Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West
Engineering, Inc

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April 11, 2024

Dharma Rain Zen Center
8500 NE Siskiyou Street
Portland, OR 97220

Attn: Kakumyo Lowe-Charde

**Re: Addendum 1**
**Updated Geotechnical Recommendations**
**Dharma Rain Zen Center**
**8500 NE Siskiyou Street**
**Portland, Oregon**
**CWE Project: Dharma-1-01-1**

## INTRODUCTION

Columbia West Engineering, Inc. (Columbia West) is pleased to submit this addendum to the geotechnical engineering report for the Dharma Rain Zen Center located in Portland, Oregon.[1] We understand that a new classroom building and detached solar carport are proposed in the north portion of the site. The purpose of this addendum is to provide foundation support recommendations for the proposed structures and provide updated seismic design recommendations in accordance with the 2022 State of Oregon Structural Specialty Code (SOSSC).

## BACKGROUND

As indicated above, a geotechnical engineering study was prepared in 2013 for development of the existing Dharma Rain Zen Center. The 2013 geotechnical report is presented in the Appendix. Prior to site development, the property operated as a landfill, which was permitted to receive building and demolition debris, wood products, metal, heavy industrial debris, and similar materials. Subsurface conditions encountered during the 2013 geotechnical study consist of a landfill soil cap underlain by up to 77 feet of landfill construction debris. Native gravel, sand, and silt were encountered below the landfill debris.

Based on the presence of landfill debris and associated static settlement concerns, geotechnical recommendations for site development included placing a 10-foot-tall surcharge over proposed building pad and pavement areas. Various areas of the site were then surcharged and monitored for settlement between 2014 and 2017, including areas of the proposed carport and classroom building. Surcharges placed over the carport and classroom building areas were left in place for approximately four months and experienced settlement ranging from 0.6 inch to 2.2 inches. The surcharge soil was subsequently removed, and the improved areas have generally remained in their existing state since 2017.

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[1] GeoDesign, Inc., 2013. *Report of Geotechnical Engineering Services; Proposed Householder Refuge and Temple; LaVelle Landfill; NE 82nd Avenue and NE Siskiyou Street; Portland, Oregon*, dated May 10, 2013.

Due to presence of wood in the landfill material, the site was also subject to long-term settlement risks associated with decomposition of organics over time. Total long-term settlement was estimated to be 12 inches with differential settlement up to 6 inches. To limit long-term differential settlement to 2 inches, site structures were supported by 4-foot-thick, geogrid-reinforced mats of structural fill.

We recently visited the site to observe the condition of the existing structures and observed no evidence of differential foundation settlement.

## FOUNDATION SUPPORT

### *CLASSROOM BUILDING*

We understand that the proposed classroom building will be two stories tall and of wood-framed construction. Foundation loads were unknown at the time this addendum was prepared; however, we assume that maximum wall loads will be less than 2 kips per foot. Cuts of fills are not planned.

Based on the subsurface conditions at the site, we recommend the proposed classroom building be supported by shallow foundations bearing on a minimum 4-foot-thick, geogrid-reinforced mat of structural fill. The structural fill should consist of crushed rock with less than 30 percent fines by weight compacted to 95 percent of the maximum dry density as determined by ASTM D1557. The structural fill should be reinforced at 12-inch intervals starting at the base of the mat using Synteen TF100 (or an engineer-approved equivalent) biaxial geogrid. The reinforced fill should extend a minimum of 8 feet beyond the perimeter of the building pad area.

### Bearing Capacity

Continuous perimeter wall and isolated spread footings should have minimum widths of 18 and 24 inches, respectively. The base of exterior footings should be at least 18 inches below the lowest adjacent exterior grade. The base of interior footings should bear at least 12 inches below the base of the floor.

Footings bearing on subgrade prepared as recommended above should be sized based on an allowable bearing pressure of 2,000 pounds per square foot. As the allowable bearing pressure is a net bearing pressure, the weight of the footing and associated backfill may be ignored when calculating footing sizes. The recommended allowable bearing pressure applies to the total of dead plus long-term live loads and may be increased by 50 percent for transient lateral forces such as seismic or wind.

### Settlement

Shallow foundations bearing on a geogrid-reinforced mat as recommended in this addendum are expected to experience total post-construction settlement of less than 4 inches. Differential post-construction settlement between comparably loaded footing elements is not expected to exceed 2 inches over a distance of 50 feet.

### Resistance to Sliding

Lateral loads on building footings can be resisted by passive earth pressure on the sides of the structures and by friction on the base of footings. Our analysis indicates that the available passive earth pressure for footings confined by the on-site soil or planned structural fill is 350 pounds per cubic foot, modeled as an equivalent fluid pressure. Adjacent floor slabs, pavement, or the upper 12-inch depth of unpaved areas should not be considered when calculating passive resistance. An allowable coefficient of friction equal to 0.4 can be used for footings in direct contact with the geogrid-reinforced mat.

These recommendations are consistent with the recommendations provided in the 2013 geotechnical report that was used for design and construction of the structures that currently occupy the site.

## *SOLAR CARPORT*

We understand that the proposed solar carport consists of a 17-foot by 61-foot solar array supported by three cantilevered metal posts bearing on individual concrete spread footings. The spread footings will be square, 48 inches wide, and embedded 5.25 feet below grade. Foundation loads are expected to approach 10 kips during downforce wind conditions. Cuts of fills are not planned. Correspondence with the carport manufacturer, MT Solar, indicates that the structure can tolerate a significant amount of differential settlement without causing damage to the array or support frame. Further, the metal support posts are designed to be adjustable and can be realigned as needed based on foundation performance.

Provided the solar carport is maintained to withstand total long-term settlement of 12 inches with up to 6 inches of differential settlement, the structure's foundation can be supported by firm site soil without the need for a geogrid-reinforced mat. Allowable bearing capacity and lateral resistance should adhere to the recommendations outlined above. The footings should be adequately sized to resist uplift forces from wind loading.

### Subgrade Observation and Preparation

All footing subgrade should be evaluated by a representative of Columbia West to confirm suitable bearing conditions. Observations should also confirm that loose or soft material, organic material, unsuitable fill, prior topsoil zones, and softened subgrade (if present) have been removed. Localized deepening of footing excavations may be required to penetrate any deleterious or soft material, particularly during wet weather conditions.

## SEISMIC DESIGN CRITERIA

Seismic design for the proposed structures is prescribed by the 2022 SOSSC, which references ASCE 7-16. As presented in the 2013 geotechnical report, the site soil meets the criteria for Site Class E. Seismic design parameters for Site Class E are presented in Table 1.

### Table 1. Seismic Design Parameters in Accordance with ASCE 7-16[1]

| Parameter | Short Period ($T_s$) | 1 Second Period ($T_1$) |
|---|---|---|
| MCE Spectral Acceleration, S | $S_s$ = 0.885 g | $S_1$ = 0.381 g |
| Site Class | E | |
| Site Coefficient, F | $F_a$ = 1.0[2] | $F_v$ = 2.5 |
| Adjusted Spectral Response Acceleration, $S_M$ | $S_{MS}$ = 0.89 g | $S_{M1}$ = 0.95 g |
| Design Spectral Response Acceleration, $S_D$ | $S_{DS}$ = 0.59 g | $S_{D1}$ = 0.64 g |

1. The structural engineer should evaluate ASCE 7-16 code requirements and exceptions to determine if these parameters are valid for design.
2. $F_a$ value corresponding to Site Class C in accordance with ASCE 7-16, Section 11.4.8, Exception 1.

g: gravitational acceleration (32.2 feet/second$^2$)
MCE: maximum considered earthquake

For Site Class E sites with a mapped MCE spectral response acceleration parameter $S_S$ greater than or equal to 1.0 or $S_1$ greater than or equal to 0.2, a ground motion hazard analysis may be required according to ASCE 7-16, Section 11.4.8 unless exemption criteria are met. According to ASCE 7-16, Section 11.4.8, Exception 1, a ground motion hazard analysis is not required for Site Class E sites with $S_S$ greater than or equal to 1.0, provided the site coefficient $F_a$ is taken as equal to that of Site Class C.

According to ASCE 7 16, Section 11.4.8, Exception 3, a ground motion hazard analysis is also not required for Site Class E sites with $S_1$ greater than or equal to 0.2, provided that T is less than or equal to $T_s$, where T is the fundamental period of the structure, and $T_s$ is equal to the design spectral response acceleration parameter at a one second period ($S_{D1}$) divided by the design spectral response acceleration parameter at short periods ($S_{DS}$).

Columbia West recommends that project structural engineer evaluate code requirements and exceptions to determine if a site-specific ground motion hazard evaluation will be required for proposed structures.

◆ ◆ ◆

We appreciate the opportunity to submit this addendum. Please do not hesitate to contact us if you have questions or require additional information.

Sincerely,

Greg L. Williamson, PE
Senior Geotechnical Engineer

Brett A. Shipton, PE, GE
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
56207
OREGON
July 11, 2000
BRETT A. SHIPTON
EXPIRES: 6/30/24

GLW:BAS:kat

Attachment

Document ID: Dharma-1-01-1-041124-geoa-1.docx

# APPENDIX

# APPENDIX
## SUBSURFACE EXPLORATION BY OTHERS

The report of a geotechnical engineering study conducted by GeoDesign, Inc. in April 2013 is presented in this appendix. The report provides geotechnical engineering recommendations that were used to design and construct the structures that currently occupy the site.

GEODESIGN INC

# REPORT OF GEOTECHNICAL ENGINEERING SERVICES

Proposed Householder Refuge and Temple
LaVelle Landfill
NE 82nd Avenue and NE Siskiyou Street
Portland, Oregon

For
Dharma Rain Zen Center
May 10, 2013

GeoDesign Project:  DharmaRain-1-03

GEODESIGN INC

May 10, 2013

Dharma Rain Zen Center
2539 SE Madison Street
Portland, OR 97214

Attention:  Kakumyo Lowe-Charde

**Report of Geotechnical Engineering Services**
Proposed Householder Refuge and Temple
LaVelle Landfill
NE 82nd Avenue and NE Siskiyou Street
Portland, Oregon
GeoDesign Project:  DharmaRain-1-03

GeoDesign is pleased to submit our report of geotechnical engineering services for the proposed Householder Refuge and Temple located at the Lavelle Landfill at NE 82nd Avenue and NE Siskiyou Street in Portland, Oregon.  Our services for this project were conducted in accordance with our revised proposal dated February 4, 2013.

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

Sincerely,

GeoDesign, Inc.

Brett A. Shipton, P.E., G.E.
Principal Engineer

VCL:BAS:kt
Attachments
One copy submitted (via email only)
Document ID: DharmaRain-1-03-051013-geor.docx

15575 SW Sequoia Pkwy, Suite 100 | Portland, OR 97224 | 503.968.8787 www.geodesigninc.com

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## 1.0 INTRODUCTION

This report presents the results of our geotechnical engineering study for the proposed Householder Refuge and Temple at the LaVelle Landfill at NE 82nd Avenue and NE Siskiyou Street in Portland, Oregon. The site is located east of NE 82nd Avenue between NE Siskiyou Street and NE Russell Street at the LaVelle Landfill site. It is our understanding that Dharma Rain Zen Center is planning to develop an approximately 14-acre parcel of land located at the eastern half of the former LaVelle Landfill. The site location relative to surrounding physical features is shown on Figure 1. For your reference, definitions of acronyms used herein are defined at the end of this document.

Based on our understanding, the preliminary plan is to build seven residential buildings, six general buildings, a roadway, and parking areas. We have assumed that the buildings will be between two and three stories tall and will be wood-framed. Foundation loads were unknown at the time of this report. However, based on our experience with similar structures, we estimate that maximum column and wall loads will be less than 100 kips and 3 kips per foot, respectively. We anticipate that floor slab loads will be less than 100 psf. Further, based on the proposed contours, we anticipate that cuts and fills will be less than 2 feet each. We understand that shallow mat or raft foundations are being considered to support the buildings. The foundation system will include permanent jacks that will be used to level the buildings if differential settlement occurs. The current plan is to install drywells at the southeast corner of the site for stormwater drainage. The site and proposed improvements are shown on Figure 2.

## 2.0 BACKGROUND

GeoDesign previously conducted a historical review of the site and a limited Phase II ESA (GeoDesign, 2001a). Our prior work at the site included installing two deep groundwater monitoring wells to assess potential impacts on regional groundwater and conducting methane monitoring at numerous existing wells across the site. In addition, GeoDesign provided a preliminary report of geotechnical engineering and environmental consulting services for a retail center on site (GeoDesign, 2001b). Our work in 2001 included drilling four borings to maximum depths of 86.5 feet BGS, excavating six test pits to maximum depths of 17 feet BGS, and installing two monitoring wells for methane measurements.

The overall 23-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 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 DEQ 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 and 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.

An active landfill gas recovery system is in-place and operational and includes extraction wells along the north side of the former landfill south of NE Siskiyou Street. Numerous gas monitoring wells exist at various locations around the perimeter of the landfill.

## 3.0 PURPOSE AND SCOPE

The scope of our services was to characterize subsurface conditions and provide geotechnical engineering recommendations for use in design and construction of the facility. Our scope of services included the following:

- Coordinated and managed the field investigation, including locating utilities and scheduling subcontractors.
- Completed a subsurface investigation that consisted of drilling the following explorations:
    - Ten drilled borings to depths ranging between 6.5 and 86.5 feet BGS. Infiltration testing was completed in three borings along the proposed NE Siskiyou half street at depths of approximately 5 feet BGS.
    - Five excavated test pits at the southeast corner of the site to depths ranging between 5.0 and 17.0 feet BGS for infiltration testing.
- Our representative obtained representative soil samples for laboratory testing and maintained a continuous log of subsurface conditions encountered in each exploration.
- Completed a laboratory testing program that consisted of the following:
    - Eighteen moisture content determinations of selected samples in general accordance with ASTM D 2216
    - Five fines content determinations in general accordance with ASTM C 117 or ASTM D 1140
    - Four organic content determinations in general accordance with ASTM D 2974
- One suite of corrosivity tests, including pH, soluble sulfate and chloride content, and soil resistivity, completed by an outside laboratory.
- Provided recommendations for site preparation, grading and drainage, stripping depths, fill type for imported material, compaction criteria, subgrade preparation, cut and fill slope criteria, and procedures for use of on-site soil and wet weather earthwork.
- Provided foundation recommendations, including anticipated foundation settlement, bearing capacity, and lateral resistance.
- Provided recommendations for mitigating future settlement, including surcharging and deep dynamic compaction.
- Provided recommendations regarding corrosion protection.
- Provided recommendations for construction of AC pavements for on-site access roads and parking areas, including subbase, base course, and pavement thickness.
- Provided a discussion of seismic activity near the site and provided parameters for use in computing design levels of ground shaking in accordance with the 2010 SOSSC.
- Provided this report summarizing the results of our geotechnical evaluation.

# 4.0 SITE CONDITIONS

## *4.1 SURFACE CONDITIONS*

The site consists of the approximate eastern half of the 23-acre property located at the southeast corner of NE 82nd Avenue and NE Siskiyou Street in Portland, Oregon. The site is bound to the west by NE 82nd Avenue and the west half of the landfill, to the north by NE Siskiyou Street, to the east by a drainage swale, and to the south by residential and commercial developments. A high school is located to the southwest across NE 82nd Avenue, and residences are located to the north across NE Siskiyou Avenue. A retail carpet store is located on the western border of the property along the east side of NE 82nd Avenue. The extraction pump housing for the methane collection system is located approximately 40 feet north of the carpet store. Remnant structures from a former golf driving range are located on the west portion of the site, to the east of the retail carpet store. The northwest corner of the site is developed with a retail plaza.

The site is relatively flat, sloping gently to the northeast, with existing elevations varying between approximately 235 and 245 feet above MSL in areas of proposed development. The site slopes downward at an approximate slope of 2H:1V to 3H:1V along the eastern and southern borders of the site. A fill berm is present at the southeast corner of the site. The berm is approximately 250 feet long, ranging from approximately 25 to 40 feet wide and from 4 to 7 feet tall.

Short and tall grass covers most of the site and thicker brush, blackberry bushes, and small deciduous trees are present along the northeast, east, and south borders of the site. Ponded water was observed at the ground surface in several locations across the site at the time of our exploration.

## *4.2 SUBSURFACE CONDITIONS*

### 4.2.1 General

Our subsurface exploration program consisted of drilling 10 borings (B-1 through B-10) to depths ranging between 6.5 and 86.5 feet BGS and excavating 5 test pits (TP-1 through TP-5) to depths ranging between 5.0 and 17.0 feet BGS. Borings B-1 through B-3 were located within the proposed NE Siskiyou half-street, outside of the landfill, to evaluate infiltration rates for proposed stormwater swales. Borings B-4 through B-10 were drilled in the general vicinity of proposed building and development areas. The test pits were located at the southeast corner of the site to evaluate infiltration capacity for proposed stormwater disposal facilities. Copies of the exploration logs and results of the laboratory testing are provided in Appendix A of this report. Copies of our previous exploration logs completed in 2001 are included in Appendix B. The locations of the current and previous explorations are shown on Figure 2.

In general, the soil conditions encountered are consistent with prior explorations at the site and consist of a landfill soil cap underlain by landfill material, in turn underlain by native dense to very dense sand and gravel.

A root zone between 2 and 6 inches thick was observed in our explorations. The subsurface units encountered in our explorations are described in the following sections.

#### 4.2.2 Fill

The landfill soil cap was encountered in all boring explorations within the landfill area (B-4 through B-10) and ranged in thickness from approximately 2.5 to 7 feet. The cap generally consists of loose to medium dense, silty sand; medium stiff to very stiff silt with varying amounts of sand and gravel; and loose to medium dense, silty gravel with sand.

Below the cap, construction debris was encountered to approximate depths ranging between 77 and 72 feet thick in borings B-9 and B-10, respectively. The construction debris observed in our explorations consisted of wood with varying amounts of paper, cardboard, metal, plastic, rubber, glass, carpet, concrete and asphalt chunks, brick fragments, and trace amounts of silt and gravel.

At the southeast corner of the site, fill was encountered in all of the test pits and generally extended to the maximum depth of test pits TP-1 through TP-3 (depths ranging between 5 and 17 feet BGS) and to depths of 2.0 and 5.5 feet BGS in TP-4 and TP-5, respectively. The fill was composed of loose to medium dense, silty gravel with cobbles, boulders, and various debris. The debris ranges with concrete, AC, brick, glass, metal pipe, and trace organic (woody) debris.

Laboratory testing of selected samples of the landfill cap soil indicates the moisture contents ranged from approximately 15 to 42 percent and samples of the landfill debris indicate that the moisture content ranged from approximately 15 to 135 percent at the time of our exploration. Laboratory testing of selected samples of the landfill debris indicate the organic content ranged from approximately 9 to 48 percent.

#### 4.2.3 Native Soil

Within the landfill area, native soil was encountered beneath the landfill material at depths of 77 and 72 feet BGS in borings B-9 and B-10, respectively. The native soil consists of medium dense to very dense gravel with varying amounts of silt and sand and very dense sand with silt and gravel to the maximum depths of the borings at 81.5 and 86.5 feet BGS, respectively.

In the borings drilled at the north edge of the property, outside of the landfill area (B-1 through B-3), native soil was encountered at the ground surface and extends to the maximum depth of the borings at 6.5 feet BGS. The soil consists of medium dense gravel with sand, cobbles, and minor silt; loose sand with varying amounts of silt and gravel; and medium stiff silt with gravel and minor sand.

At the southeast corner of the site, native soil was encountered at depths of 2 and 5.5 feet BGS in TP-4 and TP-5, respectively, and extends to the maximum depths of the explorations at 11.0 and 13.0 feet BGS. The native soil consists of medium stiff silt with sand to silty sand with gravel, ranging with trace to some organics (woody debris and rootlets) to depths of 7.5 and 11.0 feet BGS in TP-4 and TP-5, respectively. The silt and silty sand is underlain by medium dense sand with gravel and cobbles.

Laboratory testing indicates that moisture contents of the native soil ranged from 10 to 16 percent at the time of our exploration. The moisture content of the sand tested in B-3 at 5.0 feet BGS was approximately 21 percent at the time of our exploration.

### 4.2.4 Groundwater

Perched groundwater seepage was encountered at a depth of 24.5 feet BGS in boring B-10, and slow to minor groundwater seepage was encountered at depths of approximately 3 to 3.5 feet in test pits TP-1, TP-2, and TP-5.

Based on our review of water well logs on file with OWRD, projects completed in the site vicinity, and according to a recent compilation of data by the City of Portland and Gresham, Clackamas, and Multnomah Counties (Snyder, 2008), the estimated depth to groundwater in the site vicinity is greater than approximately 40 feet BGS. We anticipate the depth to permanent groundwater at this site is at the base of the landfill. The depth to groundwater may fluctuate in response to seasonal changes, prolonged rainfall, changes in surface topography, and other factors not observed in this study.

## *4.3 INFILTRATION TESTING*

Infiltration tests were conducted in three borings (B-1 through B-3) along the proposed NE Siskiyou half-street at depths recommended by CWK2 Land Development Consultants. Infiltration testing was also conducted at the southeast corner of the site in test pit TP-4. During our exploration, this area was accessible only by a trackhoe due to soft surficial soil and steep slopes. Testing was attempted in test pits TP-1 through TP-3, near the proposed locations of drywells; however, fill was encountered in the test pits and extended to the maximum depth achievable by the trackhoe (17.0 feet BGS). We excavated two test pits (TP-4 and TP-5) further to the southeast, near the property lines, to investigate the horizontal limits of the fill. We conducted infiltration testing in TP-4 at a depth of 10 feet BGS, where native soil consisting of coarse-grained sand and gravel was encountered. We attempted infiltration in TP-5 at a depth of 12 feet BGS, but we were unable to conduct the test due to the distance of the test pit downslope from our water source. Where infiltration testing was conducted, the soil was generally saturated under a low head of 1 to 2 feet. Infiltration rates were then determined by infiltrating under a falling head.

Representative grab samples were collected below the infiltration test depths for grain-size analysis. Table 1 presents a summary of infiltration test results and fines content determinations. The exploration logs and laboratory testing results are presented in Appendix A of this report.

**Table 1. Field Infiltration Test Results**

| Exploration | Depth (feet BGS) | Observed Infiltration Rate (inches/hour) | Fines Content[1] (percent) |
|---|---|---|---|
| B-1 | 5.6 | > 100 | 5.4 |
| B-2 | 5.0 | > 100 | 5.5 |
| B-3 | 5.5 | 7 | 23 |
| TP-4 | 10 | 90 | 17 |

1. Fines content: material passing the U.S. Standard No. 200 Sieve

The infiltration rates provided above are measured rates with no factor of safety. Correction factors should be applied to the measured infiltration rates by the civil engineer during design to account for the degree of long-term maintenance and influent/pre-treatment control, as well as the potential for long-term clogging due to siltation and bio-buildup, depending on the proposed length, location, and type of infiltration facility. In addition, correction factors to be applied to the test results are provided in Exhibit F.2-1 of the 2008 City of Portland Storm Water Manual. If built, we recommend that the installation of the swales and drywells be observed by a qualified geotechnical engineer to confirm that the soil conditions are consistent with our observations during our explorations.

We understand that DEQ requires that stormwater infiltration facilities be located such that water infiltrates outside and below the landfill prism. Based on our explorations at the southeast corner of the site, we recommend the bottom of the drywells be founded in the underlying sand with gravel and cobbles, since we anticipate infiltration within the overlying silt will not be favorable. Therefore, it may be necessary for the drywell excavations in this area to be deepened so that the sand or gravel layer is exposed at the bottom.

### *4.4 CORROSIVITY/CHEMICAL ACTIVITY*

One selected soil sample was tested for pH, soluble sulfates and chlorides, and specific conductivity (resistivity) by Specialty Analytical Laboratory in Clackamas, Oregon. The test results are presented in Table 2.

**Table 2. Corrosivity Test Results**

| Exploration | Depth (feet BGS) | Soil Classification | pH | Resistivity (ohm-cm) | Sulfate (mg/kg) | Chloride (mg/kg) |
|---|---|---|---|---|---|---|
| B-5 | 5.0 | Organic Soil (OL) – Landfill Material | 7.27 | 945 | 2,520 | 180 |

Soil with a measured resistivity less than 2,000 to 5,000 ohm-cm are considered to be potentially moderately corrosive (Wilmott and Jack, 2000). Values above 5,000 ohm-cm are not corrosive. pH values below 5 are considered corrosive. Sulfate contents above 200 mg/kg are considered corrosive. The tested values indicate that the soil sample tested is potentially corrosive to unprotected steel and/or ductile iron.

The results from Specialty Analytical are presented in Appendix C.

## 5.0 SITE DEVELOPMENT RECOMMENDATIONS

### *5.1 GENERAL*

Based on the results of our subsurface explorations and engineering analyses, it is our opinion that the site can be developed as proposed. In our opinion, the following factors will have an impact on design and construction of the proposed development:

- Where structural improvements are proposed, including buildings, pavement, and underground utilities, we recommend installing a surcharge on the site to mitigate potential settlement associated with the buried landfill debris. A more detailed discussion is presented in the "Surcharge Recommendations" section of this report.
- New structures should be designed to withstand total settlement of approximately 12 inches and differential settlement of approximately 6 inches.
- Foundation elements and underground utilities will need to be protected from corrosion.
- Utility pipes should include flexible joints.
- A method should be in place to control landfill gas on site. These recommendations are provided under separate cover, as described in the "Landfill Gas Mitigation" section of this report.
- The silty soil in the landfill cap can be sensitive to small changes in moisture content and difficult, if not impossible, to adequately compact during wet weather or when the moisture content of the soil is more than a couple of percent above the optimum required for compaction. If the moisture content of the soil currently is above optimum, drying will be required if used as structural fill.

The following sections present specific recommendations for use in design and construction of the proposed development.

## *5.2 LONG-TERM DIFFERENTIAL SETTLEMENT*

Based on our explorations, the landfill debris is high in organic content 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. Special design and construction methods are required to reduce the effects of settlement.

Due to the heterogeneous nature of the landfill mass, the surface of the landfill will settle differentially. That is, some areas of the landfill will settle different magnitudes and at different rates than other areas. The differential settlement is caused by the variation in thickness, initial compaction, composition, and moisture of the landfill debris. The variability of the debris makes prediction of differential settlement largely undeterminable.

To help minimize the effects of settlement on proposed structural improvements, we recommend that areas be densified prior to construction of utilities and pavements. Methods of ground densification, or improvement, applicable to this site include either surcharging or dynamic compaction. Surcharging and dynamic compaction are discussed briefly below; however, in our opinion, surcharging will be more cost effective at this site. Specific recommendations for surcharging and foundation design recommendations are presented in later sections of this report.

### 5.2.1 Surcharging

Pavement and building areas may be surcharged to reduce post-construction total and differential settlement by pre-compressing the landfill debris prior to construction. Surcharging, however, will not mitigate settlement associated with long-term decomposition, which will occur at a slow rate over many years. The surcharge height and duration are a function of the debris thickness and compressibility. The surcharge duration will be determined by settlement monitoring during surcharging. Further discussion of surcharging is provided in the "Surcharge Recommendations" section of this report.

### 5.2.2 Dynamic Compaction

Dynamic compaction is a method of ground densification where a large weight is repeatedly dropped by a crane on a grid pattern across the site. Prior to compaction, a working blanket consisting of granular fill should be placed over the area to be improved to provide support for construction equipment and protection for the landfill soil cap. In general, the weight is dropped 7 to 15 times at each grid location and multiple passes are required. After each pass the craters created by the weight are backfilled and the site is leveled using imported granular fill. The degree of ground improvement, or densification, is a function of the weight of the tamper, the drop height, the grid spacing, and the number of drops at each location.

In addition to compaction of the landfill debris, dynamic compaction will create a stiff mat of highly compacted soil at the ground surface and will likely slow the decomposition rate of organic constituents. The compacted mat of soil will greatly reduce the effect of differential settlement at the ground surface.

Like surcharging, dynamic compaction does not mitigate settlement associated with long-term decomposition. Additional drawbacks to dynamic compaction include ground vibrations and lateral spreading of the near-surface ground; however, we do not anticipate these to be significant problems at this site.

## *5.3 CORROSION PROTECTION*

Based on the corrosivity testing performed on a selected sample obtained at the site, the landfill material is considered to be corrosive. In addition to low soil resistivity, the organic landfill debris presents conditions for microbial-induced corrosion, especially where saturated conditions exist. Microbial-induced corrosion is a process by which biological organisms attach to and corrode steel, iron, and other alloys at an accelerated rate. Unlike general corrosion that affects the entire exposed surface of the embedded metal structure, microbial corrosion can be concentrated in localized areas and is unaffected by cathodic protection systems. Anaerobic sulfate-reducing bacteria can also corrode conventional concrete under certain conditions.

We recommend that alternative materials such as concrete and plastics like PVC be used for underground utilities and foundation elements to limit corrosion wherever possible. If concrete is used, we recommend testing the on-site soil and landfill material for sulfate content to determine if sulfate-resistant concrete will be required. If metal materials are used for underground utilities, we recommend use of cathodic protection methods such as galvanizing or use of impressed current cathodic protection systems. Microbial-induced corrosion may necessitate the use of anti-corrosion surface coatings to protect metal utilities in close proximity to landfill material. We do not recommend that foundation elements consist solely of steel due to microbial-induced corrosion. Foundation recommendations are presented in the "Foundation Design Recommendations" section of this report.

## *5.4 LANDFILL GAS MITIGATION*

The proposed development will require methane gas collection systems. Building and pavement areas will require collection and venting systems. Utility trenches should include impermeable sections of backfill to prevent migration of methane. Routine monitoring of existing perimeter monitoring wells, active and passive ventilation systems, utility vaults, and building interiors is recommended to identify areas of potential concern, if any. Gas detection systems may be appropriate for use in the proposed buildings and enclosed areas as early warning devices and are typically calibrated to detect methane significantly below potential hazardous levels. The landfill gas should be mitigated as recommended in our Basis of Design and Engineering Approach letter, which was provided as Exhibit C of the PPA (GeoDesign, 2012).

## *5.5 SITE PREPARATION*

### 5.5.1 Stripping and Grubbing

The existing root zone and organic material should be stripped and removed from all proposed building, pavement, and surcharge fill areas. Based on our explorations, we anticipate a general stripping depth of approximately 5 to 6 inches over the vegetated areas of the site. Greater depths may be necessary to remove localized zones of organic material or deeper root zones in looser upper material. Although not anticipated, we recommend that any brush and woody vegetation be cleared and that any stumps and roots larger than 1 inch in diameter be completely removed. Stripping should extend at least 5 feet beyond the limits of proposed structural areas. Stripped material should be transported off site for disposal or used as fill in landscaping areas.

### 5.5.2 Subgrade Evaluation

After the surcharge is complete and the site is cut to required grades, the subgrade in proposed building and pavement areas should be proofrolled with a fully loaded dump truck or similar heavy rubber-tire construction equipment to identify soft, loose, or unsuitable areas. The proofrolling should be observed by a qualified geotechnical engineer or geotechnical field technician who should evaluate the suitability of the subgrade and identify areas of yielding, which are indicative of soft or loose soil. If soft or loose zones are identified during proofrolling, these areas should be excavated to the extent indicated by the engineer or technician and replaced with structural fill.

### 5.5.3 Wet Weather/Wet Soil Considerations

Trafficability of the surficial silty soil can be difficult during periods of wet weather or when the moisture content of the material is more than a few percentage points above optimum. This will likely be throughout the year, except mid-summer through early fall. When wet, the on-site silty soil is susceptible to disturbance and will provide inadequate support for construction equipment.

If site grading and fill placement must occur during wet weather conditions, we recommend that demolition be accomplished using track-mounted equipment and modified construction methods. For example, a track-mounted excavator equipped with a smooth-edged bucket could be used working from the paved surface or a granular pad and loading into trucks supported on granular haul roads or the existing pavement.

During wet weather conditions, the subgrade should be evaluated by probing with a steel rod rather than by proofrolling. Soil that is disturbed during site preparation activities during wet weather, as well as soft or loose zones identified during probing, should be removed and replaced with compacted structural fill.

### 5.5.4 Haul Road Guidelines

The use of granular haul roads will be necessary for support of construction traffic during most of the year, with the possible exception of the mid-summer to early fall period (typically from early July to mid-October). The contractor should be responsible for selecting the appropriate thickness of haul roads and working blankets. In our experience, a 12-inch-thick layer of imported granular material placed over the undisturbed subgrade is sufficient for light staging areas. An 18-inch-thick layer is typically adequate in areas exposed to repeated construction traffic. The imported granular material should be placed in one lift over the prepared subgrade and compacted using a smooth-drum roller without the use of vibratory action. To provide additional support, haul roads and granular working pads can be underlain by a woven subgrade geotextile meeting the requirements of OSSC 02320.

## *5.6 EXCAVATION*

### 5.6.1 Trench Cuts and Shoring

Excavations should stand vertical to a depth of approximately 4 feet, provided groundwater seepage does not occur. 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 maximum slope of 1.5H:1V, groundwater seepage does not occur, and with the understanding that some sloughing may occur. Shoring will be required for vertical cuts deeper than 8 feet where side slopes are not possible.

Approved temporary shoring is recommended for cuts where groundwater is present. 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.

### 5.6.2 Dewatering

Shallow excavations should not encounter the groundwater table, and significant dewatering operations are not expected. Runoff water may accumulate in excavations during periods of precipitation, and zones of perched groundwater may be encountered during extended periods of wet weather. A sump located within the trench excavation likely will be sufficient to remove the accumulated water, depending on the amount and persistence of water seepage and the length of time the trench is left open. Flow rates for dewatering are likely to vary depending on location, soil type, and the season during which the excavation occurs. The dewatering systems should be capable of adapting to variable flows. If groundwater is present at the base of utility excavations, we recommend placing up to 12 inches of trench stabilization material at the base of the excavation. Specifications for trench stabilization material are provided in the "Structural Fill" section of this report.

### 5.6.3 Safety

All excavations should be made in accordance with applicable OSHA and state regulations. While we have described certain approaches to the utility vault and trench excavations in the foregoing discussions, the contractor is responsible for selecting the excavation and dewatering methods, monitoring the trench excavations for safety, and providing shoring as required to protect personnel and adjacent improvements.

## *5.7 STRUCTURAL FILL*

Structural fill includes fill beneath foundations, slabs, pavements, other areas intended to support structures, or within the influence zones of structures. Fill should only be placed over a subgrade that has been prepared in conformance with the "Site Preparation" section of this report. All material used as structural fill should be free of organic matter or other unsuitable material. The material should meet the specifications provided in OSSC 00330. All structural fill should have a maximum particle size of 3 inches and not contain frozen, organic, or other deleterious material. A brief characterization of some of the acceptable material and our recommendations for its use as structural fill is provided below.

### 5.7.1 Landfill Cap Soil/Native Soil

The landfill cap soil and native soil encountered in the explorations along the proposed NE Siskiyou half-street are suitable for use as structural fill, provided they meet the specifications provided in OSSC 00330.12. Based on laboratory test results, the moisture content of the on-site silty soil was above optimum at the time of our explorations. We anticipate that significant moisture conditioning will be required to dry the soil to moisture contents near optimum. This will require an extended period of dry weather, typically experienced between early July and mid-October. When used as structural fill, the on-site soil should be placed in lifts with a maximum uncompacted thickness of 8 inches and compacted to not less than 92 percent of the maximum dry density, as determined by ASTM D 1557.

### 5.7.2 Imported Granular Material

Imported granular material used for 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 and OSSC 00330.15. Imported granular material should be fairly well graded between coarse and fine particle sizes and have less than 5 percent by dry weight passing the U.S. Standard No. 200 Sieve. The material should be placed in lifts with a maximum uncompacted thickness of 12 inches and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D 1557. During the wet season or when wet subgrade conditions exists, the initial lift should be approximately 18 inches in uncompacted thickness and compacted by rolling with a smooth-drum roller without use of vibratory action.

### 5.7.3 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 specifications provided in OSSC 00641. In addition, the aggregate should have less than 5 percent by dry weight passing the U.S. Standard No. 200 Sieve. The base aggregate should be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D 1557.

### 5.7.4 Trench Backfill

Trench backfill for the utility pipe base and pipe zone should consist of well-graded granular material with a maximum particle size of ¾ inch and less than 5 percent by dry weight passing the U.S. Standard No. 200 Sieve. The material should also meet the specifications provided in OSSC 00405.14. Backfill for the pipe base and pipe zone should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D 1557, or as recommended by the pipe manufacturer.

Within building, pavement, and other structural areas, trench backfill placed above the pipe zone should consist of imported granular material as specified above. The backfill should be compacted to at least 92 percent of the maximum dry density, as determined by ASTM D 1557, at depths greater than 2 feet below the finished subgrade and 95 percent of the maximum dry density, as determined by ASTM D 1557, within 2 feet of finished subgrade. In all other areas, trench backfill above the pipe zone should be compacted to at least 92 percent of the maximum dry density, as determined by ASTM D 1557.

### 5.7.5 Trench Stabilization Material

Trench stabilization material should consist of pit- or quarry-run rock, crushed rock, or crushed gravel and sand that meet the specifications provided in OSSC 00330.14 and OSSC 00330.15. In addition, the material should have a minimum particle size of 4 inches and contain less than 5 percent by dry weight passing the U.S. Standard No. 4 Sieve. The material should be free of organic matter and other deleterious material. Trench stabilization material should be placed in one lift and compacted until well keyed.

### 5.7.6 Drain Rock

Drain rock used for back-of-wall drains should meet the specifications provided in OSSC 00430.11. However, the material must also have a minimum of two fractured faces. The drain rock should be wrapped in a drainage geotextile fabric as described below.

## *5.8 TEMPORARY AND PERMANENT SLOPES*

Temporary cut slopes may be used where setbacks from existing structures are sufficient and groundwater seepage is not encountered in the cut. We recommend that temporary slopes not exceed 1.5H:1V for excavations up to 8 feet in height. Flatter slopes may be required if excavations extend into the landfill debris. The top of temporary slopes should be located at least 5 feet from pavements, utilities, buildings, or other such structures. Sloughing of temporary slopes can be expected, and maintenance during construction will likely be required. All temporary slopes should be made and maintained in accordance with applicable OSHA and state regulations.

Permanent cut and fill slopes completed in the native soil or structural fill should not exceed 2H:1V. Flatter slopes may be necessary where the landfill debris is near the ground surface. Footings, buildings, access roads, and pavements should be located at least 5 feet horizontally from the top of the slope. Slopes should be planted with appropriate vegetation as soon as possible after grading to provide protection against erosion. Surface water runoff should be collected and directed away from slopes to prevent water from running down the face of the slope.

### *5.9 SITE DRAINAGE*

We recommend that roof drains, retaining wall back drains, and other subsurface drains be connected to non-perforated pipes leading to the storm drain facilities. Access road, parking, and open space areas should be sloped so that surface water runoff is collected and routed to suitable discharge points. We recommend that ground surfaces within 10 feet of buildings be sloped at least 2 percent away from the foundations.

We anticipate stormwater at the site will be limited to precipitation and runoff of newly paved areas and roof drains and will not come into contact with waste, thereby, eliminating the need for special testing or additional source controls.

### *5.10 EROSION CONTROL*

The on-site soil is moderately susceptible to erosion. Consequently, we recommend that slopes be covered with an appropriate erosion control product if construction occurs during periods of wet weather. We recommend that all slope surfaces be planted as soon as practical to minimize erosion. Surface water runoff should be collected and directed away from slopes to prevent water from running down the slope face. Erosion control measures (such as straw bales, sediment fences, and temporary detention and settling basins) should be used in accordance with local and state ordinances.

## 6.0 SURCHARGE RECOMMENDATIONS

### *6.1 GENERAL*

As discussed in the “Long-Term Differential Settlement” section of this report, based on our subsurface explorations and analyses, it is our opinion that a surcharge program will be necessary to reduce post-construction settlement beneath proposed buildings and pavement areas on site. We recommend surcharging areas of proposed building footprints and pavement, and a minimum of 10 feet beyond these areas. We estimate the necessary height of the surcharge will be approximately 10 feet. The surcharge fill should have an in-place unit weight of at least 110 pcf. Temporary fill slopes for the surcharge can be built to a maximum gradient of 1.5H:1V. We anticipate a three-month surcharge period; however, the actual duration of the surcharge should be verified as described in the “Surcharge Monitoring” section of this report.

All fill placed below finished soil subgrade elevation should be placed and compacted in accordance with the recommendations in the “Structural Fill” section of this report. Surcharge material placed above finished subgrade does not need to be compacted as structural fill, provided the total unit weight of the material is at least 110 pcf. The settlement caused by the surcharge is very difficult to predict as the landfill debris is highly variable. We anticipate settlement from a few inches to a few feet.

Only some of the settlement will be mitigated by the surcharge program. Long-term settlement is still expected as the landfill material degrades over time, particularly where there is organic material present.

### *6.2 SURCHARGE MONITORING*

Settlement plates should be provided to monitor the progress of the surcharge. We recommend monitoring the surcharge settlement with one settlement plate per each 10,000 square feet of area and a minimum of four settlement plates for separate surcharge areas or phases.

A typical settlement plate detail is shown on Figure 3. For ease in handling, the casing and rod portions of the settlement plate are usually installed in 5-foot sections. As filling progresses, couplings are used to install additional sections. Continuity in the monitoring data is maintained by reading and recording the top of the measurement rod immediately prior to and following the addition of new sections. Care must be taken during fill construction not to bend or break the rods.

The settlement plates should be installed prior to site filling and immediately surveyed. Survey measurements should be taken at each settlement plate at least twice per week during fill construction and for at least one month after fill construction, followed by once weekly thereafter. In addition to recording the elevation of the settlement plates during each survey event, a complete record of the surcharge history requires reading and recording the fill height at each settlement plate.

The settlement plates should be monitored using survey equipment with an accuracy of 1/100th of a foot and referenced to a stationary datum established at least 500 feet from the edge of the surcharge area.

The survey data should be supplied to GeoDesign within three days of the survey. We will provide a Microsoft Excel spreadsheet to the surveyors that can be used to transfer data via email. Alternatively, GeoDesign could be retained to provide the settlement monitoring.

## 7.0 FOUNDATION DESIGN RECOMMENDATIONS

Based on the results of our explorations and analyses, it is our opinion that the proposed structures, with the anticipated design foundation loads as previously described, can be supported on shallow foundations bearing on firm soil. The buildings and foundations should be designed to withstand anticipated total settlement of approximately 12 inches and differential settlement of approximately 6 inches. The following sections provide our recommendations for use in foundation design and construction.

### *7.1 SHALLOW FOUNDATIONS*

#### 7.1.1 Bearing Capacity

We recommend the proposed structure be supported on shallow foundations bearing on firm soil. We recommend using an allowable bearing pressure of 2,000 psf for footings supported on 12-inch-thick granular pads. This is a net bearing pressure; the weight of the footing and overlying backfill can be ignored in calculating footing sizes. The recommended allowable bearing pressure applies to the total of dead plus long-term live loads and may be increased by 50 percent for short-term loads, such as those resulting from wind or seismic forces.

Granular pads should extend 6 inches beyond the margins of the footings for every foot excavated below the footings base grade. The granular pads should consist of imported granular material, as defined in the "Structural Fill" section of this report. The imported granular material should be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D 1557, or, as determined by one of our geotechnical staff, until well keyed. We recommend that a member of our geotechnical staff observe the prepared footing subgrade.

Continuous wall and spread footings should be at least 18 and 24 inches wide, respectively. The bottom of exterior footings should be at least 18 inches below the lowest adjacent final grade. The bottom of interior footings should be placed at least 12 inches below the base of the floor slab.

### 7.1.2 Lateral Resistance

Lateral loads on footings can be resisted by passive earth pressure on the sides of the structures and by friction on the base of the footings. Our analysis indicates that the available passive earth pressure for footings confined by firm soil and structural fill is 350 pcf. Adjacent floor slabs, pavements, or the upper 12-inch depth of adjacent unpaved areas should not be considered when calculating passive resistance. A coefficient of friction equal to 0.40 may be used when calculating resistance to sliding for footings in direct contact with the granular pads.

## *7.2 MAT FOUNDATIONS*

If the building can tolerate some minor settlement, it may be possible to support loads on a mat foundation bearing on firm soil.

We recommend the mat foundation be designed using a subgrade modulus ($k_s$) of 100 pci. We recommend that the maximum sustained allowable contact pressure from dead and long-term live loads not exceed 1,000 psf.

We recommend the mat foundation be underlain by at least 18 inches of imported crushed rock. The crushed rock should meet the requirements of aggregate base as described in the "Structural Fill" section of this report.

## *7.3 SETTLEMENT*

Foundations should be designed to withstand a total settlement of at least 12 inches and differential settlement approximately one-half of the total settlement. If grading plans or structural loads change, we should be contacted to perform additional settlement analyses.

## *7.4 SLABS ON GRADE*

We anticipate that slabs on grade can be damaged from long-term settlement; therefore, we recommend that buildings have crawl spaces instead.

If slabs on grade are used, subgrade support for building floor slabs supporting up to 100 psf areal loading can be obtained on subgrade prepared as recommended in the "Site Preparation" section of this report. A minimum 6-inch-thick layer of base rock (imported granular material) should be placed and compacted over the prepared subgrade to assist as a capillary break.

Provided the base rock is kept clean, this material can be a component of the granular pad as recommended in the "Haul Road Guidelines" section of this report.

The base rock should be crushed rock or crushed gravel and sand meeting the requirements outlined in the "Structural Fill" section of this report. The imported granular material should be placed in one lift and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D 1557. A subgrade modulus of 100 pci may be used to design the floor slab. Floor slab base rock contaminated with excessive fines (greater than 5 percent by dry weight passing the U.S. Standard No. 200 Sieve) should be replaced.

Vapor barriers are often required by flooring manufacturers to protect flooring and flooring adhesives. Many flooring manufacturers will warrant their product only if a vapor barrier is installed according to their recommendations. Selection and design of an appropriate vapor barrier (if needed) should be based on discussions among members of the design team. We can provide additional information to assist you with your decision.

## 8.0 UTILITIES

Underground utilities will be adversely affected by large differential settlement. We anticipate that utility pipes will need to be constructed of flexible pipe with flexible joints to reduce the impacts from differential settlement. To increase the longevity of the utilities we recommend steep pipe slopes or that gravity systems be substituted with pumped systems. As discussed above, we recommend pipe and pipe joints be constructed of materials that will resist corrosion or incorporate methods to prevent corrosion and/or pipe degradation, such as cathode protection pipe wrapping to separate corrodible materials from the source of corrosion. Gravity storm pipelines should be constructed with steep gradients to prevent bellies from forming.

## 9.0 PAVEMENT DESIGN RECOMMENDATIONS

Pavement will also be adversely affected by large differential settlement. With ground improvement by surcharging, we anticipate that the pavement areas would need large-scale repairs during its serviceable life. Surcharging pavement areas will help increase the time frame.

New pavement should be installed on competent subgrade or new engineered fill prepared in conformance with the "Site Preparation" and "Structural Fill" sections of this report. Given the building facility proposed, our pavement recommendations are based on the assumption that the standard-duty traffic section will be subject to passenger cars and occasional maintenance and delivery truck trucks. We do not have specific information on the frequency and type of vehicles that will use the area; however, we have assumed that standard traffic conditions will consist of a maximum of 2 trucks per day and a maximum of 200 cars per day. We recommend that the heavy-duty pavement section be constructed in areas that will be subject to higher traffic volumes (such as entrances and areas subject to repeated delivery vehicles). The heavy-duty section assumes that traffic will consist of up to 10 trucks per day.

We calculated pavement sections using the above-referenced traffic conditions using a design life of 10 and 20 years and AASHTO design methods. The design of the recommended pavement section is based on an assumed resilient modulus of 3,500 psi and the assumption that construction will be completed during an extended period of dry weather. Wet weather construction may require an increased thickness of aggregate base to support the rock trucks and compaction equipment. Table 3 summarizes the recommended pavement sections.

**Table 3. Pavement Section Thickness**

| Design Life (years) | Standard-Duty Section | | Heavy-Duty Section | |
|---|---|---|---|---|
| | AC Thickness (inches) | Aggregate Base Thickness (inches) | AC Thickness (inches) | Aggregate Base Thickness (inches) |
| 10 | 2.5 | 7.0 | 3.0 | 10.0 |
| 20 | 2.5 | 8.0 | 3.5 | 10.0 |

The AC should be Level 2, ½-inch, dense MHMAC according to OSSC 00744 and compacted to 91 percent of the maximum specific gravity, as determined by AASHTO T-209. Minimum lift thickness for ½-inch MHMAC is 2.0 inches. Asphalt binder should be performance graded and conform to PG 64-22. The aggregate base should meet the specifications for aggregate base rock provided in the "Structural Fill" section of this report. If the subgrade is stabilized with portland cement, the crushed base rock thickness can be reduced to 6 inches or to 4 inches in areas of car traffic only. Proper compaction of the pavement materials will be impossible unless they are constructed over firm, unyielding subgrade. This is anticipated in areas where the fill cap is thin. In addition, significant settlement could cause uneven surfaces that collect water during precipitation events.

Construction traffic should be limited to non-building, unpaved portions of the site or haul roads. Construction traffic should not be allowed on new pavements. If construction traffic is to be allowed on newly constructed road sections, an allowance for this additional traffic will need to be made in the design pavement section.

## 10.0 RETAINING WALLS

We understand that retaining walls may be considered for the proposed pedestrian pathway along the eastern edge of the site. We recommend choosing a flexible retaining wall system that can tolerate movement and is easily repaired.

### *10.1 WALL DESIGN PARAMETERS*

For unrestrained retaining walls, an active pressure of 35 pcf equivalent fluid pressure should be used for design. For embedded building walls, 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 a distance of 0.6H from the base of the wall. Where retaining walls are restrained from rotation prior to being backfilled, a pressure of 55 pcf equivalent fluid pressure should be used for design.

If surcharges (e.g., retained slopes, building foundations, vehicles, steep slopes, terraced walls, etc.) are located within a horizontal distance from the back of a wall equal to twice the height of the wall, then 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 18 inches below lowest adjacent grade. The footing excavations should then be lined with a minimum 6-inch-thick layer of compacted, imported granular material, as described in the "Structural Fill" section of this report.

The wall footings should be designed in accordance with the guidelines provided in the appropriate portion of the "Shallow Foundations" section of this report.

### *10.2 WALL DRAINAGE AND BACKFILL*

The above design parameters have been provided assuming that back-of-wall drains will be installed to prevent buildup of hydrostatic pressures behind all walls. If a drainage system is not installed, then 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 well-graded sand or gravel, with not more than 5 percent by dry weight passing the U.S. Standard No. 200 Sieve and meeting OSSC 00510.12. We recommend the select granular wall backfill be separated from general fill, native soil, and/or topsoil using a geotextile fabric that meets the requirements provided in OSSC 00350 and OSSC 02320 for drainage geotextiles.

Alternatively, the native soil can be used as backfill material provided a minimum 2-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 or foundation drains to within approximately 1 foot of the ground surface. The angular drain rock should meet the requirements provided in the "Structural Fill" section of this report.

The wall backfill should be compacted to a minimum of 95 percent of the maximum dry density, as determined by ASTM D 1557. However, backfill located within a horizontal distance of 3 feet from a retaining wall should only be compacted to approximately 90 percent of the maximum dry density, as determined by ASTM D 1557. Backfill placed within 3 feet of the wall should be compacted in lifts less than 6 inches thick using hand-operated tamping equipment (such as a jumping jack or vibratory plate compactor). If flatwork (sidewalks or pavements) will be placed atop the wall backfill, we recommend that the upper 2 feet of material be compacted to 95 percent of the maximum dry density, as determined by ASTM D 1557.

Perforated collector pipes should be placed at the base of the granular backfill behind the walls. The pipe should be embedded in a minimum 2-foot-wide zone of angular drain rock. The drain rock should meet specifications provided in the "Structural Fill" section of this report. The drain rock should be wrapped in a geotextile fabric that meets the specifications provided in

OSSC 00350 and OSSC 02320 for drainage geotextiles. The collector pipes should discharge at an appropriate location away from the base of the wall. Unless measures are taken to prevent backflow into the wall's drainage system, the discharge pipe should not be tied directly into stormwater drain systems.

## 11.0 SEISMIC CONSIDERATIONS

Based on our explorations, the following design parameters can be applied if the building is designed using the applicable provisions of the 2009 IBC and 2010 SOSSC. The parameters in Table 4 should be used to compute seismic base shear forces.

**Table 4. IBC Seismic Design Parameters**

| Parameter | Short Period | 1 Second |
|---|---|---|
| Spectral Acceleration | $S_s$ = 0.95 g | $S_1$ = 0.33 g |
| Site Class | E | |
| Site Coefficient | $F_a$ = 0.96 | $F_v$ = 2.68 |
| Adjusted Spectral Acceleration | $S_{MS}$ = 0.91 g | $S_{M1}$ = 0.88 g |
| Design Spectral Response Acceleration Parameters | $S_{DS}$ = 0.61 g | $S_{D1}$ = 0.59 g |
| Design Spectral PGA | 0.24 g | |

Liquefaction settlement is the result of seismically induced densification and subsequent ground settlement of loose sand and silty sand below the groundwater table. Subsurface conditions consist primarily of silty soil, and the static groundwater level is anticipated to be more than 50 feet BGS at the site. Consequently, the risk of liquefaction at the site is considered low under design levels of ground shaking.

## 12.0 OBSERVATION OF CONSTRUCTION

Satisfactory foundation and earthwork performance depends to a large degree on quality of construction. 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. Subsurface conditions observed during construction should be compared with those encountered during the subsurface exploration. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect if subsurface conditions change significantly from those anticipated.

We recommend that GeoDesign be retained to observe earthwork activities, including stripping, surcharge installation, proofrolling of the subgrade and repair of soft areas, performing laboratory compaction and field moisture-density tests, observing final proofrolling of the pavement subgrade and base rock, and asphalt placement and compaction.

## 13.0 LIMITATIONS

We have prepared this report for use by the Dharma Rain Zen Center, CWK2 Land Development Consultants, and the design and construction team for the proposed development. The data and report can be used for bidding or estimating purposes, but our report, conclusions, and interpretations should not be construed as warranty of the subsurface conditions and are not applicable to other sites.

Exploration observations indicate soil conditions only at specific locations and only to the depths penetrated. They 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.

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 or location, configuration, design loads, or type of construction for the buildings, 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 our report for consideration in design.

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

◆ ◆ ◆

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,

GeoDesign, Inc.

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Project Engineer

Brett A. Shipton, P.E., G.E.
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## REFERENCES

GeoDesign, Inc., 2001a, *Limited Environmental Site Assessment; LaVelle Landfill Site; Portland, Oregon,* dated August 28, 2001. GeoDesign Project: QGInvestment-1-01.

GeoDesign, Inc., 2001b, *Preliminary Report of Geotechnical Engineering and Environmental Consulting Services; 82nd Avenue Retail Center; Portland, Oregon,* dated October 26, 2001. GeoDesign Project: QGInvestment-2-01.

GeoDesign, Inc., 2012, *Basis of Design and Engineering Approach; Proposed Householder Refuge and Temple; Eastern Half of Former H.G. LaVelle Landfill; NE 82nd Avenue and NE Siskiyou Street; Portland, Oregon,* dated August 29, 2012. GeoDesign Project: DharmaRain-1-01.

International Building Code, 2009.

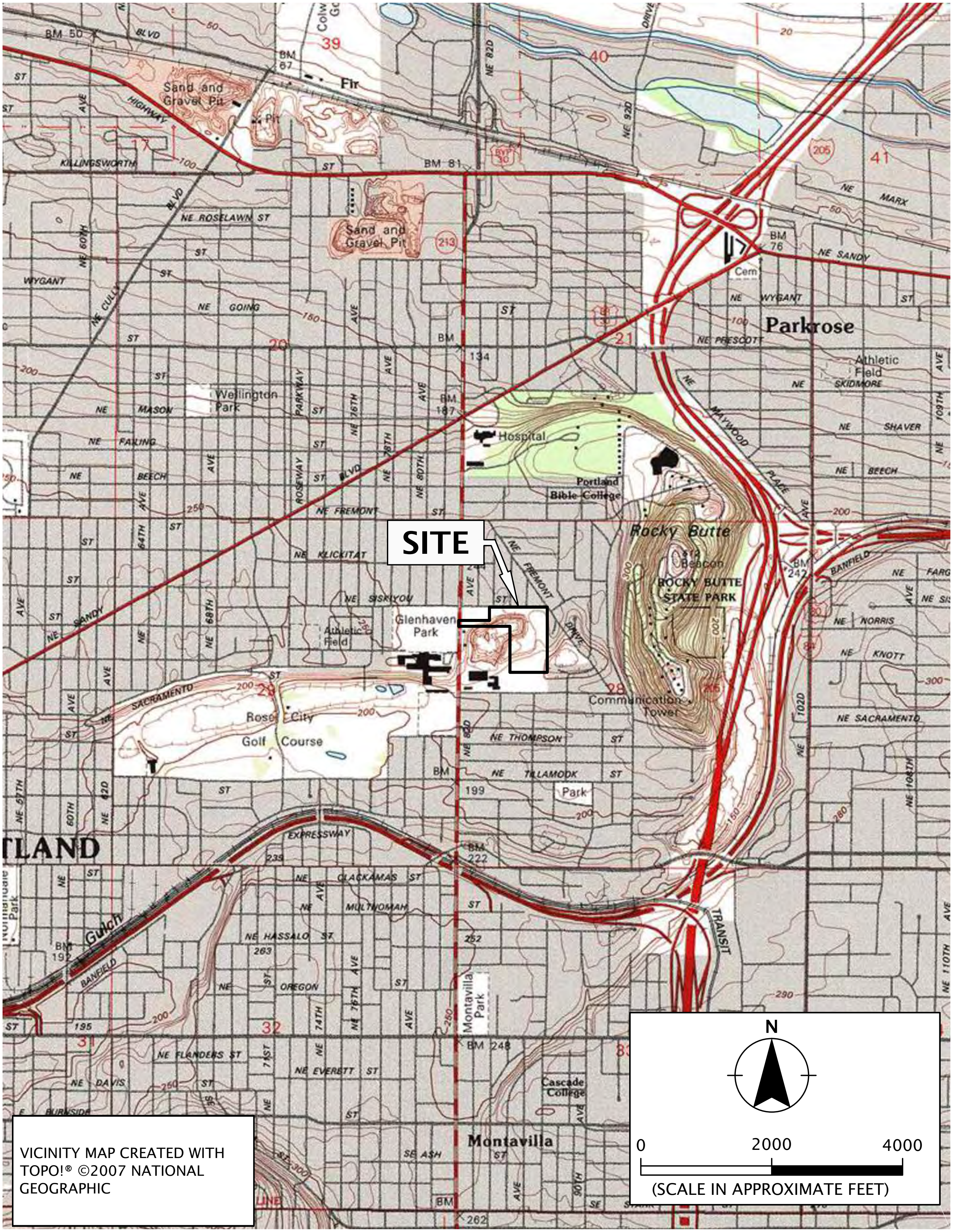
Oregon Department of Transportation, 2008, Standard Specifications for Highway Construction, Oregon Department of Transportation, 2008 Edition.

Oregon Structural Specialty Code, 2010, International Conference of Building Codes.

Snyder, Daniel T., 2008, Estimated Depth to Ground Water and Configuration of the Water Table in the Portland, Oregon Area, prepared in cooperation with the City of Portland, the City of Gresham, Clackamas County's Water Environment Services, and Multnomah County, U.S. Geological Survey Scientific Investigations Report 2008–5059

Wilmott, M. J. and T.R. Jack, 2000. Corrosion by Soils in Uhlig's Corrosion Handbook, 2nd Edition, p. 329-348.

# FIGURES



VICINITY MAP CREATED WITH TOPO!® ©2007 NATIONAL GEOGRAPHIC

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DHARMARAIN-1-03

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## VICINITY MAP

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE 1**

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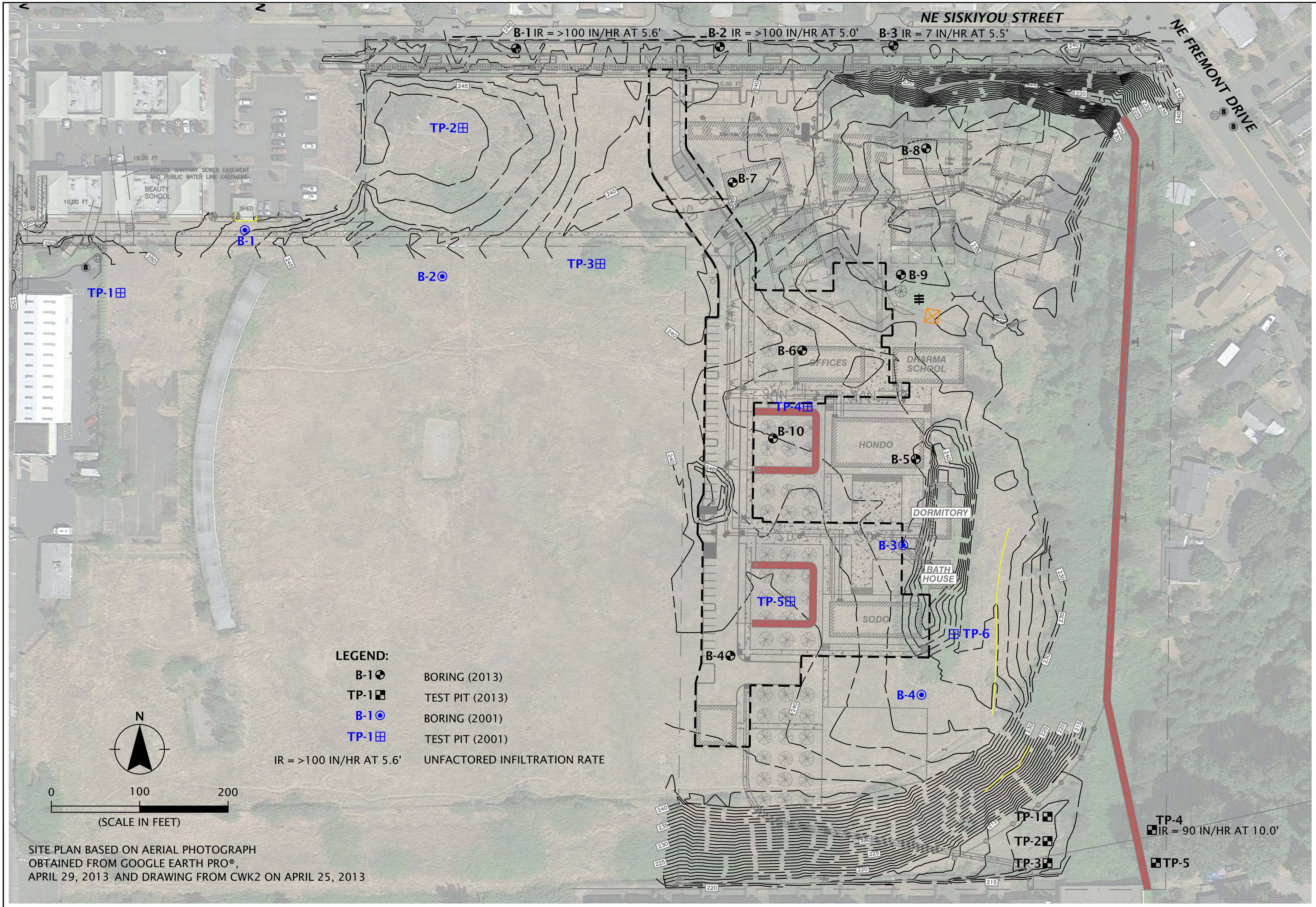
File Name: J:\A-D\DharmaRain\DharmaRain-1\DharmaRain-1-03-originally_1-02\Figures\CAD\DharmaRain-1-03-VM01.dwg | Layout: FIGURE 1



LEGEND:

| | |
|---|---|
| B-1 ◕ | BORING (2013) |
| TP-1 ▣ | TEST PIT (2013) |
| B-1 ◉ | BORING (2001) |
| TP-1 ⊞ | TEST PIT (2001) |
| IR = >100 IN/HR AT 5.6' | UNFACTORED INFILTRATION RATE |

SITE PLAN BASED ON AERIAL PHOTOGRAPH
OBTAINED FROM GOOGLE EARTH PRO®,
APRIL 29, 2013 AND DRAWING FROM CWK2 ON APRIL 25, 2013

Printed By: aday | Print Date: 5/10/2013 9:38:33 AM
File Name: J:\A-D\DharmaRain\DharmaRain-1\DharmaRain-1-03-originally_1-02\Figures\CAD\DharmaRain-1-03-SP01.dwg | Layout: FIGURE 2

FIGURE 2

SITE PLAN

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

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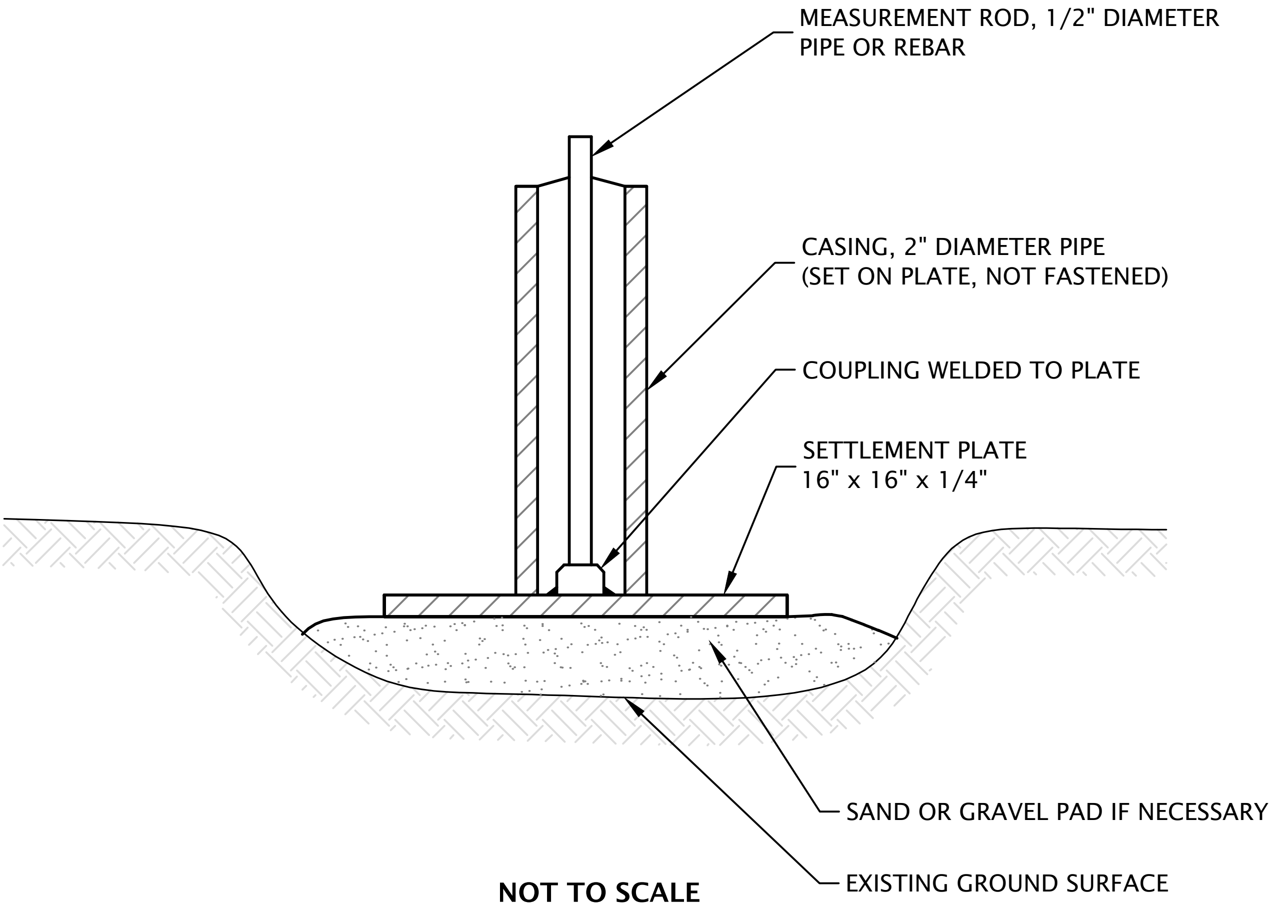

**NOTES:**

1. INSTALL MARKERS ON FIRM GROUND OR ON SAND OR GRAVEL PADS IF NEEDED FOR STABILITY. TAKE INITIAL READING ON TOP OF ROD AND AT ADJACENT GROUND LEVEL PRIOR TO PLACING ANY FILL.
2. FOR EASE IN HANDLING, ROD AND CASING ARE USUALLY INSTALLED IN 5-FOOT SECTIONS. AS FILL PROGRESSES, COUPLINGS ARE USED TO INSTALL ADDITIONAL LENGTHS. CONTINUITY IS MAINTAINED BY READING THE TOP OF THE MEASUREMENT ROD, THEN IMMEDIATELY ADDING THE NEW SECTION AND READING THE TOP OF THE ADDED ROD. BOTH READINGS ARE RECORDED.
3. RECORD THE ELEVATION OF THE TOP OF THE MEASUREMENT ROD IN EACH MARKER AT THE RECOMMENDED TIME INTERVALS. EACH TIME, NOTE THE ELEVATION OF THE ADJACENT FILL SURFACE.
4. READ THE MARKER TO THE NEAREST 0.01 FOOT, OR 0.005 FOOT IF POSSIBLE. NOTE THE FILL ELEVATION TO THE NEAREST 0.1 FOOT.
5. THE ELEVATIONS SHOULD BE REFERENCED TO A TEMPORARY BENCHMARK LOCATED ON STABLE GROUND AT LEAST 500 FEET FROM THE EMBANKMENT.

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**SETTLEMENT PLATE DETAIL**

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE 3**

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File Name: J:\A-D\DharmaRain\DharmaRain-1\DharmaRain-1-03-originally_1-02\Figures\CAD\DharmaRain-1-03-det01.dwg | Layout: FIGURE 3

# APPENDIX A

# APPENDIX A

# FIELD EXPLORATIONS

## *GENERAL*

We explored subsurface conditions at the site by drilling 10 borings (B-1 through B-10) and excavating 5 test pits (TP-1 through TP-5) at the approximate locations shown on Figure 2. The explorations were completed from April 9 through 15, 2013 by Western States Soil Conservation, Inc., of Hubbard, Oregon, utilizing hollow-stem auger and mud-rotary drilling techniques and a trackhoe. The explorations were observed by a member of our geological staff. We obtained representative samples of the various soil encountered in the explorations for geotechnical laboratory testing. Classifications and sampling depths are presented on the exploration logs included in this appendix.

Approximate locations of our explorations are shown on Figure 2. Exploration locations were chosen based on preliminary site plans provided to our office by SERA Architects, Inc. The locations of the explorations were determined in the field by pacing from existing site features. This information should be considered accurate only to the degree implied by the methods used.

## *SOIL SAMPLING*

Soil samples were obtained from the borings using SPT sampling methods. SPTs were performed in general conformance with ASTM D 1586. The sampler was driven with a 140-pound hammer free-falling 30 inches. The number of blows required to drive the sampler 1 foot, or as otherwise indicated, into the soil is shown adjacent to the sample symbols on the exploration logs. Disturbed samples were obtained from the split barrel for subsequent classification and index testing. Samples were also obtained using a Dames & Moore type U sampler. The sampler was driven using a 140-pound hammer free-falling 30 inches, just as with the SPT samples, and the penetration resistance was recorded for general correlation with previous subsurface information. Samples retained from the split barrel consist of up to six 1-inch-high by 2.48-inch-diameter brass rings. In addition, relatively undisturbed samples were obtained by pushing thin-walled standard Shelby tubes into the base of the boring in general accordance with ASTM D 1587.

Grab samples were obtained from the test pit walls and/or base using the excavator bucket.

## *SOIL CLASSIFICATION*

The soil samples were classified in accordance with the “Exploration Key” (Table A-1) and “Soil Classification System” (Table A-2), which are included in this appendix. The exploration logs indicate the depths at which the soil or its characteristics change, although the change could be gradual. A horizontal line between soil types indicates an observed (visual or drill action) change. If the change occurred between sample locations and was not observed or obvious, the depth was interpreted and the change is indicated using a dashed line. Classifications and sampling intervals are presented on the exploration logs included in this appendix.

## LABORATORY TESTING

### *CLASSIFICATION*

The soil samples were classified in the laboratory to confirm field classifications. The laboratory classifications are presented on the exploration logs if those classifications differed from the field classifications.

### *MOISTURE CONTENT*

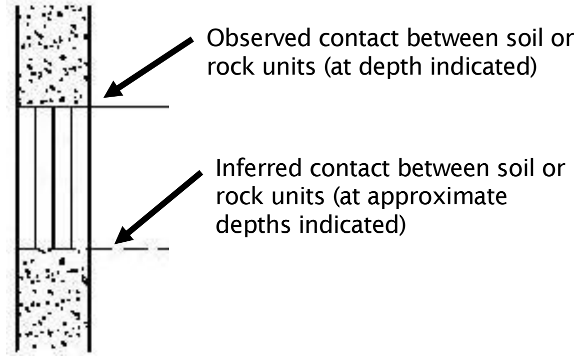
The natural moisture content of selected soil samples was determined in general accordance with ASTM D 2216. The natural moisture content is a ratio of the weight of the water to soil in a test sample and is expressed as a percentage. The test results are presented on the exploration logs included in this appendix.

### *GRAIN-SIZE TESTING*

Grain-size testing was performed on selected soil samples to determine the distribution of soil particle sizes. The testing consisted of particle-size analysis completed in accordance with percent fines determination (percent passing the U.S. Standard No. 200 Sieve) completed in general accordance with the ASTM C 117 and ASTM D 1140 (P200). Test results are presented on the exploration logs included 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



## 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 |

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**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<br>(more than 50% retained on No. 200 sieve) | GRAVEL<br>(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<br>(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<br>(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 % |

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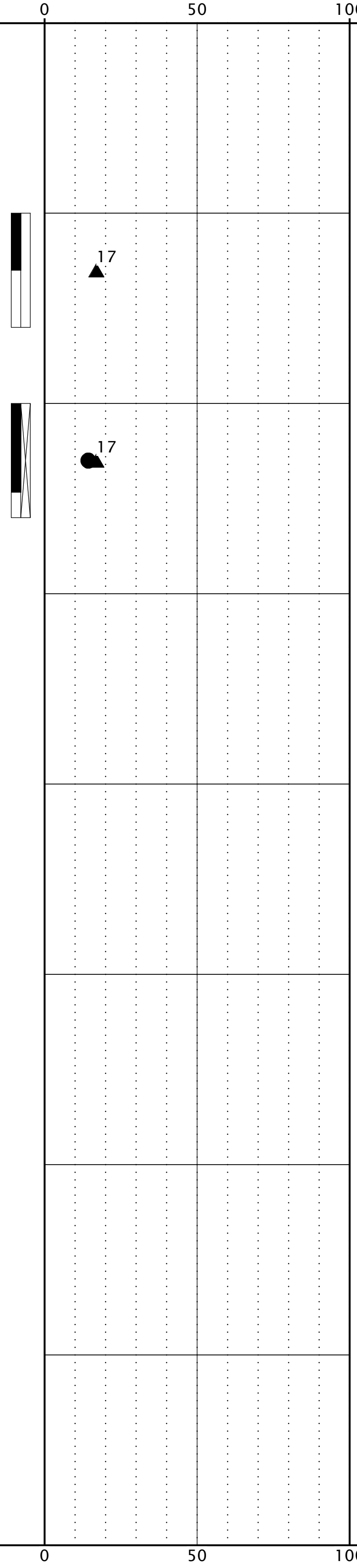
**SOIL CLASSIFICATION SYSTEM**

**TABLE A-2**

| DEPTH FEET | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | INSTALLATION AND COMMENTS |
|---|---|---|---|---|
| 0.0 | Medium dense, gray-brown GRAVEL with sand and cobbles (GW), minor silt; moist, stratified beds of silty sand (up to 4 inches thick) (2- to 3 3/4-inch-thick root zone). | | | |
| 2.5 | | | | |
| 5.0 | Loose, gray-brown SAND with gravel (SP), minor silt; moist to wet, medium to coarse. | 5.0 | P200 | P200 = 5%<br>Infiltration test: >100 inches per hour at 5.6 feet.<br>Surface elevation was not measured at the time of exploration. |
| | Exploration completed at a depth of 6.5 feet. | 6.5 | | |
| 7.5 | | | | |
| 10.0 | | | | |
| 12.5 | | | | |
| 15.0 | | | | |
| 17.5 | | | | |
| 20.0 | | | | |

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



DRILLED BY: Western States Soil Conservation, Inc.
LOGGED BY: JGH
COMPLETED: 04/09/13

BORING METHOD: hollow-stem auger (see report text)
BORING BIT DIAMETER: 8-inch

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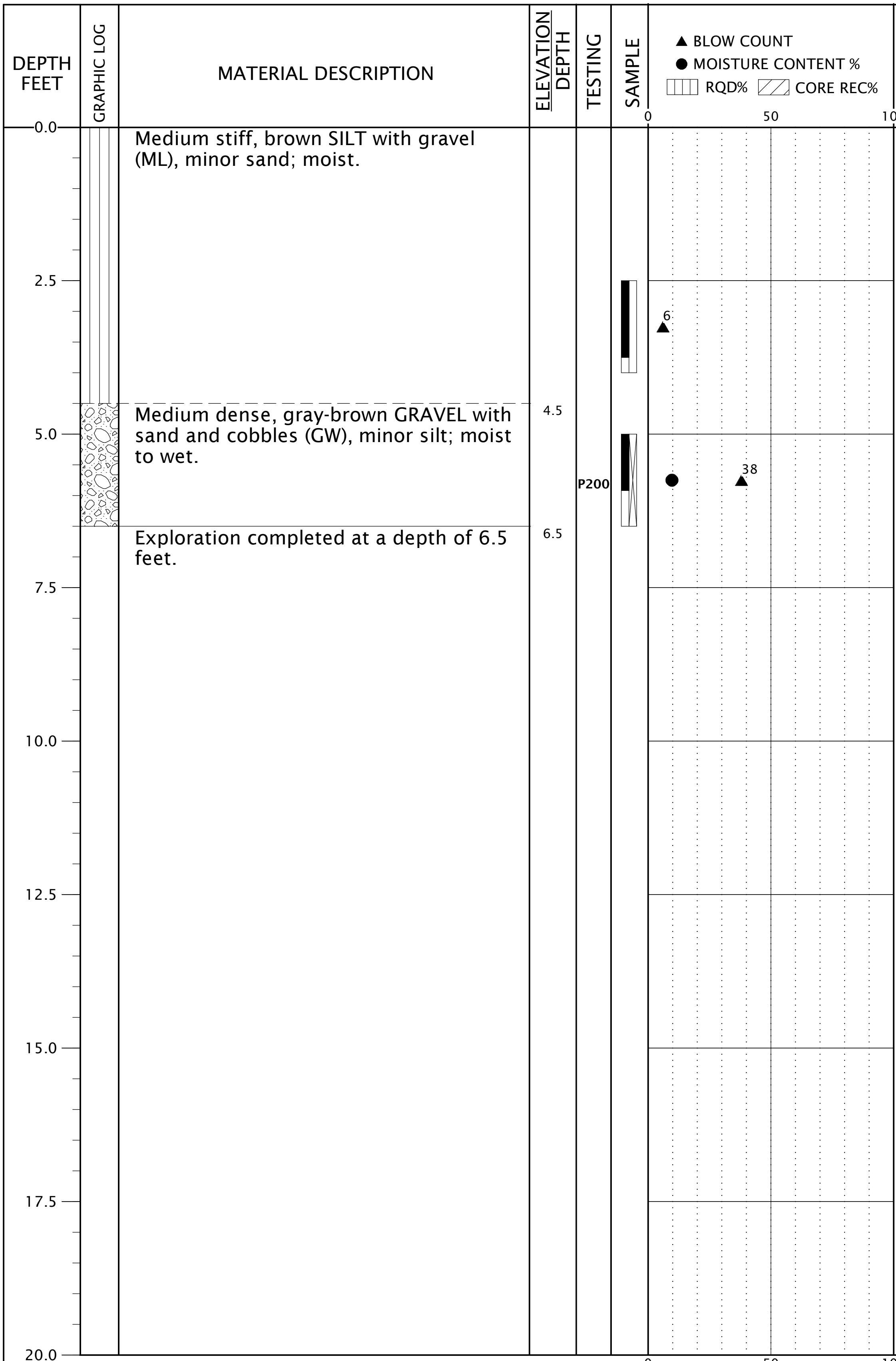
**BORING B-1**

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-1**

BORING LOG DHARMARAIN-1-03-B1_10-TP1_5.GPJ GEODESIGN.GDT PRINT DATE: 5/10/13:KT

| DEPTH FEET | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | INSTALLATION AND COMMENTS |
|---|---|---|---|---|
| 0.0 | Medium stiff, brown SILT with gravel (ML), minor sand; moist. | | | |
| 4.5 | Medium dense, gray-brown GRAVEL with sand and cobbles (GW), minor silt; moist to wet. | 4.5 | P200 | Driller Comment: gravel at 4.5 feet.<br>Infiltration test: >100 inches per hour at 5.0 feet.<br>P200 = 6% |
| 6.5 | Exploration completed at a depth of 6.5 feet. | 6.5 | | Surface elevation was not measured at the time of exploration. |



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: JGH

COMPLETED: 04/09/13

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

BORING BIT DIAMETER: 8-inch

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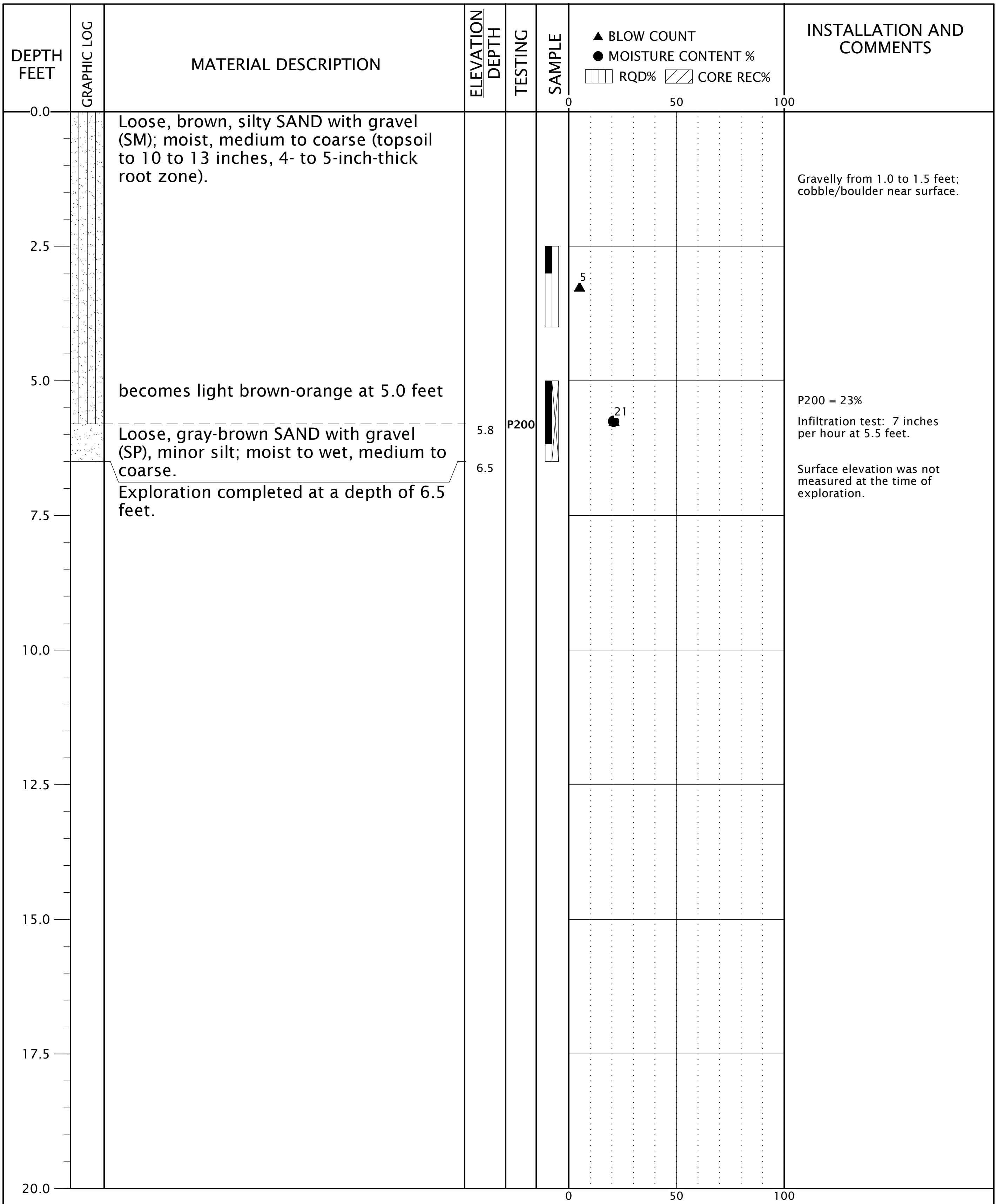
**BORING B-2**

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-2**

BORING LOG DHARMARAIN-1-03-B1_10-TP1_5.GPJ GEODESIGN.GDT PRINT DATE: 5/10/13:KT



## INSTALLATION AND COMMENTS

Loose, brown, silty SAND with gravel (SM); moist, medium to coarse (topsoil to 10 to 13 inches, 4- to 5-inch-thick root zone).

becomes light brown-orange at 5.0 feet

Loose, gray-brown SAND with gravel (SP), minor silt; moist to wet, medium to coarse.

Exploration completed at a depth of 6.5 feet.

Gravelly from 1.0 to 1.5 feet; cobble/boulder near surface.

P200 = 23%

Infiltration test: 7 inches per hour at 5.5 feet.

Surface elevation was not measured at the time of exploration.

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: JGH

COMPLETED: 04/09/13

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

BORING BIT DIAMETER: 8-inch

BORING LOG DHARMARAIN-1-03-B1_10-TP1_5.GPJ GEODESIGN.GDT PRINT DATE: 5/10/13:KT

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## BORING B-3

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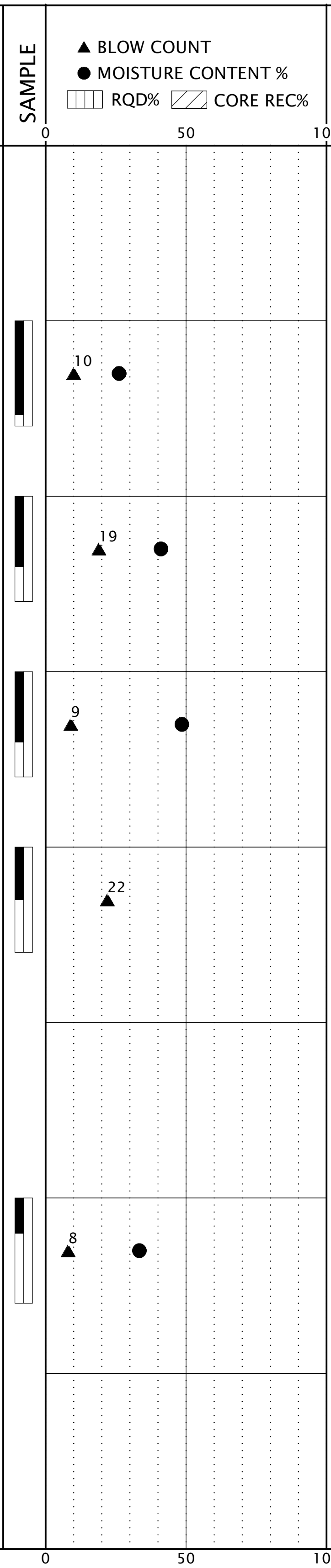
PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-3**

| DEPTH FEET | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | INSTALLATION AND COMMENTS |
|---|---|---|---|---|
| 0.0 | Loose to medium dense, brown, silty SAND (SM); moist (topsoil to 6 to 8 inches, 3- to 4-foot-thick root zone) - **CAP FILL**. | | | Driller Comment: gravelly, scattered at 0.5 foot. |
| 4.5 | Very stiff, dark gray-brown ORGANIC SOIL with woody debris and construction debris (concrete) (OL); moist - **FILL**. | 4.5 | | Drilling is smooth and hard at 4.5 feet. |
| 7.5 | grades to stiff, without construction debris at 7.5 feet | | | |
| 10.0 | becomes dark gray-light gray, with construction debris (concrete fragments, metal, plastic) at 10.0 feet | | | Wood is 4 inches thick. |
| 14.0 | | | | Drilling becomes smoother at 14.0 feet. |
| 15.0 | grades to medium stiff to stiff, with construction debris (glass, cloth, wire, roof tiles); moist to wet at 15.0 feet | | OC | OC = 26% |



DRILLED BY: Western States Soil Conservation, Inc.
LOGGED BY: JGH
COMPLETED: 04/09/13

BORING METHOD: hollow-stem auger (see report text)
BORING BIT DIAMETER: 8-inch

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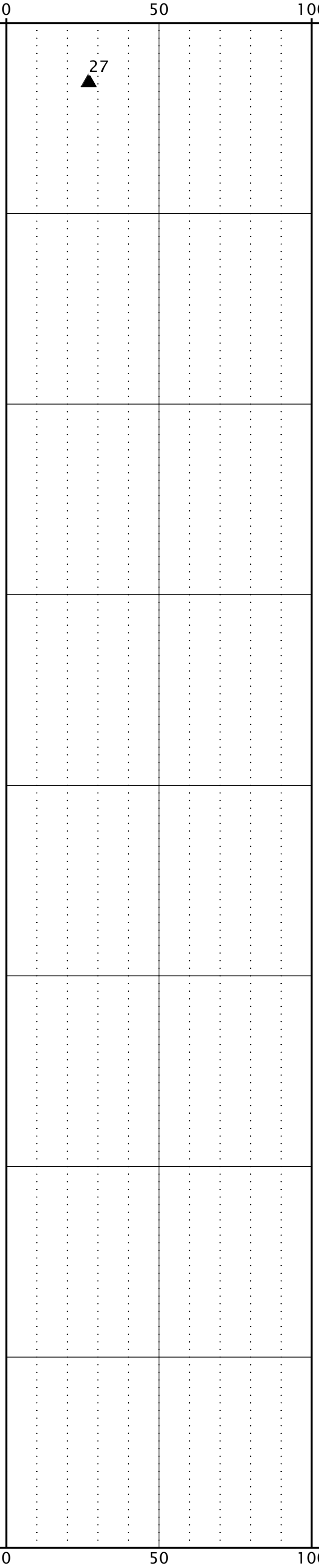
**BORING B-4**

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-4**

| DEPTH FEET | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | SAMPLE | ▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC% | INSTALLATION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| 20.0 | ▨ | becomes very stiff at 20.0 feet | | | | 27 | |
| | | Exploration completed at a depth of 21.5 feet. | 21.5 | | | | Surface elevation was not measured at the time of exploration. |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |
| 35.0 | | | | | | | |
| 37.5 | | | | | | | |
| 40.0 | | | | | | | |



DRILLED BY: Western States Soil Conservation, Inc.    LOGGED BY: JGH    COMPLETED: 04/09/13

BORING METHOD: hollow-stem auger (see report text)    BORING BIT DIAMETER: 8-inch

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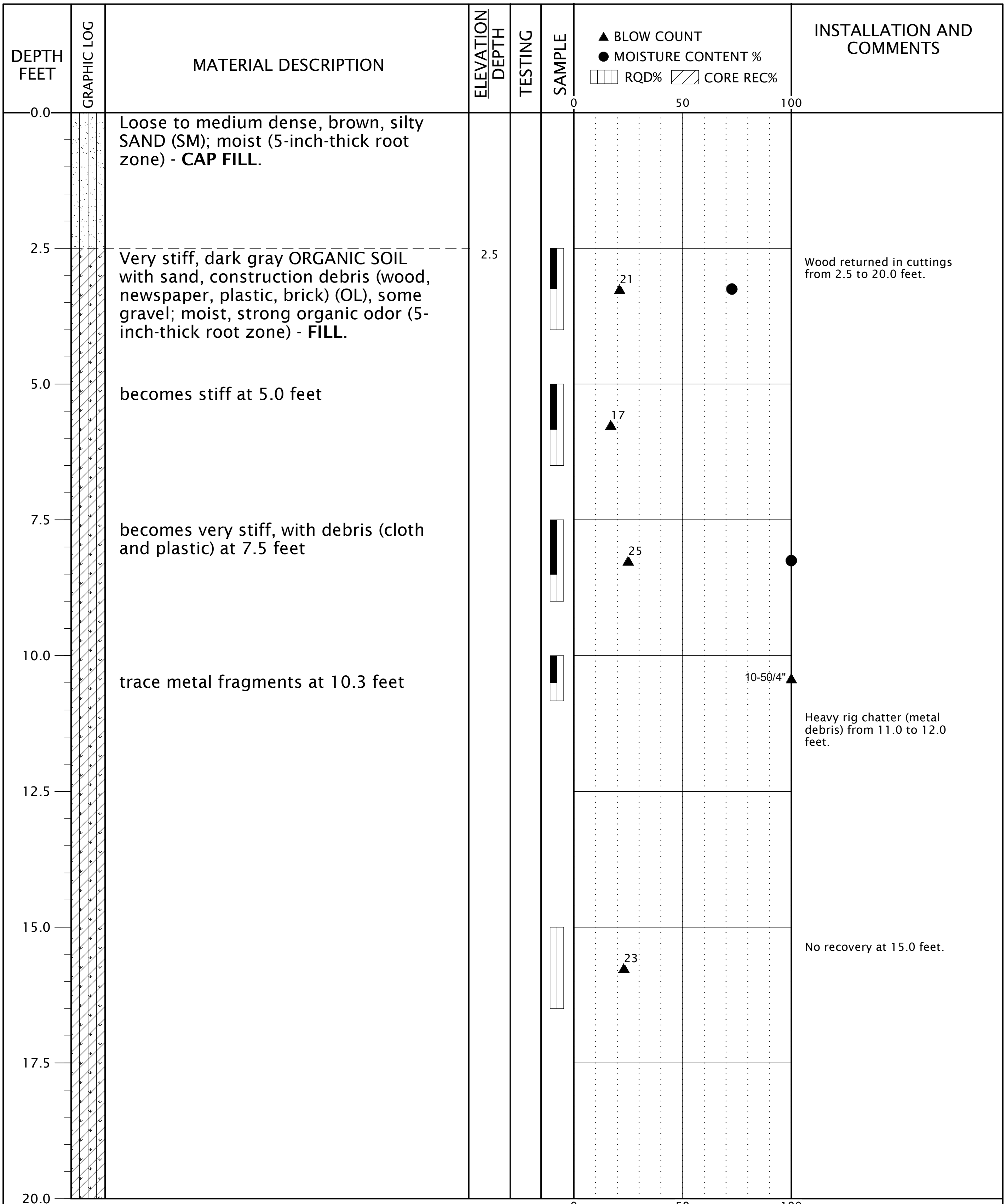
**BORING B-4**
(continued)

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-4**

BORING LOG DHARMARAIN-1-03-B1_10-TP1_5.GPJ GEODESIGN.GDT PRINT DATE: 5/10/13:KT



| DEPTH FEET | MATERIAL DESCRIPTION | ELEVATION DEPTH | BLOW COUNT | INSTALLATION AND COMMENTS |
|---|---|---|---|---|
| 0.0 | Loose to medium dense, brown, silty SAND (SM); moist (5-inch-thick root zone) - **CAP FILL**. | | | |
| 2.5 | Very stiff, dark gray ORGANIC SOIL with sand, construction debris (wood, newspaper, plastic, brick) (OL), some gravel; moist, strong organic odor (5-inch-thick root zone) - **FILL**. | 2.5 | 21 | Wood returned in cuttings from 2.5 to 20.0 feet. |
| 5.0 | becomes stiff at 5.0 feet | | 17 | |
| 7.5 | becomes very stiff, with debris (cloth and plastic) at 7.5 feet | | 25 | |
| 10.0 | trace metal fragments at 10.3 feet | | 10-50/4" | Heavy rig chatter (metal debris) from 11.0 to 12.0 feet. |
| 15.0 | | | 23 | No recovery at 15.0 feet. |

DRILLED BY: Western States Soil Conservation, Inc.    LOGGED BY: CR    COMPLETED: 04/10/13

BORING METHOD: mud rotary (see report text)    BORING BIT DIAMETER: 4 7/8-inch

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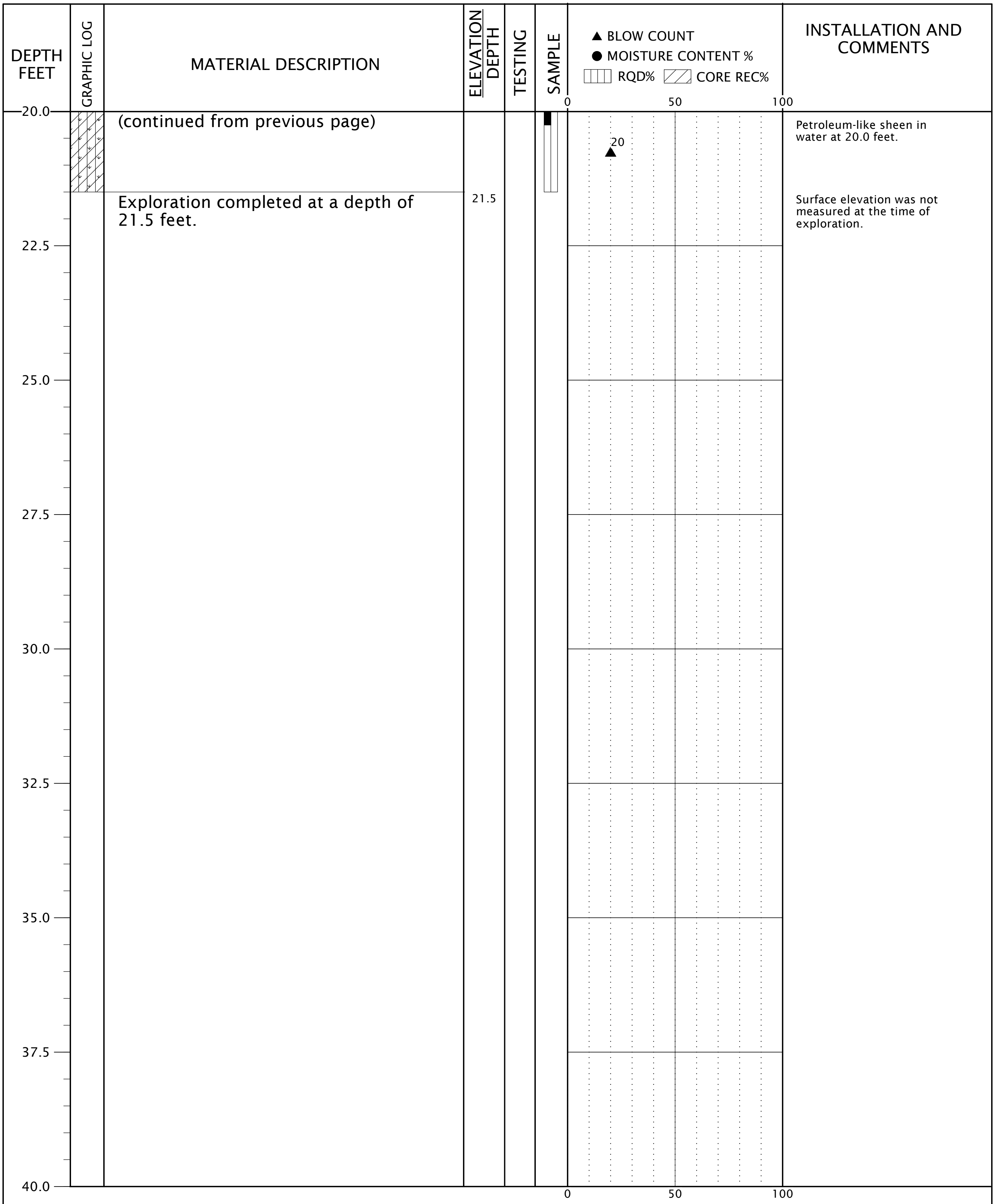
**BORING B-5**

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-5**

BORING LOG DHARMARAIN-1-03-B1_10-TP1_5.GPJ GEODESIGN.GDT PRINT DATE: 5/10/13:KT



(continued from previous page)

Exploration completed at a depth of 21.5 feet.

Petroleum-like sheen in water at 20.0 feet.

Surface elevation was not measured at the time of exploration.

DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: CR COMPLETED: 04/10/13

BORING METHOD: mud rotary (see report text) BORING BIT DIAMETER: 4 7/8-inch

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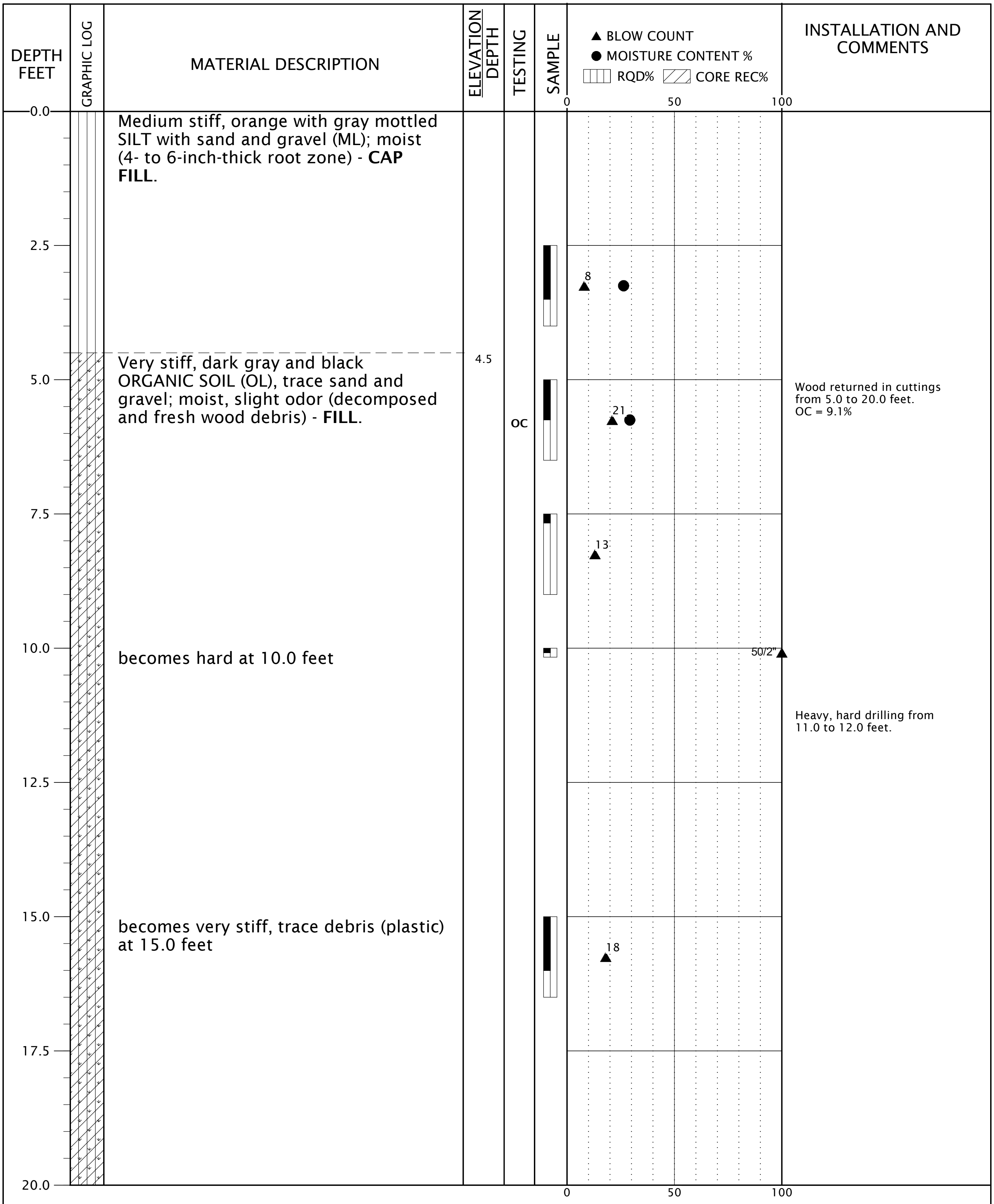
DHARMARAIN-1-03

MAY 2013

**BORING B-5**
(continued)

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-5**



| DEPTH FEET | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | BLOW COUNT | INSTALLATION AND COMMENTS |
|---|---|---|---|---|---|
| 0.0 | Medium stiff, orange with gray mottled SILT with sand and gravel (ML); moist (4- to 6-inch-thick root zone) - **CAP FILL**. | | | | |
| 2.5 | | | | 8 | |
| 4.5 | Very stiff, dark gray and black ORGANIC SOIL (OL), trace sand and gravel; moist, slight odor (decomposed and fresh wood debris) - **FILL**. | 4.5 | | | |
| 5.0 | | | OC | 21 | Wood returned in cuttings from 5.0 to 20.0 feet.<br>OC = 9.1% |
| 7.5 | | | | 13 | |
| 10.0 | becomes hard at 10.0 feet | | | 50/2" | |
| 11.0 | | | | | Heavy, hard drilling from 11.0 to 12.0 feet. |
| 15.0 | becomes very stiff, trace debris (plastic) at 15.0 feet | | | 18 | |
| 20.0 | | | | | |

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: CR

COMPLETED: 04/10/13

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

BORING BIT DIAMETER: 8 1/4-inch

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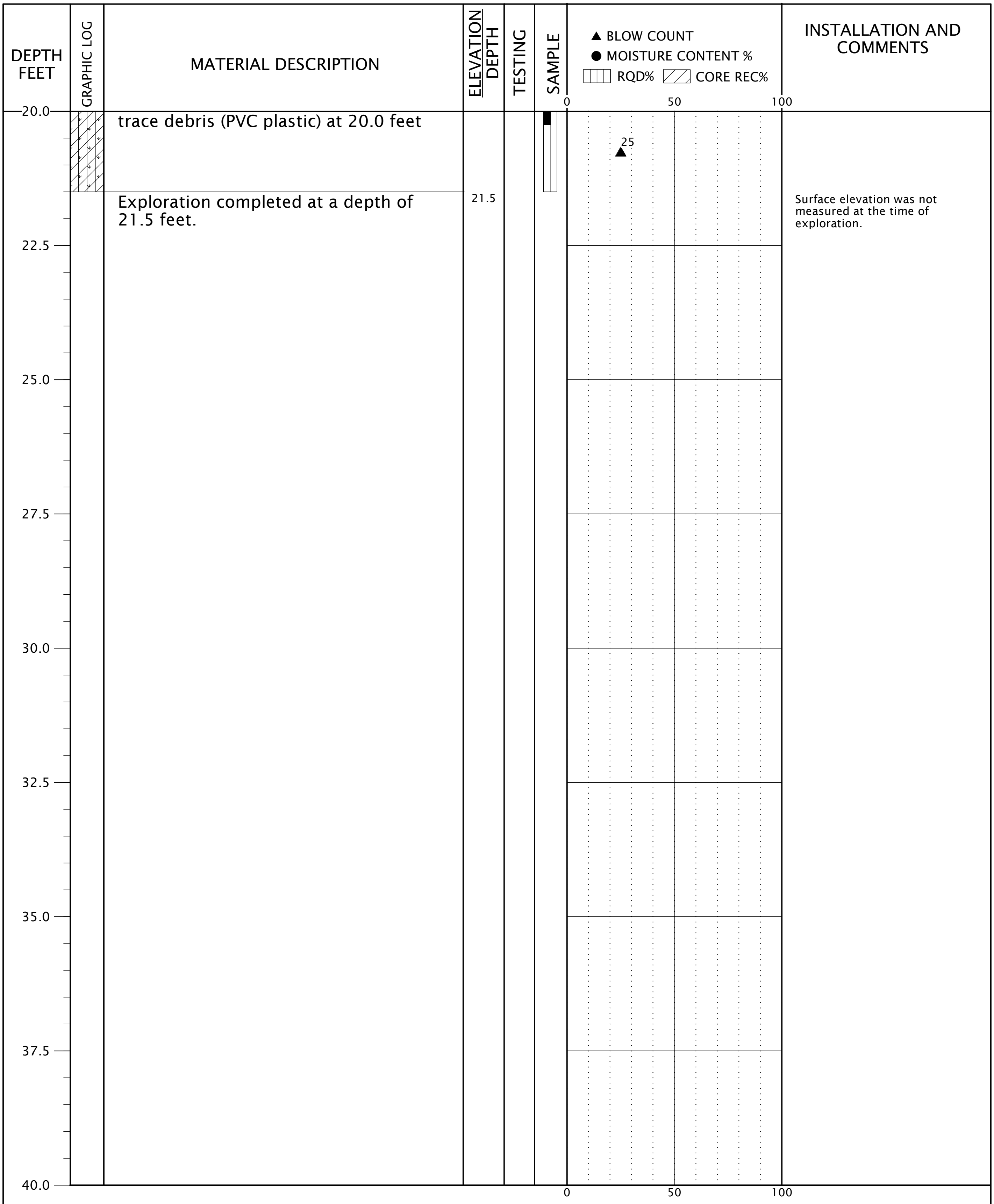
**BORING B-6**

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-6**

BORING LOG DHARMARAIN-1-03-B1_10-TP1_5.GPJ GEODESIGN.GDT PRINT DATE: 5/10/13:KT



| DEPTH FEET | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | SAMPLE | ▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC% | INSTALLATION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| 20.0 | ▨ | trace debris (PVC plastic) at 20.0 feet | | | | 25 | |
| | | Exploration completed at a depth of 21.5 feet. | 21.5 | | | | Surface elevation was not measured at the time of exploration. |

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: CR

COMPLETED: 04/10/13

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

BORING BIT DIAMETER: 8 1/4-inch

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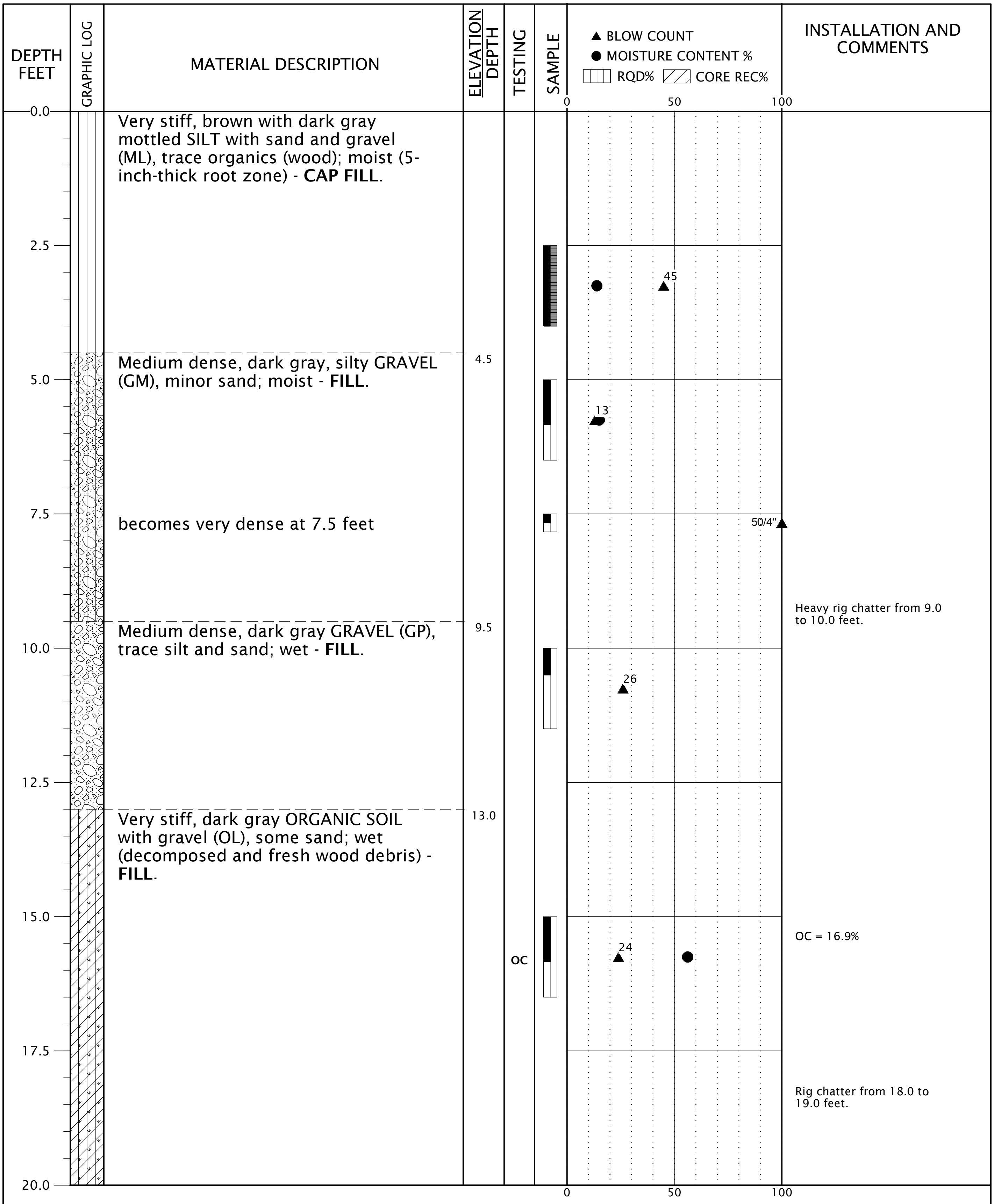
**BORING B-6**
(continued)

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-6**



| ELEVATION DEPTH | MATERIAL DESCRIPTION | TESTING | INSTALLATION AND COMMENTS |
|---|---|---|---|
| | Very stiff, brown with dark gray mottled SILT with sand and gravel (ML), trace organics (wood); moist (5-inch-thick root zone) - **CAP FILL**. | | |
| 4.5 | Medium dense, dark gray, silty GRAVEL (GM), minor sand; moist - **FILL**. | | |
| | becomes very dense at 7.5 feet | | |
| | | | Heavy rig chatter from 9.0 to 10.0 feet. |
| 9.5 | Medium dense, dark gray GRAVEL (GP), trace silt and sand; wet - **FILL**. | | |
| 13.0 | Very stiff, dark gray ORGANIC SOIL with gravel (OL), some sand; wet (decomposed and fresh wood debris) - **FILL**. | | |
| | | **OC** | OC = 16.9% |
| | | | Rig chatter from 18.0 to 19.0 feet. |

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: CR

COMPLETED: 04/10/13

BORING METHOD: mud rotary (see report text)

BORING BIT DIAMETER: 4 7/8-inch

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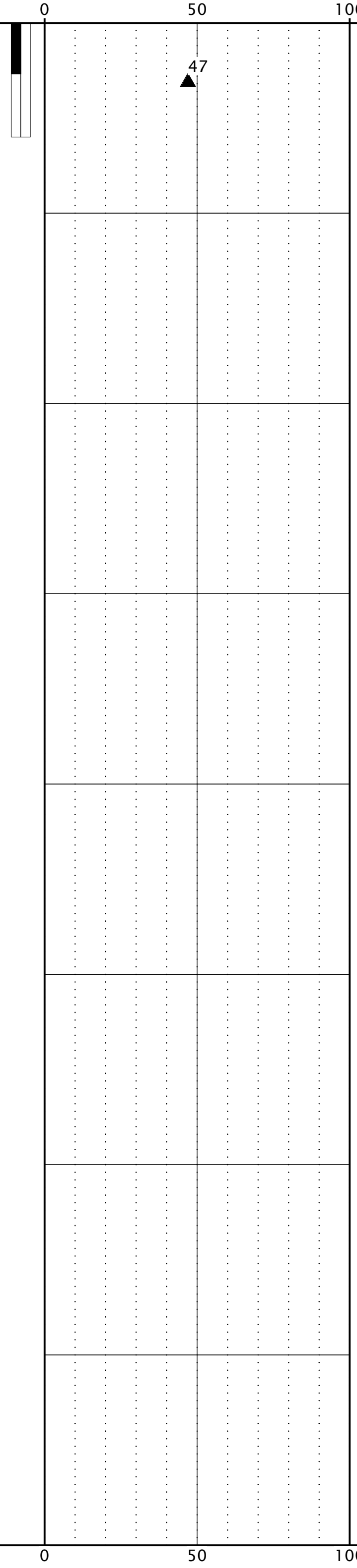
## BORING B-7

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-7**

BORING LOG DHARMARAIN-1-03-B1_10-TP1_5.GPJ GEODESIGN.GDT PRINT DATE: 5/10/13:KT

| DEPTH FEET | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | SAMPLE | ▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC% | INSTALLATION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| 20.0 | | becomes with sand, some gravel and debris (plastic bags); wet at 20.0 feet | | | | 47 | |
| | | Exploration completed at a depth of 21.5 feet. | 21.5 | | | | Surface elevation was not measured at the time of exploration. |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |
| 35.0 | | | | | | | |
| 37.5 | | | | | | | |
| 40.0 | | | | | | | |



DRILLED BY: Western States Soil Conservation, Inc.
LOGGED BY: CR
COMPLETED: 04/10/13

BORING METHOD: mud rotary (see report text)
BORING BIT DIAMETER: 4 7/8-inch

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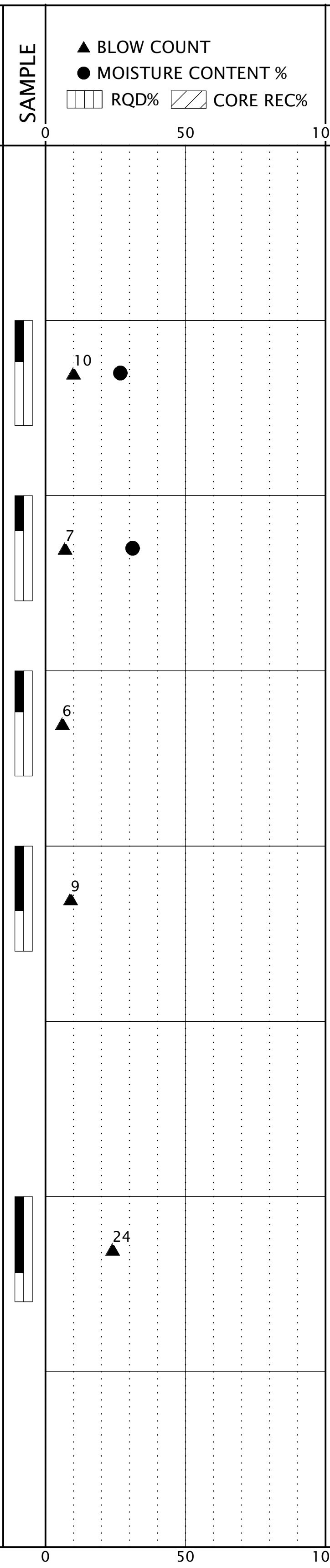
**BORING B-7**
(continued)

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-7**

BORING LOG DHARMARAIN-1-03-B1_10-TP1_5.GPJ GEODESIGN.GDT PRINT DATE: 5/10/13:KT

| DEPTH FEET | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | INSTALLATION AND COMMENTS |
|---|---|---|---|---|
| 0.0 | Medium dense, brown with dark gray mottled, silty GRAVEL with sand (GM); moist, sand is fine to medium - **CAP FILL**. | | | Rig chatter from 1.0 to 2.5 feet. |
| 5.0 | becomes loose at 5.0 feet | | | |
| 7.0 | Medium stiff, dark gray SILT with gravel (ML), minor sand; moist to wet, fine to medium - **FILL**. | 7.0 | | |
| 10.0 | becomes wet at 10.0 feet | | | |
| 13.0 | Medium dense, dark gray, silty GRAVEL (GM), trace sand; wet. | 13.0 | | |
| 20.0 | | | | |



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: CR

COMPLETED: 04/10/13

BORING METHOD: mud rotary (see report text)

BORING BIT DIAMETER: 4 7/8-inch

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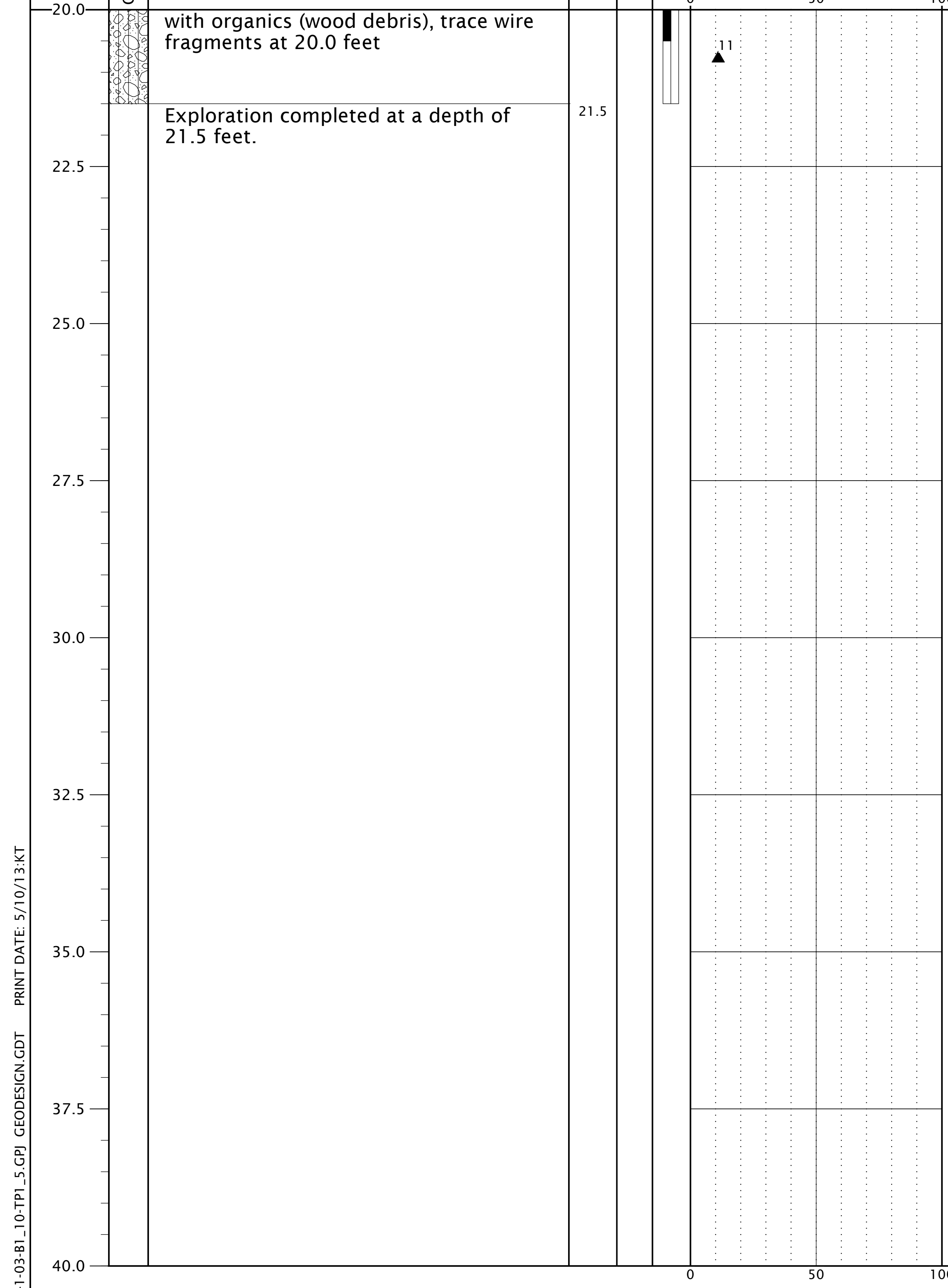
**BORING B-8**

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-8**

| DEPTH FEET | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | SAMPLE | ▲ BLOW COUNT<br>● MOISTURE CONTENT %<br>▥ RQD% ▨ CORE REC% | INSTALLATION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| 20.0 | | with organics (wood debris), trace wire fragments at 20.0 feet | | | | 11 | |
| | | Exploration completed at a depth of 21.5 feet. | 21.5 | | | | Surface elevation was not measured at the time of exploration. |



DRILLED BY: Western States Soil Conservation, Inc.  LOGGED BY: CR  COMPLETED: 04/10/13

BORING METHOD: mud rotary (see report text)  BORING BIT DIAMETER: 4 7/8-inch

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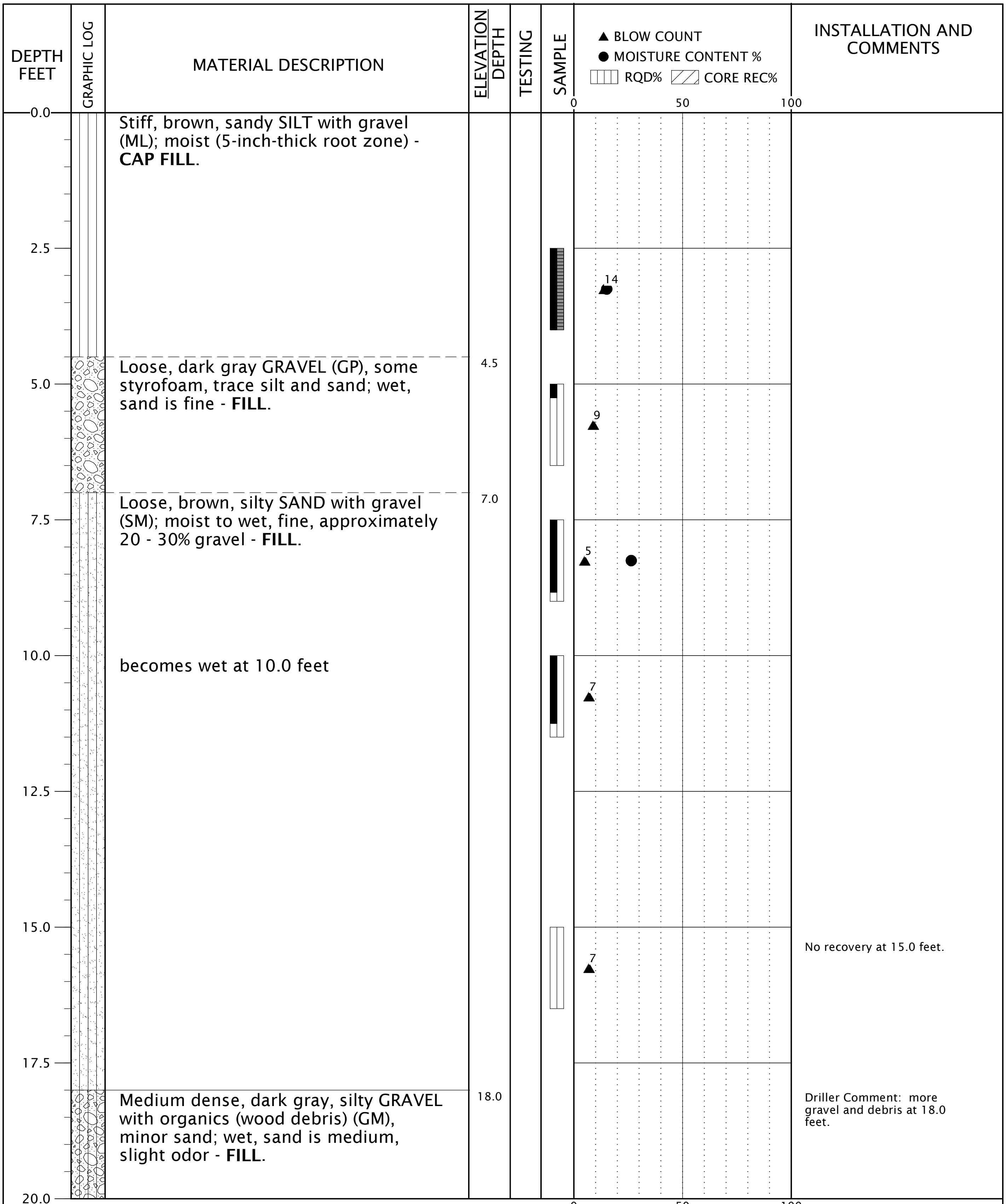
**BORING B-8**
(continued)

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-8**



Stiff, brown, sandy SILT with gravel (ML); moist (5-inch-thick root zone) - **CAP FILL**.

Loose, dark gray GRAVEL (GP), some styrofoam, trace silt and sand; wet, sand is fine - **FILL**.

Loose, brown, silty SAND with gravel (SM); moist to wet, fine, approximately 20 - 30% gravel - **FILL**.

becomes wet at 10.0 feet

Medium dense, dark gray, silty GRAVEL with organics (wood debris) (GM), minor sand; wet, sand is medium, slight odor - **FILL**.

No recovery at 15.0 feet.

Driller Comment: more gravel and debris at 18.0 feet.

DRILLED BY: Western States Soil Conservation, Inc.
LOGGED BY: CR
COMPLETED: 04/11/13

BORING METHOD: mud rotary (see report text)
BORING BIT DIAMETER: 8 1/4-inch

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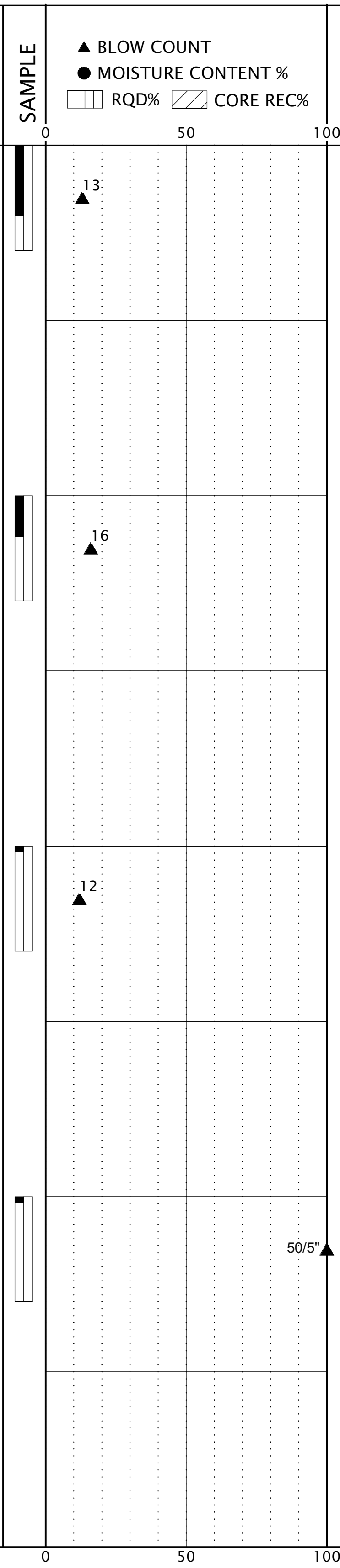
**BORING B-9**

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-9**

| DEPTH FEET | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | INSTALLATION AND COMMENTS |
|---|---|---|---|---|
| 20.0 | (continued from previous page) | | | |
| 28.0 | Medium dense, dark gray GRAVEL (GP), trace silt and organics (wood debris); wet - **FILL**. | 28.0 | | |
| 32.0 | | | | Very hard drilling at 32.0 feet.<br>Metal returned in cuttings from 32.0 to 33.0 feet. |
| 35.0 | | | | Poor recovery, wood fragments and metal in cuttings at 35.0 feet. |
| 36.0 | | | | Hard drilling at 36.0 feet. |
| 38.0 | Loose, dark gray, silty GRAVEL with organics (wood debris) and debris (copper) (GM); moist - **FILL**. | 38.0 | | |
| 40.0 | | | | |



DRILLED BY: Western States Soil Conservation, Inc.
LOGGED BY: CR
COMPLETED: 04/11/13

BORING METHOD: mud rotary (see report text)
BORING BIT DIAMETER: 8 1/4-inch

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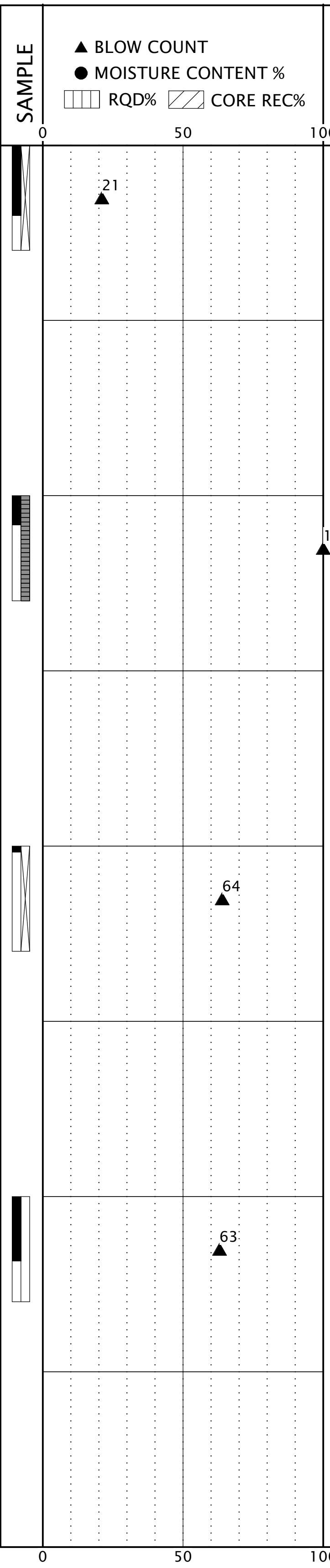
**BORING B-9**
(continued)

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-9**

| DEPTH FEET | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | SAMPLE | ▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC% | INSTALLATION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| 40.0 | | (continued from previous page) | | | | 21 | |
| 42.5 | | | | | | | |
| 45.0 | | becomes very dense, with debris (newspaper, rubber shoe heel); wet at 45.0 feet | | | | 121 | |
| 47.5 | | | | | | | |
| 50.0 | | becomes medium dense, with debris (concrete), without organics, newspaper, rubber shoe heel at 50.0 feet | | | | 64 | |
| 52.5 | | | | | | | |
| 55.0 | | becomes very dense, trace debris (wires, plastics, unknown material) at 55.0 feet | | | | 63 | |
| 57.5 | | | | | | | |
| 60.0 | | | | | | | |



DRILLED BY: Western States Soil Conservation, Inc.
LOGGED BY: CR
COMPLETED: 04/11/13

BORING METHOD: mud rotary (see report text)
BORING BIT DIAMETER: 8 1/4-inch

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**BORING B-9**
(continued)

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-9**

| DEPTH FEET | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | SAMPLE | ▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC% (0 50 100) | INSTALLATION AND COMMENTS |
|---|---|---|---|---|---|---|
| 60.0 | becomes without plastics at 60.0 feet | | | | | |
| | | | | | 91 | |
| 62.5 | | | | | | |
| 65.0 | | | | | | |
| | | | | | 38-40-50/4" | |
| 67.5 | | | | | | |
| 70.0 | trace copper wires at 70.0 feet | | | | 120/5" | Poor recovery at 70.0 feet. Boring caving from 70.0 to 75.0 feet during drilling of 75.0 to 80.0 feet. |
| | | | | | | Loss of circulation at 72.0 feet. |
| 72.5 | | | | | | |
| 75.0 | | | | | 50/2" | No recovery at 75.0 feet. |
| | Medium dense, gray GRAVEL with silt and sand (GP-GM); wet, fine and subrounded, sand is fine to coarse (alluvium). | 77.0 | | | | Driller Comment: change in drilling at 77.0 feet. |
| 77.5 | | | | | | |
| 80.0 | | | | | 0 50 100 | |

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: CR

COMPLETED: 04/11/13

BORING METHOD: mud rotary (see report text)

BORING BIT DIAMETER: 8 1/4-inch

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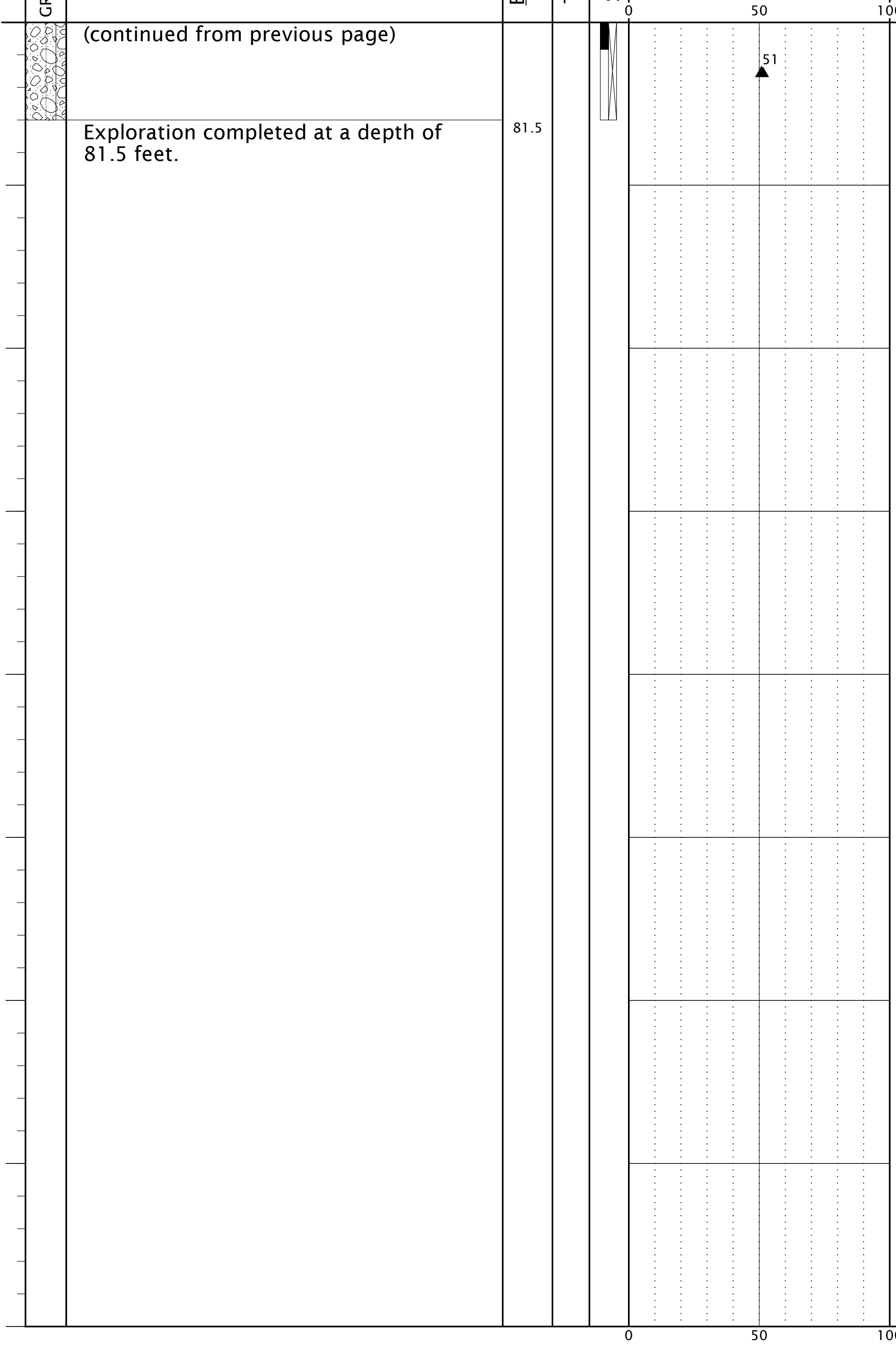
**BORING B-9**
(continued)

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-9**

| DEPTH FEET | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | SAMPLE | ▲ BLOW COUNT<br>● MOISTURE CONTENT %<br>▥ RQD% ▨ CORE REC% | INSTALLATION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| 80.0 | | (continued from previous page) | | | | 51 | |
| | | Exploration completed at a depth of 81.5 feet. | 81.5 | | | | Surface elevation was not measured at the time of exploration. |
| 82.5 | | | | | | | |
| 85.0 | | | | | | | |
| 87.5 | | | | | | | |
| 90.0 | | | | | | | |
| 92.5 | | | | | | | |
| 95.0 | | | | | | | |
| 97.5 | | | | | | | |
| 100.0 | | | | | | | |



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: CR

COMPLETED: 04/11/13

BORING METHOD: mud rotary (see report text)

BORING BIT DIAMETER: 8 1/4-inch

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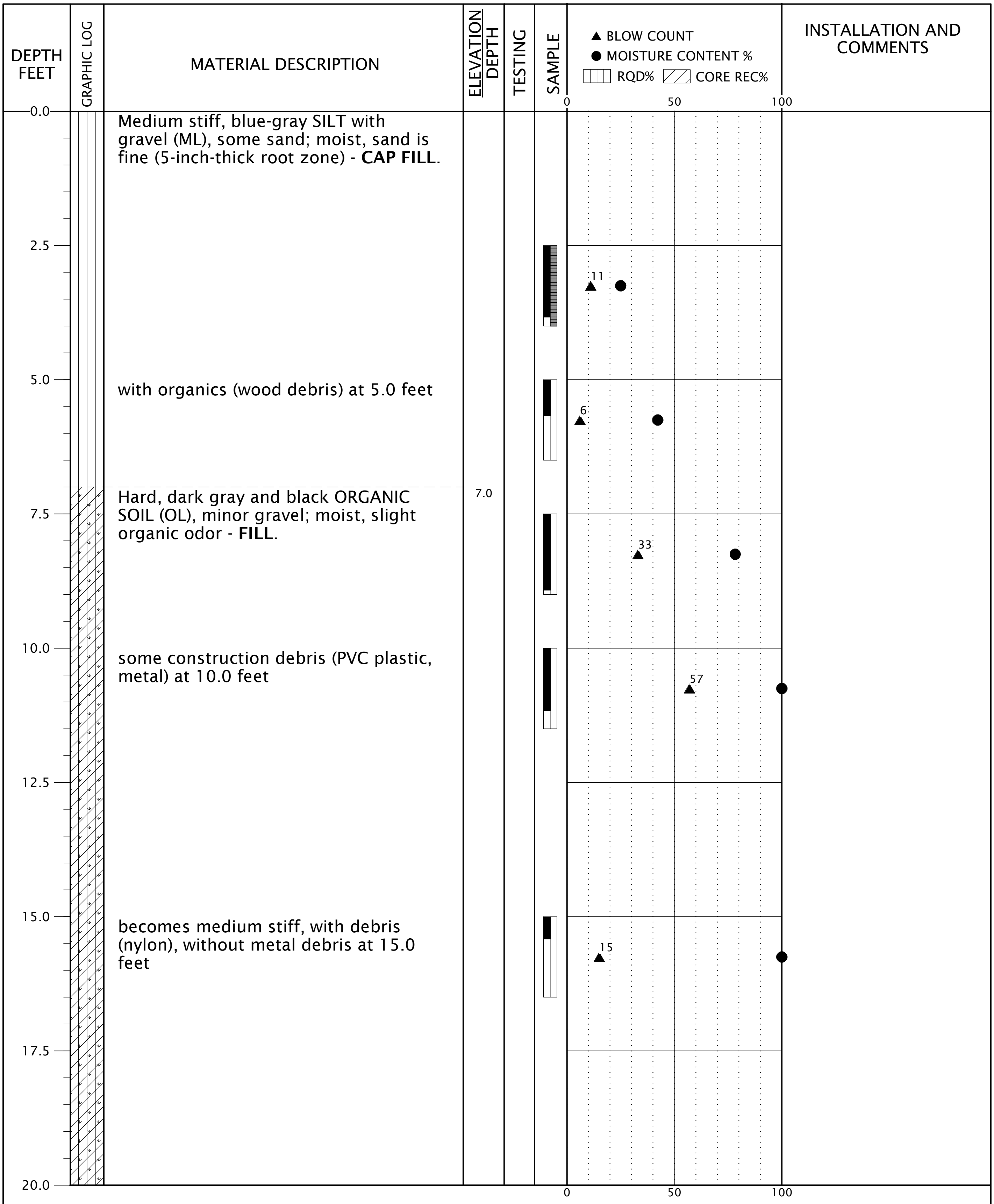
**BORING B-9**
(continued)

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-9**



Medium stiff, blue-gray SILT with gravel (ML), some sand; moist, sand is fine (5-inch-thick root zone) - **CAP FILL**.

with organics (wood debris) at 5.0 feet

Hard, dark gray and black ORGANIC SOIL (OL), minor gravel; moist, slight organic odor - **FILL**.

some construction debris (PVC plastic, metal) at 10.0 feet

becomes medium stiff, with debris (nylon), without metal debris at 15.0 feet

DRILLED BY: Western States Soil Conservation, Inc.    LOGGED BY: CR    COMPLETED: 04/15/13

BORING METHOD: mud rotary (see report text)    BORING BIT DIAMETER: 4 7/8-inch

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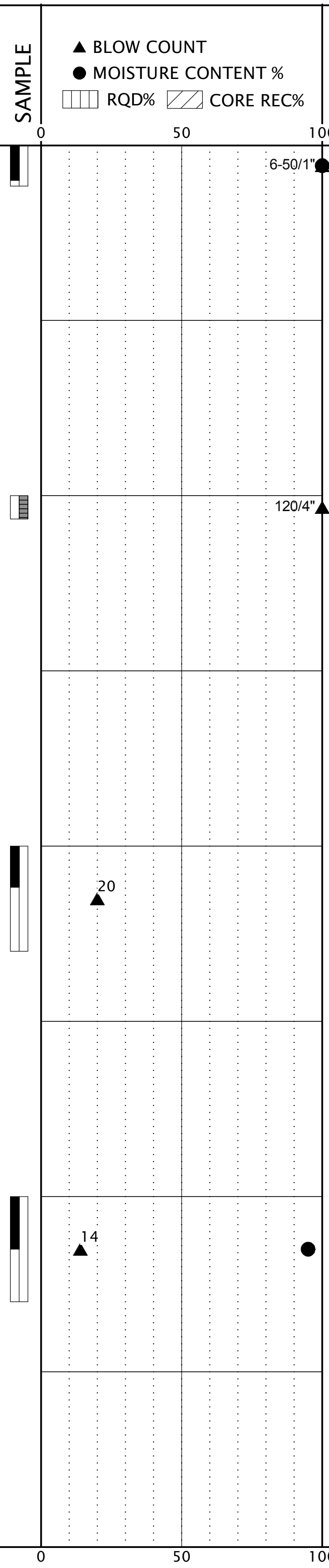
**BORING B-10**

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-10**

| DEPTH FEET | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | INSTALLATION AND COMMENTS |
|---|---|---|---|---|
| 20.0 | becomes hard at 20.0 feet | | | |
| 22.5 | | | | |
| 24.5 | | | | ⊻ 24.5 feet, during drilling |
| 25.0 | | | | No recovery at 25.0 feet.<br>Driller Comment: feels like rubber. Rubber returned in cuttings at 25.0 feet.<br>Boring sidewalls caving at 25.0 feet.<br>Driller switched to 6-inch tricone bit due to sidewalls caving. |
| 27.5 | | | | |
| 30.0 | becomes very stiff, with debris (cloth and PVC plastic); wet at 30.0 feet | | | Boring sidewalls caving at 30.0 feet. Re-drilled boring 3 times; collapse around 10.0 feet. Offset boring ~10 feet and re-attempted with auger method. |
| 32.5 | | | | |
| 35.0 | becomes medium stiff, without cloth at 35.0 feet | | OC | Set hollow-stem auger and switched to mud rotary 3 7/8-inch tricone bit at 35.0 feet.<br>OC = 47.5% |
| 37.5 | | | | |
| 40.0 | | | | |



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: CR

COMPLETED: 04/15/13

BORING METHOD: mud rotary (see report text)

BORING BIT DIAMETER: 4 7/8-inch

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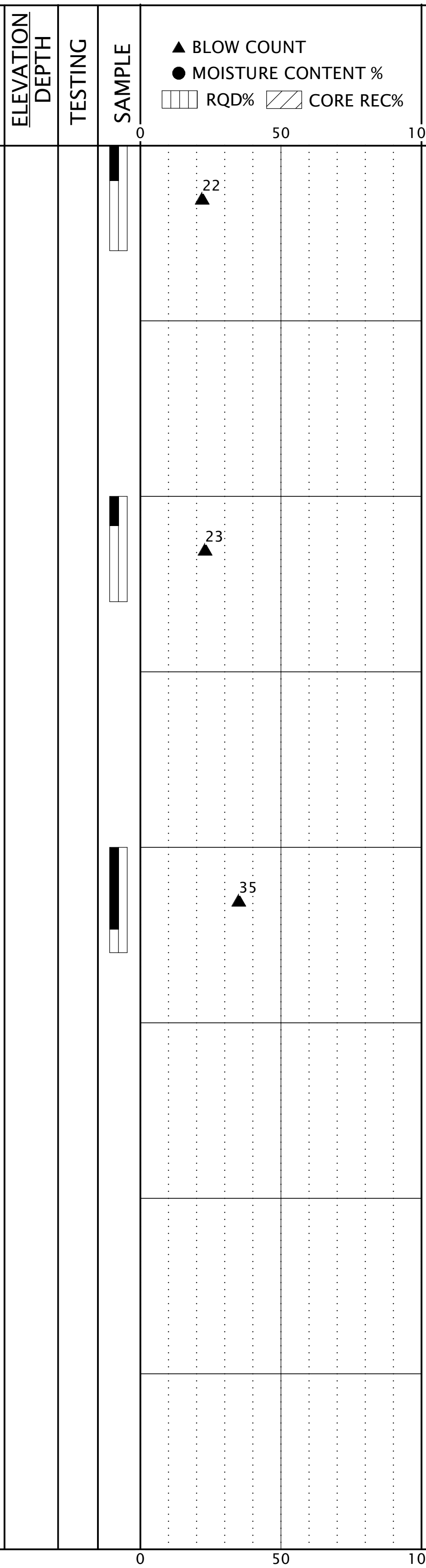
**BORING B-10**
(continued)

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-10**

| DEPTH FEET | MATERIAL DESCRIPTION | INSTALLATION AND COMMENTS |
|---|---|---|
| 40.0 | becomes very stiff, trace debris (brick, glass, PVC plastic) at 40.0 feet | |
| 42.5 | | |
| 45.0 | becomes without glass at 45.0 feet | Sidewalls caving at ~45.0 feet during trip down to 50.0 feet. |
| 47.5 | | |
| 50.0 | becomes hard at 50.0 feet | ?? Switching to 10-foot sample interval due to time/budget restraints. ?? |
| 52.5 | | |
| 55.0 | | |
| 57.5 | | |
| 60.0 | | |



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: CR

COMPLETED: 04/15/13

BORING METHOD: mud rotary (see report text)

BORING BIT DIAMETER: 4 7/8-inch

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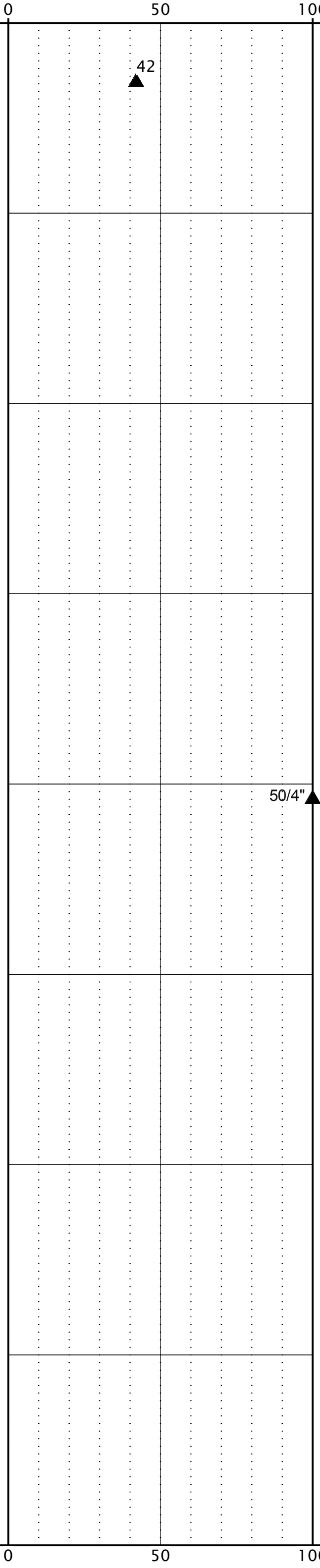
## BORING B-10
(continued)

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-10**

BORING LOG DHARMARAIN-1-03-B1_10-TP1_5.GPJ GEODESIGN.GDT PRINT DATE: 5/10/13:KT

| DEPTH FEET | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | SAMPLE | ▲ BLOW COUNT<br>● MOISTURE CONTENT %<br>▥ RQD% ▨ CORE REC% | INSTALLATION AND COMMENTS |
|---|---|---|---|---|---|---|
| 60.0 | trace debris (PVC plastic) at 60.0 feet | | | | 42 | Driller Comment: partial loss of circulation from 60.0 to 70.0 feet. Minor water return; used ~ 700 gallons of water. |
| 69.0 | Very dense, dark gray GRAVEL with debris (glass, plastic, rubber [shoe]) (GP), minor sand, trace organics (wood debris); wet, sand is fine - **FILL**. | 69.0 | | | 50/4" | Driller Comment: change in drilling at 69.0 feet, harder drilling. |
| 72.0 | Very dense, dark gray GRAVEL (GP), minor sand, trace silt; wet (alluvium). | 72.0 | | | | Heavy chatter, very hard drilling at 72.0 feet. |



Depth scale: 60.0, 62.5, 65.0, 67.5, 70.0, 72.5, 75.0, 77.5, 80.0

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: CR

COMPLETED: 04/15/13

BORING METHOD: mud rotary (see report text)

BORING BIT DIAMETER: 4 7/8-inch

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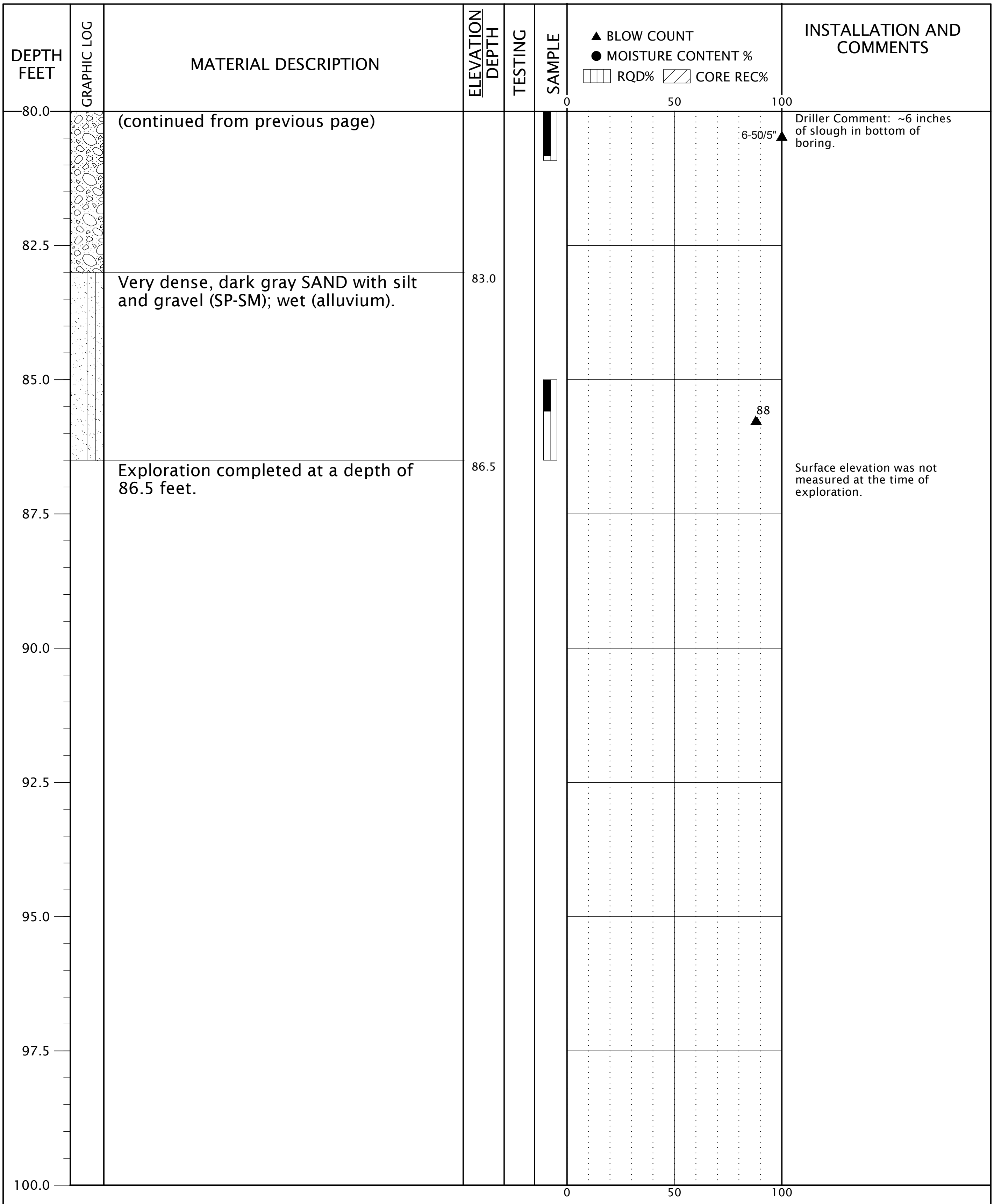
**BORING B-10**
(continued)

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-10**



(continued from previous page)

Very dense, dark gray SAND with silt and gravel (SP-SM); wet (alluvium).

Exploration completed at a depth of 86.5 feet.

Driller Comment: ~6 inches of slough in bottom of boring.

Surface elevation was not measured at the time of exploration.

DRILLED BY: Western States Soil Conservation, Inc.
LOGGED BY: CR
COMPLETED: 04/15/13

BORING METHOD: mud rotary (see report text)
BORING BIT DIAMETER: 4 7/8-inch

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**BORING B-10**
(continued)

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-10**

| DEPTH FEET | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION<br>DEPTH | TESTING | SAMPLE | ● MOISTURE CONTENT %<br>0 50 100 | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0.0 | ▨ | Medium dense, brown to gray, silty GRAVEL with debris (concrete, asphalt concrete, brick, glass, metal pipe) and cobbles to boulders (GM), minor sand, trace organics (woody debris); moist, concrete is 3 feet by 2 feet by 8 inches (3 1/2- to 4-inch-thick root zone) - **FILL**. | | | | | |
| 2.5 | ▨ | | | | | | Slow groundwater seepage observed at 3.5 feet.<br>Minor caving observed at >3.5 feet. |
| 5.0 | ▨ | | | | | | Surface elevation was not measured at the time of exploration. |
| | | Exploration completed at a depth of 6.0 feet. | 6.0 | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | 0 50 100 | |

EXCAVATED BY: Western States Soil Conservation, Inc.

LOGGED BY: JGH

COMPLETED: 04/11/13

EXCAVATION METHOD: trackhoe (see report text)

GEODESIGN INC
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DHARMARAIN-1-03

MAY 2013

**TEST PIT TP-1**

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-11**

TEST PIT LOG - 1 PER PAGE DHARMARAIN-1-03-B1_10-TP1_5.GPJ GEODESIGN.GDT PRINT DATE: 5/9/13:KT

| DEPTH FEET | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | SAMPLE | ● MOISTURE CONTENT % 0 50 100 | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0.0 | | Medium dense, brown to gray, silty GRAVEL with debris (brick, concrete, asphalt concrete) and cobbles to boulders (GM), minor sand, trace organics (woody debris); moist (3 1/2-inch-thick root zone) - **FILL**. | | | | | Stiff excavating. |
| 2.5 | | with debris (metal pipe 2 inches by 6 feet, glass, plastic) at 3.0 feet | | | | | Minor groundwater seepage observed at 3.0 feet. |
| 5.0 | | | | | | | Moderate to severe caving observed at >5.0 feet. |
| 7.5 | | | | | | | Minor groundwater seepage observed at 8.0 feet. |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | Surface elevation was not measured at the time of exploration. |
| 17.5 | | Exploration completed at a depth of 17.0 feet. | 17.0 | | | | |
| 20.0 | | | | | | 0 50 100 | |

EXCAVATED BY: Western States Soil Conservation, Inc.

LOGGED BY: JGH

COMPLETED: 04/11/13

EXCAVATION METHOD: trackhoe (see report text)

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**TEST PIT TP-2**

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-12**

| DEPTH FEET | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | SAMPLE | ● MOISTURE CONTENT % (0 50 100) | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0.0 | | Medium dense, brown to gray, silty GRAVEL with debris (concrete, brick, asphalt concrete, glass) and cobbles to boulders (GM), minor sand, trace organics (woody debris); moist, concrete is 14 inches by 12 inches by 6 inches (3-inch-thick root zone) - **FILL**. | | | | | Minor to moderate caving observed from 0.0 to 5.0 feet.<br>No groundwater seepage observed to the depth explored. |
| 2.5 | | | | | | | |
| 5.0 | | Exploration completed at a depth of 5.0 feet. | 5.0 | | | | Surface elevation was not measured at the time of exploration. |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | 0 50 100 | |

EXCAVATED BY: Western States Soil Conservation, Inc.

LOGGED BY: JGH

COMPLETED: 04/11/13

EXCAVATION METHOD: trackhoe (see report text)

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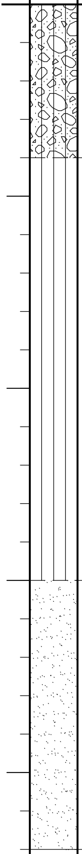
**TEST PIT TP-3**

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-13**

| DEPTH FEET | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | SAMPLE | ● MOISTURE CONTENT % 0 50 100 | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0.0 |  | Loose to medium dense, dark gray to brown, silty GRAVEL with debris (asphalt concrete, brick, concrete fragments) and cobbles to boulders (GM), minor sand, trace organics (woody debris/roots); moist (3- to 4-inch-thick root zone) - **FILL**. | 2.0 | | | | Minor to moderate caving observed at a depth of 2.0 feet. |
| 2.5 | | Medium stiff, light brown-orange SILT with sand to silty SAND with gravel (ML/SM), trace organics (rootlets); moist, sand is medium to coarse. | | | | | |
| 5.0 | | | | | | | |
| 7.5 | | Medium dense, light brown-orange SAND with gravel and cobbles (SP), minor silt; moist, medium to coarse. | 7.5 | | | | |
| 10.0 | | | | P200 | ☒ | ● | Infiltration test: ~90 inches per hour at 10.0 feet.<br>P200 = 17%<br>No groundwater seepage observed to the depth explored.<br>Surface elevation was not measured at the time of exploration. |
| | | Exploration completed at a depth of 11.0 feet. | 11.0 | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | 0 50 100 | |

EXCAVATED BY: Western States Soil Conservation, Inc.
LOGGED BY: JGH
COMPLETED: 04/11/13

EXCAVATION METHOD: trackhoe (see report text)

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**TEST PIT TP-4**

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-14**

| DEPTH FEET | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION DEPTH | TESTING | SAMPLE | ● MOISTURE CONTENT % 0 50 100 | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0.0 | | Loose to medium dense, brown-gray, silty GRAVEL to silty SAND with gravel,debris (concrete fragments, asphalt concrete), and cobbles to boulders (GM/SM); moist, concrete fragments are 1 foot by 1 foot by 5 inches - **FILL**. | | | | | Minor to moderate caving observed from 0.0 to 13.0 feet. |
| 2.5 | | | | | | | Slow groundwater seepage observed at 3.0 feet. |
| 5.0 | | | | | | | |
| | | Medium stiff, gray SILT with sand and organics (woody debris and roots) (ML); moist, organics are up to 3-inch diameter. | 5.5 | | | | |
| | | Medium stiff, light brown-orange SILT with sand to silty SAND with gravel (ML/SM), trace organics (rootlets); moist, sand is medium to coarse. | 7.0 | | | | |
| 7.5 | | | | | ☒ | | |
| 10.0 | | | | | | | |
| | | Medium dense, light brown-orange SAND with gravel and cobbles (SP), minor silt; moist, medium to coarse. | 11.0 | | | | |
| 12.5 | | | | P200 | ☒ | ● | P200 = 17%<br>Surface elevation was not measured at the time of exploration. |
| | | Exploration completed at a depth of 13.0 feet. | 13.0 | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | 0 50 100 | |

EXCAVATED BY: Western States Soil Conservation, Inc. LOGGED BY: JGH COMPLETED: 04/11/13

EXCAVATION METHOD: trackhoe (see report text)

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**TEST PIT TP-5**

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-15**

| EXPLORATION NUMBER | SAMPLE DEPTH (FEET) | MOISTURE CONTENT (PERCENT) | ORGANIC CONTENT (PERCENT) |
|---|---|---|---|
| B-4 | 15.0 | 33 | 26 |
| B-6 | 5.0 | 29 | 9 |
| B-7 | 15.0 | 56 | 17 |
| B-10 | 35.0 | 95 | 48 |
| | | | |
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## ORGANIC CONTENT TEST RESULTS

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-16**

| 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 (PERCENT) | PLASTIC LIMIT (PERCENT) | PLASTICITY INDEX (PERCENT) |
| B-1 | 5.0 | | 14 | | | | 5 | | | |
| B-2 | 5.0 | | 10 | | | | 6 | | | |
| B-3 | 5.0 | | 21 | | | | 23 | | | |
| B-4 | 2.5 | | 26 | | | | | | | |
| B-4 | 5.0 | | 41 | | | | | | | |
| B-4 | 7.5 | | 49 | | | | | | | |
| B-4 | 15.0 | | 33 | | | | | | | |
| B-5 | 2.5 | | 73 | | | | | | | |
| B-5 | 7.5 | | 107 | | | | | | | |
| B-6 | 2.5 | | 26 | | | | | | | |
| B-6 | 5.0 | | 29 | | | | | | | |
| B-7 | 2.5 | | 14 | | | | | | | |
| B-7 | 5.0 | | 15 | | | | | | | |
| B-7 | 15.0 | | 56 | | | | | | | |
| B-8 | 2.5 | | 27 | | | | | | | |
| B-8 | 5.0 | | 31 | | | | | | | |
| B-9 | 2.5 | | 15 | | | | | | | |
| B-9 | 7.5 | | 26 | | | | | | | |
| B-10 | 2.5 | | 25 | | | | | | | |
| B-10 | 5.0 | | 42 | | | | | | | |
| B-10 | 7.5 | | 78 | | | | | | | |
| B-10 | 10.0 | | 122 | | | | | | | |
| B-10 | 15.0 | | 105 | | | | | | | |
| B-10 | 20.0 | | 135 | | | | | | | |
| B-10 | 35.0 | | 95 | | | | | | | |
| TP-4 | 10.0 | | 16 | | | | 17 | | | |
| TP-5 | 12.0 | | 16 | | | | 17 | | | |

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## SUMMARY OF LABORATORY DATA

PROPOSED HOUSEHOLDER REFUGE AND TEMPLE
PORTLAND, OR

**FIGURE A-17**

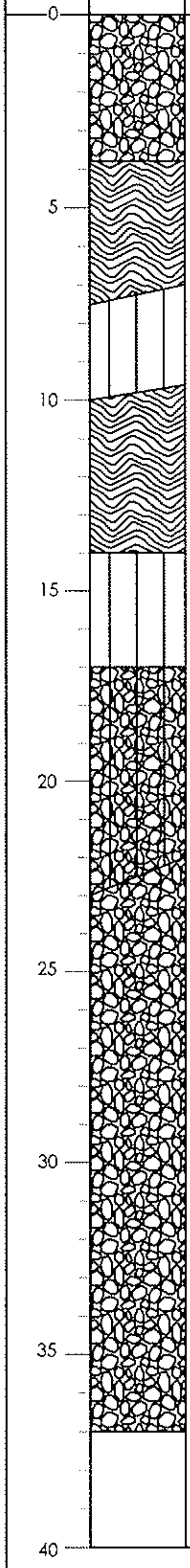
# APPENDIX B

## APPENDIX B

## PREVIOUS EXPLORATIONS BY GEODESIGN

This appendix contains copies of the exploration logs for borings B-1 through B-4 and test pits TP-1 through TP-6 that were completed by GeoDesign in October 2001. The locations of these explorations are shown on Figure 2.

DEPTH FEET | GRAPHIC LOG



## MATERIAL DESCRIPTION

**GP-FILL** Very dense, brown, sandy GRAVEL FILL with trace construction and wood debris; dry to moist.

**FILL** Dark brown FILL (wood debris) with trace sand; moist.

**ML-FILL** Very stiff, brown SILT FILL with trace sand, gravel, and wood debris; moist.

**FILL** Dark brown FILL (wood debris) with some silt and gravel; moist.

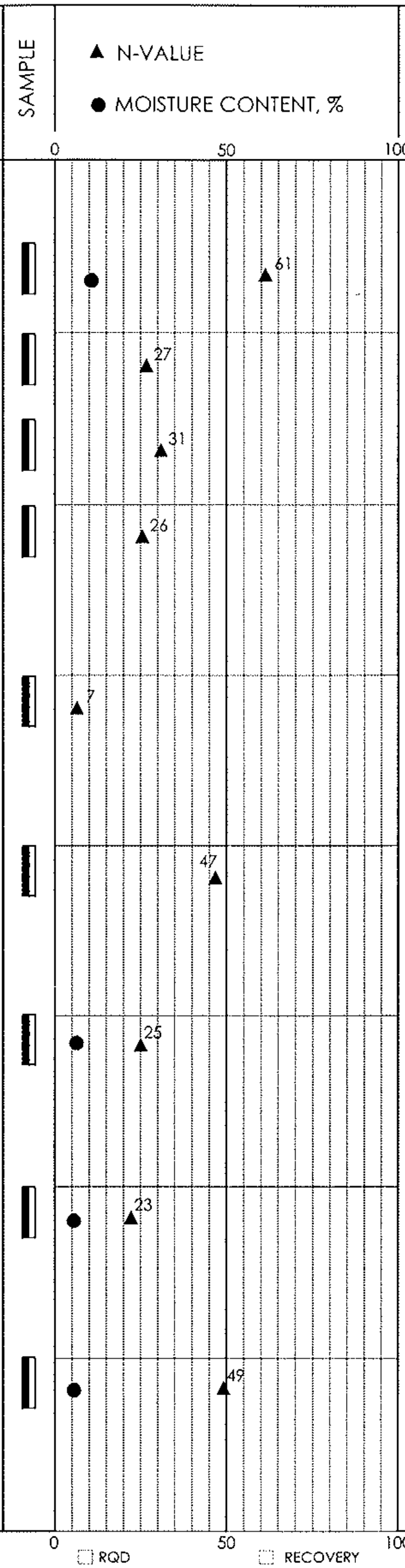
**ML-FILL** Medium stiff, dark brown SILT FILL with trace gravel and organics; moist.

**GM-FILL** Dense, brown, silty GRAVEL FILL with trace sand and organics; moist.

**GP** Medium dense, brown, subrounded GRAVEL with trace sand and silt; moist.

becomes dense at 35.0 feet

Boring completed at 37.0 feet due to refusal on September 6, 2001.

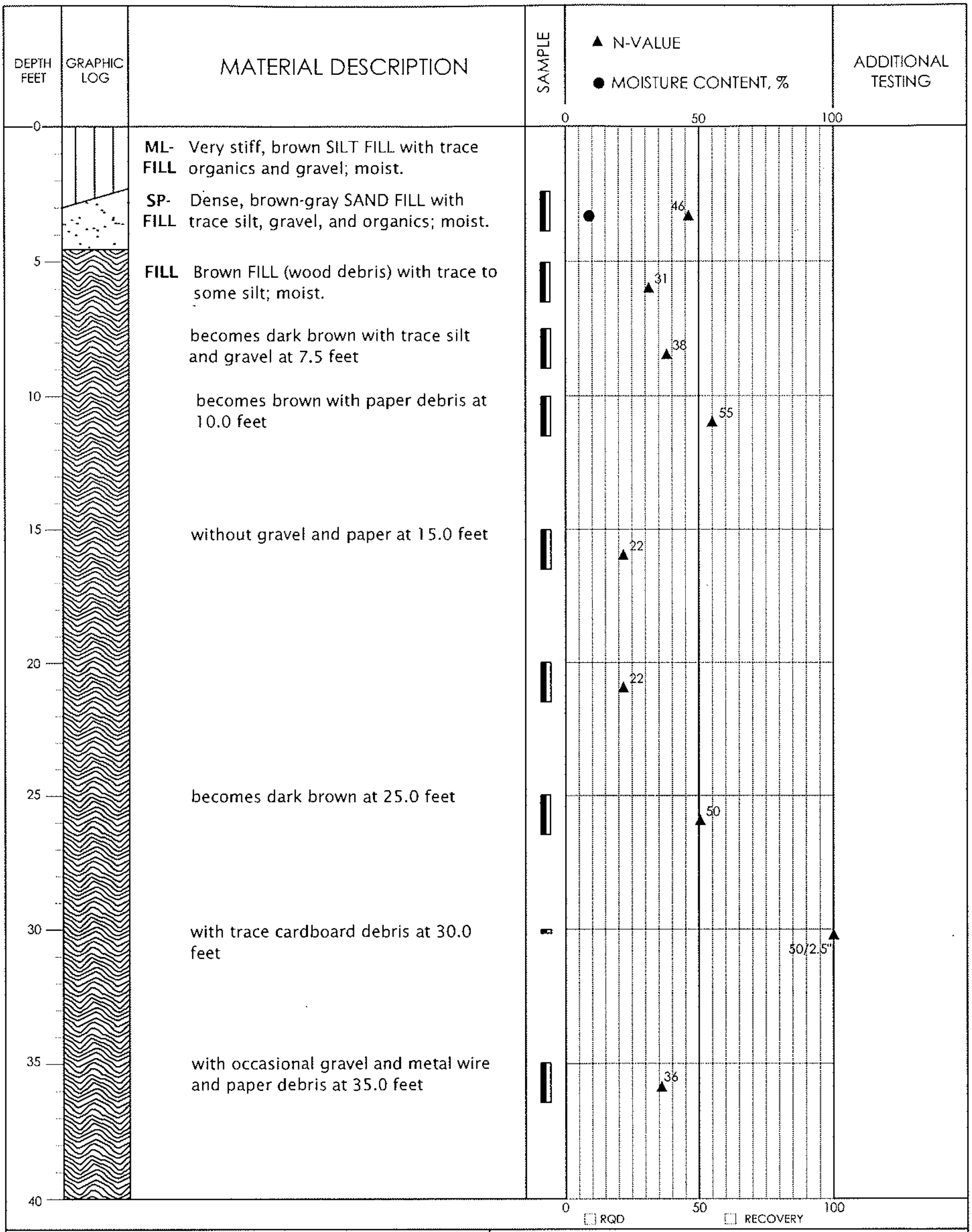


ADDITIONAL TESTING

GEODESIGN INC

## BORING B-1

| QGINVESTMENT-2 | OCTOBER 2001 | FIGURE A-1 |
|---|---|---|



MATERIAL DESCRIPTION

**ML-FILL** Very stiff, brown SILT FILL with trace organics and gravel; moist.

**SP-FILL** Dense, brown-gray SAND FILL with trace silt, gravel, and organics; moist.

**FILL** Brown FILL (wood debris) with trace to some silt; moist.

becomes dark brown with trace silt and gravel at 7.5 feet

becomes brown with paper debris at 10.0 feet

without gravel and paper at 15.0 feet

becomes dark brown at 25.0 feet

with trace cardboard debris at 30.0 feet

with occasional gravel and metal wire and paper debris at 35.0 feet

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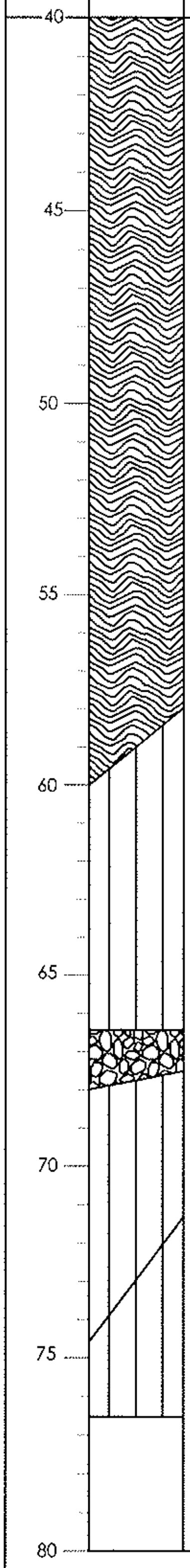
## BORING B-2

| QGINVESTMENT-2 | OCTOBER 2001 | FIGURE A-2 |
|---|---|---|

| DEPTH FEET | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE | ▲ N-VALUE<br>● MOISTURE CONTENT, % | ADDITIONAL TESTING |
|---|---|---|---|---|---|



with trace sand and occasional construction debris (glass, foam and screen) at 45.0 feet

with trace silt and occasional cardboard debris at 50.0 feet

with trace silt and sand at 55.0 feet

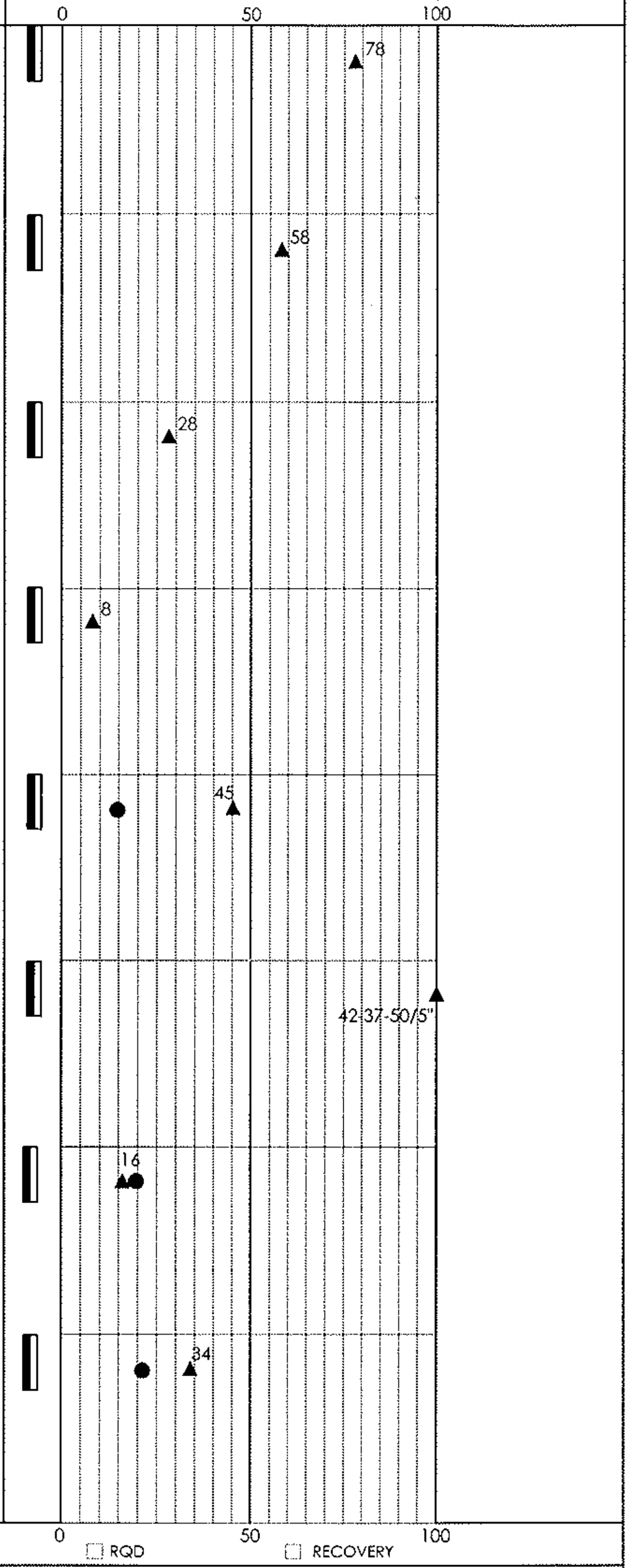
**ML-FILL** Hard, dark brown SILT FILL with trace to some gravel and trace wood debris; moist.

becomes gravelly at 65.0 feet

gravel layer

**ML** Hard, gray SILT with interbedded layers of fine sand and sandy silt; moist.

Boring completed at 76.5 feet due to refusal on September 6, 2001.



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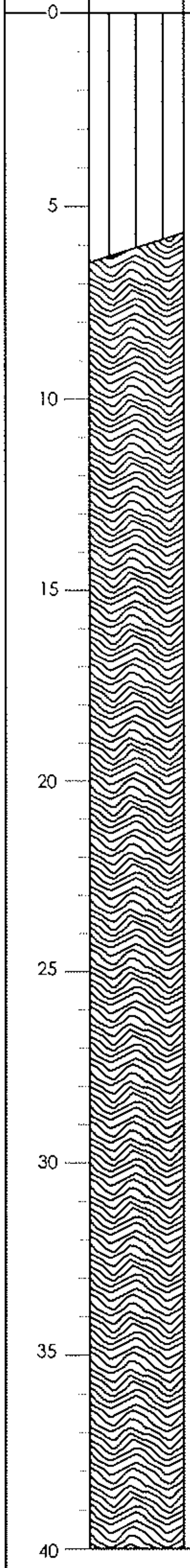
## BORING B-2 (CONT.)

| QGINVESTMENT-2 | OCTOBER 2001 | FIGURE A-2 |
|---|---|---|

DEPTH FEET | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE | ▲ N-VALUE ● MOISTURE CONTENT, % | ADDITIONAL TESTING



**ML-FILL** Stiff to very stiff, brown SILT FILL with trace sand and organics; moist.

**FILL** Brown and black FILL (wood debris) with some black granular material, and trace silt and gravel; moist.

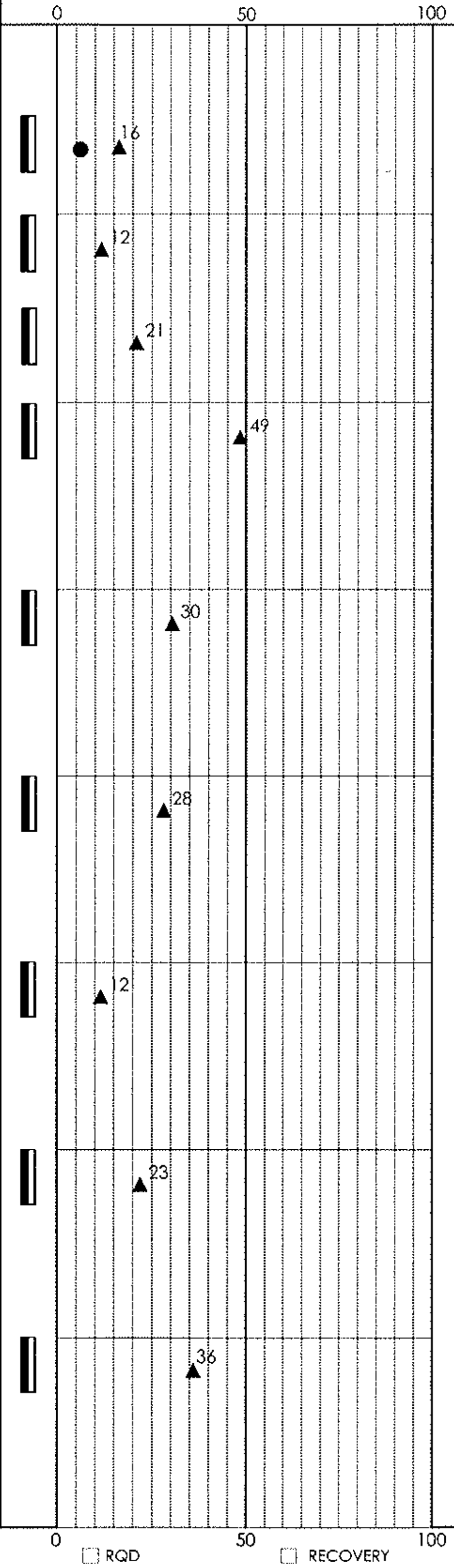
becomes wet at 15.0 feet

with trace plastic debris and occasional gravel; moist to wet at 20.0 feet

with some gravel and occasional brick fragments; wet at 25.0 feet

with trace silt at 30.0 feet

with some silt, trace sand and occasionalgravel and fabric at 35.0 feet



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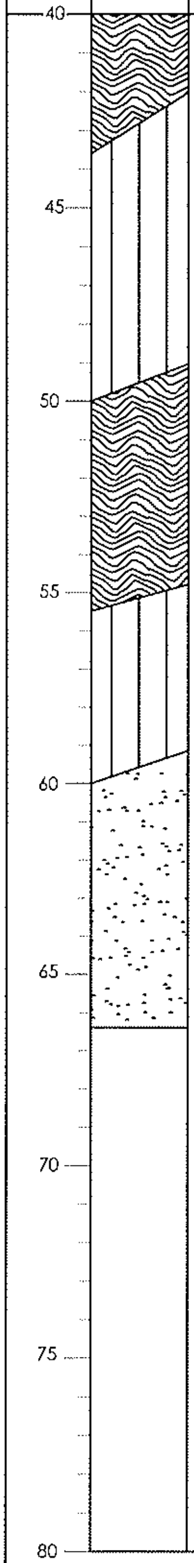
## BORING B-3

QGINVESTMENT-2 | OCTOBER 2001 | FIGURE A-3

| DEPTH FEET | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE | ▲ N-VALUE<br>● MOISTURE CONTENT, % | ADDITIONAL TESTING |
|---|---|---|---|---|---|



with occasional metal wire debris at 40.0 feet

**ML-FILL** Stiff, dark brown SILT FILL with some wood debris and trace fine sand and gravel; moist.

**FILL** Brown FILL (wood debris) with some silt and trace construction debris (brick fragments and metal wire); moist to wet.

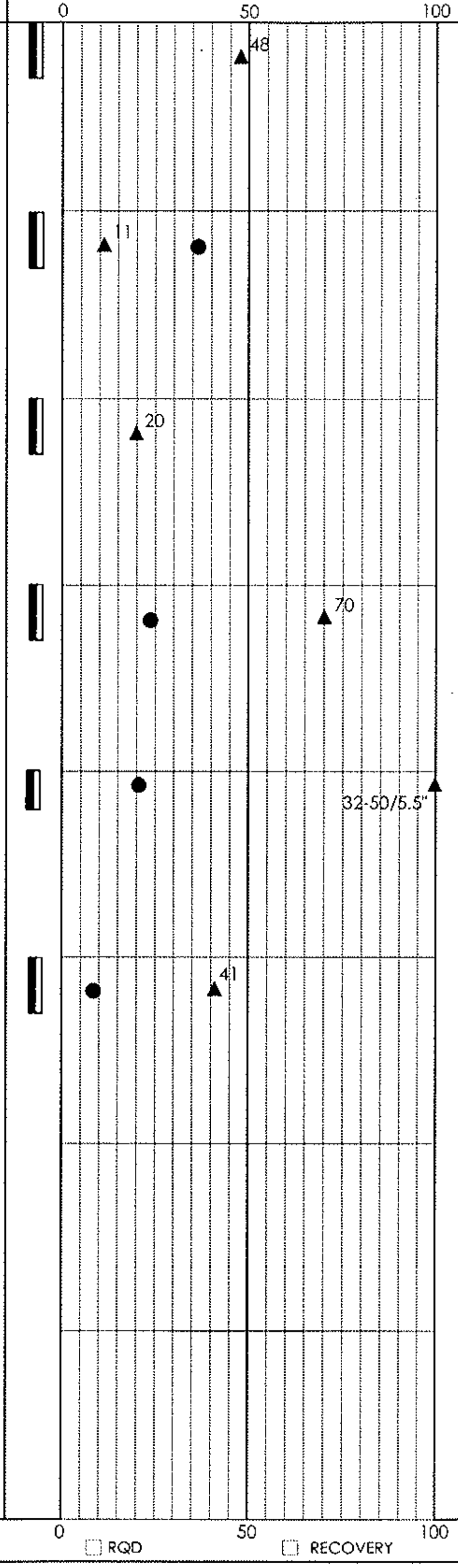
**ML-FILL** Hard, dark gray SILT FILL with trace gravel, wood, and construction debris (brick fragments); moist.

**SP** Very dense, gray, fine SAND; moist.

with interbedded gravel lenses from 60.0 to 65.0 feet

becomes dense, with some fine gravel and trace silt at 65.0 feet

Boring completed at 66.5 feet on September 7, 2001.



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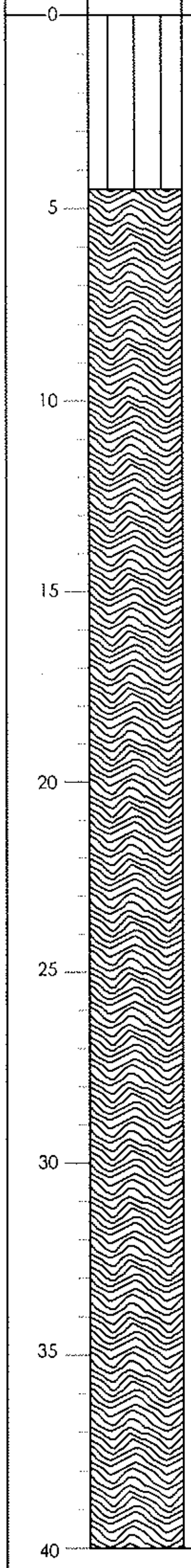
## BORING B-3 (CONT.)

| QGINVESTMENT-2 | OCTOBER 2001 | FIGURE A-3 |
|---|---|---|

| DEPTH FEET | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE | ▲ N-VALUE<br>● MOISTURE CONTENT, % | ADDITIONAL TESTING |
|---|---|---|---|---|---|



**ML-FILL** Very stiff, brown SILT FILL with trace organics and occasional gravel; moist.

becomes gray with trace sand at 3.5 feet

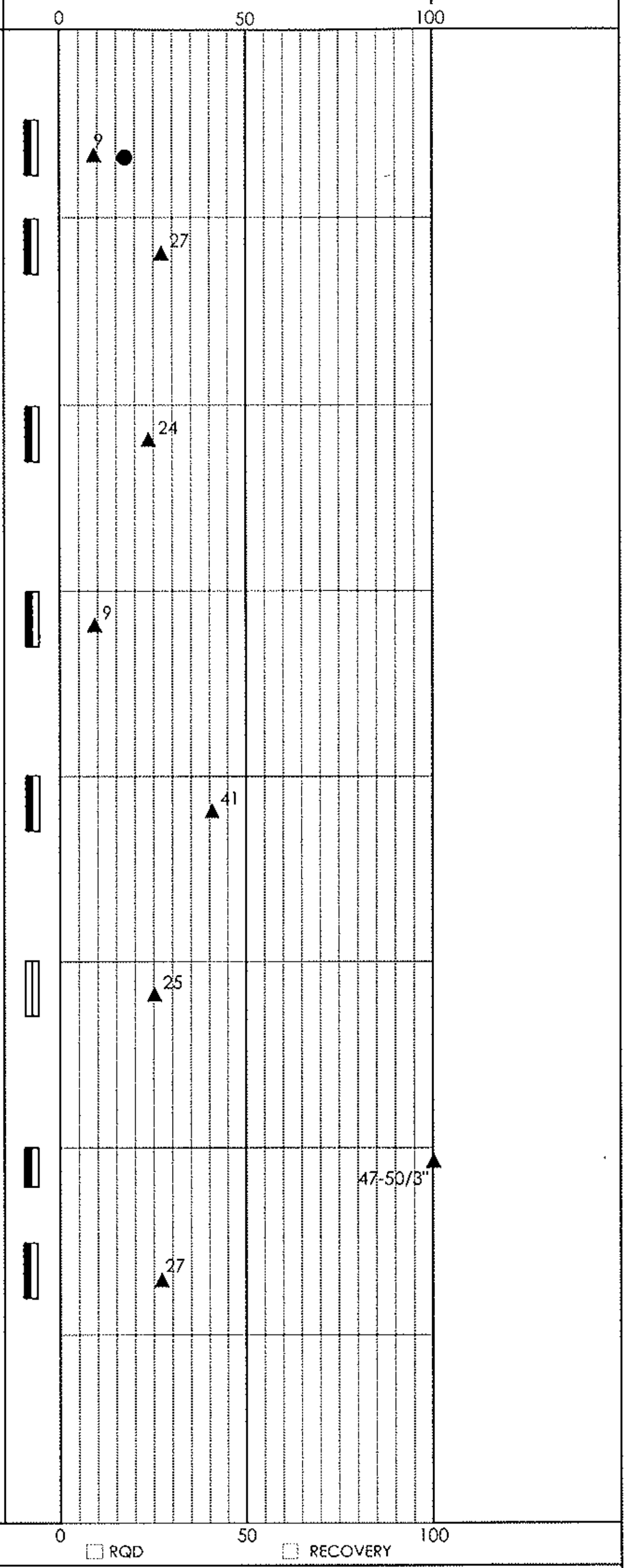
**FILL** Black FILL (wood debris) with trace to some silt; moist.

with trace silt and construction debris (foam) at 10.0 feet

becomes wet at 16.0 feet

with some construction debris (foam and asphalt) and trace gravel at 20.0 feet

with some gravel and occasional brick fragments at 25.0 feet



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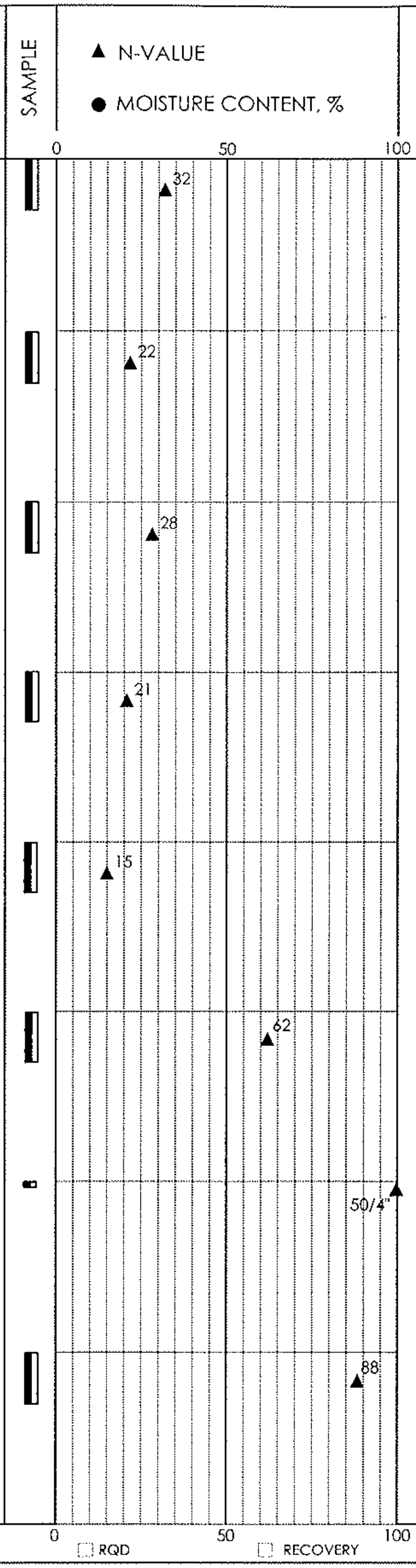
## BORING B-4

QGINVESTMENT-2 | OCTOBER 2001 | FIGURE A-4

| DEPTH FEET | GRAPHIC LOG | MATERIAL DESCRIPTION | ADDITIONAL TESTING |
|---|---|---|---|
| 40 | | with trace silt and occasional fine gravel at 40.0 feet | |
| 45 | | with occasional metal fragments and fine gravel at 45.0 feet | |
| 50 | | | |
| 55 | | with some silt and occasional plastic debris at 55.0 feet | |
| 60 | | with trace silt and gravel at 60.0 feet | |
| 65 | | with some gravel and glass fragments, and trace silt at 65.0 feet | |
| 70 | | with some silt and occasional glass fragments; moist at 70.0 feet | |
| 75 | | with some metal wire at 75.0 feet | |
| 80 | | | |



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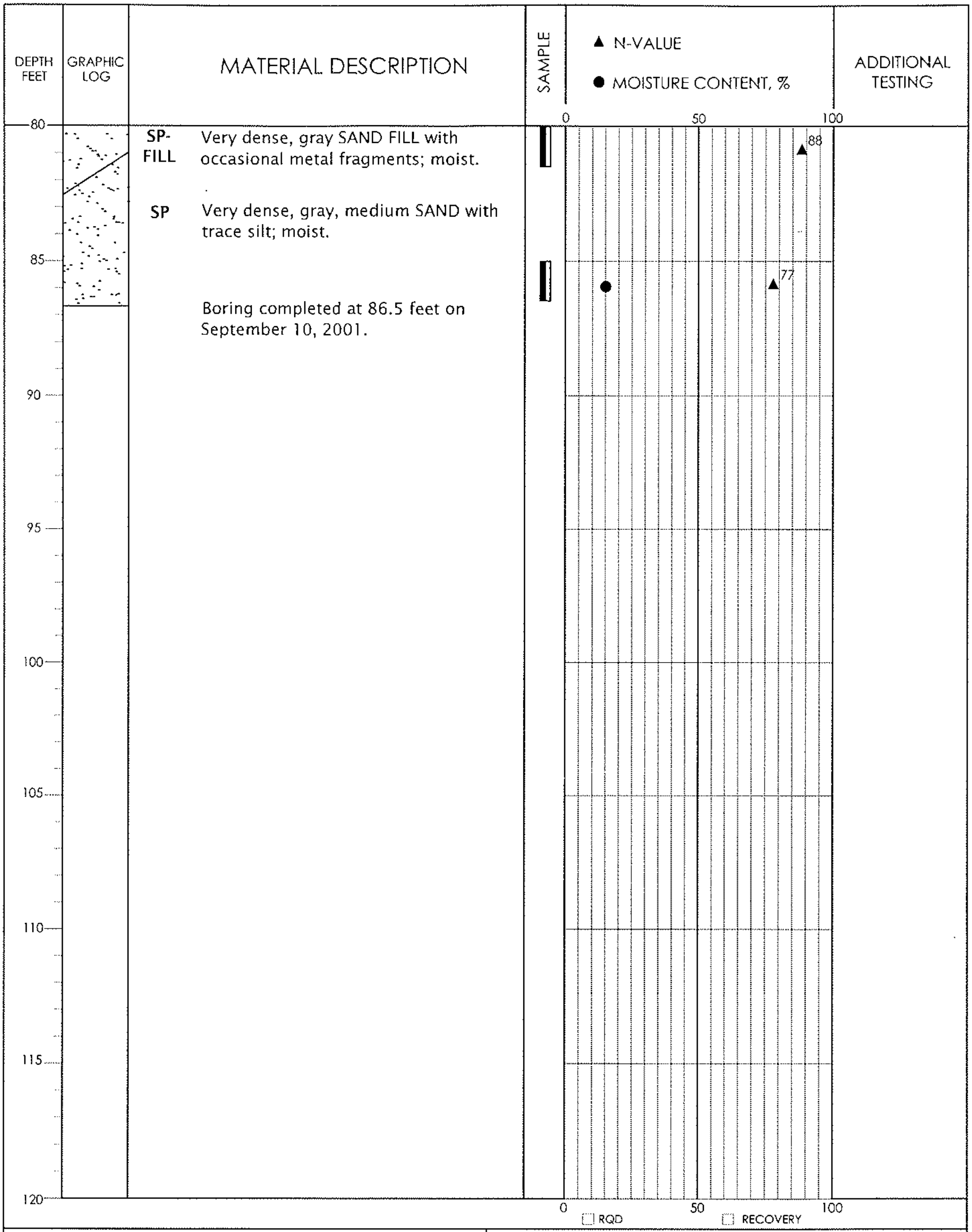
## BORING B-4 (CONT.)

| QGINVESTMENT-2 | OCTOBER 2001 | FIGURE A-4 |
|---|---|---|



**SP-FILL** Very dense, gray SAND FILL with occasional metal fragments; moist.

**SP** Very dense, gray, medium SAND with trace silt; moist.

Boring completed at 86.5 feet on September 10, 2001.

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## BORING B-4 (CONT.)

| QGINVESTMENT-2 | OCTOBER 2001 | FIGURE A-4 |
|---|---|---|

## TP-1

| DEPTH/FT | | MATERIAL DESCRIPTION | TESTING |
|---|---|---|---|
| 0 | ML-FILL | Stiff, brown, gravelly SILT FILL with trace to some sand; moist (3-inch thick root zone). | W = 7% |
| 1 | | | |
| 2 | | | |
| 3 | ML | Stiff, dark brown-gray, gravelly SILT with trace sand and occasional construction debris; moist.<br>water irrigation line encountered at 3.5 feet | W = 13% |
| 4 | | | |
| 5 | | Test pit completed at 4.0 feet on September 13, 2001.<br>Disturbed samples obtained at 0.5 and 3.0 feet.<br>No groundwater seepage observed to the depth explored.<br>No caving observed to the depth explored. | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |

GEODESIGN INC

TEST PIT LOGS

| QGINVESTMENT-2 | OCTOBER 2001 | FIGURE A-5 |
|---|---|---|

## TP-2

| DEPTH/FT | | MATERIAL DESCRIPTION | TESTING |
|---|---|---|---|
| 0 | | | |
| 1 | ML-FILL | Hard, brown SILT FILL with some gravel and trace organics; moist (5-inch thick root zone). | |
| 2 | SP-FILL | Medium dense, gray SAND FILL with trace silt; moist. | |
| 3 | | | |
| 4 | FILL | Brown-black FILL (wood debris) with trace sand, plastic, and metal debris; moist. | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | with occasional plastic sheeting, plywood, cardboard, and foam at 8.0 feet | |
| 9 | | | |
| 10 | | | |
| 11 | | concrete debris encountered at 11.0 feet | |
| 12 | | | |
| 13 | | with some sand and trace gravel at 13.0 feet | |
| 14 | | | |
| 15 | SM-FILL | Medium dense, dark gray, silty SAND FILL with trace to some subrounded gravel, wood, and glass debris; moist. | |
| 16 | | | |
| 17 | | | |
| 18 | | Test pit completed at 17.0 feet on September 13, 2001.<br>Disturbed sample obtained at 14.5 feet.<br>No groundwater seepage observed to the depth explored.<br>No caving observed to the depth explored. | |
| 19 | | | |
| 20 | | | |
| 21 | | | |
| 22 | | | |
| 23 | | | |
| 24 | | | |
| 25 | | | |

GEODESIGN INC

TEST PIT LOGS

| QGINVESTMENT-2 | OCTOBER 2001 | FIGURE A-6 |
|---|---|---|

## TP-3

| DEPTH/FT | | MATERIAL DESCRIPTION | TESTING |
|---|---|---|---|
| 0 | | | |
| 1 | ML-FILL | Hard, brown SILT FILL with trace gravel and fine sand; dry to moist (6-inch thick root zone). | W = 10% |
| 2 | | becomes gravelly at 2.5 feet | |
| 3 | | with occasional subrounded cobbles at 3.0 feet | W = 15% |
| 4 | | becomes gray at 4.0 feet | |
| 5 | | | |
| 6 | FILL | Brown-black FILL (wood debris) with some silt and trace gravel; moist.<br>with occasional plywood, plastic, metal wire, and miscellaneous debris at 6.0 feet | |
| 7 | | sawdust observed in sidewall at 7.0 feet<br>becomes gray at 7.5 feet | |
| 8 | | | |
| 9 | | | |
| 10 | | tire encountered at 10.0 feet | |
| 11 | | | |
| 12 | | | |
| 13 | | insulation encountered at 13.0 feet | |
| 14 | | Test pit completed at 14.0 feet due to refusal on September 13, 2001. | |
| 15 | | Disturbed samples obtained at 1.0 and 3.0 feet.<br>No groundwater seepage observed to the depth explored.<br>No caving observed to the depth explored. | |

## TP-4

| DEPTH/FT | | MATERIAL DESCRIPTION | TESTING |
|---|---|---|---|
| 0 | | | |
| 1 | ML-FILL | Hard, brown SILT FILL with trace fine sand, and occasional gravel and subrounded cobbles; moist (5-inch thick root zone). | |
| 2 | | | |
| 3 | ML-FILL | Medium stiff to stiff, dark gray SILT FILL with some gravel and occasional plastic and wood; moist. | |
| 4 | | | |
| 5 | | | |
| 6 | FILL | Dark brown FILL (wood debris) with some miscellaneous construction debris and trace gravel and silt; moist. | |
| 7 | | | |
| 8 | | with some silt and trace gravel at 8.0 feet | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | carpet encountered at 11.5 feet | |
| 13 | | | |
| 14 | | Test pit completed at 14.0 feet due to refusal on September 13, 2001. | |
| 15 | | No groundwater seepage observed to the depth explored.<br>No caving observed to the depth explored. | |

GEODESIGN INC

# TEST PIT LOGS

QGINVESTMENT-2 | OCTOBER 2001 | FIGURE A-7

## TP-5

| DEPTH/FT | | MATERIAL DESCRIPTION | TESTING |
|---|---|---|---|
| 0 | ML-FILL | Very stiff to hard, brown SILT FILL with trace organics and occasional subrounded gravel; moist (5-inch thick root zone). | |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | FILL | Black FILL (wood debris) with some miscellaneous debris and trace silt; moist. | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | concrete debris encountered at 11.0 feet | |
| 12 | | | |
| 13 | | | |
| 14 | | Test pit completed at 14.0 feet due to refusal on September 13, 2001.<br>No groundwater seepage observed to the depth explored.<br>No caving observed to the depth explored. | |
| 15 | | | |

## TP-6

| DEPTH/FT | | MATERIAL DESCRIPTION | TESTING |
|---|---|---|---|
| 0 | GM-FILL | Dense to very dense, brown, silty GRAVEL FILL with trace sand and organics, and occasional cobbles; moist (4-inch thick root zone). | |
| 1 | | | |
| 2 | | | |
| 3 | GP-FILL | Dense to very dense, gray GRAVEL FILL with trace sand; moist. | |
| 4 | | | |
| 5 | GM-FILL | Dense to very dense, brown, silty GRAVEL FILL with trace sand and organics, and occasional cobbles; moist. | |
| 6 | | | |
| 7 | SM-FILL | Loose to medium dense, gray, silty, fine SAND FILL with trace organics and occasional gravel; moist. | |
| 8 | ML-FILL | Very stiff, brown SILT FILL with trace organics and occasional gravel; moist. | W = 21% |
| 9 | | Test pit completed at 9.0 feet due to refusal on September 13, 2001.<br>Disturbed sample obtained at 8.0 feet.<br>No groundwater seepage observed to the depth explored.<br>No caving observed to the depth explored. | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |

# APPENDIX C

# APPENDIX C

## CORROSIVITY/CHEMICAL ACTIVITY

A selected soil sample was tested for pH, soluble sulfates and chlorides, and specific conductivity (resistivity). Testing was performed as a measure of corrosivity of the on-site soil and for total sulfate content per EPA Method 300.0 by Specialty Analytical in Clackamas, Oregon. The test results are included in this appendix.

**Specialty Analytical**

11711 SE Capps Road, Ste B
Clackamas, Oregon 97015
TEL: 503-607-1331 FAX: 503-607-1336
Website: www.specialtyanalytical.com

---

May 08, 2013

Viadas Zievys
GeoDesign, Inc.
15575 SW Sequoia Parkway
Ste 100
Portland, OR 97224

TEL: (503) 968-8787
FAX (503) 968-3068

RE: Dharma Rain

Dear Viadas Zievys: Order No.: 1305011

Specialty Analytical received 1 sample(s) on 5/1/2013 for the analyses presented in the following report.

There were no problems with the analysis and all data for associated QC met EPA or laboratory specifications, except where noted in the Case Narrative, or as qualified with flags. Results apply only to the samples analyzed. Without approval of the laboratory, the reproduction of this report is only permitted in its entirety.

If you have any questions regarding these tests, please feel free to call.

Sincerely,

Marty French
Lab Director

# Specialty Analytical

**Date Reported:** **08-May-13**

| | | | |
|---|---|---|---|
| **CLIENT:** | GeoDesign, Inc. | **Collection Date:** | 5/1/2013 3:30:00 PM |
| **Project:** | Dharma Rain | | |
| **Lab ID:** | 1305011-001 | | |
| **Client Sample ID:** | B-05 @ 5' | **Matrix:** | SOIL |

| Analyses | Result | RL | Qual | Units | DF | Date Analyzed |
|---|---|---|---|---|---|---|
| **WATER SOLUBLE CHLORIDE** | | **T291-94** | | | | Analyst: **AT** |
| Chloride | 180 | 7.50 | | mg/Kg | 5 | 5/3/2013 7:05:00 PM |
| **PH OF SOIL-CORROSION TESTING** | | **T289-91** | | | | Analyst: **AT** |
| pH | 7.27 | 0 | | pH Units | 1 | 5/2/2013 4:35:00 PM |
| **SOIL RESISTIVITY** | | **T288-91** | | | | Analyst: **AT** |
| Minimum Soil Resistivity | 945 | 1.00 | | ohm-cm | 1 | 5/3/2013 12:15:00 PM |
| **WATER SOLUBLE SULFATE ION** | | **T290-95** | | | | Analyst: **AT** |
| Sulfate | 2520 | 75.0 | | mg/Kg | 50 | 5/3/2013 7:20:00 PM |

# QC SUMMARY REPORT

WO#: **1305011**

***08-May-13***

## Specialty Analytical

**Client:** GeoDesign, Inc.

**Project:** Dharma Rain

**TestCode:** **CL_AASHTO**

Sample ID: **MB-R9539** SampType: **MBLK** TestCode: **CL_AASHTO** Units: **mg/Kg** Prep Date: RunNo: **9539**

Client ID: **PBS** Batch ID: **R9539** TestNo: **T291-94** Analysis Date: **5/3/2013** SeqNo: **119323**

| Analyte | Result | PQL | SPK value | SPK Ref Val | %REC | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Chloride | ND | 1.50 | | | | | | | | | |

Sample ID: **LCS-R9539** SampType: **LCS** TestCode: **CL_AASHTO** Units: **mg/Kg** Prep Date: RunNo: **9539**

Client ID: **LCSS** Batch ID: **R9539** TestNo: **T291-94** Analysis Date: **5/3/2013** SeqNo: **119324**

| Analyte | Result | PQL | SPK value | SPK Ref Val | %REC | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Chloride | 44.5 | 1.50 | 45.00 | 0 | 98.8 | 90 | 110 | | | | |

Sample ID: **1305011-001AMS** SampType: **MS** TestCode: **CL_AASHTO** Units: **mg/Kg** Prep Date: RunNo: **9539**

Client ID: **B-05 @ 5'** Batch ID: **R9539** TestNo: **T291-94** Analysis Date: **5/3/2013** SeqNo: **119326**

| Analyte | Result | PQL | SPK value | SPK Ref Val | %REC | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Chloride | 1630 | 150 | 1500 | 162.3 | 98.1 | 80 | 120 | | | | |

Sample ID: **1305011-001AMSD** SampType: **MSD** TestCode: **CL_AASHTO** Units: **mg/Kg** Prep Date: RunNo: **9539**

Client ID: **B-05 @ 5'** Batch ID: **R9539** TestNo: **T291-94** Analysis Date: **5/3/2013** SeqNo: **119327**

| Analyte | Result | PQL | SPK value | SPK Ref Val | %REC | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Chloride | 1640 | 150 | 1500 | 162.3 | 98.4 | 80 | 120 | 1634 | 0.251 | 20 | |

**Qualifiers:**

B Analyte detected in the associated Method Blank

R RPD outside accepted recovery limits

H Holding times for preparation or analysis exceeded

S Spike Recovery outside accepted recovery limits

ND Not Detected at the Reporting Limit

**Client:** GeoDesign, Inc.

**Project:** Dharma Rain **TestCode:** **CL_AASHTO**

Sample ID: **CCV** SampType: **CCV** TestCode: **CL_AASHTO** Units: **mg/Kg** Prep Date: RunNo: **9539**

Client ID: **CCV** Batch ID: **R9539** TestNo: **T291-94** Analysis Date: **5/3/2013** SeqNo: **119328**

| Analyte | Result | PQL | SPK value | SPK Ref Val | %REC | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Chloride | 14.8 | 0.500 | 15.00 | 0 | 98.9 | 90 | 110 | | | | |

| **Qualifiers:** | | | | | | |
|---|---|---|---|---|---|---|
| | B | Analyte detected in the associated Method Blank | H | Holding times for preparation or analysis exceeded | ND | Not Detected at the Reporting Limit |
| | R | RPD outside accepted recovery limits | S | Spike Recovery outside accepted recovery limits | | |

# QC SUMMARY REPORT

WO#: **1305011**

***08-May-13***

# Specialty Analytical

**Client:** GeoDesign, Inc.

**Project:** Dharma Rain

**TestCode:** **PH_AASHTO**

Sample ID: **1305011-001ADUP** SampType: **DUP** TestCode: **PH_AASHTO** Units: **pH Units** Prep Date: RunNo: **9528**

Client ID: **B-05 @ 5'** Batch ID: **R9528** TestNo: **T289-91** Analysis Date: **5/2/2013** SeqNo: **119241**

| Analyte | Result | PQL | SPK value | SPK Ref Val | %REC | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | 7.23 | 0 | | | | | | 7.270 | 0.552 | 20 | |

| **Qualifiers:** | | | | | | |
|---|---|---|---|---|---|---|
| | B | Analyte detected in the associated Method Blank | H | Holding times for preparation or analysis exceeded | ND | Not Detected at the Reporting Limit |
| | R | RPD outside accepted recovery limits | S | Spike Recovery outside accepted recovery limits | | |

**Client:** GeoDesign, Inc.

**Project:** Dharma Rain **TestCode:** T290_95

Sample ID: **MB-R9540** SampType: **MBLK** TestCode: **T290_95** Units: **mg/Kg** Prep Date: RunNo: **9540**

Client ID: **PBS** Batch ID: **R9540** TestNo: **T290-95** Analysis Date: **5/3/2013** SeqNo: **119330**

| Analyte | Result | PQL | SPK value | SPK Ref Val | %REC | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sulfate | ND | 1.50 | | | | | | | | | |

Sample ID: **LCS-R9540** SampType: **LCS** TestCode: **T290_95** Units: **mg/Kg** Prep Date: RunNo: **9540**

Client ID: **LCSS** Batch ID: **R9540** TestNo: **T290-95** Analysis Date: **5/3/2013** SeqNo: **119331**

| Analyte | Result | PQL | SPK value | SPK Ref Val | %REC | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sulfate | 46.9 | 1.50 | 45.00 | 0 | 104 | 80 | 120 | | | | |

Sample ID: **1305011-001AMS** SampType: **MS** TestCode: **T290_95** Units: **mg/Kg** Prep Date: RunNo: **9540**

Client ID: **B-05 @ 5'** Batch ID: **R9540** TestNo: **T290-95** Analysis Date: **5/3/2013** SeqNo: **119333**

| Analyte | Result | PQL | SPK value | SPK Ref Val | %REC | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sulfate | 3880 | 150 | 1500 | 2564 | 87.8 | 69.1 | 120 | | | | |

Sample ID: **1305011-001AMSD** SampType: **MSD** TestCode: **T290_95** Units: **mg/Kg** Prep Date: RunNo: **9540**

Client ID: **B-05 @ 5'** Batch ID: **R9540** TestNo: **T290-95** Analysis Date: **5/3/2013** SeqNo: **119334**

| Analyte | Result | PQL | SPK value | SPK Ref Val | %REC | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sulfate | 3880 | 150 | 1500 | 2564 | 87.7 | 69.1 | 120 | 3881 | 0.0448 | 20 | |

**Qualifiers:**

B Analyte detected in the associated Method Blank

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

R RPD outside accepted recovery limits

S Spike Recovery outside accepted recovery limits

# QC SUMMARY REPORT

WO#: **1305011**

***08-May-13***

# Specialty Analytical

---

**Client:** GeoDesign, Inc.

**Project:** Dharma Rain **TestCode:** **T290_95**

Sample ID: **CCV** SampType: **CCV** TestCode: **T290_95** Units: **mg/Kg** Prep Date: RunNo: **9540**

Client ID: **CCV** Batch ID: **R9540** TestNo: **T290-95** Analysis Date: **5/3/2013** SeqNo: **119335**

| Analyte | Result | PQL | SPK value | SPK Ref Val | %REC | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sulfate | 15.6 | 0.500 | 15.00 | 0 | 104 | 90 | 110 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Qualifiers:** B | Analyte detected in the associated Method Blank | H | Holding times for preparation or analysis exceeded | ND | Not Detected at the Reporting Limit |
| R | RPD outside accepted recovery limits | S | Spike Recovery outside accepted recovery limits | | |

# KEY TO FLAGS

Rev. May 12, 2010

| | |
|---|---|
| A | This sample contains a Gasoline Range Organic not identified as a specific hydrocarbon product. The result was quantified against gasoline calibration standards |
| A1 | This sample contains a Diesel Range Organic not identified as a specific hydrocarbon product. The result was quantified against diesel calibration standards. |
| A2 | This sample contains a Lube Oil Range Organic not identified as a specific hydrocarbon product. The result was quantified against a lube oil calibration standard. |
| A3 | The result was determined to be Non-Detect based on hydrocarbon pattern recognition. The product was carry-over from another hydrocarbon type. |
| A4 | The product appears to be aged or degraded diesel. |
| B | The blank exhibited a positive result great than the reporting limit for this compound. |
| CN | See Case Narrative. |
| D | Result is based from a dilution. |
| E | Result exceeds the calibration range for this compound. The result should be considered as estimate. |
| F | The positive result for this hydrocarbon is due to single component contamination. The product does not match any hydrocarbon in the fuels library. |
| G | Result may be biased high due to biogenic interferences. Clean up is recommended. |
| H | Sample was analyzed outside recommended holding time. |
| HT | At clients request, samples was analyzed outside of recommended holding time. |
| J | The result for this analyte is between the MDL and the PQL and should be considered as estimated concentration. |
| K | Diesel result is biased high due to amount of Oil contained in the sample. |
| L | Diesel result is biased high due to amount of Gasoline contained in the sample. |
| M | Oil result is biased high due to amount of Diesel contained in the sample. |
| MC | Sample concentration is greater than 4x the spiked value, the spiked value is considered insignificant. |
| MI | Result is outside control limits due to matrix interference. |
| MSA | Value determined by Method of Standard Addition. |
| O | Laboratory Control Standard (LCS) exceeded laboratory control limits, but meets CCV criteria. Data meets EPA requirements. |
| Q | Detection levels elevated due to sample matrix. |
| R | RPD control limits were exceeded. |
| RF | Duplicate failed due to result being at or near the method-reporting limit. |
| RP | Matrix spike values exceed established QC limits; post digestion spike is in control. |
| S | Recovery is outside control limits. |
| SC | Closing CCV or LCS exceeded high recovery control limits, but associated samples are non-detect. Data meets EPA requirements. |
| * | The result for this parameter was greater that the maximum contaminant level of the TCLP regulatory limit. |

# CHAIN OF CUSTODY RECORD

Page 1 of 1

**Specialty Analytical**
11711 SE Capps Road
Clackamas, OR 97015
Phone: 503-607-1331
Fax: 503-607-1336

VZievys@geodesigninc.com

Contact Person/Project Manager Vaidas Zievys
Company GeoDesign, Inc.
Address 15575 SW Sequoia Pkwy, Ste. 100
Portland OR 97224
Phone 503.968.8787 Fax 503.968.3068
Project No. Dharma Rain Project Name
Project Site Location OR X WA Other
Invoice To P.O. No.

Collected By:
Signature
Printed
Signature
Printed

Turn Around Time
☒ Normal 5-7 Business Days
☐ Rush
Specify
**Rush Analyses Must Be Scheduled With The Lab In Advance**

**For Laboratory Use**
Lab Job No. 1305011
Shipped Via Client
Air Bill No.
Temperature On Receipt Amb °C
Specialty Analytical Containers? Y / N
Specialty Analytical Trip Blanks? Y / N

| | | | | | Analyses | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Time | Sample I.D. | Matrix | No. of Containers | pH | Resistivity | Sulfates | Chloride | | | | | | | Comments | Lab I.D. |
| 5/1/13 | 3:30 | B-05 @ 5' | | 1 | 1 | 1 | 1 | 1 | | | | | | | | |
| | | | | | | | | | | | | | | | | |
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|---|---|---|---|---|---|---|
| Relinquished By:<br>Company: | Date<br>5/1/13 | Time<br>3:30 | Received By:<br>Company: | Relinquished By:<br>Company: | Date | Time |
| Unless Reclaimed, Samples Will Be Disposed of 60 Days After Receipt.<br>Samples held beyond 60 days subject to storage fee(s) | | | | Received For Lab By:<br>Nikki Buppes | Date<br>5/1/13 | Time<br>1530 |

Copies: White-Original Yellow-Project File Pink-Customer Copy

# ACRONYMS

## ACRONYMS

| | |
|---|---|
| AASHTO | American Association of State Highway and Transportation Officials |
| AC | asphalt concrete |
| ASTM | American Society for Testing and Materials |
| BGS | below ground surface |
| DEQ | Oregon Department of Environmental Quality |
| EPA | U.S. Environmental Protection Agency |
| ESA | environmental site assessment |
| g | gravitational acceleration (32.2 feet/second$^2$) |
| H:V | horizontal to vertical |
| IBC | International Building Code |
| mg/kg | milligrams per kilogram |
| MHMAC | minor hot mixed asphalt concrete |
| MSL | mean sea level |
| ohm-cm | ohm-centimeter |
| OSHA | Occupational Safety and Health Administration |
| OSSC | Oregon Standard Specifications for Construction (2008) |
| OWRD | Oregon Water Resourced Department |
| pcf | pounds per cubic foot |
| pci | pounds per cubic inch |
| PGA | peak ground acceleration |
| PPA | Prospective Purchaser's Agreement |
| psf | pounds per square foot |
| psi | pounds per square inch |
| PVC | polyvinyl chloride |
| SOSSC | State of Oregon Structural Specialty Code |
| SPT | standard penetration test |

www.geodesigninc.com