[3]	-----

1. Trench backfill above the pipe zone in non-structural areas should be compacted to 85 percent.
2. Or as recommended by the pipe manufacturer.
3. Should be reduced to 90 percent within a horizontal distance of 3 feet from the retaining wall.

6.6 EROSION CONTROL

The fines-rich soil at this site is eroded easily by wind and water; therefore, erosion control measures should be carefully planned and in place before construction begins. Measures that can be employed to reduce erosion include the use of silt fences, hay bales, buffer zones of natural growth, sedimentation ponds, and granular haul roads. All erosion control methods should be in accordance with local jurisdiction standards. During earthwork at the site, the contractor should be responsible for temporary drainage of surface water as necessary to prevent standing water and/or erosion at the working surface.

7.0 OBSERVATION OF CONSTRUCTION

Satisfactory earthwork and foundation performance depend to a large degree on the quality of construction. Subsurface conditions observed during construction should be compared with those encountered during the subsurface explorations. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those anticipated. In addition, sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications.

8.0 LIMITATIONS

We have prepared this report for use by Audubon Society of Portland, Oregon / Portland Audubon Wildlife Care Center LLC and members of the design and construction team for the proposed project. The data and report can be used for estimating purposes, but our report, conclusions, and interpretations should not be construed as a warranty of the subsurface conditions and are not applicable to other sites.

Soil explorations indicate soil conditions only at specific locations and only to the depths penetrated. The soil explorations do not necessarily reflect soil strata or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, re-evaluation will be necessary. In addition, if design changes are made, we should be retained to review our conclusions and recommendations and to provide a written evaluation or modification.

The site development plans and design details were preliminary at the time this report was prepared. When the design has been finalized and if there are changes in the site grades, location, or configuration; design loads; or type of construction, the conclusions and recommendations presented may not be applicable. If design changes are made, we request that we be retained to review our conclusions and recommendations and to provide a written modification or verification.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in this report for consideration in design.

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

♦ ♦ ♦

We appreciate the opportunity to be of continued service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,

NV5

Jessica Pence, E.I.T.
Project Manager

Jeffery D. Tucker, P.E., G.E.
Principal Engineer

REGISTERED PROFESSIONAL
ENGINEER
74942PE
OREGON
July 13, 2004
JEFFERY D. TUCKER
EXPIRES: 6/30/24

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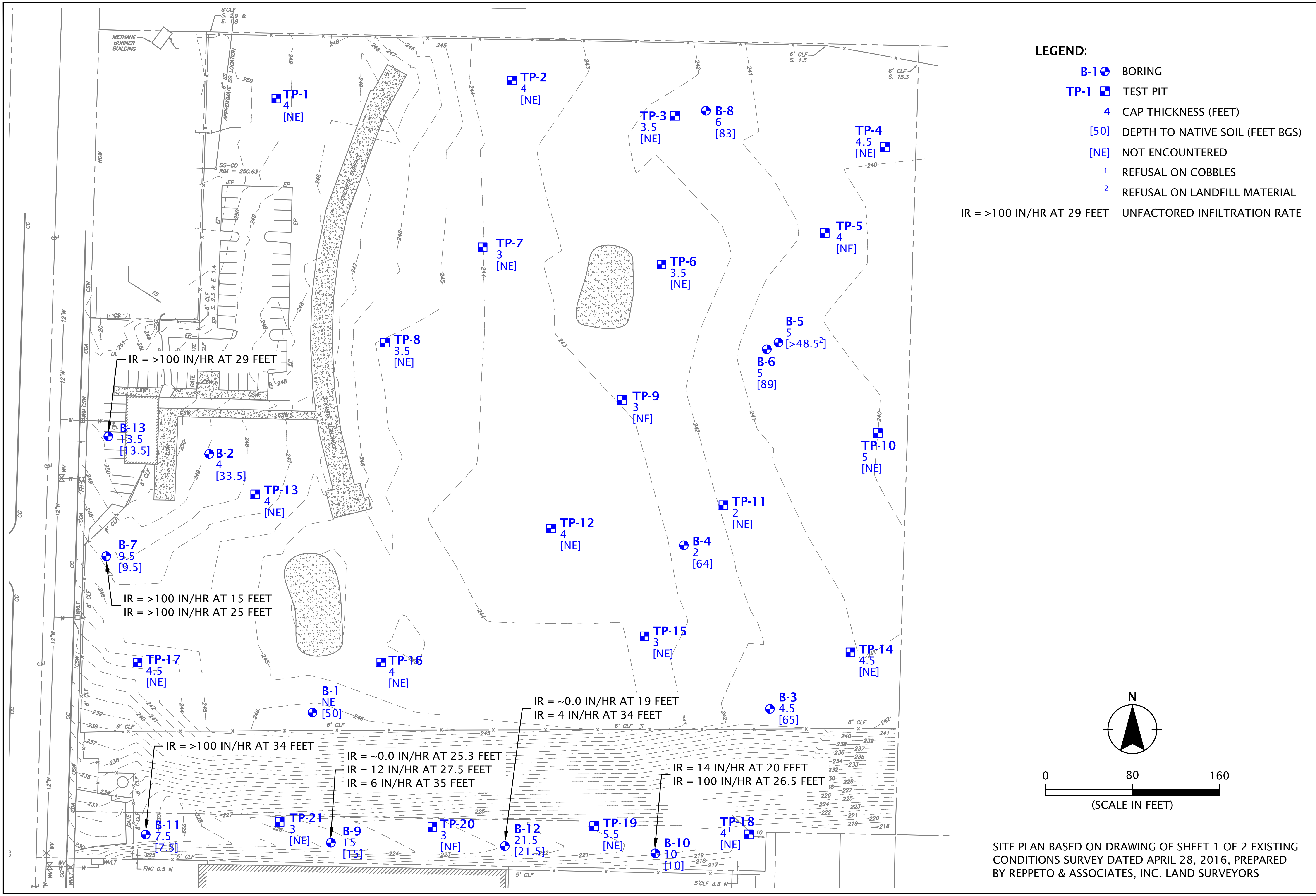
VICINITY MAP BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO®

NV5	SOJ-7-01	**VICINITY MAP**	
	OCTOBER 2023	2800 NE 82ND AVENUE DEVELOPMENT PORTLAND, OR	**FIGURE 1**



LEGEND:

B-1 ◐	BORING
TP-1 ◩	TEST PIT
4	CAP THICKNESS (FEET)
[50]	DEPTH TO NATIVE SOIL (FEET BGS)
[NE]	NOT ENCOUNTERED
1	REFUSAL ON COBBLES
2	REFUSAL ON LANDFILL MATERIAL
IR = >100 IN/HR AT 29 FEET	UNFACTORED INFILTRATION RATE

SITE PLAN BASED ON DRAWING OF SHEET 1 OF 2 EXISTING CONDITIONS SURVEY DATED APRIL 28, 2016, PREPARED BY REPPETO & ASSOCIATES, INC. LAND SURVEYORS

SITE PLAN

2800 NE 82ND AVENUE DEVELOPMENT
PORTLAND, OR

FIGURE 2

SOJ-7-01

OCTOBER 2023

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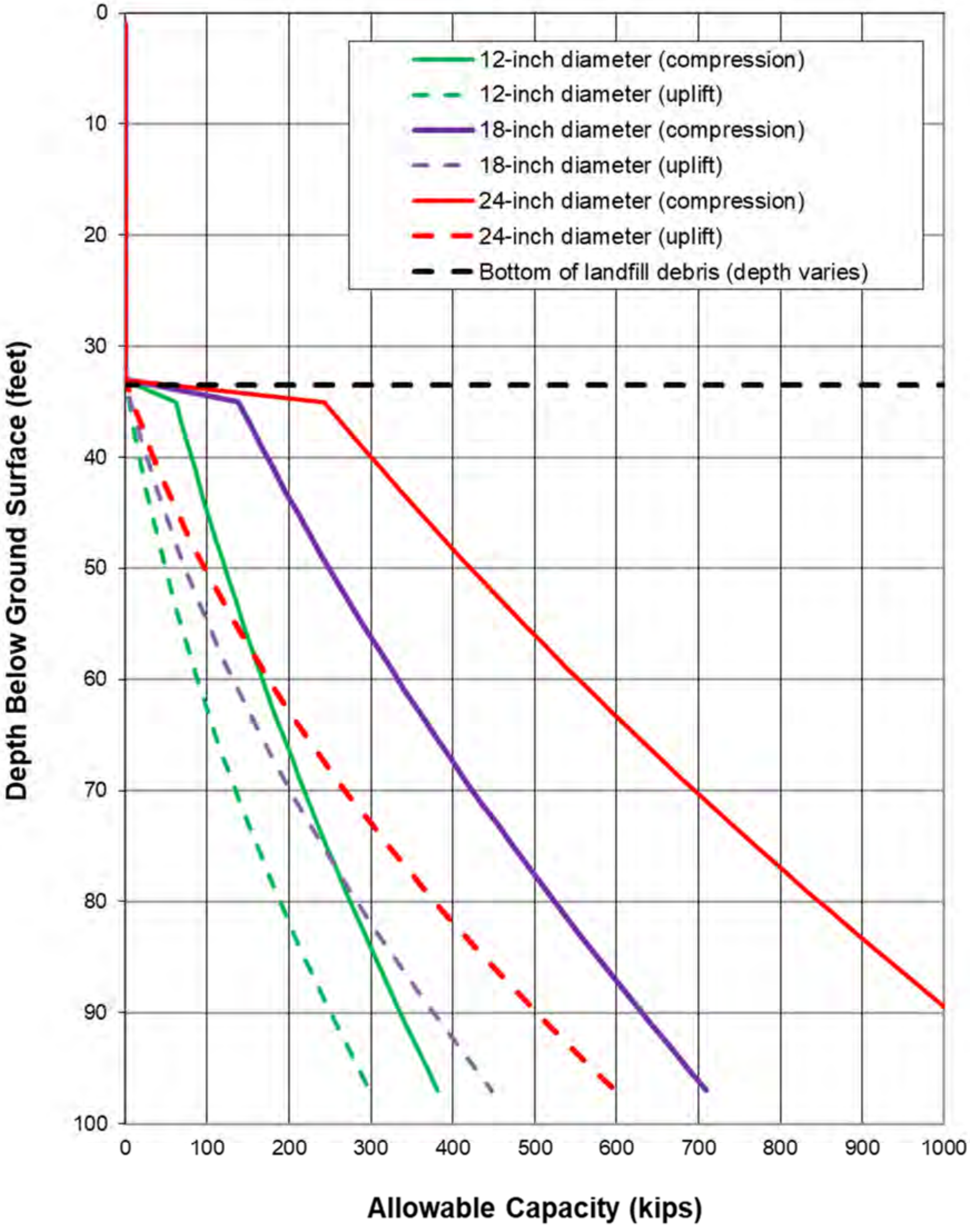
File Name: J:\S-Z\SOJ\SOJ-7\SOJ-7-01\Figures\CAD\SOJ-7-01-SP01.dwg | Layout: FIGURE 2



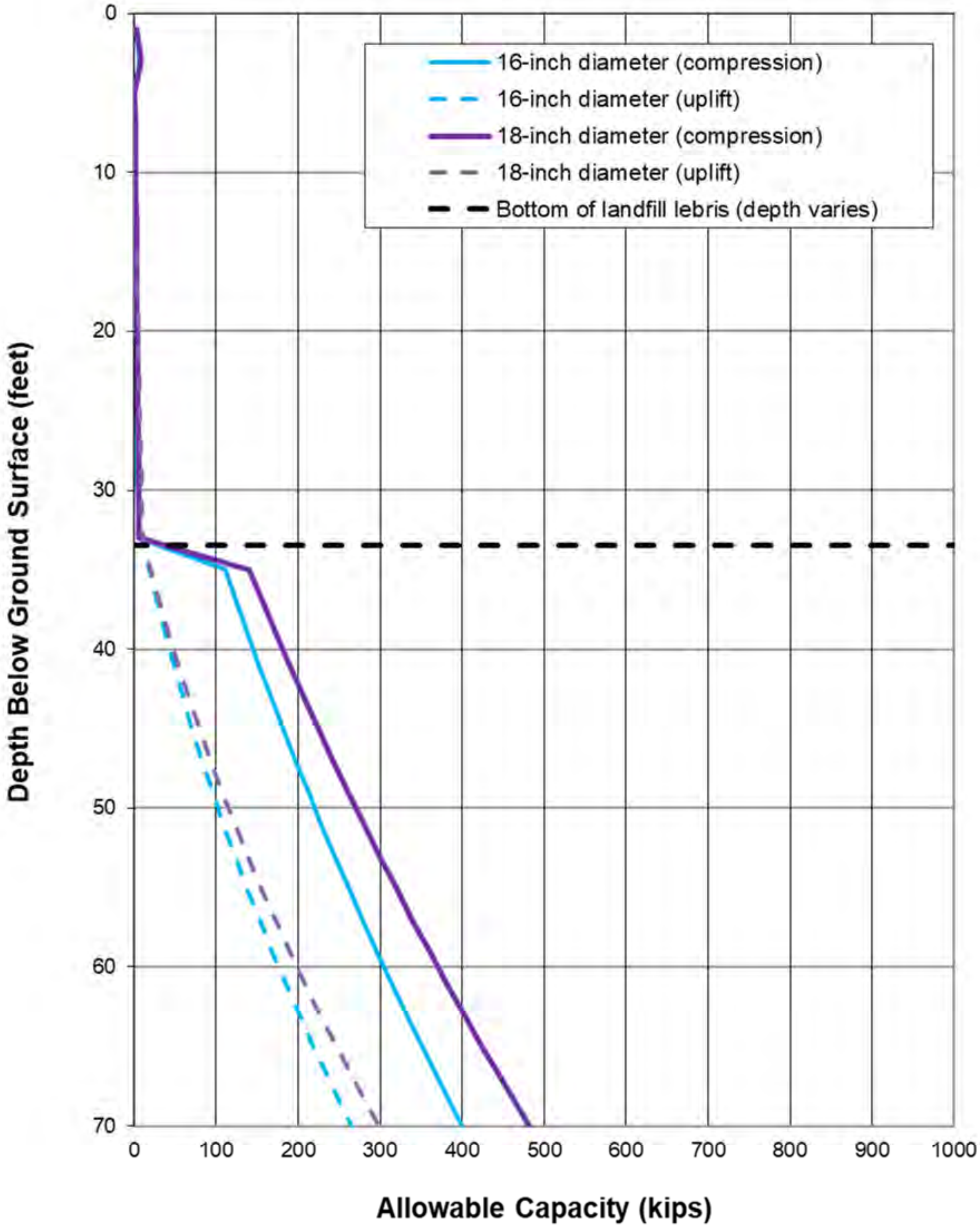
SOJ-7-01

STEEL PIPE PILE CAPACITIES FOR 33.5 FEET OF LANDFILL DEBRIS

OCTOBER 2023

2800 NE 82ND AVENUE DEVELOPMENT
PORTLAND, OR

FIGURE 3



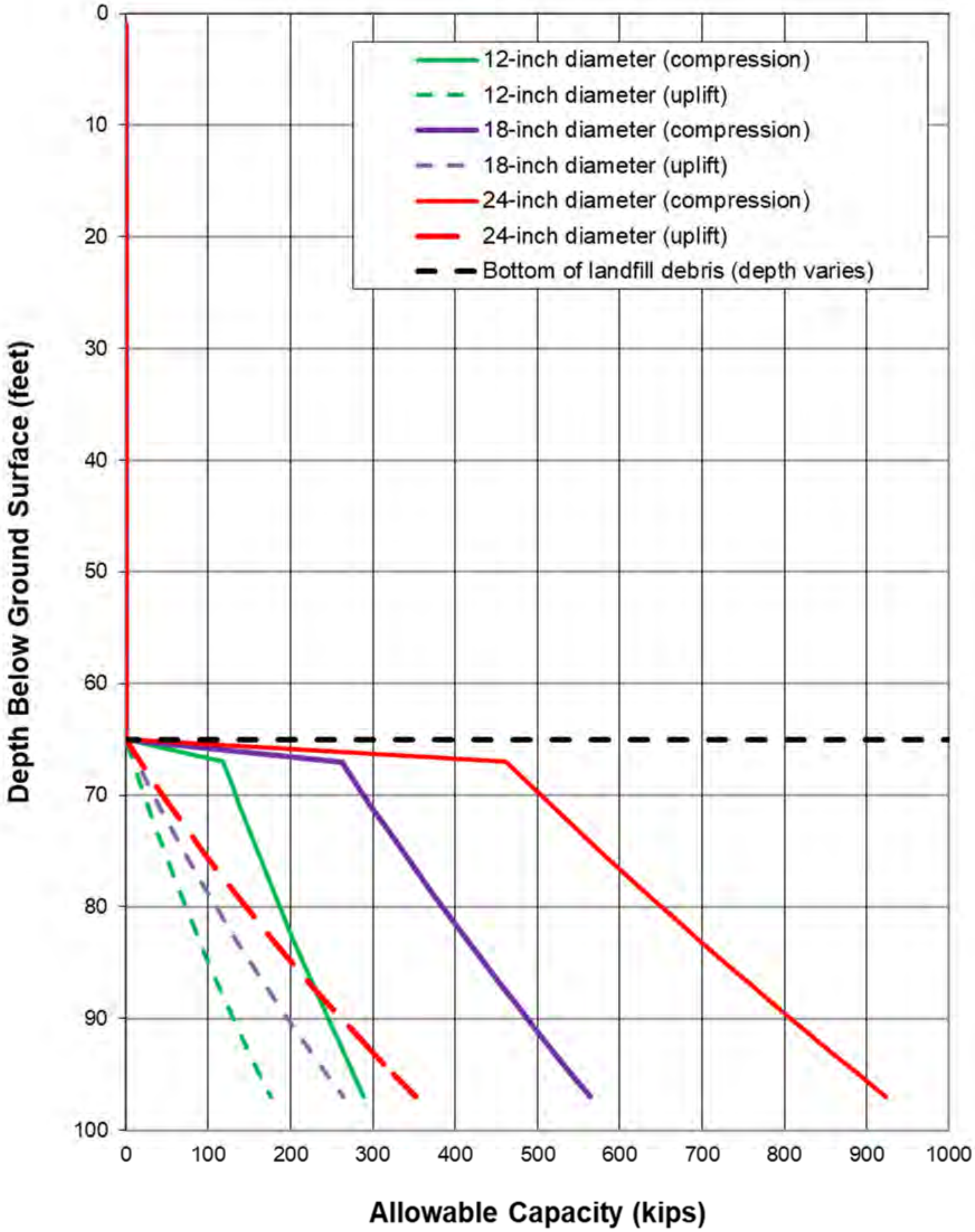
SOJ-7-01

DRIVEN GROUT PILE CAPACITIES FOR 33.5 FEET OF LANDFILL DEBRIS

OCTOBER 2023

2800 NE 82ND AVENUE DEVELOPMENT
PORTLAND, OR

FIGURE 4



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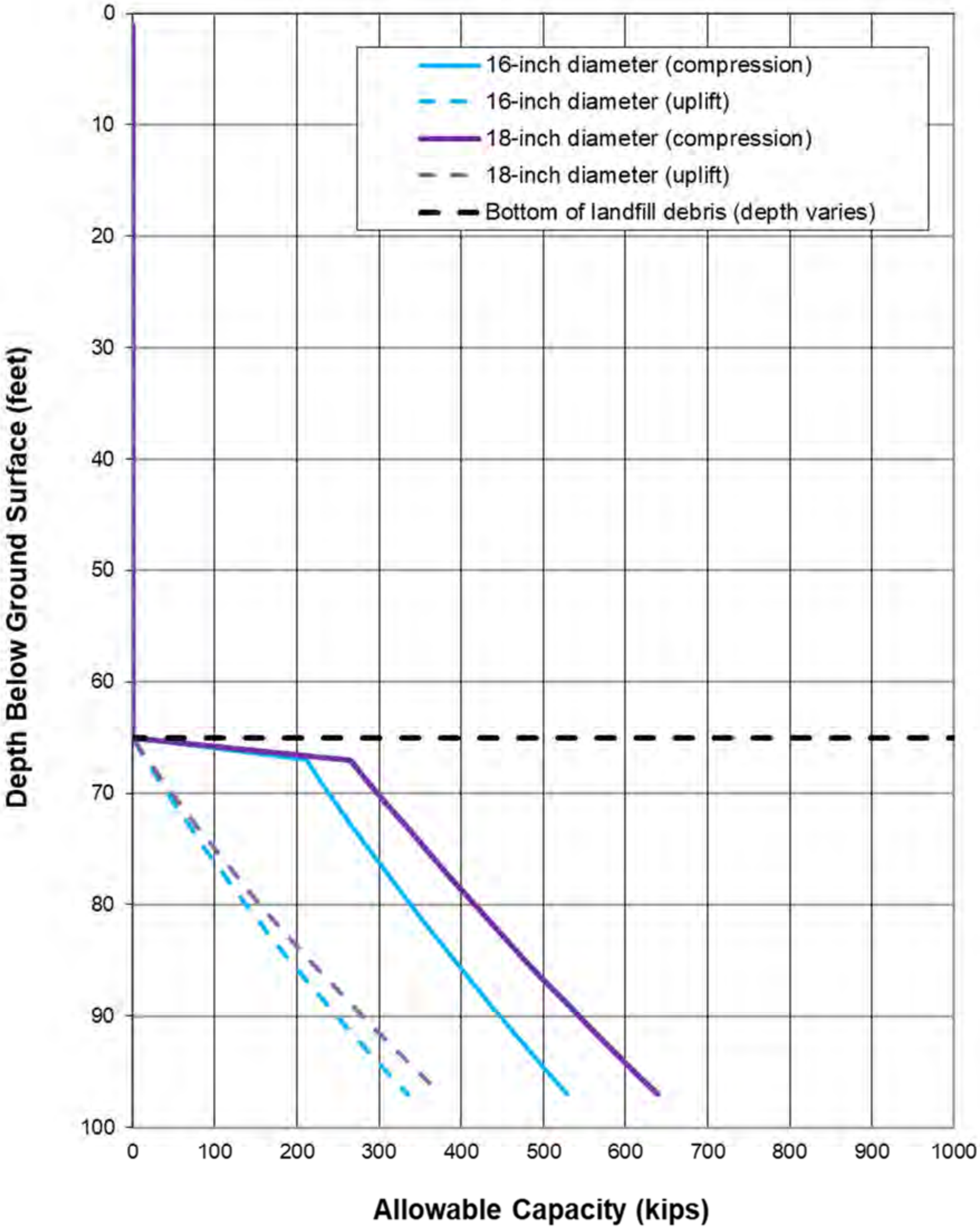
SOJ-7-01

OCTOBER 2023

STEEL PIPE PILE CAPACITIES FOR 65 FEET OF LANDFILL DEBRIS

2800 NE 82ND AVENUE DEVELOPMENT
PORTLAND, OR

FIGURE 5



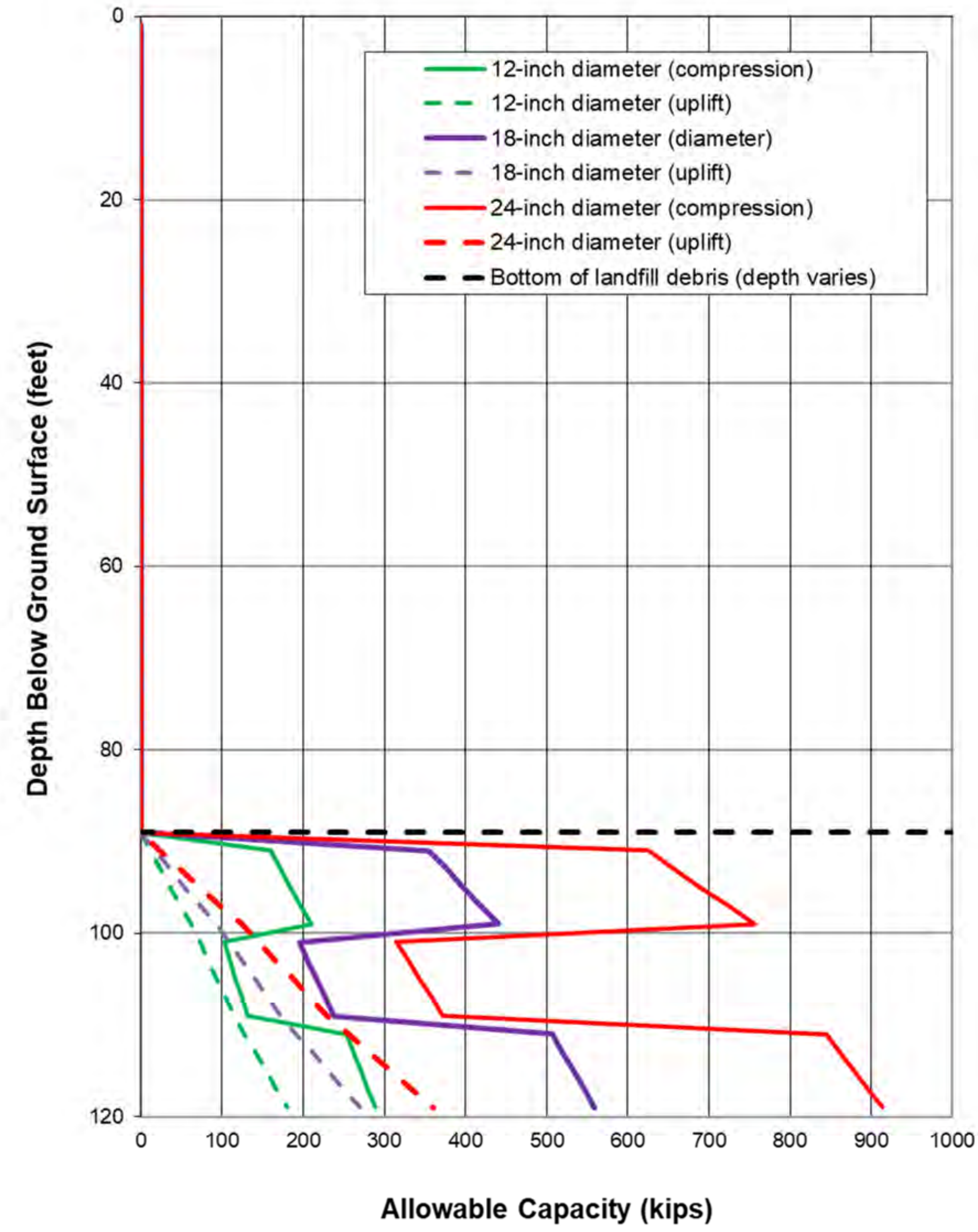
SOJ-7-01

DRIVEN GROUT PILE CAPACITIES FOR 65 FEET OF LANDFILL DEBRIS

OCTOBER 2023

2800 NE 82ND AVENUE DEVELOPMENT
PORTLAND, OR

FIGURE 6



SOJ-7-01-F3_8.docx Print Date: 10/26/23

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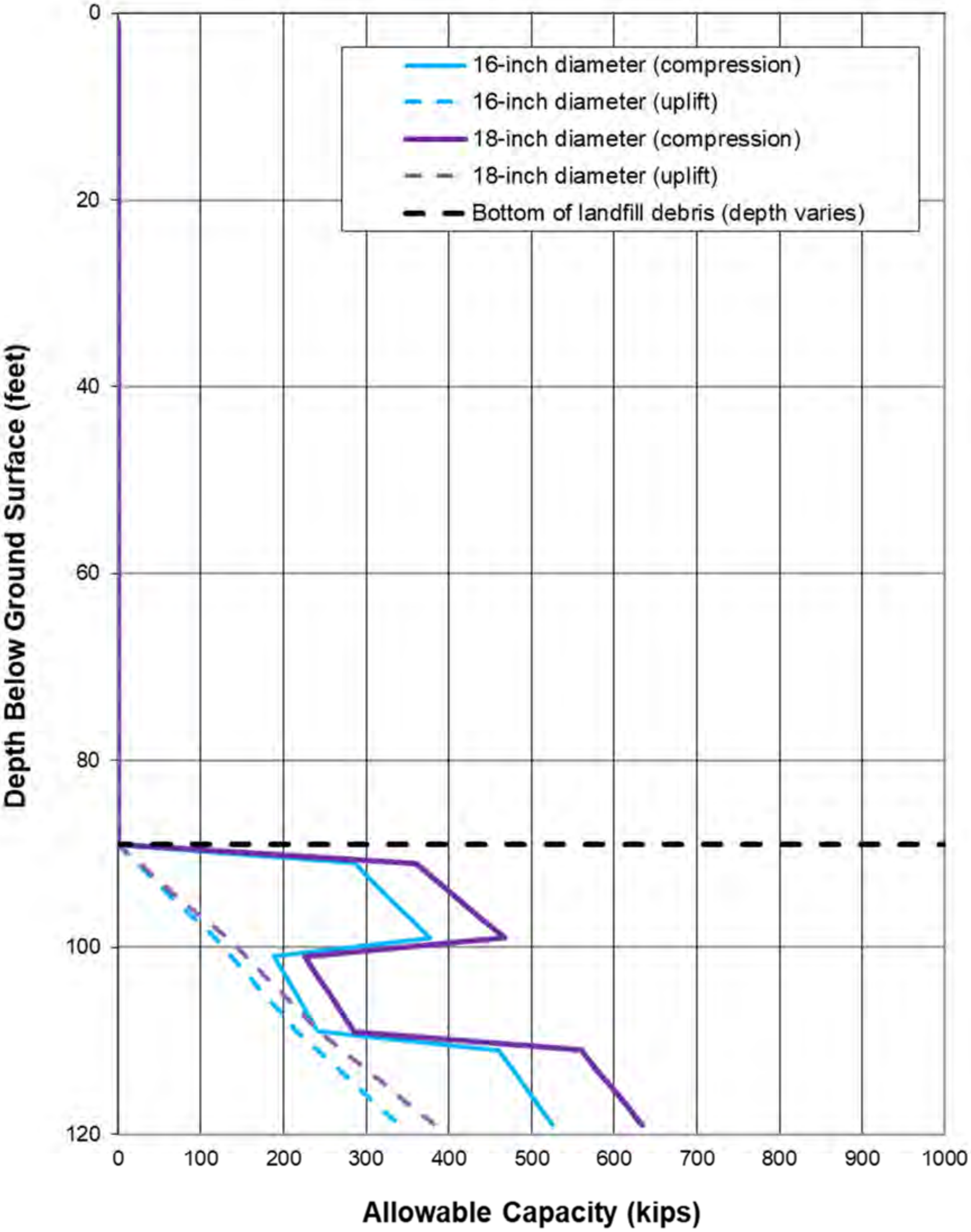
OCTOBER 2023

STEEL PIPE PILE CAPACITIES FOR 89 FEET OF LANDFILL DEBRIS

2800 NE 82ND AVENUE DEVELOPMENT
PORTLAND, OR

FIGURE 7



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OCTOBER 2023

DRIVEN GROUT PILE CAPACITIES FOR 89 FEET OF LANDFILL DEBRIS

2800 NE 82ND AVENUE DEVELOPMENT
PORTLAND, OR

FIGURE 8

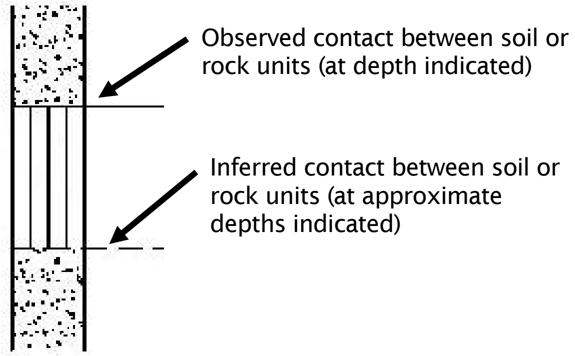
APPENDIX

PREVIOUS FIELD EXPLORATIONS

We previously explored subsurface conditions at the site by drilling 13 borings (B-1 through B-13) and excavating 21 test pits (TP-1 through TP-21) in May 2016. The approximate exploration locations are shown on Figure 2. The explorations logs and laboratory testing results are presented in this appendix.

SYMBOL	SAMPLING DESCRIPTION
◧	Location of sample obtained in general accordance with ASTM D 1586 Standard Penetration Test with recovery
▮	Location of sample obtained using thin-wall Shelby tube or Geoprobe® sampler in general accordance with ASTM D 1587 with recovery
▤	Location of sample obtained using Dames & Moore sampler and 300-pound hammer or pushed with recovery
▥	Location of sample obtained using Dames & Moore and 140-pound hammer or pushed with recovery
▧	Location of sample obtained using 3-inch-O.D. California split-spoon sampler and 140-pound hammer
☒	Location of grab sample
▩	Rock coring interval
▽	Water level during drilling
▼	Water level taken on date shown

Graphic Log of Soil and Rock Types



Observed contact between soil or rock units (at depth indicated)

Inferred contact between soil or rock units (at approximate depths indicated)

GEOTECHNICAL TESTING EXPLANATIONS

ATT	Atterberg Limits	PP	Pocket Penetrometer
CBR	California Bearing Ratio	P200	Percent Passing U.S. Standard No. 200 Sieve
CON	Consolidation		
DD	Dry Density	RES	Resilient Modulus
DS	Direct Shear	SIEV	Sieve Gradation
HYD	Hydrometer Gradation	TOR	Torvane
MC	Moisture Content	UC	Unconfined Compressive Strength
MD	Moisture-Density Relationship	VS	Vane Shear
OC	Organic Content	kPa	Kilopascal
P	Pushed Sample		

ENVIRONMENTAL TESTING EXPLANATIONS

CA	Sample Submitted for Chemical Analysis	ND	Not Detected
P	Pushed Sample	NS	No Visible Sheen
PID	Photoionization Detector Headspace Analysis	SS	Slight Sheen
		MS	Moderate Sheen
ppm	Parts per Million	HS	Heavy Sheen

EXPLORATION KEY

TABLE A-1

RELATIVE DENSITY - COARSE-GRAINED SOILS

Relative Density	Standard Penetration Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)
Very Loose	0 – 4	0 - 11	0 - 4
Loose	4 – 10	11 - 26	4 - 10
Medium Dense	10 – 30	26 - 74	10 - 30
Dense	30 – 50	74 - 120	30 - 47
Very Dense	More than 50	More than 120	More than 47

CONSISTENCY - FINE-GRAINED SOILS

Consistency	Standard Penetration Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)	Unconfined Compressive Strength (tsf)
Very Soft	Less than 2	Less than 3	Less than 2	Less than 0.25
Soft	2 - 4	3 – 6	2 - 5	0.25 - 0.50
Medium Stiff	4 - 8	6 – 12	5 - 9	0.50 - 1.0
Stiff	8 - 15	12 – 25	9 - 19	1.0 - 2.0
Very Stiff	15 - 30	25 – 65	19 – 31	2.0 - 4.0
Hard	More than 30	More than 65	More than 31	More than 4.0

PRIMARY SOIL DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOILS (more than 50% retained on No. 200 sieve)	GRAVEL (more than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVELS (< 5% fines)	GW or GP	GRAVEL
		GRAVEL WITH FINES (≥ 5% and ≤ 12% fines)	GW-GM or GP-GM	GRAVEL with silt
			GW-GC or GP-GC	GRAVEL with clay
		GRAVELS WITH FINES (> 12% fines)	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND (50% or more of coarse fraction passing No. 4 sieve)	CLEAN SANDS (<5% fines)	SW or SP	SAND
		SANDS WITH FINES (≥ 5% and ≤ 12% fines)	SW-SM or SP-SM	SAND with silt
			SW-SC or SP-SC	SAND with clay
		SANDS WITH FINES (> 12% fines)	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOILS (50% or more passing No. 200 sieve)	SILT AND CLAY	Liquid limit less than 50	ML	SILT
			CL	CLAY
			CL-ML	silty CLAY
			OL	ORGANIC SILT or ORGANIC CLAY
		Liquid limit 50 or greater	MH	SILT
			CH	CLAY
			OH	ORGANIC SILT or ORGANIC CLAY
HIGHLY ORGANIC SOILS			PT	PEAT

MOISTURE CLASSIFICATION

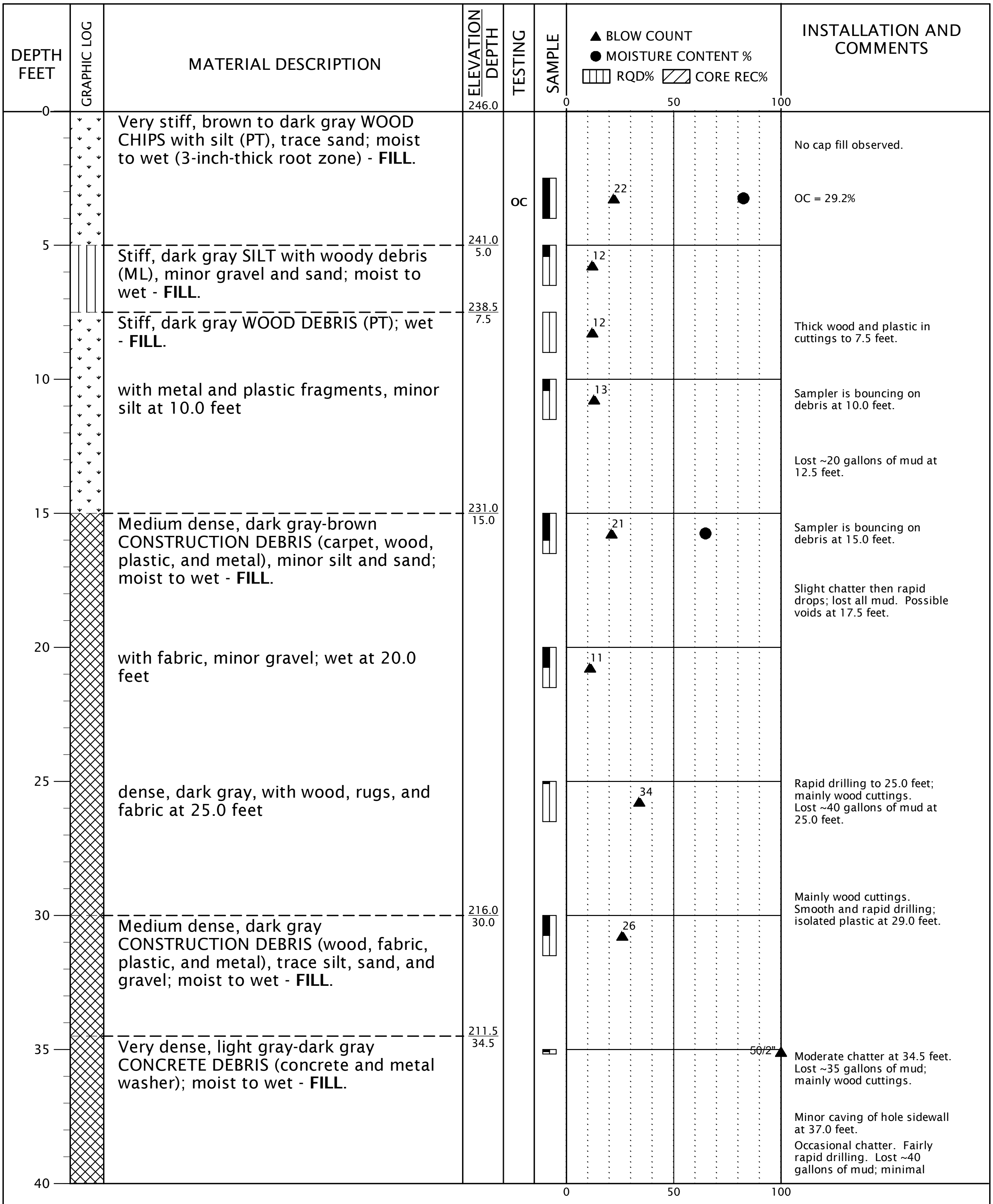
Term	Field Test
dry	very low moisture, dry to touch
moist	damp, without visible moisture
wet	visible free water, usually saturated

ADDITIONAL CONSTITUENTS

Secondary granular components or other materials such as organics, man-made debris, etc.					
Percent	Silt and Clay In:		Percent	Sand and Gravel In:	
	Fine-Grained Soils	Coarse-Grained Soils		Fine-Grained Soils	Coarse-Grained Soils
< 5	trace	trace	< 5	trace	trace
5 – 12	minor	with	5 – 15	minor	minor
> 12	some	silty/clayey	15 – 30	with	with
			> 30	sandy/gravelly	Indicate %

SOIL CLASSIFICATION SYSTEM

TABLE A-2



ELEVATION DEPTH	MATERIAL DESCRIPTION	TESTING	BLOW COUNT	INSTALLATION AND COMMENTS
246.0	Very stiff, brown to dark gray WOOD CHIPS with silt (PT), trace sand; moist to wet (3-inch-thick root zone) - **FILL**.			No cap fill observed.
		OC	22	OC = 29.2%
241.0 5.0	Stiff, dark gray SILT with woody debris (ML), minor gravel and sand; moist to wet - **FILL**.		12	
238.5 7.5	Stiff, dark gray WOOD DEBRIS (PT); wet - **FILL**.		12	Thick wood and plastic in cuttings to 7.5 feet.
	with metal and plastic fragments, minor silt at 10.0 feet		13	Sampler is bouncing on debris at 10.0 feet.
				Lost ~20 gallons of mud at 12.5 feet.
231.0 15.0	Medium dense, dark gray-brown CONSTRUCTION DEBRIS (carpet, wood, plastic, and metal), minor silt and sand; moist to wet - **FILL**.		21	Sampler is bouncing on debris at 15.0 feet.
				Slight chatter then rapid drops; lost all mud. Possible voids at 17.5 feet.
	with fabric, minor gravel; wet at 20.0 feet		11	
	dense, dark gray, with wood, rugs, and fabric at 25.0 feet		34	Rapid drilling to 25.0 feet; mainly wood cuttings. Lost ~40 gallons of mud at 25.0 feet.
				Mainly wood cuttings. Smooth and rapid drilling; isolated plastic at 29.0 feet.
216.0 30.0	Medium dense, dark gray CONSTRUCTION DEBRIS (wood, fabric, plastic, and metal), trace silt, sand, and gravel; moist to wet - **FILL**.		26	
211.5 34.5	Very dense, light gray-dark gray CONCRETE DEBRIS (concrete and metal washer); moist to wet - **FILL**.		50/2"	Moderate chatter at 34.5 feet. Lost ~35 gallons of mud; mainly wood cuttings.
				Minor caving of hole sidewall at 37.0 feet.
				Occasional chatter. Fairly rapid drilling. Lost ~40 gallons of mud; minimal

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LOGGED BY: JGH

COMPLETED: 05/18/16

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 4 3/8 inches

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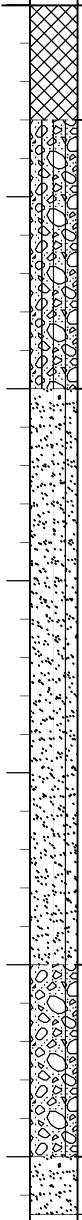
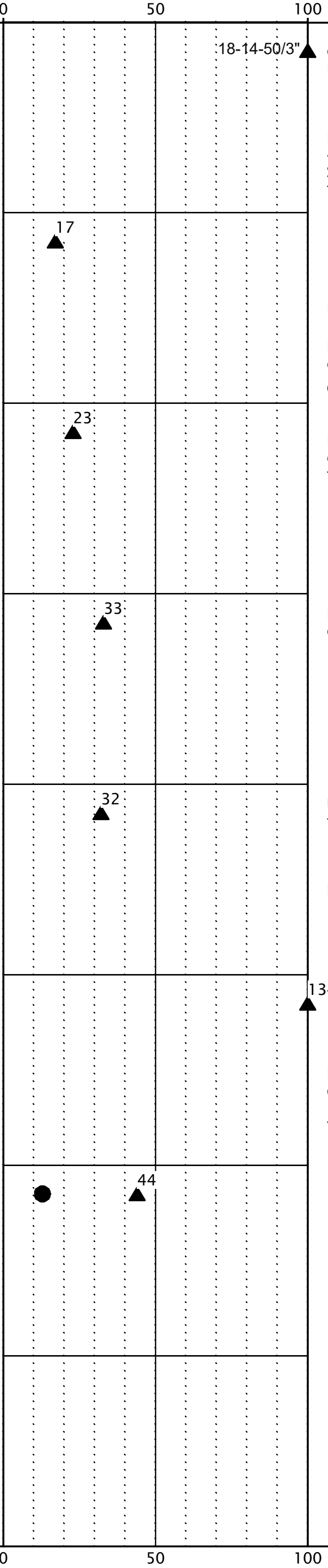
BORING B-1

82ND AND SISKIYOU DEVELOPMENT
PORTLAND, OR

FIGURE A-1

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT %	INSTALLATION AND COMMENTS
40	with rubber fragments at 40.0 feet			▮	18-14-50/3"	cuttings at 38.5 feet. No circulation at 40.0 feet.
	Medium dense, gray-dark gray, silty GRAVEL with sand and debris (concrete fragments); moist to wet - **FILL**.	203.0 43.0				Lost ~40 gallons of mud at 42.5 feet. Smooth and rapid drilling from 41.0 to 43.0 feet.
45	interbeds of SAND (4 inches thick) at 46.0 feet			▮	17	Rapid drilling from 47.0 to 50.0 feet. Lost ~30 gallons of mud; no circulation at 48.0 feet. Clean plugged drill rods at 50.0 feet.
50	Medium dense, gray SAND with gravel and silt (SP-SM); moist, medium.	196.0 50.0		▮	23	Lost circulation; alternate chatter and smooth drilling from 50.0 to 55.0 feet.
55	dense, trace gravel; fine to medium, laminated bed of SILT (1/4 inch thick) at 55.0 feet			▮	33	Lost 2 tubs of mud during cleanout at 55.0 feet.
60	gray to gray-orange; laminated to stratified beds of silty SAND, SAND, and SILT at 60.0 feet			▮	32	Using 1 tub of mud every 5 feet. In and out of gravel zones.
65	Very dense, gray-brown GRAVEL with sand and silt (GP-GM); moist.	181.0 65.0		▮	134	Driller Comment: hard drilling, possible cobbles or boulders from 67.5 to 70.0 feet.
70	Dense, gray-brown SAND (SP), trace gravel and silt; moist to wet, medium to coarse.	176.0 70.0		▮	● 44	
	Exploration completed at a depth of 71.5 feet. Hammer efficiency factor is 85 percent. Latitude: 45.542183 Longitude: -122.577914 (determined from hand-held GPS)	174.5 71.5				
75						
80						





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BORING METHOD: mud rotary (see document text)   BORING BIT DIAMETER: 4 3/8 inches

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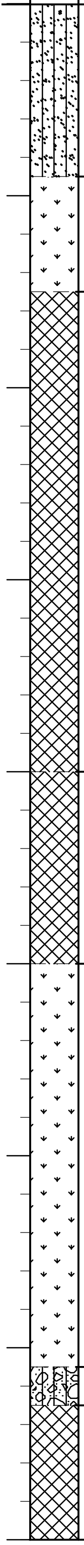
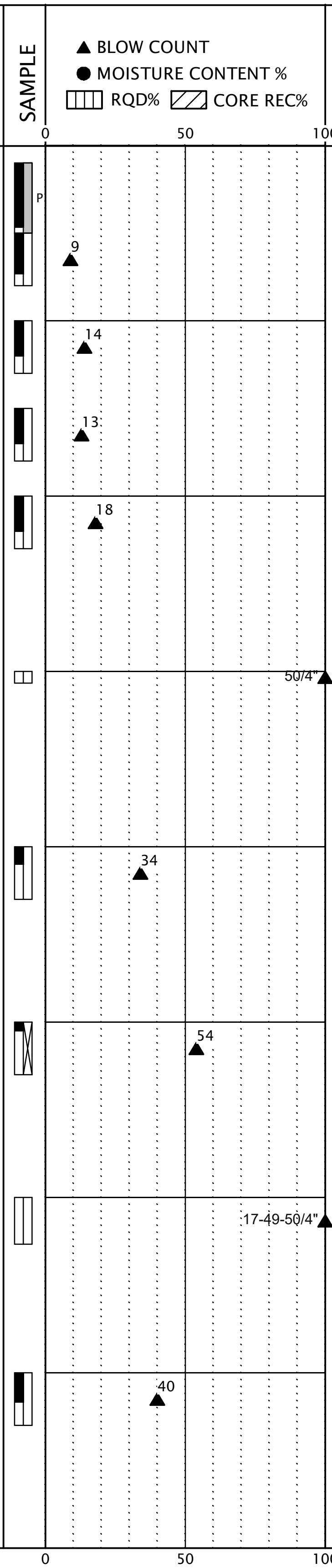
BORING B-1
(continued)

82ND AND SISKIYOU DEVELOPMENT
PORTLAND, OR

FIGURE A-1



DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION / DEPTH	INSTALLATION AND COMMENTS
0	Loose, gray, silty SAND (SM); moist, fine (3-inch-thick root zone) - **CAP FILL**.	241.2	
4.5	Medium dense, brown to dark gray WOOD DEBRIS (PT), trace silt and gravel; moist - **FILL**.	236.7 / 4.5	Woody debris in cuttings; dark gray at 5.0 feet.
7.5	Medium dense, dark gray-red CONSTRUCTION DEBRIS (wood, brick, tile, and metal wire), trace silt; moist to wet - **FILL**.	233.7 / 7.5	Thick wood/occasional fabric at 7.5 feet. Slight chatter from 9.0 to 9.5 feet.
10	dark gray-gray, with slag, tile, and plastic at 10.0 feet		Occasional chatter zones (~4 to ~6 inches) at 12.5 feet.
15	very dense at 15.0 feet		⊻ 15.0 feet, during drilling Sampler is bouncing; possible rubber tire(s) at 15.0 feet. Chatter from ~18 to 18.5 feet, then rapid drilling to 20.0 feet. Fabric, wood, plastic, glass, and rubber in cuttings at 19.0 feet.
20	Dense, gray-light gray CONSTRUCTION DEBRIS (wood, fabric, glass, metal wires, and plastic bags/ plastic); moist to wet - **FILL**.	221.2 / 20.0	Thick fabric fibers, wood, and plastic debris at 22.5 feet.
25	Medium dense, gray-dark gray WOOD DEBRIS with plastic, wire, glass, and fabric (rugs, cloth) (PT); moist to wet - **FILL**.	216.2 / 25.0	Lost ~1 tub of mud (40 gallons) from 27.0 to 30.0 feet.
30	very dense at 30.0 feet		Sampler is bouncing; possible rubber/tire(s) at 30.0 feet. Minor caving at 32.5 feet. Lost circulation and 40 gallon of mud; no cuttings return at 34.0 feet.
35.5	Dense, gray, silty GRAVEL (GM), minor sand, trace organics (rootlets/ carbonized wood); moist - **FILL**.	205.7 / 35.5	
36.5	Very dense, dark gray CONSTRUCTION DEBRIS (tires, plastic, metal, bags, fabric, and wood), trace gravel and silt;	204.7 / 36.5	No circulation; lost 40 feet of mud. Low chatter with 1- to 2-foot rapid drilling zones at 38.0 feet.
40			



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COMPLETED: 05/20/16

BORING METHOD: mud rotary (see document text)
BORING BIT DIAMETER: 4 7/8 inches

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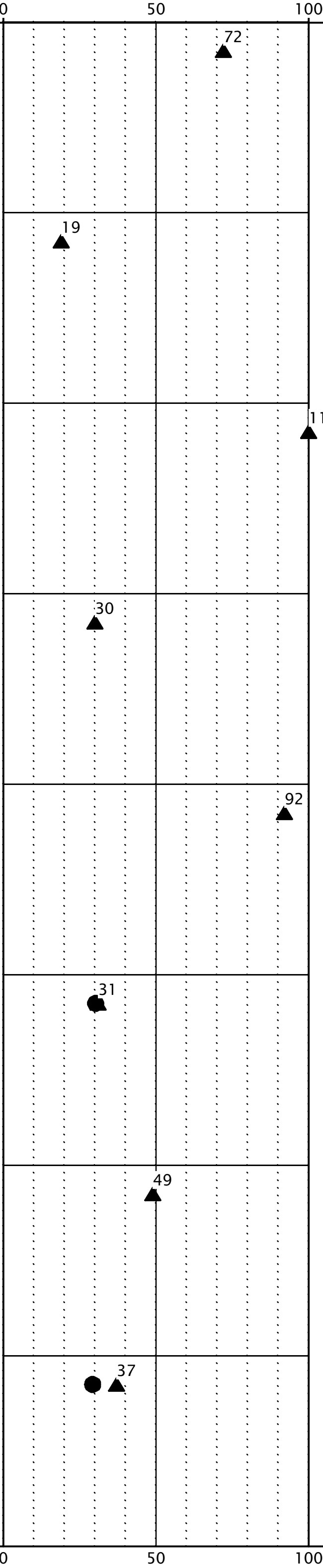
BORING B-3

82ND AND SISKIYOU DEVELOPMENT
PORTLAND, OR

FIGURE A-3

▲ BLOW COUNT
● MOISTURE CONTENT %
▥ RQD% ▨ CORE REC%



DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	BLOW COUNT	INSTALLATION AND COMMENTS
40	moist to wet - **FILL**.			72	No recovery with SPT; collected sample using 3-inch sampler.
45	Medium dense, dark gray CONSTRUCTION DEBRIS (wood, fabric, and plastic); moist to wet - **FILL**.	196.2 45.0		19	No circulation to 45.0 feet. Chatter zones and rapid (smooth) drilling zones, lost 1 tub of mud to 45.0 feet. Chatter at 47.5 feet then smooth, rapid drilling.
50	dense, with wood, metal, plastic bags, and fabric debris, trace silt at 50.0 feet			110	Sampler is bouncing; possible wood/rubber at 50.0 feet.
55	medium dense to dense, with wood, tarp, fabric, and wire debris at 55.0 feet			30	Extremely rapid rate, just dropped to 55.0 feet. Lost 1/2 tub of mud; possible voids.
	Dense, gray, silty SAND with gravel (SM); moist - **FILL**.	183.7 57.5			Hard and chatter drilling; possible gravel and wood. Lost 80 gallons of mud from 57.5 to 60.0 feet.
60				92	Possible pit floor at 60.0 feet.
65	Dense, gray, silty SAND (SM); wet, fine to medium.	176.2 65.0	P200	31	Switch to 3 7/8-inch tricone; alternate zones of gravel and sand at 65.0 feet. P200 = 31%
70	Dense, gray SAND (SP), trace silt; moist to wet, fine to medium.	171.2 70.0		49	Lost 3/4 tub of mud at 69.5 feet. Lost 1 tub of mud at 73.5 feet.
75	Dense, gray SAND with silt (SP-SM); moist, fine, laminated to stratified beds of SAND and silty SAND.	166.2 75.0		37	Driller Comment: sand formation at 75.0 feet.
80					Smooth, firm drilling with

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BORING METHOD: mud rotary (see document text)
BORING BIT DIAMETER: 4 7/8 inches

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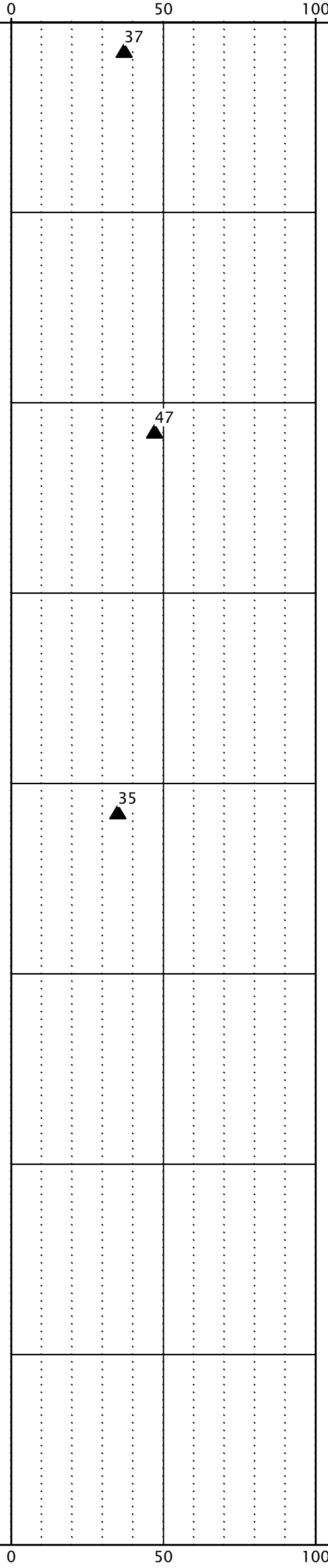
BORING B-3
(continued)

82ND AND SISKIYOU DEVELOPMENT
PORTLAND, OR

FIGURE A-3

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC%	INSTALLATION AND COMMENTS
80		gray-light brown at 80.0 feet				37	occasional gravel chatter zones from 80.0 to 90.0 feet. Lost 2 1/2 tubs of mud from 80.0 to 90.0 feet.
90		Dense, gray SAND (SP), trace silt; wet, medium.	151.2 90.0			47	
100		Dense, gray, silty SAND (SM); wet, fine.	141.2 100.0			35	
		Exploration completed at a depth of 101.5 feet. Hammer efficiency factor is 85 percent. Latitude: 45.542222 Longitude: -122.576272 (determined from hand-held GPS)	139.7 101.5				



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COMPLETED: 05/20/16

BORING METHOD: mud rotary (see document text)
BORING BIT DIAMETER: 4 7/8 inches

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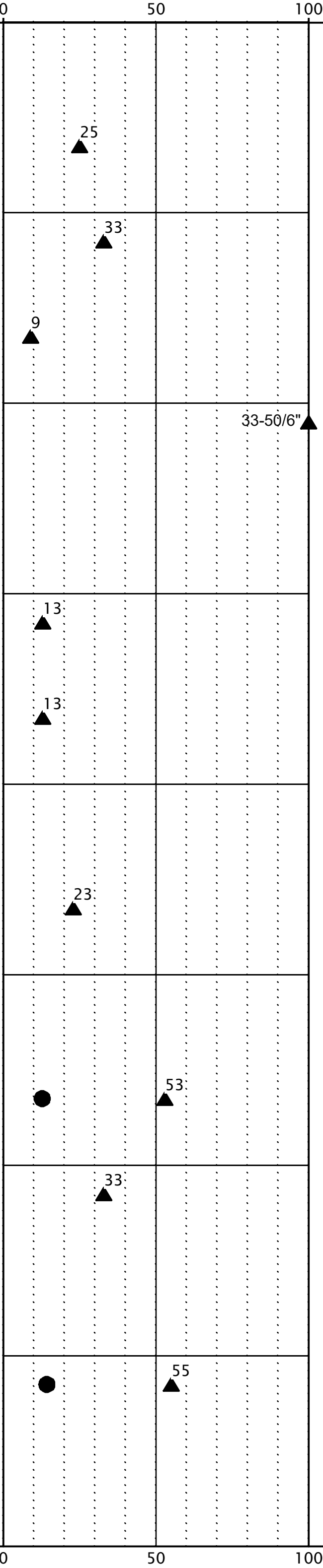
BORING B-3
(continued)

82ND AND SISKIYOU DEVELOPMENT
PORTLAND, OR

FIGURE A-3

BORING LOG CAPSTONE-13-01-B1_13-TP1_21.GPJ GEODESIGN.GDT PRINT DATE: 9/15/23:RC:KT

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC%	INSTALLATION AND COMMENTS
0	Medium dense, dark gray to brown, silty GRAVEL with sand (GM), trace organics (isolated carbonized wood); moist (2 1/2-inch-thick root zone) - **CAP FILL**.	225.3		▲ 25	Cuttings are gravel with sand and silt to 2.5 feet.
5	Dense, dark brown to dark gray, silty SAND with gravel and debris (asphalt fragments), trace organics (woody debris); moist, debris is 1-inch thick, organics are 3/8-inch diameter - **CAP FILL**.	220.3 5.0		▲ 33	Woody debris in cuttings at 4.5 feet.
	Stiff, brown-gray SILT with sand (ML), trace gravel; moist - **CAP FILL**.	217.8 7.5		▲ 9	Gray, sandy cuttings to 7.5 feet; not much wood.
10	Very dense, dark gray, silty GRAVEL with sand and debris (occasional brick) (GM), trace organics (carbonized wood) and clay; moist, organics are millimeter scale - **CAP FILL**.	215.3 10.0		▲ 33-50/6"	Poor recovery; cuttings are silty to 10.0 feet. Bottom 3 inches look native in shoe; brown-orange. Drill chatter at 13.0 feet. Smooth drilling, then back to low chatter from 14.0 to 14.5 feet.
15	Loose, light gray-orange SAND (SP), minor gravel, trace silt; moist, fine to medium.	210.3 15.0		▲ 13	
	Loose, brown-gray SAND (SP), trace silt; moist, medium to coarse, interbeds of silty SAND (SM) (up to 4 inches thick).	207.8 17.5		▲ 13	Top 3 to 4 inches silty at 17.5 feet.
20					Fairly smooth drilling to 20.0 feet.
	Medium dense, brown-orange to gray SAND (SP), trace gravel and silt; moist, fine to medium.	202.8 22.5		▲ 23	
25					A little chatter at 25.0 feet. Infiltration test: ~0 inches per hour at 25.3 feet.
	Medium dense, gray-brown SAND with silt (SP-SM), minor gravel; moist, medium.	197.8 27.5	P200	● ▲ 53	Infiltration test: 12 inches per hour at 27.5 feet. P200 = 9%
30	dense at 30.0 feet			▲ 33	
35	medium dense; fine to medium, laminated beds of SILT at 35.0 feet		P200	● ▲ 55	Infiltration test: 6 inches per hour at 35.0 feet. P200 = 13%
	Exploration completed at a depth of 36.5 feet. Hammer efficiency factor is 85 percent. Latitude: 45.541856	188.8 36.5			
40					



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LOGGED BY: JGH

COMPLETED: 05/26/16

BORING METHOD: hollow-stem auger (see document text)

BORING BIT DIAMETER: 10 inches

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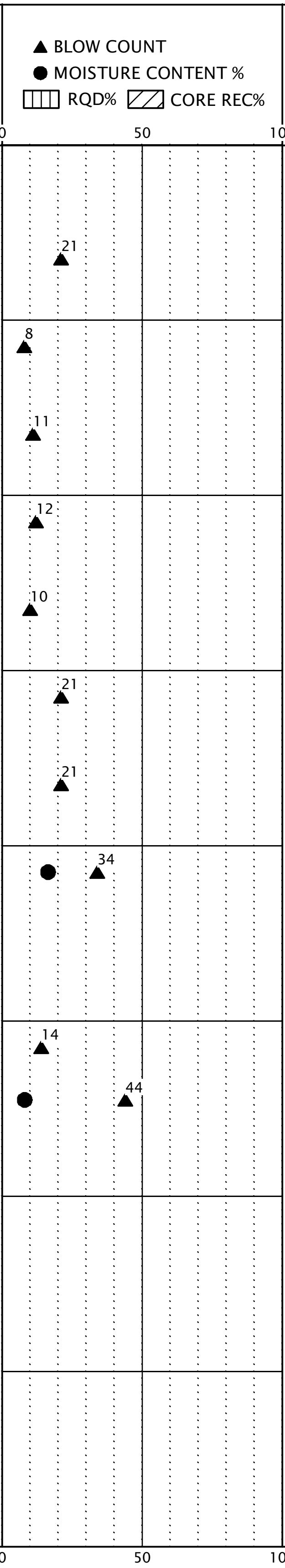
BORING B-9

82ND AND SISKIYOU DEVELOPMENT
PORTLAND, OR

FIGURE A-9

BORING LOG CAPSTONE-13-01-B1_13-TP1_21.GPJ GEODESIGN.GDT PRINT DATE: 9/15/23:RC:KT

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	▲ BLOW COUNT	● MOISTURE CONTENT %	INSTALLATION AND COMMENTS
0	Medium dense, brown-orange to gray, silty SAND to SILT with sand with debris (asphalt concrete fragments) and gravel (SM/ML); moist (2 1/4-inch-thick root zone) - **CAP FILL**.	220.0		21		
5	loose, brown-orange, minor gravel, without debris at 5.0 feet			8		
	Stiff, dark gray SILT with sand and gravel (ML), trace clay and organics (carbonized wood); moist - **CAP FILL**.	212.5 7.5		11		
10	Stiff, light brown-orange SILT (ML), minor gravel and sand, trace organics (isolated carbonized wood); moist, organics are 1/8-inch diameter.	210.0 10.0		12		
	Stiff, light brown-orange, sandy SILT to silty SAND (ML/SM); moist, sand is fine.	207.5 12.5		10		
15	Medium dense, brown-gray, silty SAND (SM), trace gravel; moist.	205.0 15.0		21		
	Medium dense, brown-orange to gray SAND with silt (SP-SM), trace gravel; moist.	202.5 17.5		21		
20			P200	34	●	Infiltration test: 14 inches per hour at 20.0 feet. P200 = 12%
25	minor gravel at 25.0 feet			14		Broke auger keyway at 25.0 feet.
	Medium dense, gray GRAVEL with sand and silt (GP-GM); moist.	193.5 26.5	P200	44	●	Infiltration test: 100 inches per hour at 26.5 feet. P200 = 7%
	Medium dense, light brown SAND with silt (SP-SM); moist, fine.	192.5 27.5				
30	Exploration completed at a depth of 28.0 feet. Hammer efficiency factor is 85 percent. Latitude: 45.54185 Longitude: -122.57667 (determined from hand-held GPS)	192.0 28.0				



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COMPLETED: 05/26/16

BORING METHOD: hollow-stem auger (see document text)
BORING BIT DIAMETER: 10 inches

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BORING B-10

82ND AND SISKIYOU DEVELOPMENT
PORTLAND, OR

FIGURE A-10

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC% (0 50 100)	INSTALLATION AND COMMENTS
0	Medium dense, brown GRAVEL with sand and silt (GP-GM); moist (2 1/2-inch-thick root zone) - **CAP FILL**.	230.0				
	gray-dark gray at 3.0 feet					Brown, gravelly cuttings to 3.0 feet then dark gray with asphalt concrete fragments.
5	Medium dense, dark gray, silty GRAVEL with sand and debris (asphalt concrete fragments); moist to wet - **CAP FILL**.	224.5 5.5				Cuttings are gray and silty with gravel; moist to wet at 5.5 feet.
	Medium dense, brown-light gray SAND (SP), minor gravel, trace silt; moist, medium.	222.5 7.5		◧	▲ 23	
10						
	with gravel at 12.0 feet			◧	▲ 14	In and out of gravel zones at 11.5 feet. Driller Comment: gravel chatter between 14.0 and 15.0 feet, then smooth with minor chatter zones to 19.0 feet; mainly sandy cuttings.
15						
20						Smooth drilling from 19.0 to 22.0 feet.
						Scattered gravel at 22.0 feet.
25				⊠		
						Smooth drilling from 26.5 to 29.0 feet.
30						Scattered gravel from 29.5 to 30.5 feet then smooth.
						Scattered gravel then smooth from 33.5 to 34.0 feet. Scattered gravel zones from 34.0 to 39.0 feet.
35	Medium dense, brown-gray SAND with silt (SP-SM), minor gravel; moist, fine to coarse; laminated SILT beds and stratified beds of medium to coarse SAND and fine SAND.	196.0 34.0	P200	◧	● ▲ 35	Infiltration test: 100 inches per hour at 34.0 feet. P200 = 8%
40						

DRILLED BY: Western States Soil Conservation, Inc.
LOGGED BY: JGH
COMPLETED: 06/24/16

BORING METHOD: hollow-stem auger (see document text)
BORING BIT DIAMETER: 10 inches

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CAPSTONE-13-01

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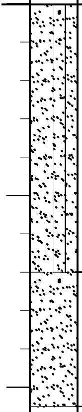
BORING B-11

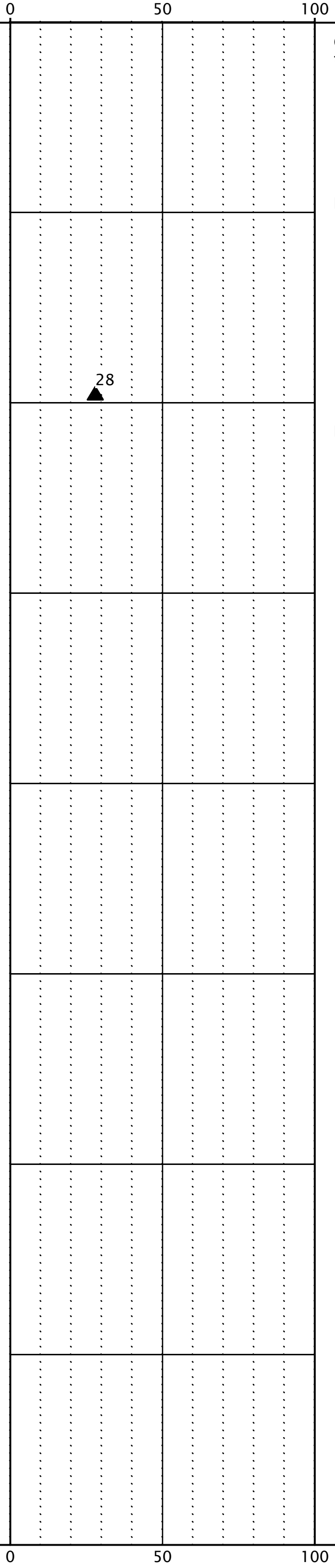
82ND AND SISKIYOU DEVELOPMENT
PORTLAND, OR

FIGURE A-11

BORING LOG CAPSTONE-13-01-B1_13-TP1_21.GPJ GEODESIGN.GDT PRINT DATE: 9/15/23:RC:KT

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC%	INSTALLATION AND COMMENTS
40		(continued from previous page)					Chatter drill zone from 40.0 to 47.0 feet.
45							Drill bit is dry at 44.0 feet.
		Medium dense, light brown-light gray SAND (SP), trace silt; moist, fine.	183.0 47.0				
50					▮	28	
		Exploration completed at a depth of 50.5 feet. Hammer efficiency factor is 98.9 percent. Latitude: 45.5418904 Longitude: -122.5785024 (determined from hand-held GPS)	179.5 50.5				Dry hole at 50.5 feet.





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BORING METHOD: hollow-stem auger (see document text)
BORING BIT DIAMETER: 10 inches

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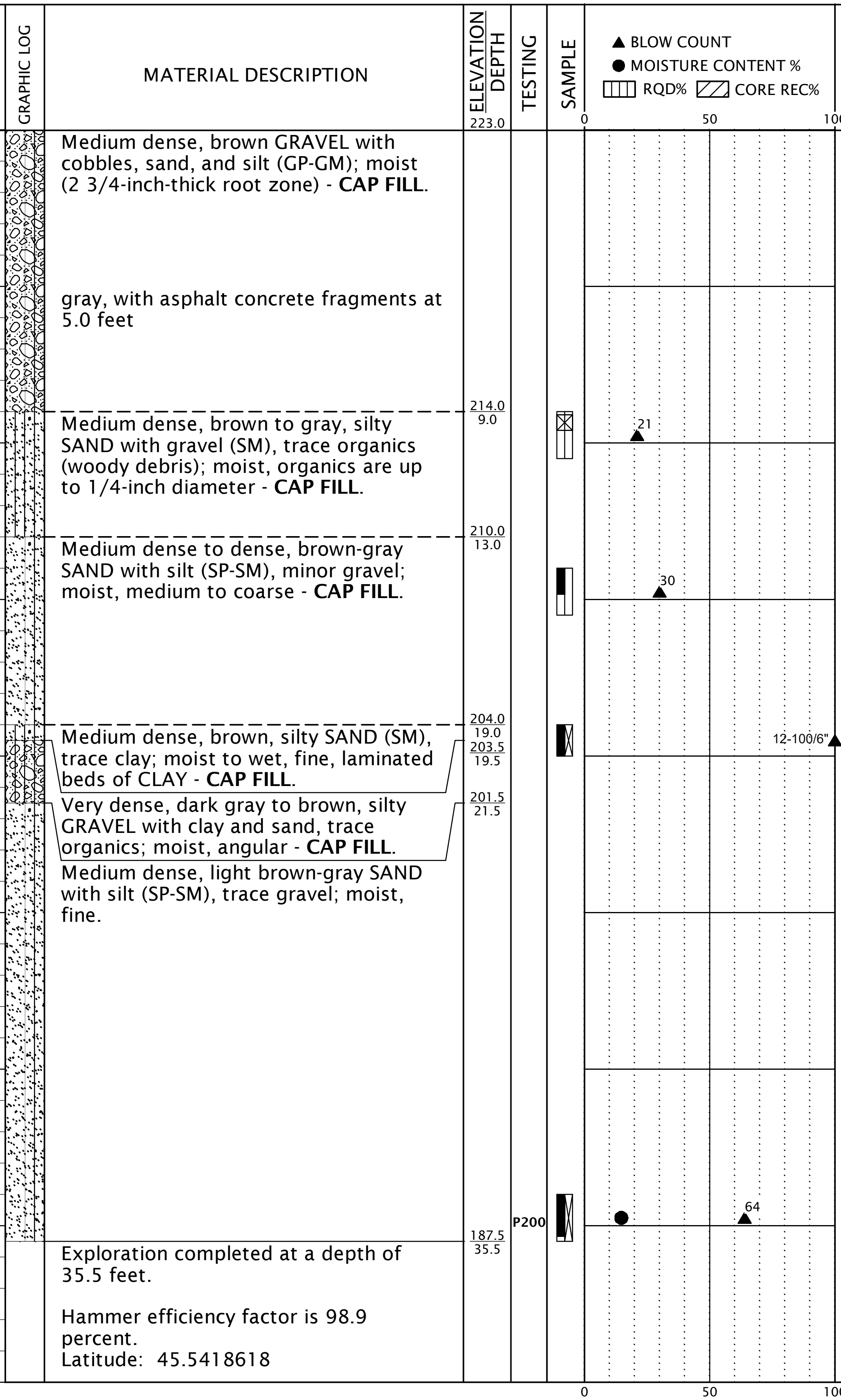
BORING B-11
(continued)

82ND AND SISKIYOU DEVELOPMENT
PORTLAND, OR

FIGURE A-11

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	BLOW COUNT	INSTALLATION AND COMMENTS
0	Medium dense, brown GRAVEL with cobbles, sand, and silt (GP-GM); moist (2 3/4-inch-thick root zone) - **CAP FILL**.	223.0			
5	gray, with asphalt concrete fragments at 5.0 feet				
9.0	Medium dense, brown to gray, silty SAND with gravel (SM), trace organics (woody debris); moist, organics are up to 1/4-inch diameter - **CAP FILL**.	214.0 9.0		21	No recovery on SPT at 9.0 feet. Switch to 3-inch sampler to collect sample.
13.0	Medium dense to dense, brown-gray SAND with silt (SP-SM), minor gravel; moist, medium to coarse - **CAP FILL**.	210.0 13.0		30	Smooth drilling from 13.0 to 19.0 feet with occasional minor chatter.
19.0	Medium dense, brown, silty SAND (SM), trace clay; moist to wet, fine, laminated beds of CLAY - **CAP FILL**.	204.0 19.0		12-100/6"	Infiltration test: ~0 inches per hour at 19.0 feet.
19.5	Very dense, dark gray to brown, silty GRAVEL with clay and sand, trace organics; moist, angular - **CAP FILL**.	203.5 19.5			Smooth drilling at 21.5 feet.
21.5	Medium dense, light brown-gray SAND with silt (SP-SM), trace gravel; moist, fine.	201.5 21.5			Occasional minor chatter from 21.5 to 24.0 feet. Moderate chatter from 27.0 to 29.0 feet; scattered gravel. Smooth at 29.0 feet. Occasional minor chatter at 32.5 feet.
35			P200	64	Infiltration test: 4 inches per hour at 34.0 feet. P200 = 9%
35.5	Exploration completed at a depth of 35.5 feet. Hammer efficiency factor is 98.9 percent. Latitude: 45.5418618	187.5 35.5			



DRILLED BY: Western States Soil Conservation, Inc.
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COMPLETED: 06/24/16

BORING METHOD: hollow-stem auger (see document text)
BORING BIT DIAMETER: 10 inches

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BORING B-12

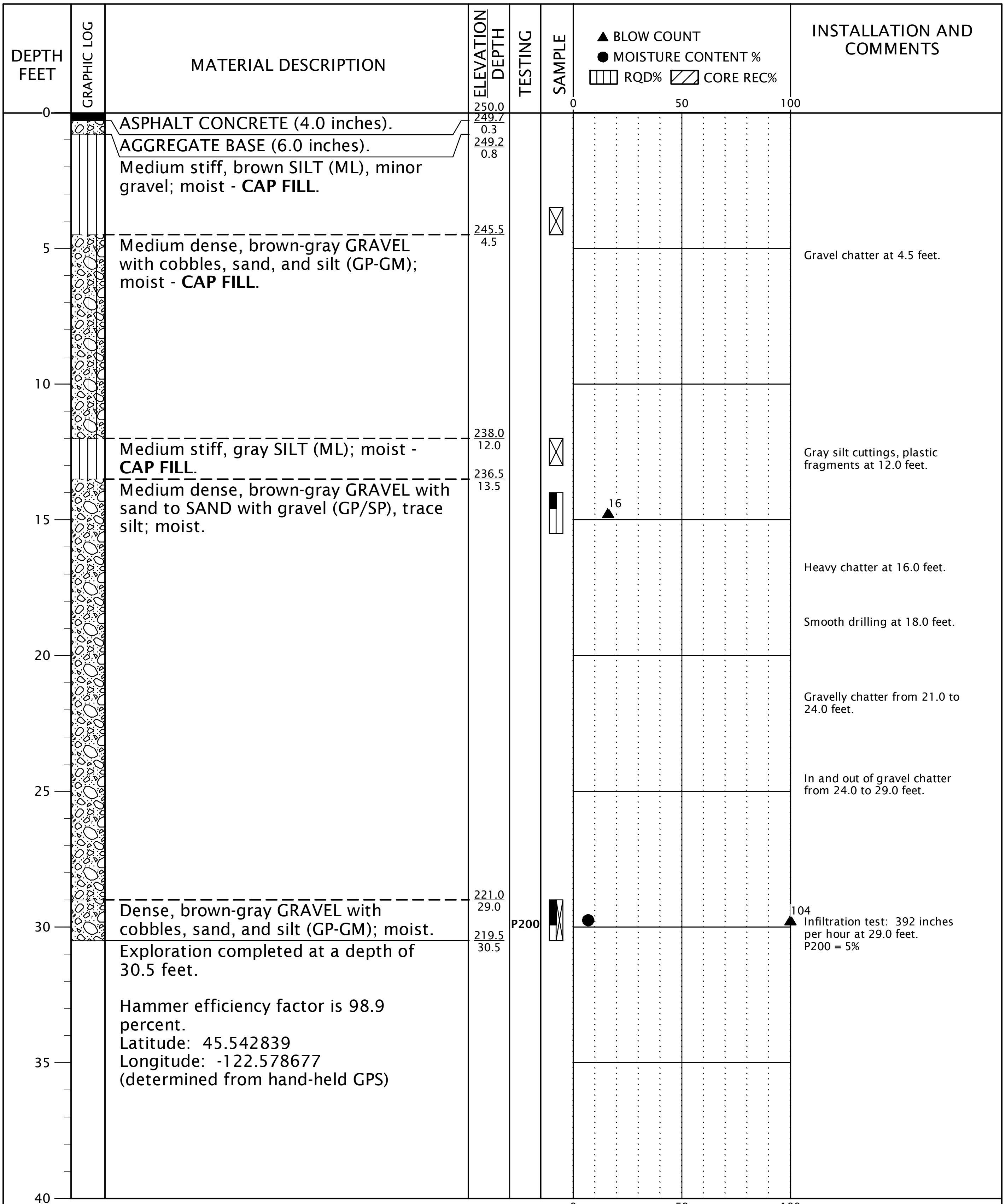
82ND AND SISKIYOU DEVELOPMENT
PORTLAND, OR

FIGURE A-12

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC% 0 50 100	INSTALLATION AND COMMENTS
40		Longitude: -122.5772237 (determined from hand-held GPS)					
45							
50							
55							
60							
65							
70							
75							
80						0 50 100	

DRILLED BY: Western States Soil Conservation, Inc.
LOGGED BY: JGH
COMPLETED: 06/24/16

BORING METHOD: hollow-stem auger (see document text)
BORING BIT DIAMETER: 10 inches



MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	INSTALLATION AND COMMENTS
	250.0		
ASPHALT CONCRETE (4.0 inches).	249.7 0.3		
AGGREGATE BASE (6.0 inches).	249.2 0.8		
Medium stiff, brown SILT (ML), minor gravel; moist - **CAP FILL**.	245.5 4.5		
Medium dense, brown-gray GRAVEL with cobbles, sand, and silt (GP-GM); moist - **CAP FILL**.	238.0 12.0		Gravel chatter at 4.5 feet.
Medium stiff, gray SILT (ML); moist - **CAP FILL**.	236.5 13.5		Gray silt cuttings, plastic fragments at 12.0 feet.
Medium dense, brown-gray GRAVEL with sand to SAND with gravel (GP/SP), trace silt; moist.	221.0 29.0		Heavy chatter at 16.0 feet. Smooth drilling at 18.0 feet. Gravelly chatter from 21.0 to 24.0 feet. In and out of gravel chatter from 24.0 to 29.0 feet.
Dense, brown-gray GRAVEL with cobbles, sand, and silt (GP-GM); moist.	219.5 30.5	P200	Infiltration test: 392 inches per hour at 29.0 feet. P200 = 5%

Exploration completed at a depth of 30.5 feet.

Hammer efficiency factor is 98.9 percent.
Latitude: 45.542839
Longitude: -122.578677
(determined from hand-held GPS)

DRILLED BY: Western States Soil Conservation, Inc.
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COMPLETED: 06/24/16

BORING METHOD: hollow-stem auger (see document text)
BORING BIT DIAMETER: 10 inches

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BORING B-13

82ND AND SISKIYOU DEVELOPMENT
PORTLAND, OR

FIGURE A-13

BORING LOG CAPSTONE-13-01-B1_13-TP1_21.GPJ GEODESIGN.GDT PRINT DATE: 9/15/23:RC:KT

TP-13

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT (%) 0 50 100	COMMENTS
0.0		Loose, gray SAND with gravel (SP), trace silt; dry to moist (3-inch-thick root zone) - **CAP FILL**.	247.5				Moderate caving observed from 0.0 to 2.5 feet. ~40% gravel at 2.0 feet.
2.5		Stiff, dark gray SILT (ML), minor sand and gravel, trace clay and organics (woody debris); moist - **CAP FILL**.	245.0 2.5		☒		Wood and brick debris at 4.0 feet.
5.0		Exploration terminated at a depth of 4.0 feet on landfill material. Latitude: 45.542730 Longitude: -122.57814 (determined from hand-held GPS)	243.5 4.0				No groundwater seepage observed to the depth explored.
7.5							
10.0							
12.5							

0 50 100

TP-14

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT (%) 0 50 100	COMMENTS
0.0		Medium stiff, brown SILT (ML), minor sand, trace gravel, clay, and organics (rootlets); moist, sand is fine, interbeds of medium dense, gray SAND (SP) (up to 4 inches thick) (5-inch-thick root zone) - **CAP FILL**.	241.1				
2.5		Stiff, gray-blue SILT with sand and cobbles (ML), minor gravel, trace clay and organics (wood debris); moist - **CAP FILL**.	239.1 2.0		☒	●	~5% cobbles at 3.0 feet. Concrete and wood debris at 4.5 feet.
5.0		Exploration terminated at a depth of 4.5 feet on landfill material. Latitude: 45.542370 Longitude: -122.575988 (determined from hand-held GPS)	236.6 4.5				No groundwater seepage observed to the depth explored. No caving observed to the depth explored.
7.5							
10.0							
12.5							

0 50 100

EXCAVATED BY: Western States Soil Conservation, Inc.

LOGGED BY: JCH

COMPLETED: 05/19/16

EXCAVATION METHOD: trackhoe (see document text)

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TEST PIT

82ND AND SISKIYOU DEVELOPMENT
PORTLAND, OR

FIGURE A-20

TP-15

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT (%) 0 50 100	COMMENTS
0.0		Stiff, dark brown SILT with sand and gravel (ML), trace clay and organics (rootlets); moist (4-inch-thick root zone) - **CAP FILL**.	243.6		☒		Metal debris/pipes at 1.0 foot.
		Stiff, blue-gray SILT (ML), minor sand and gravel, trace clay and organics (woody debris); moist - **CAP FILL**.	241.6 2.0				Wood and concrete debris at 3.0 feet.
		Exploration terminated at a depth of 3.0 feet on landfill material. Latitude: 45.542397 Longitude: -122.576729 (determined from hand-held GPS)	240.6 3.0				No groundwater seepage observed to the depth explored. No caving observed to the depth explored.

TP-16

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT (%) 0 50 100	COMMENTS
0.0		Loose, gray SAND (SP), trace silt and organics (rootlets); dry to moist (3-inch-thick root zone) - **CAP FILL**.	245.0				Moderate caving observed from 0.0 to 1.5 feet.
		Stiff, brown SILT (ML), minor sand and clay, trace gravel; moist - **CAP FILL**. gray-blue at 2.0 feet	243.5 1.5		☒		
		Exploration terminated at a depth of 4.0 feet on landfill material. Latitude: 45.542314 Longitude: -122.577672 (determined from hand-held GPS)	241.0 4.0				Wood debris at 4.0 feet. No groundwater seepage observed to the depth explored.

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EXCAVATION METHOD: trackhoe (see document text)

TP-17

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT (%) 0 50 100	COMMENTS
0.0	Medium stiff, red-brown SILT with sand (ML), minor clay and gravel, trace organics (rootlets); moist (4-inch-thick root zone) - **CAP FILL**. with gravel at 2.0 feet blue-gray, some clay at 3.5 feet	243.4		☒		
5.0	Exploration terminated at a depth of 4.5 feet on landfill material. Latitude: 45.542298 Longitude: -122.578547 (determined from hand-held GPS)	238.9 4.5				Wood debris at 4.5 feet. No groundwater seepage observed to the depth explored. No caving observed to the depth explored

TP-18

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT (%) 0 50 100	COMMENTS
0.0	Medium stiff, red-brown SILT with sand (ML), trace clay, gravel, and organics (rootlets); moist (6-inch-thick root zone) - **CAP FILL**. gravelly, with cobbles at 1.5 feet	219.6				Metal and plastic debris at 0.5 foot. ~15% cobbles at 1.5 feet.
2.5	Dense, gray, silty GRAVEL with cobbles (GM), minor sand, trace clay; moist - **CAP FILL**. very dense at 4.0 feet	217.1 2.5		☒	●	~5% cobbles at 2.5 feet. Hard digging; ~20% cobbles at 4.0 feet.
5.0	Exploration terminated at a depth of 4.0 feet due to refusal on cobbles. Latitude: 45.541904 Longitude: -122.576336 (determined from hand-held GPS)	215.6 4.0				No groundwater seepage observed to the depth explored. No caving observed to the depth explored.

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EXCAVATION METHOD: trackhoe (see document text)

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TEST PIT

82ND AND SISKIYOU DEVELOPMENT
PORTLAND, OR

FIGURE A-22

TP-19

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT (%) 0 50 100	COMMENTS
0.0 2.5		Medium stiff, brown SILT with sand (ML), minor gravel, trace organics (rootlets); moist (3-inch-thick root zone) - **CAP FILL**. plastic, metal, and brick debris at 3.0 feet gray-brown, with gravel and cobbles at 3.5 feet	221.0 217.0 4.0				Large concrete, brick, and metal debris at the ground surface to the depth explored. ~15% cobbles at 3.0 feet. ~10% cobbles at 4.0 feet. ~20% cobbles at 4.5 feet.
5.0		Dense, gray-brown GRAVEL with silt and cobbles (GP-GM), minor sand; moist - **CAP FILL**. dark gray at 4.5 feet	215.5 5.5		☒		Dense cobbles and concrete debris at 5.5 feet. No groundwater seepage observed to the depth explored. No caving observed to the depth explored.
7.5 10.0 12.5		Exploration terminated at a depth of 5.5 feet on landfill material. Latitude: 45.541915 Longitude: -122.576892 (determined from hand-held GPS)				0 50 100	

TP-20

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT (%) 0 50 100	COMMENTS
0.0 2.5		Medium stiff, brown SILT with sand (ML), minor gravel, trace clay and organics (rootlets); moist (4-inch-thick root zone) - **CAP FILL**. gravelly at 2.5 feet gray, with metal debris at 3.0 feet	223.7 220.7 3.0		☒	●	Trash and metal debris from 0.5 foot to the depth explored. Slow groundwater seepage observed at 3.0 feet. No caving observed to the depth explored.
5.0 7.5 10.0 12.5		Exploration terminated at a depth of 3.0 feet on landfill material. Latitude: 45.541902 Longitude: -122.577473 (determined from hand-held GPS)				0 50 100	

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COMPLETED: 05/19/16

EXCAVATION METHOD: trackhoe (see document text)

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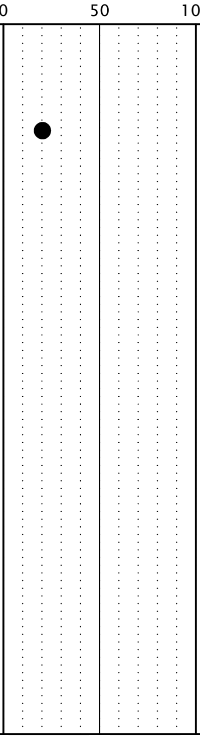
TEST PIT

82ND AND SISKIYOU DEVELOPMENT
PORTLAND, OR

FIGURE A-23

TP-21

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT (%)	COMMENTS
0.0		Medium stiff, brown SILT with sand (ML), minor gravel, trace clay and organics (rootlets); moist (4-inch-thick root zone) - **CAP FILL**.	225.9			0 50 100	Asphalt concrete and plastic debris at 0.5 foot.
2.5					☒		Metal debris at 2.0 feet.
		gray at 3.0 feet	222.9 3.0				Metal debris and wood debris at 3.0 feet.
		Exploration terminated at a depth of 3.0 feet on landfill material.					No groundwater seepage observed to the depth explored. No caving observed to the depth explored.
5.0		Latitude: 45.541905 Longitude: -122.578022 (determined from hand-held GPS)					
7.5							
10.0							
12.5							
						0 50 100	

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EXCAVATION METHOD: trackhoe (see document text)

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	JANUARY 2017	82ND AND SISKIYOU DEVELOPMENT PORTLAND, OR	**FIGURE A-24**

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
B-1	2.5	243.5	82							
B-1	15.0	231.0	65							
B-1	70.0	176.0	13							
B-2	15.0	233.9	90							
B-2	45.0	203.9	8							
B-3	65.0	176.2	30				31			
B-3	75.0	166.2	29							
B-4	2.5	240.3	105							
B-4	65.0	177.8	21							
B-5	3.0	237.6	13							
B-5	5.0	235.6	96							
B-5	15.0	225.6	56							
B-5	25.0	215.6	29							
B-6	90.0	150.7	26							
B-6	100.0	140.7	36				68			
B-7	15.0	232.3	7				5			
B-7	25.0	222.3	8				5			
B-8	30.0	211.6	30							
B-8	80.0	161.6	121							
B-8	85.0	156.6	26							
B-8	115.0	126.6	26				81			
B-8	125.0	116.6	27							
B-9	27.5	197.8	13				9			
B-9	35.0	190.3	14				13			
B-10	20.0	200.0	16				12			
B-10	26.5	193.5	8				7			
B-11	34.0	196.0	17				8			

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SUMMARY OF LABORATORY DATA

82ND AND SISKIYOU DEVELOPMENT
PORTLAND, OR

FIGURE A-25

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
B-12	34.0	189.0	15				9			
B-13	29.0	221.0	7				5			
TP-1	3.0	246.4	11							
TP-2	1.5	241.9	15							
TP-4	2.0	238.1	20							
TP-8	3.0	242.0	12							
TP-14	3.5	237.6	20							
TP-18	3.5	216.1	12							
TP-20	2.0	221.7	18							
TP-21	2.0	223.9	20							

LAB SUMMARY CAPSTONE-13-01-B1_13-TP1_21.GPJ GEODESIGN.GDT PRINT DATE: 1/11/17:KT

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SUMMARY OF LABORATORY DATA
(continued)

82ND AND SISKIYOU DEVELOPMENT
PORTLAND, OR

FIGURE A-25

WSSC-7-01 - TEST BORING B-7 25FT
OP: WMN

TRACK RIG NO. 2
Date: 30-May-2015

AR: 1.41 in²
LE: 29.25 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft³
EM: 30,000 ksi
JC: 0.00 ▯

ETR: Energy Transfer Ratio
EMX: Max Transferred Energy
CSB: Compression Stress at Bottom
BPM: Blows per Minute
FFS: Force Full Scale

DMX: Maximum Displacement
SFR: Skin friction w/ damping correction
MEX: Maximum Strain
VMX: Maximum Velocity

BL#	depth ft	BLC bl/ft	ETR (%)	EMX k-ft	CSB ksi	BPM bpm	FFS kips	DMX in	SFR kips	MEX µE	VMX f/s
10	25.16	6	81.3	0.3	0.0	48.5	60	1.09	0	957	13.6
12	25.48	6	87.0	0.3	0.0	49.1	60	0.82	0	973	14.4
14	25.81	6	83.8	0.3	0.0	49.0	60	0.67	0	915	14.0
16	26.13	6	86.2	0.3	0.0	48.7	60	0.57	0	986	14.4
18	26.45	6	83.8	0.3	0.0	48.7	60	0.53	0	974	14.1
20	26.77	6	85.7	0.3	0.0	48.7	60	0.56	0	950	14.3
22	27.10	6	85.0	0.3	0.0	48.8	60	0.57	0	942	14.2
24	27.42	6	86.7	0.3	0.0	48.3	60	0.61	0	985	14.5
26	27.74	6	84.7	0.3	0.0	48.6	60	0.57	0	968	14.4
28	28.06	6	86.4	0.3	0.0	48.2	60	0.82	0	941	14.5
30	28.39	6	84.0	0.3	0.0	48.3	60	0.56	0	939	14.0
40	30.00	6	85.1	0.3	0.0	48.5	60	1.03	0	900	14.8
42	30.27	7	81.9	0.3	0.0	48.8	60	0.59	0	893	13.8
44	30.54	7	82.0	0.3	0.0	48.8	60	0.97	0	912	13.8
46	30.81	7	85.4	0.3	0.0	48.5	60	0.59	0	936	14.3
48	31.08	7	81.7	0.3	0.0	48.6	60	0.49	0	873	13.7
50	31.35	7	85.7	0.3	0.0	48.3	60	0.55	0	920	14.0
52	31.62	7	84.4	0.3	0.0	48.3	60	0.56	0	928	14.0
54	31.89	7	84.0	0.3	0.0	48.4	60	0.48	0	865	13.9
56	32.16	7	88.3	0.3	0.0	48.4	60	0.89	0	914	14.5
58	32.43	7	82.2	0.3	0.0	48.5	60	0.38	0	937	13.9
60	32.70	7	84.1	0.3	0.0	48.7	60	1.12	0	858	13.5
62	32.97	7	86.7	0.3	0.0	48.4	60	0.93	0	883	14.1
64	33.24	7	83.0	0.3	0.0	48.6	60	0.95	0	929	13.9
66	33.51	7	81.1	0.3	0.0	48.3	60	0.36	0	911	13.7
82	35.67	7	84.7	0.3	0.0	48.7	60	0.66	0	809	16.1
84	35.83	13	82.9	0.3	0.0	48.7	60	0.53	0	780	15.2
86	35.98	13	84.6	0.3	0.0	48.8	60	0.67	0	796	15.6
88	36.14	13	84.7	0.3	0.0	48.5	60	0.75	0	790	15.8
90	36.30	13	83.8	0.3	0.0	48.2	60	0.55	0	794	16.1
92	36.46	13	85.8	0.3	0.0	48.5	60	0.43	0	867	17.1
94	36.61	13	87.3	0.3	0.0	48.6	60	1.18	0	858	17.0
96	36.77	13	82.1	0.3	0.0	48.5	60	0.38	0	803	15.5
98	36.93	13	83.0	0.3	0.0	48.5	60	0.67	0	782	15.6
100	37.09	13	83.9	0.3	0.0	48.7	60	0.37	0	861	16.8
102	37.24	13	85.3	0.3	0.0	48.5	60	0.37	0	882	17.1
104	37.40	13	83.7	0.3	0.0	48.4	60	0.37	0	879	16.7
106	37.56	13	84.7	0.3	0.0	48.3	60	0.37	0	848	17.4
108	37.72	13	84.8	0.3	0.0	48.3	60	0.38	0	855	16.8
110	37.87	13	84.2	0.3	0.0	48.4	60	0.37	0	869	16.6
112	38.03	13	86.9	0.3	0.0	48.3	60	0.45	0	883	17.5
114	38.19	13	86.1	0.3	0.0	48.5	60	0.44	0	869	17.3
116	38.35	13	84.3	0.3	0.0	48.4	60	0.83	0	858	16.2
118	38.50	13	84.8	0.3	0.0	48.3	60	0.38	0	860	16.4
120	38.66	13	85.2	0.3	0.0	48.3	60	0.68	0	839	16.1

WSSC-7-01 - TEST BORING B-7 25FT
OP: WMN

TRACK RIG NO. 2
Date: 30-May-2015

BL#	depth	BLC	ETR	EMX	CSB	BPM	FFS	DMX	SFR	MEX	VMX
	ft	bl/ft	(%)	k-ft	ksi	bpm	kips	in	kips	µE	f/s
122	38.82	13	84.2	0.3	0.0	48.4	60	0.37	0	872	16.7
124	38.98	13	84.7	0.3	0.0	48.4	60	0.75	0	836	16.6
126	39.13	13	83.4	0.3	0.0	48.3	60	0.48	0	834	16.0
137	40.00	13	84.9	0.3	0.0	50.8	60	0.56	0	925	14.9
139	40.16	13	85.4	0.3	0.0	50.3	60	0.54	0	917	14.7
141	40.31	13	84.1	0.3	0.0	50.4	60	0.50	0	914	14.3
143	40.47	13	87.5	0.3	0.0	50.3	60	0.83	0	933	14.6
145	40.63	13	86.8	0.3	0.0	50.6	60	0.85	0	929	14.1
147	40.79	13	86.4	0.3	0.0	50.6	60	0.66	0	948	14.6
149	40.94	13	84.2	0.3	0.0	50.7	60	0.44	0	929	14.4
151	41.10	13	85.2	0.3	0.0	50.5	60	0.45	0	933	14.0
153	41.26	13	85.8	0.3	0.0	50.5	60	0.56	0	924	14.4
155	41.42	13	86.6	0.3	0.0	50.4	60	0.63	0	936	14.5
157	41.57	13	85.7	0.3	0.0	50.8	60	0.55	0	926	14.7
159	41.73	13	86.8	0.3	0.0	50.6	60	0.51	0	930	14.4
161	41.89	13	85.6	0.3	0.0	50.5	60	0.55	0	899	13.7
163	42.05	13	87.3	0.3	0.0	50.5	60	0.92	0	918	13.8
165	42.20	13	85.5	0.3	0.0	50.1	60	0.86	0	923	13.5
167	42.36	13	85.1	0.3	0.0	50.8	60	0.71	0	922	13.8
		Average	85.0	0.3	0.0	49.0	60	0.64	0	892	15.0
		Std. Dev.	1.8	0.0	0.0	0.9	0	0.25	0	53	1.2

Total number of blows analyzed: 128

BL# Sensors

9-167 F3: [SPT B1] 217.8 (1.00); F4: [SPT B2] 218.9 (1.00); A3: [K0232] 290.0 (1.00);
A4: [K0231] 325.0 (1.00)

BL# Comments

31 N: 7,9,14
40 LE = 34.20 ft; WC = 16,765.8 f/s
67 N: 7,10,18
82 LE = 39.42 ft; WC = 16,764.7 f/s
127 N: 13, 20, 26
137 LE = 44.10 ft; WC = 16,774.5 f/s
167 N: 8,15,16

Time Summary

Drive	27 seconds	5:31 PM - 5:32 PM (5/30/2015) BN 9 - 31
Stop	14 minutes 52 seconds	5:32 PM - 5:47 PM
Drive	33 seconds	5:47 PM - 5:47 PM BN 40 - 67
Stop	19 minutes 59 seconds	5:47 PM - 6:07 PM
Drive	55 seconds	6:07 PM - 6:08 PM BN 82 - 127
Stop	16 minutes 13 seconds	6:08 PM - 6:24 PM
Drive	35 seconds	6:24 PM - 6:25 PM BN 137 - 167

Total time [00:53:37] = (Driving [00:02:31] + Stop [00:51:06])

WSSC-7-01 - TEST BORING B-6 25FT
OP: WMN

TRUCK NO. 5
Date: 30-May-2015

AR: 1.41 in^2
LE: 29.42 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft^3
EM: 30,000 ksi
JC: 0.00 □

ETR: Energy Transfer Ratio
EMX: Max Transferred Energy
CSB: Compression Stress at Bottom
BPM: Blows per Minute
FFS: Force Full Scale

DMX: Maximum Displacement
SFR: Skin friction w/ damping correction
MEX: Maximum Strain
VMX: Maximum Velocity

BL#	depth ft	BLC bl/ft	ETR (%)	EMX k-ft	CSB ksi	BPM bpm	FFS kips	DMX in	SFR kips	MEX µE	VMX f/s
10	25.00	6	87.8	0.3	0.0	42.9	60	1.16	0	1,087	17.7
11	25.18	6	92.2	0.3	0.0	43.1	60	1.86	0	1,119	18.6
12	25.36	6	95.3	0.3	0.0	43.1	60	0.87	0	1,116	18.4
13	25.54	6	94.2	0.3	0.0	43.1	60	1.08	0	1,183	18.6
14	25.71	6	88.3	0.3	0.0	43.3	60	0.66	0	1,113	17.4
15	25.89	6	90.2	0.3	0.0	43.1	60	1.41	0	1,064	17.6
16	26.07	6	95.2	0.3	0.0	43.2	60	1.38	0	1,105	18.3
17	26.25	6	86.0	0.3	0.0	43.2	60	0.90	0	1,060	17.0
18	26.43	6	88.7	0.3	0.0	43.2	60	1.02	0	1,139	17.3
19	26.61	6	89.6	0.3	0.0	43.2	60	1.53	0	1,125	18.0
20	26.79	6	93.7	0.3	0.0	43.1	60	1.02	0	1,150	18.0
21	26.96	6	91.3	0.3	0.0	43.2	60	1.44	0	1,098	17.4
22	27.14	6	93.2	0.3	0.0	43.1	60	0.91	0	1,123	17.9
23	27.32	6	90.9	0.3	0.0	43.2	60	0.98	0	1,111	17.3
24	27.50	6	94.6	0.3	0.0	43.1	60	0.85	0	1,201	18.0
25	27.68	6	95.9	0.3	0.0	43.1	60	0.89	0	1,197	18.1
26	27.86	6	92.4	0.3	0.0	43.2	60	1.63	0	1,066	17.0
27	28.04	6	85.8	0.3	0.0	43.2	60	0.52	0	1,116	16.0
28	28.21	6	90.5	0.3	0.0	43.2	60	0.62	0	1,120	16.6
29	28.39	6	89.1	0.3	0.0	43.2	60	0.97	0	1,133	16.4
30	28.57	6	89.5	0.3	0.0	43.4	60	0.62	0	1,146	16.2
31	28.75	6	90.7	0.3	0.0	43.0	60	0.80	0	1,092	16.3
38	30.00	6	92.2	0.3	0.0	48.0	60	0.92	0	1,004	18.2
39	30.17	6	90.3	0.3	0.0	47.8	60	1.17	0	1,025	18.2
40	30.33	6	94.2	0.3	0.0	47.9	60	0.90	0	1,008	18.2
41	30.50	6	96.5	0.3	0.0	47.5	60	1.02	0	1,027	18.3
42	30.67	6	92.7	0.3	0.0	47.9	60	1.27	0	1,000	18.1
43	30.83	6	91.8	0.3	0.0	47.9	60	1.00	0	1,018	18.4
44	31.00	6	94.9	0.3	0.0	47.8	60	1.42	0	1,023	18.1
45	31.17	6	95.2	0.3	0.0	47.7	60	1.20	0	1,072	18.4
46	31.33	6	97.9	0.3	0.0	47.8	60	1.57	0	998	18.0
47	31.50	6	93.0	0.3	0.0	47.8	60	0.90	0	1,008	18.0
48	31.67	6	91.1	0.3	0.0	47.7	60	0.92	0	981	17.7
49	31.83	6	94.3	0.3	0.0	48.1	60	1.01	0	1,013	18.2
50	32.00	6	95.1	0.3	0.0	47.8	60	0.92	0	1,073	18.5
51	32.17	6	90.9	0.3	0.0	47.8	60	0.72	0	1,003	17.7
52	32.33	6	93.5	0.3	0.0	47.7	60	0.91	0	1,005	17.8
53	32.50	6	97.8	0.3	0.0	48.0	60	0.96	0	1,065	18.4
54	32.67	6	100.2	0.4	0.0	47.8	60	1.31	0	1,017	18.2
55	32.83	6	91.6	0.3	0.0	47.6	60	0.64	0	1,054	18.1
56	33.00	6	84.5	0.3	0.0	48.0	60	0.80	0	983	17.3
57	33.17	6	88.4	0.3	0.0	47.9	60	0.40	0	1,050	18.1
58	33.33	6	99.6	0.3	0.0	47.6	60	1.72	0	1,012	17.9
68	35.00	6	96.0	0.3	0.0	46.9	60	0.85	0	1,023	17.8
69	35.12	8	89.8	0.3	0.0	47.0	60	0.70	0	972	17.1

WSSC-7-01 - TEST BORING B-6 25FT
OP: WMN
TRUCK NO. 5
Date: 30-May-2015

BL#	depth ft	BLC bl/ft	ETR (%)	EMX k-ft	CSB ksi	BPM bpm	FFS kips	DMX in	SFR kips	MEX µE	VMX f/s
70	35.24	8	96.5	0.3	0.0	46.9	60	0.75	0	1,089	18.4
71	35.37	8	73.6	0.3	0.0	46.5	60	0.96	0	906	15.5
72	35.49	8	99.6	0.3	0.0	47.4	60	0.67	0	1,028	18.3
73	35.61	8	93.9	0.3	0.0	47.0	60	0.68	0	1,018	17.5
74	35.73	8	93.0	0.3	0.0	47.0	60	0.71	0	1,007	17.6
75	35.85	8	93.1	0.3	0.0	46.9	60	0.94	0	1,014	17.3
76	35.98	8	97.3	0.3	0.0	46.9	60	1.05	0	1,013	17.7
77	36.10	8	92.0	0.3	0.0	47.1	60	0.56	0	1,024	17.3
78	36.22	8	95.5	0.3	0.0	46.9	60	0.82	0	1,015	17.6
79	36.34	8	96.7	0.3	0.0	47.0	60	1.26	0	1,037	17.9
80	36.46	8	97.5	0.3	0.0	47.0	60	0.66	0	1,051	18.2
81	36.59	8	99.7	0.3	0.0	47.1	60	0.57	0	1,071	18.4
82	36.71	8	93.1	0.3	0.0	47.0	60	0.75	0	1,041	17.6
83	36.83	8	101.8	0.4	0.0	46.9	60	1.14	0	1,043	18.4
84	36.95	8	93.0	0.3	0.0	47.0	60	0.54	0	1,033	17.6
85	37.07	8	101.3	0.4	0.0	46.9	60	1.11	0	1,076	18.4
86	37.20	8	96.0	0.3	0.0	47.0	60	0.75	0	1,030	18.1
87	37.32	8	94.5	0.3	0.0	47.1	60	0.38	0	1,069	18.0
88	37.44	8	100.3	0.4	0.0	46.9	60	1.11	0	1,079	18.4
89	37.56	8	103.0	0.4	0.0	47.0	60	1.24	0	1,065	18.4
90	37.68	8	92.4	0.3	0.0	46.9	60	0.61	0	1,022	17.7
91	37.80	8	97.4	0.3	0.0	47.0	60	0.46	0	1,034	18.4
92	37.93	8	94.7	0.3	0.0	47.0	60	0.83	0	1,044	18.0
93	38.05	8	97.4	0.3	0.0	47.1	60	0.98	0	1,026	17.8
94	38.17	8	97.9	0.3	0.0	46.9	60	0.75	0	1,030	17.9
95	38.29	8	95.1	0.3	0.0	46.9	60	0.44	0	1,050	18.0
96	38.41	8	93.9	0.3	0.0	47.0	60	0.34	0	1,046	17.9
97	38.54	8	94.2	0.3	0.0	47.1	60	0.33	0	1,069	18.4
109	40.00	8	95.5	0.3	0.0	49.4	60	0.81	0	1,056	18.7
110	40.12	8	96.5	0.3	0.0	49.5	60	1.18	0	1,080	18.9
111	40.24	8	99.1	0.3	0.0	49.6	60	1.42	0	1,119	19.4
112	40.37	8	97.5	0.3	0.0	49.6	60	1.07	0	1,110	19.0
113	40.49	8	93.5	0.3	0.0	49.3	60	1.35	0	1,041	18.8
114	40.61	8	91.0	0.3	0.0	49.4	60	0.66	0	1,091	17.7
115	40.73	8	99.7	0.3	0.0	49.4	60	0.78	0	1,084	19.6
116	40.85	8	97.6	0.3	0.0	49.5	60	1.32	0	1,114	19.7
117	40.98	8	97.9	0.3	0.0	49.4	60	1.24	0	1,070	19.5
118	41.10	8	93.1	0.3	0.0	49.5	60	1.26	0	1,055	18.9
119	41.22	8	97.5	0.3	0.0	49.5	60	1.29	0	1,133	19.6
120	41.34	8	96.8	0.3	0.0	49.3	60	1.29	0	1,134	19.2
121	41.46	8	94.7	0.3	0.0	49.5	60	0.79	0	1,107	18.4
122	41.59	8	94.3	0.3	0.0	49.4	60	0.55	0	1,044	17.9
123	41.71	8	96.3	0.3	0.0	49.4	60	2.00	0	1,073	19.4
124	41.83	8	98.9	0.3	0.0	49.4	60	0.68	0	1,114	19.0
125	41.95	8	95.9	0.3	0.0	49.5	60	0.66	0	1,092	18.4
126	42.07	8	98.3	0.3	0.0	49.4	60	1.12	0	1,069	18.3
127	42.20	8	95.6	0.3	0.0	49.3	60	1.41	0	1,075	18.0
128	42.32	8	96.9	0.3	0.0	49.6	60	0.84	0	1,079	18.1
129	42.44	8	94.7	0.3	0.0	49.6	60	0.47	0	1,146	18.5
		Average	94.2	0.3	0.0	46.8	60	0.96	0	1,064	18.0
		Std. Dev.	4.2	0.0	0.0	2.2	0	0.34	0	52	0.7

Total number of blows analyzed: 94

BL#	Sensors
10-129	F3: [SPT B1] 217.8 (1.00); F4: [SPT B2] 218.9 (1.00); A3: [K0232] 290.0 (1.00); A4: [K0231] 325.0 (1.00)

BL#	Comments
31	N: 8,10,11
38	LE = 35.10 ft; WC = 16,715.9 f/s
58	5, 7, 14
68	LE = 40.10 ft; WC = 16,794.3 f/s
97	N: 8,13,17
109	LE = 45.10 ft; WC = 16,714.3 f/s
129	N: 10,10,11

Time Summary

Drive	29 seconds	4:13 PM - 4:13 PM (5/30/2015) BN 10 - 31
Stop	37 minutes 37 seconds	4:13 PM - 4:51 PM
Drive	25 seconds	4:51 PM - 4:51 PM BN 38 - 58
Stop	23 minutes 16 seconds	4:51 PM - 5:14 PM
Drive	37 seconds	5:14 PM - 5:15 PM BN 68 - 97
Stop	26 minutes 48 seconds	5:15 PM - 5:42 PM
Drive	24 seconds	5:42 PM - 5:42 PM BN 109 - 129

Total time [01:29:38] = (Driving [00:01:55] + Stop [01:27:43])

WSSC-7-01 - TEST BORING B-5 25.5FT TRACK RIG NO.7
OP: WMN Date: 30-May-2015

AR: 1.41 in² SP: 0.492 k/ft³
LE: 29.25 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.00 Π

ETR: Energy Transfer Ratio
EMX: Max Transferred Energy
CSB: Compression Stress at Bottom
BPM: Blows per Minute
FFS: Force Full Scale
DMX: Maximum Displacement
SFR: Skin friction w/ damping correction
MEX: Maximum Strain
VMX: Maximum Velocity

BL#	depth ft	BLC bl/ft	ETR (%)	EMX k-ft	CSB ksi	BPM bpm	FFS kips	DMX in	SFR kips	MEX µE	VMX f/s
9	25.68	6	97.2	0.3	0.0	48.5	60	2.02	0	982	20.2
11	26.04	6	98.6	0.3	0.0	48.6	60	1.91	0	995	19.7
13	26.40	6	96.6	0.3	0.0	48.6	60	1.11	0	968	18.1
15	26.76	6	98.3	0.3	0.0	48.6	60	0.98	0	986	18.3
17	27.12	6	97.6	0.3	0.0	48.5	60	0.88	0	1,025	18.1
19	27.48	6	97.7	0.3	0.0	48.7	60	0.96	0	1,069	18.4
21	27.84	6	97.1	0.3	0.0	48.4	60	1.10	0	1,047	17.9
23	28.20	6	99.0	0.3	0.0	48.5	60	1.15	0	1,017	18.1
25	28.56	6	98.0	0.3	0.0	48.6	60	1.05	0	1,047	17.8
34	30.14	7	99.9	0.3	0.0	50.7	60	1.39	0	973	18.4
36	30.42	7	100.2	0.4	0.0	50.5	60	1.39	0	944	18.8
38	30.69	7	100.0	0.4	0.0	50.6	60	1.32	0	1,006	17.5
40	30.97	7	98.1	0.3	0.0	50.4	60	0.72	0	1,018	17.6
42	31.25	7	99.3	0.3	0.0	50.4	60	0.64	0	1,028	16.9
44	31.53	7	100.5	0.4	0.0	50.5	60	0.82	0	1,000	19.3
46	31.81	7	100.8	0.4	0.0	50.4	60	0.76	0	1,041	17.8
48	32.08	7	101.0	0.4	0.0	50.3	60	0.65	0	987	19.1
50	32.36	7	102.0	0.4	0.0	50.8	60	0.65	0	1,049	17.7
52	32.64	7	99.0	0.3	0.0	50.3	60	0.75	0	971	19.4
54	32.92	7	101.0	0.4	0.0	50.5	60	0.49	0	1,048	17.9
56	33.19	7	101.8	0.4	0.0	50.5	60	0.91	0	1,040	18.6
58	33.47	7	98.6	0.3	0.0	50.3	60	0.48	0	978	19.4
69	35.00	7	100.4	0.4	0.0	50.3	60	0.69	0	1,055	17.2
71	35.22	9	99.2	0.3	0.0	50.3	60	0.60	0	1,070	17.0
73	35.44	9	97.6	0.3	0.0	50.2	60	0.67	0	1,068	17.3
75	35.67	9	95.0	0.3	0.0	50.2	60	0.70	0	1,055	16.5
77	35.89	9	99.9	0.3	0.0	50.1	60	0.49	0	1,088	17.1
79	36.11	9	98.5	0.3	0.0	50.1	60	0.53	0	1,075	17.0
81	36.33	9	98.5	0.3	0.0	50.2	60	0.62	0	1,094	17.2
83	36.56	9	100.7	0.4	0.0	50.1	60	0.60	0	1,101	17.0
85	36.78	9	99.9	0.3	0.0	50.0	60	0.61	0	1,109	17.4
87	37.00	9	100.6	0.4	0.0	50.2	60	0.89	0	1,106	17.1
89	37.22	9	100.2	0.4	0.0	50.2	60	0.49	0	1,075	17.3
91	37.44	9	98.8	0.3	0.0	50.0	60	0.52	0	1,036	17.3
93	37.67	9	100.1	0.4	0.0	50.2	60	0.54	0	1,025	17.2
95	37.89	9	98.9	0.3	0.0	50.1	60	0.44	0	1,080	17.0
97	38.11	9	99.9	0.3	0.0	50.0	60	0.42	0	1,051	17.4
99	38.33	9	97.6	0.3	0.0	50.2	60	0.67	0	1,050	16.9
101	38.56	9	102.0	0.4	0.0	49.9	60	0.69	0	1,046	17.0
103	38.78	9	100.6	0.4	0.0	50.1	60	0.69	0	1,038	17.7
105	39.00	9	99.6	0.3	0.0	50.0	60	0.42	0	1,081	17.7
115	40.11	9	96.5	0.3	0.0	49.9	60	0.88	0	982	17.3
117	40.33	9	97.2	0.3	0.0	49.7	60	1.25	0	991	16.9
119	40.56	9	97.7	0.3	0.0	49.8	60	0.80	0	1,029	17.0
121	40.78	9	98.4	0.3	0.0	50.0	60	0.94	0	1,027	17.2

WSSC-7-01 - TEST BORING B-5 25.5FT
OP: WMN

TRACK RIG NO.7
Date: 30-May-2015

BL#	depth ft	BLC bl/ft	ETR (%)	EMX k-ft	CSB ksi	BPM bpm	FFS kips	DMX in	SFR kips	MEX µE	VMX f/s
123	41.00	9	97.8	0.3	0.0	50.0	60	1.05	0	996	17.7
125	41.22	9	97.5	0.3	0.0	49.9	60	1.01	0	958	18.1
127	41.44	9	97.1	0.3	0.0	49.7	60	0.87	0	1,009	17.6
129	41.67	9	96.7	0.3	0.0	49.9	60	0.95	0	955	17.7
131	41.89	9	97.9	0.3	0.0	49.9	60	1.02	0	984	17.5
133	42.11	9	99.2	0.3	0.0	49.8	60	1.04	0	995	18.0
135	42.33	9	98.1	0.3	0.0	49.9	60	0.91	0	979	17.8
		Average	98.9	0.3	0.0	49.9	60	0.88	0	1,027	17.7
		Std. Dev.	1.7	0.0	0.0	0.6	0	0.33	0	41	0.8

Total number of blows analyzed: 105

BL#	Sensors
8-136	F3: [SPT B1] 217.8 (1.00); F4: [SPT B2] 218.9 (1.00); A3: [K0232] 290.0 (1.00); A4: [K0231] 325.0 (1.00)

BL#	Comments
25	N: 6,6,12
33	LE = 33.75 ft; WC = 16,714.3 f/s
59	N: 6,9,18
69	LE = 38.75 ft; WC = 16,774.9 f/s
105	N: 8,16,21
114	LE = 44.10 ft
136	N: 7,9,14

Time Summary

Drive	20 seconds	3:11 PM - 3:12 PM (5/30/2015) BN 8 - 25
Stop	13 minutes 22 seconds	3:12 PM - 3:25 PM
Drive	30 seconds	3:25 PM - 3:26 PM BN 33 - 59
Stop	18 minutes 53 seconds	3:26 PM - 3:44 PM
Drive	43 seconds	3:44 PM - 3:45 PM BN 69 - 105
Stop	17 minutes 56 seconds	3:45 PM - 4:03 PM
Drive	26 seconds	4:03 PM - 4:04 PM BN 114 - 136

Total time [00:52:14] = (Driving [00:02:01] + Stop [00:50:12])

NV5

Delivering Solutions
Improving Lives