GEODESIGN INC

REPORT OF GEOTECHNICAL ENGINEERING SERVICES
Proposed Industrial Building
33619 NE Crown Zellerbach Road
Scappoose, Oregon

For
Hedges Creek Management #1, LLC
September 27, 2007

GeoDesign Projects: HedgesCM-1-01

GEODESIGN INC

September 27, 2007

Hedges Creek Management #1, LLC
14660 NW Rock Creek Road
Portland, OR 97231

Attention: Ms. Tina A Saulnier

Report of Geotechnical Engineering Services
Proposed Industrial Building
33619 NE Crown Zellerbach Road
Scappoose, Oregon
GeoDesign Project: HedgesCM-1-01

GeoDesign, Inc. is pleased to submit our report of geotechnical engineering services for the proposed industrial building in Scappoose, Oregon. Our services for this project were conducted in accordance with our proposal dated July 31, 2007.

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

Sincerely,

GeoDesign, Inc.

Jeffery D. Tucker, P.E.
Principal Engineer

cc: Mr. Blake Patsy, KPFF Consulting Engineers

CMC:VCL:TCM:JDT:kt
Attachments
Two copies submitted
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1.0 INTRODUCTION

GeoDesign, Inc. is pleased to submit this geotechnical engineering report for the proposed industrial building and construction repair yard located at 33619 NE Crown Zellerbach Road in Scappoose, Oregon. The approximately 10.2-acre site, currently designated as Parcel 2, is an undeveloped area located at the north end of an area previously occupied by a gravel mining operation and located northwest of the intersection of NE Crown Zellerbach Road and West Lane Road. The approximate location of the site relative to surrounding physical features is presented on Figure 1. For your reference, definitions of all acronyms used are attached at the end of this document.

2.0 PROJECT UNDERSTANDING

Based on our discussions with you, it is our understanding that the proposed development will consist of an approximately 27,600-square-foot prefabricated, metal industrial building with attached offices. The site will be used as a construction equipment repair and maintenance facility, and floor slab will be required to support movement of heavy construction equipment with total loads of up to 200 kips and areal loads of up to 2,800 psf. The area around the building will not be paved and will be constructed as a gravel-surfaced equipment yard.

We understand that the site was historically mined and was then used as a dirt fill site. The area of the proposed development is estimated to contain between 48 and 55 feet of fill material that was placed between the mid-1980s and mid-1990s. It is our further understanding that a 12-foot-thick surcharge was placed in the proposed improvement area and remained for an estimated 10 years before it was removed in the fall of 2006. After removal of the surcharge, the site was brought to the current grade with approximately 1 foot of gravel fill. Based on our discussion with the structural engineer, Mr. Blake Patsy, the column loads for the building will be less than 200 kips. We anticipate a maximum allowable distributed floor slab load of 300 psf and that maximum cuts and fills will be less than approximately 5 feet each. The site layout, along with our exploration locations, is shown on Figure 2.

3.0 PURPOSE AND SCOPE

The purpose of our services was to explore subsurface conditions at the site to provide the basis for geotechnical recommendations for site development and foundation design. Our specific scope of work included the following:

- Reviewed readily available published geologic data and our in-house files for existing information on subsurface conditions in the site vicinity.
- Coordinated and managed the field investigation, which included locating utilities and scheduling subcontractors.
- Explored subsurface soil and groundwater conditions in the proposed building area with three borings to depths ranging between 51 to 56.5 feet BGS.
- Completed laboratory analyses on disturbed and undisturbed soil samples obtained from the explorations, as follows:
  - Fifteen moisture contents and two dry density determinations in general accordance with ASTM D 2216 and D 2937, respectively

  - One Atterberg limits test in general accordance with ASTM D 4318
  - One particle-size analysis in general accordance with ASTM C 136
  - One consolidation test in general accordance with ASTM D 2435
- Provided recommendations for site preparation and grading (including temporary and permanent slopes, fill placement criteria, suitability of on-site soils for fill, subgrade preparation, and recommendations for wet weather construction).
- Provided recommendations for excavation and excavation support.
- Provided foundation recommendations for the support of the proposed structure (including allowable bearing capacity, estimated settlement, and lateral resistance).
- Provided recommendations for use in the design of conventional retaining walls (including backfill and drainage requirements, and lateral earth pressures).
- Provided recommendations for rock sections for use in the equipment yard.
- Evaluated groundwater conditions at the site, and provided general recommendations for dewatering during construction and subsurface drainage.
- Discussed the potential seismic activity near the site, and provided seismic design criteria in accordance with the 2006 IBC.
- Prepared this geotechnical engineering report that presents our findings, conclusions, and recommendations.

4.0 SITE CONDITONS

4.1 SURFACE CONDITIONS

The site is predominantly undeveloped and is relatively level with low topographic relief. The surface is covered in gravel from recent fill after the 12-foot surcharge pile of soil was removed. The site is surrounded by industrial property to the west, Scappoose Creek to the north, a pond to the east, and two large ponds to the south.

4.2 GEOLOGIC SETTING

The site is located along the western edge of the Columbia River floodplain at the northwestern corner of the Portland Basin, near where the basin terminates at the Coast Ranges. North of Scappoose, the Columbia River flows into a wide canyon incised through the Coast Ranges en route to the Pacific Ocean. The Portland Basin is part of the larger Puget Sound-Willamette Valley physiographic province, a tectonically active lowland located between the Coast Ranges to the west and the Cascade Mountains to the east (Orr and Orr, 1999).

Basement rocks in the vicinity of the site consist of the Miocene age (approximately 17 to 6 million years old) CRBG. The CRBG consists of a series of thick basalt flows erupted from fissures in eastern Oregon, Washington, and western Idaho that traveled down the ancient Columbia River Gorge to fill areas around the Portland Basin and vicinity. The specific CRBG basalt flows mapped as underlying the site vicinity are exposed in the mountains to the northwest belongs to the Sentinal Bluffs Unit of the Grande Ronde Basalt (Evarts, 2004). These flat-lying flows were later folded and faulted into mountains and valleys from the compressional tectonics of the region. Rivers eroded channels through the uplifted basalts and deposited alluvium along their beds.

The bedrock is overlain by Pliocene to Pleistocene age (approximately 5 to 1 million years old) conglomerate that forms a northeast-trending ridge along the base of the Coast Range Mountains to the west of the site. The conglomerate is the mapped surficial geologic unit at the site and primarily consists of semi-consolidated fine to coarse, rounded gravel with cobbles interbedded with minor sand and clay layers (Evarts, 2004). Well logs available from the Oregon Water Resources Department in the vicinity of the site indicate that the gravel deposits are interbedded with sand and clay layers, and the unit extended to depths in excess of 140 feet BGS.

4.3 SUBSURFACE CONDITIONS

4.3.1 General

Our field investigation consisted of three borings (B-1 through B-3) to depths of up to 56.5 feet BGS. The approximate exploration locations are shown on Figure 2. Exploration logs and laboratory test results are included in the Appendix of this report. The site is generally underlain by fill materials placed during reclamation of the gravel pit. The fill extends to depths ranging from 44 feet BGS to greater than 51 feet BGS (boring B-3). The following provides description of the soil units encountered.

4.3.2 Soil

The surface of the site is covered by a layer of loose, well-graded gravel fill that extends to a depth of approximately 1 foot BGS. The gravel fill is underlain by various fill materials consisting of loose to very dense, silty gravel; very loose, clayey sand; and soft to hard silt with small amounts of sand and gravel. The fill material contains variable amounts of brick, concrete, and organics (wood fragments). The various fill materials generally extend to depths ranging from 23.0 to 28.5 feet BGS. Laboratory testing on samples of the coarse-grained fill indicate moisture contents are between 18 to 34 percent with a fines content of approximately 42 percent. Laboratory testing on samples of the fine-grained fill indicate moisture contents are between 20 to 32 percent.

The variable fill material is underlain by fine-grained fill material consisting of soft to hard silt with small amounts of sand, gravel, blocks of concrete, wood fragments, and metal. The silt fill contains a medium dense gravel fill layer that extends from approximately 39 to 44.5 feet BGS in borings B-1 and B-3. The silt fill extends to depths ranging from 44 to 50 feet BGS in borings B-1 and B-2, and to the bottom of our exploration at 50 feet BGS in boring B-3. Laboratory testing on samples of the silt fill indicates moisture contents are between 20 to 37 percent.

The fill is underlain by native soil in borings B-1 and B-2 that extends to the bottom of our explorations at a maximum depth of 56.5 feet BGS. The native material generally consists of medium stiff to stiff silt with variable amounts of sand and gravel. Laboratory testing on samples of the native silt indicates moisture contents are between 18 and 25 percent.

4.3.3 Groundwater

Groundwater was observed in our explorations and was measured at depths ranging between 14 and 14.5 feet BGS during drilling operations. We estimate that perched groundwater may be as shallow as 14 feet BGS or higher during extended periods of wet weather.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

Based on the results of our subsurface explorations and analyses, it is our opinion that the project can be developed as proposed provided the site is prepared as recommended in this report. The recommendations in this report should be incorporated into design and construction, as well as incorporated into project specifications. The following summarizes general considerations for the planned construction project:

- The proposed building is located in an area with variable fill material. Although the 12-foot-thick soil acted as a surcharge for the site, we recommend that the proposed building foundations be underlain by a layer of imported granular material to help reduce the differential foundation settlement. A more detailed discussion regarding the recommended foundation system is presented in the "Foundation Support" section of this report.
- Loose gravel covered the majority of the site, and the fill material encountered in our explorations contains variable amounts of brick, concrete, and organics (wood fragments). Soft or loose soil and fill material is unsuitable for support of the proposed structure and pavement areas. Within all building and improvement areas, we recommend that unsuitable material be removed and replaced with adequately compacted structural fill, as recommended in the "Site Preparation" and "Structural Fill" sections of this report.
- Footing excavation in the gravelly soils may result in some disturbance at the surface. Loose or disturbed materials should be removed or compacted as described for structural fill before placing reinforcing steel and concrete.

The following sections present specific geotechnical recommendations for design and construction of the proposed building.

5.2 EROSION CONTROL AND DISTURBED SOIL

Erosion of the soil at this site will occur as exposed surfaces are disturbed due to construction activities and exposure to climatic conditions. Erosion control plans are typically required on construction projects by local and county ordinances. Jurisdictional requirements should be incorporated into the project development plan. Measures that can be employed to reduce erosion include the use of silt fences, hay bales, buffer zones of natural growth, sedimentation ponds, and granular haul roads.

Surface slopes and stockpiled soils should be protected by some form of weather-resistant cover or erosion control product if left exposed. Temporary erosion control measures in accordance with local and state ordinances should be in place prior to and during construction. Permanent slopes should be re-vegetated or otherwise protected as soon as practical after construction.

Subgrade or fill soil that becomes loose or disturbed should be excavated to expose undisturbed soil and replaced with properly compacted fill. The contractor may reduce soil disturbance by the following:

- Working off of existing paved surfaces
- Preventing construction traffic over unprotected soil in stripped and cut areas

- Providing appropriate gravel working mats over stripped and cut areas
- Sloping excavated surfaces to promote runoff
- Trenching and providing brow ditches above cut slopes
- Sealing the exposed surface by rolling with a smooth-drum compactor or rubber-tire roller at the end of each working day and removing wet surface soil prior to commencing filling each day

5.3 SITE PREPARATION

5.3.1 Stripping and Grubbing

We understand that the site is currently gravel covered with no vegetation cover. If improvements extend to vegetated areas, stripping depths should be based on field observations at the time of construction. Stripped material should be transported off site for disposal or used in landscaped areas.

5.3.2 Subgrade Evaluation

A member of our geotechnical staff should observe the exposed subgrades after stripping and site cutting have been completed to determine if there are additional areas of unsuitable or unstable soil. Our representative should observe a proofroll with a fully loaded dump truck or similarly heavy rubber-tire construction equipment to identify soft, loose, or unsuitable areas. Areas that appear to be too wet and soft to support proofrolling equipment should be evaluated by probing and prepared in accordance with the recommendations for wet weather construction presented in the "Wet Weather/Wet Soil Grading" section of this report.

5.3.3 Wet Weather/Wet Soil Grading

If fine-grained fill soils are exposed during grading, they are easily disturbed during the wet season and when they are moist. If not carefully executed, site preparation, utility trench work, and excavation can create extensive soft areas and will result in significant subgrade repair costs. If construction is planned when the surficial soils are wet of optimum moisture content or during wet weather, the construction methods and schedule should be carefully considered with respect to protecting the subgrade to reduce the need to over-excavate disturbed or softened soil. The project budget should reflect the recommendations below if construction is planned during wet weather or when the surficial soils are wet.

If construction occurs when wet soils are present, site preparation activities may need to be accomplished using track-mounted excavating equipment that loads removed material into trucks supported on granular haul roads. The thickness of the granular material for haul roads and staging areas will depend on the amount and type of construction traffic. Generally, a 12- to 18-inch-thick mat of imported granular material is sufficient for light staging areas and the basic building pad, but is not expected to be adequate to support heavy equipment or truck traffic. The granular mat for haul roads and areas with repeated heavy construction traffic typically needs to be increased to between 18 and 24 inches. The actual thickness of haul roads and staging areas should be selected by the contractor who has control over site development methods and the amount and type of construction traffic. The imported granular material should be placed in one lift over the prepared, undisturbed subgrade and compacted using a smooth-drum roller without the use of vibratory action. In addition, the imported granular material should meet the specifications in the "Structural Fill" section of this report. A geotextile fabric can be placed as a barrier between the subgrade and imported granular material in areas of repeated construction traffic. The geotextile should have a minimum Mullen burst strength of 250 psi for puncture resistance and an AOS between a U.S. Standard No. 70 and No. 100 Sieve.

5.4 EXCAVATION

Excavation can be readily accomplished by conventional earthmoving equipment. The contractor should expect to encounter miscellaneous debris, including concrete and brick fragments, during excavation. Excavations in the gravelly fill may experience some caving, which may result in widening of excavations.

5.4.1 Trench Cuts and Shoring

Trench cuts should stand near vertical to a depth of at least 4 feet. Some raveling and caving should be expected in the loose gravels and sands. Open excavation techniques may generally be used to excavate trenches with depths between 4 and 8 feet, provided the walls of the excavation are cut at a slope of 1H:1V, groundwater seepage is not present, and with the understanding that some minor caving may occur. If excessive caving occurs, the trenches should be flattened to 1½H:1V or 2H:1V if workers are required to enter.

Shoring for trenches less than 8 feet deep and above the groundwater table should be possible with a conventional box system. Moderate caving should be expected outside the box, particularly in areas where invert elevations extend into the gravels. Shoring deeper than 8 feet or that requires dewatering should be evaluated by a registered engineer before installation. It is the contractor's responsibility to select the excavation and dewatering methods, monitor the trench excavations for safety, and provide shoring required to protect personnel and adjacent improvements.

5.4.2 Dewatering

Groundwater was observed at depths ranging between 14 and 14.5 feet BGS during our explorations. If necessary, dewatering will likely be readily accomplished by means of sumps if the invert elevations of the proposed utilities are deeper than the groundwater table or if seepage or surface water runs into excavations. Removed water should be pumped to a suitable discharge point.

5.4.3 Safety

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

5.5 STRUCTURAL FILL

5.5.1 General

Fills 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 materials. The material should meet the specifications provided in

OSSC 00330, depending on the application. All structural fill should have a maximum particle size of 4 inches. A brief characterization of some of the acceptable materials and our recommendations for their use as structural fill is provided below.

5.5.2 Silt

The silt soils are generally suitable for use as structural fill if they meet the requirements set forth in OSSC 00330.12 (Borrow Material). Based on laboratory test results, the moisture content of the native silt varied from 20 to 32 percent at the time of our explorations. Based on our experience, we estimate the optimum moisture content for compaction to be approximately 17 to 20 percent for the native silt. Moisture conditioning (drying) will be required to use the silt for structural fill. Accordingly, extended dry weather will be required to adequately condition and place the soils as structural fill. When used as structural fill, the silt 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.

5.5.3 Gravel

The gravels are generally suitable for use as structural fill provided they meet the requirements set forth in OSSC 00330.12 (Borrow Material). Fine grading of gravelly soils may result in segregating coarse gravels from the sandy/fine gravel matrix, resulting in unsatisfactory (poorly graded or "boney") fill. Fill material should be maintained as well graded with gravelly and sandy material for proper compaction during fill placement and mass grading. When used as structural fill, the gravel 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.

5.5.4 Imported Granular Material

Imported granular material used during periods of wet weather, for replacement of soft soils, or construction of building pad subgrade, etc. should be pit- or quarry-run rock, crushed rock, or crushed gravel and sand and should meet the requirements set forth in OSSC 00330.14 and 00330.15. Imported granular material should be fairly well graded between coarse and fine material and have less than 5 percent by dry weight passing a U.S. Standard No. 200 Sieve. When used as structural fill, imported granular 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.

5.5.5 Floor Slab Base Rock

Imported granular material placed beneath building floor slabs should be clean, crushed rock or crushed gravel and sand that is fairly well graded between coarse and fine. The granular materials should have a maximum particle size of 1½ inches, less than 5 percent by dry weight passing a U.S. Standard No. 200 Sieve, at least two mechanically fractured faces, and should meet OSSC 00641. 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.

5.5.6 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 1 inch, less than 5 percent by dry weight passing a U.S.

Standard No. 200 Sieve, and should meet OSSC 00405.14 (Class B Backfill). The material should be free of roots, organic matter, and other unsuitable materials. 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.

5.5.7 Stabilization Material

Stabilization material for the haul roads for construction traffic, for the equipment yard, or for stabilization of trench bases should consist of pit- or quarry-run rock, crushed rock, or crushed gravel and sand and should meet the requirements set forth in OSSC 00330.14 and 00330.15, with a minimum particle size of 6 inches and less than 5 percent by dry weight passing a U.S. Standard No. 4 Sieve. The material should be free of organic matter and other deleterious material. Stabilization material should be placed in lifts between 12 and 18 inches thick and compacted to a firm condition with a smooth-drum roller without using vibratory action.

5.5.8 Drain Rock

Drain rock should consist of angular, granular material with a maximum particle size of 2 inches and should meet OSSC 00430.11 (Granular Drain Backfill Material). The material should be free of roots, organic matter, and other unsuitable materials and have less than 2 percent by dry weight passing a U.S. Standard No. 200 Sieve (washed analysis). Drain rock should be compacted to a firm condition.

5.6 PERMANENT SLOPES

It is our understanding that no new significant slopes are planned for the site. Permanent cut and fill slopes should not exceed 2H:1V. Buildings, access roads, and pavements should be located at least 5 feet from the top of cut and fill slopes. The slopes should be planted with appropriate vegetation to provide protection against erosion as soon as possible after grading. Surface water runoff should be collected and directed away from slopes to prevent water from running down the face of the slope.

6.0 FOUNDATION SUPPORT

6.1 GENERAL

Based on the results of our investigation, it is our opinion that the site soils should be capable of supporting the foundation loads listed above on conventional spread footings. Because of the presence of highly variable fill that includes moderately compressible soils beneath the proposed building pads, the use of compacted granular pads beneath the footings may be required. Any loose or disturbed soils and deleterious materials (such as construction debris or organics) encountered in the foundation excavations should be removed down to firm soils as directed by the project geotechnical engineer or their representative.

6.2 *DIMENSIONS AND CAPACITIES*

Continuous wall and isolated 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 exterior grade. The bottom of interior footings should be established at least 12 inches below the base of the slab.

All building footings should be underlain by a minimum 24-inch-thick layer of compacted, imported granular material. The granular pad should extend laterally at least 1 foot beyond the edges of the footings; be compacted to at least 95 percent of the maximum dry density, as determined by ASTM D 1557; and meet the imported granular material specifications provided in the "Structural Fill" section of this report.

Based on the above assumptions, we recommend using an allowable bearing pressure of 2,500 psf for footings on granular pads. Footings for non-building improvements (e.g., site retaining walls) do not require the granular pad. Non-building footings bearing on existing fill soils should be designed for an allowable bearing pressure of 2,000 psf.

The recommended allowable bearing pressure applies to the total of dead plus long-term live loads. The allowable bearing pressure may be increased by one-third for short-term loads (such as those resulting from wind and seismic forces). Total settlement of footings founded as recommended is anticipated to be less than 1 inch. Differential settlements are estimated at one-half of the total settlement.

6.3 *RESISTANCE TO SLIDING*

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 structural fill is 300 pcf modeled as an equivalent fluid pressure. Adjacent floor slabs, pavements, or the upper 12-inch depth of adjacent, unpaved areas should not be considered when calculating passive resistance. In addition, in order to rely upon passive resistance, a minimum of 10 feet of horizontal clearance must exist between the face of the footings and any adjacent down slopes.

For footings in contact with silt, a coefficient of friction equal to 0.30 may be used when calculating resistance to sliding. This value should be increased to 0.40 for footings in contact with gravel or imported granular material.

6.4 *FOOTING SUBGRADE*

All footing and floor subgrades should be evaluated by the project geotechnical engineer or their representative to confirm suitable bearing conditions. Observations should also confirm that all loose or soft material, organics, unsuitable fill, prior topsoil zones, and softened subgrades (if present) have been removed. Localized deepening of footing excavations may be required to penetrate any deleterious materials.

Shallow foundations should be founded on a prepared surface consisting of competent soil or compacted structural fill overlying competent soil. Excavation of the gravel soils may result in some disturbance at the surface. Loose or disturbed materials should be removed or compacted as described for structural fill before placing reinforcing steel and concrete. Foundation-bearing surfaces should not be exposed to standing water. Should water infiltrate and pool in the excavation, it should be removed before placing reinforcing steel or concrete.

If construction is undertaken during periods of rain, a 2- to 4-inch-thick layer of compacted crushed rock may be required over the footing subgrades and excavation bases to help protect them from disturbance resulting from foot traffic over wet subgrade.

7.0 FLOOR SLABS

We understand that the floor slab in the maintenance facility will be subject to loading by construction equipment with total loads of up to 200 kips and minimum areal loads of up to 2,800 psf. We recommend that a structural engineer design the floor slab for the anticipated loads using a modulus of subgrade reaction of 150 psi.

Satisfactory subgrade support for the office building and other floor slabs with areal loading of less than 100 psf can be obtained provided site preparation is performed as described in this report. A 6-inch-thick layer of imported granular material should be placed and compacted over the prepared subgrade to assist as a capillary break and for structural support of the floor slabs at or near current grades.

Imported granular material beneath floor slabs should consist of crushed rock or crushed gravel and sand that is fairly well graded between coarse and fine, contain no deleterious materials, have a maximum particle size of 1½ inches, and have a maximum fines content of 5 percent. The fines content should be determined by the wet wash method (ASTM D 1140). 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 150 pci may be used to design the floor slab.

Settlement of floor slabs supporting the anticipated design loads and constructed as recommended is not expected to exceed approximately ½ inch.

8.0 SEISMIC DESIGN CRITERIA

8.1 IBC PARAMETERS

Based on our investigation, the following design parameters can be applied if the building is designed using the applicable provisions of the 2006 IBC and SOSSC. The parameters in Table 1 should be used to compute seismic base shear forces.

Table 1. IBC Parameters

Seismic Design Parameter	Short Period (T_s = 0.2 second)	1-Second Period (T_1 = 1.0 second)
Maximum Credible Earthquake Spectral Acceleration	$S_s = 0.93$ g	$S_1 = 0.35$ g
Site Class	E	
Site Coefficient	$F_a = 0.98$	$F_v = 2.62$
Adjusted Spectral Acceleration	$S_{MS} = 0.92$ g	$S_{M1} = 0.91$ g
Design Spectral Response Acceleration Parameters	$S_{DS} = 0.61$ g	$S_{D1} = 0.60$ g
Design Spectral PGA	0.24 g	

9.0 EQUIPMENT YARD

We understand that the area around the proposed building will be left unpaved and is intended as an equipment yard. We do not have specific information on the traffic loads or the frequency of traffic. The thickness of the granular mat of imported material will depend on the amount and type of traffic. We recommend that the supporting rock section be constructed on competent subgrade or new engineered fills prepared in conformance with the "Site Preparation" and "Structural Fill" sections of this report.

We recommend the rock section consist of a minimum thickness between 18 to 24 inches. The imported granular material should be placed in one lift over the prepared, undisturbed subgrade and compacted using a smooth-drum roller without the use of vibratory action. In addition, a geotextile fabric should be placed as a barrier between the subgrade and imported granular material. The geotextile fabric should meet the requirements provided in the "Wet Weather/Wet Soil Grading" section of this report. The imported granular material should meet the specifications for stabilization material in the "Structural Fill" section of this report.

10.0 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, proofrolling of the subgrade and repair of soft areas, footing subgrade preparation, performing laboratory compaction and field moisture-density tests, observing final proofrolling of the pavement subgrade and base rock, and asphalt placement and compaction.

11.0 LIMITATIONS

We have prepared this report for use by Hedges Creek Management #1, LLC and the design and construction team for the proposed project. 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, expressed 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.

Viola Lai, P.E.
Project Engineer

Tacia C. Miller

Tacia C. Miller, P.E.
Associate Engineer

Jeffery D Tucker

Jeffery D. Tucker, P.E.
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
74942PE
OREGON
July 13, 2004
JEFFERY D. TUCKER
EXPIRES: 6/30/08

REFERENCES

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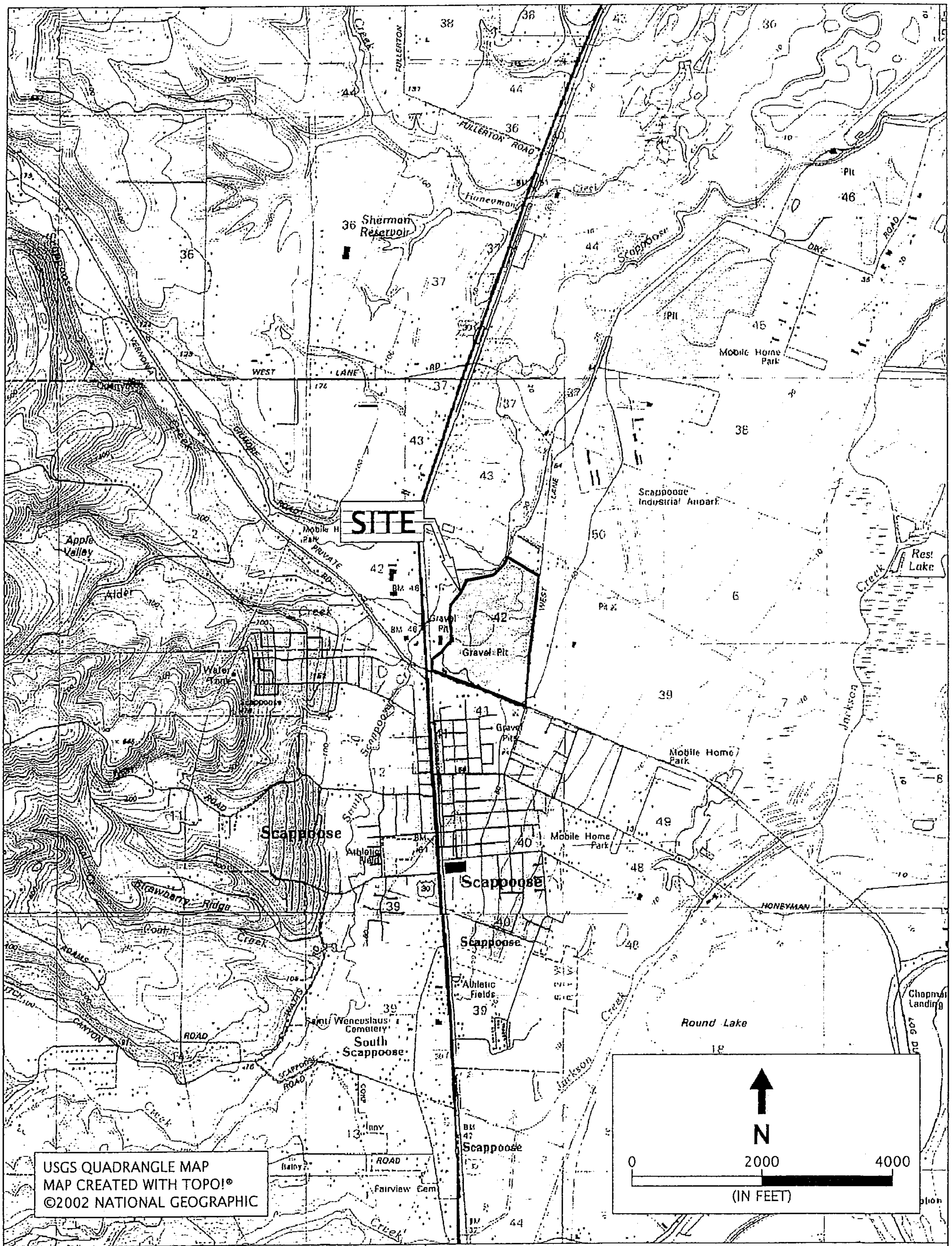
FIGURES



USGS QUADRANGLE MAP
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HEDGESCM-1-01

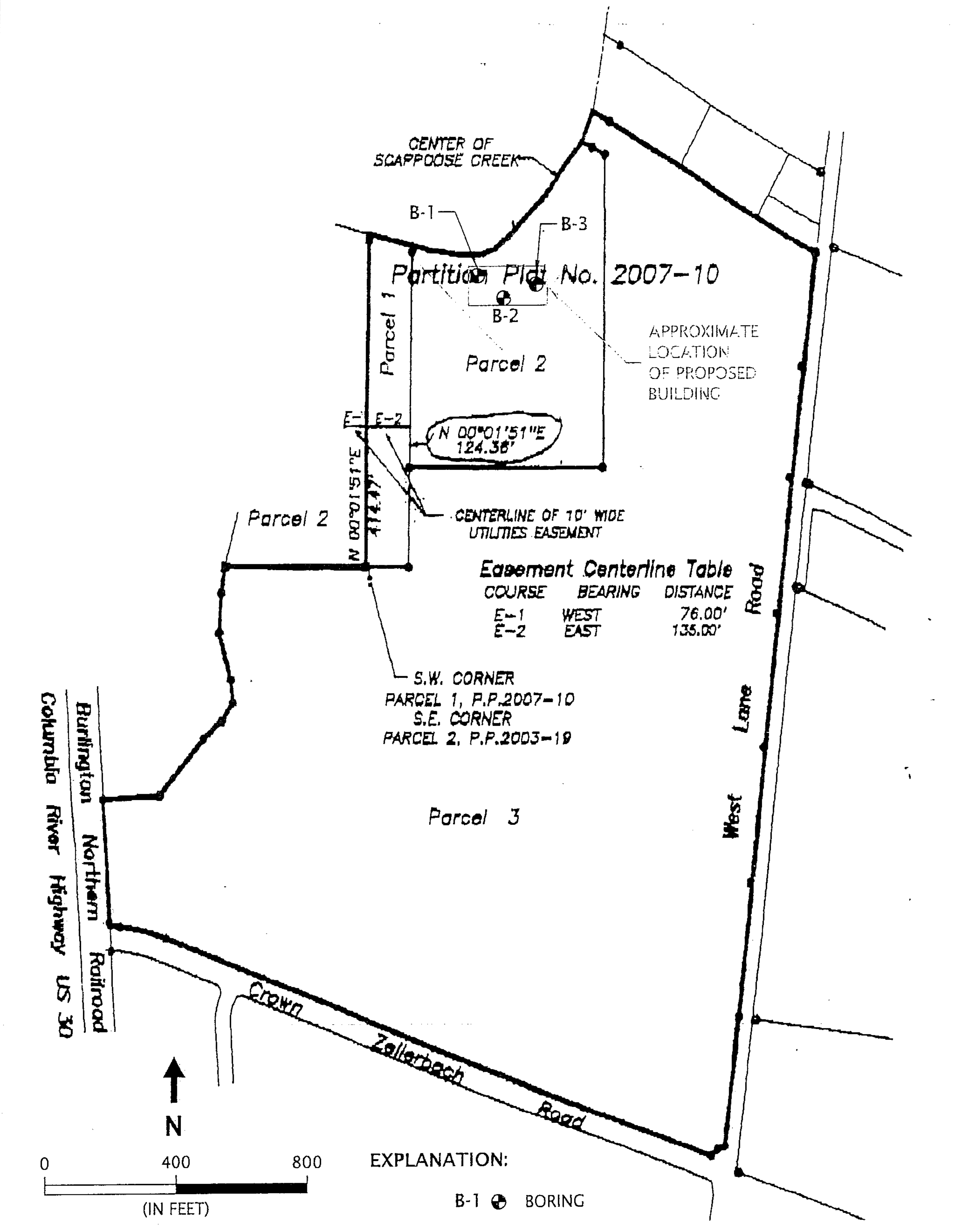
SEPTEMBER 2007

VICINITY MAP

PROPOSED INDUSTRIAL BUILDING
SCAPPOOSE, OR

FIGURE 1

DWG Name: HedgesCM-1-01-F1-VM.dwg | Layout: Layout1 | Updated By: aday | Date: 9/27/2007 1:06:41 PM



SITE PLAN BASED ON FIGURE PROVIDED
BY HEDGES CREEK MANAGEMENT #1, LLC

DWG Name: HedgesCM-1-01-F2-SP.dwg | Layout: Layout1 | Updated By: aday | Date: 9/27/2007 1:03:51 PM

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SITE PLAN

PROPOSED INDUSTRIAL BUILDING
SCAPPOOSE, OR

FIGURE 2

APPENDIX

APPENDIX

FIELD EXPLORATIONS

GENERAL

Our field investigation consisted of three soil borings (B-1 through B-3) to depths of up to 56.5 feet BGS. Western States Soil Conservation, Inc. of Aurora, Oregon, performed the boring explorations on August 15 and 16, 2007 using a rubber-tire drill rig and hollow-stem drilling methods. The approximate exploration locations are shown on Figure 2. The locations of the explorations were determined in the field by referencing and pacing from the staked location of the proposed building. This information should be considered accurate to the degree implied by the methods used.

A member of our geotechnical staff observed all explorations. We obtained undisturbed samples of the soils encountered in the test pits for geotechnical laboratory testing. Classifications and sampling intervals are presented on the exploration logs included in this appendix.

SOIL SAMPLING

Representative samples of the soil were obtained from the borings using one of the following methods:

1. 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 soils is shown adjacent to the sample symbols on the boring log. Disturbed samples were obtained from the split barrel for subsequent classification and index testing.
2. Higher quality relatively undisturbed samples were obtained using a standard shelby tube in general accordance with guidelines presented in ASTM D 1587 (the Standard Practice for Thin-walled Tube Sampling of Soils).

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 soils or their 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

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.

ATTERBERG LIMITS TESTING

The Atterberg limits (plastic and liquid limits) of one soil sample was determined in accordance with ASTM D 4318. The plastic limit is defined as the moisture content where the soil becomes brittle. The liquid limit is defined as the moisture content where the soil begins to act similar to a liquid. The plasticity index is the difference between the liquid and plastic limits. The results are presented on the appropriate exploration log and on Figure A-4.

CONSOLIDATION TESTING

A one-dimensional consolidation test was completed on one relatively undisturbed soil sample obtained from the borings. The test was conducted in general accordance with ASTM D 2435. The test measures the volume change (consolidation) of a soil sample under predetermined loads. The test results are included on Figure A-5.

DRY DENSITY

The in-situ dry density of selected soil samples were determined in general accordance with ASTM D 2937. The dry density is the ratio between the mass of the soil (not including water) and the volume of the intact sample. The density is expressed in units of pcf. The test values are presented on the appropriate exploration logs included in this appendix.

GRAIN-SIZE TESTING

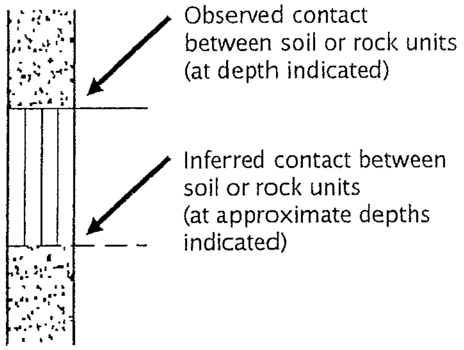
We completed grain-size testing on selected soil samples in order to determine the distribution of soil particle sizes. The testing consisted of percent fines determination (percent passing a U.S. Standard No. 200 Sieve) analyses completed in general accordance with the guidelines presented in ASTM C 117 and D 1140. The results of the testing are presented on the appropriate exploration logs and the summary included in this appendix.

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.

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 or 3-inch-O.D. split-spoon sampler and 140-pound hammer or pushed with recovery
☒	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	RES	Resilient Modulus
DD	Dry Density	SIEV	Sieve Gradation
DS	Direct Shear	TOR	Torvane
HYD	Hydrometer Gradation	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
ppm	Parts per Million	MS	Moderate Sheen
		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 (more than 50% retained on No. 200 sieve)	GRAVEL (more than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVELS (< 5% fines)	GW	well-graded GRAVEL
			GP	poorly graded GRAVEL
		GRAVEL WITH FINES (≥ 5% and ≤ 12% fines)	GW-GM or GP-GM	well-graded or poorly graded GRAVEL with silt
			GW-GC or GP-GC	well-graded or poorly graded GRAVEL with clay
		GRAVELS WITH FINES (> 12% fines)	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND (50% or more of coarse fraction passing No. 4 sieve)	CLEAN SANDS (<5% fines)	SW	well-graded SAND
			SP	poorly graded SAND
		SANDS WITH FINES (≥ 5% and ≤ 12% fines)	SW-SM or SP-SM	well-graded or poorly graded SAND with silt
			SW-SC or SP-SC	well-graded or poorly graded SAND with clay
		SANDS WITH FINES (> 12% fines)	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOILS (50% or more passing No. 200 sieve)	SILT AND CLAY	Liquid limit less than 50	ML	SILT
			CL	CLAY
			CL-ML	silty CLAY
			OL	ORGANIC SILT or ORGANIC CLAY
		Liquid limit 50 or greater	MH	SILT
			CH	CLAY
			OH	ORGANIC SILT or ORGANIC CLAY
HIGHLY ORGANIC SOILS			PT	PEAT

MOISTURE CLASSIFICATION

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

ADDITIONAL CONSTITUENTS

Secondary granular components or other materials such as organics, man-made debris, etc.	
trace	0 – 5%
minor	5 – 15%

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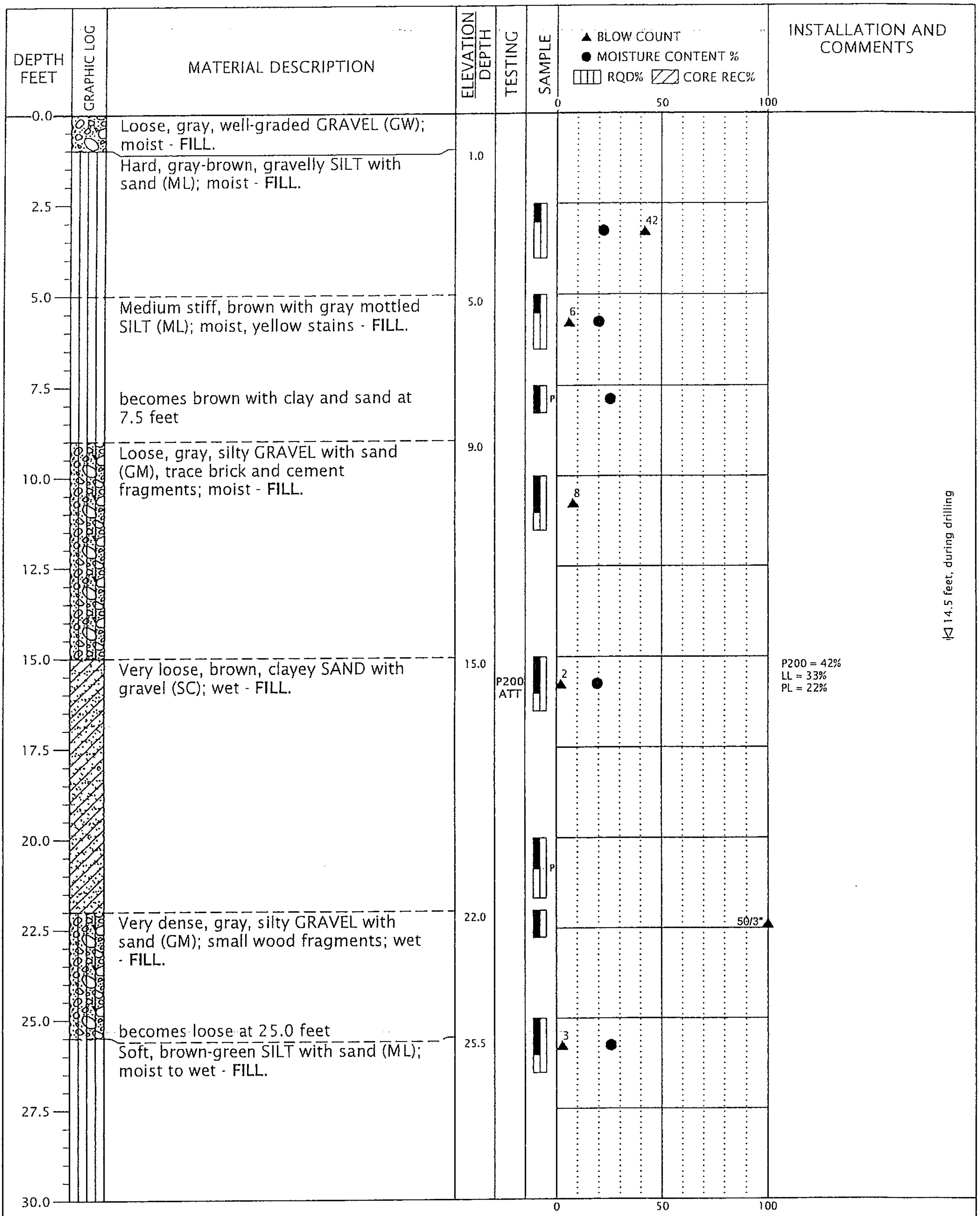
SOIL CLASSIFICATION SYSTEM

TABLE A-2



MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	INSTALLATION AND COMMENTS
Loose, gray, well-graded GRAVEL (GW); moist - **FILL**.			
Hard, gray-brown, gravelly SILT with sand (ML); moist - **FILL**.	1.0		
Medium stiff, brown with gray mottled SILT (ML); moist, yellow stains - **FILL**.	5.0		
becomes brown with clay and sand at 7.5 feet			
Loose, gray, silty GRAVEL with sand (GM), trace brick and cement fragments; moist - **FILL**.	9.0		⊻ 14.5 feet, during drilling
Very loose, brown, clayey SAND with gravel (SC); wet - **FILL**.	15.0	P200 ATT	P200 = 42% LL = 33% PL = 22%
Very dense, gray, silty GRAVEL with sand (GM); small wood fragments; wet - **FILL**.	22.0		
becomes loose at 25.0 feet			
Soft, brown-green SILT with sand (ML); moist to wet - **FILL**.	25.5		

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: MAR

COMPLETED: 08/15/07

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

BORING BIT DIAMETER:

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BORING B-1

PROPOSED INDUSTRIAL BUILDING
SCAPPOOSE, OR

FIGURE A-1

BORING LOG HEDGESCM-1-01-81-3.GPJ GEODESIGN.GDT PRINT DATE: 9/27/07:08

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC% (0 – 50 – 100)	INSTALLATION AND COMMENTS
30.0	grades to medium stiff and gravelly at 30.0 feet			▲ 6	
32.5					
35.0	becomes dark green with large blocks of cement at 35.0 feet			▲ 6 ●	
37.5					
40.0	Medium dense, green-black, silty GRAVEL (GM), asphalt pieces; wet - FILL.	39.5		▲ 26	
42.5					
45.0	Stiff, green-black, gravelly SILT (ML); wet.	44.0		▲ 14	
47.5					
50.0	becomes medium stiff with fine sand at 50.0 feet			▲ 7	
52.5					
55.0	becomes stiff with red rock (volcanic) at 55.0 feet			▲ 10	
57.5	Exploration completed at a depth of 56.5 feet.	56.5			Surface elevation was not measured at the time of exploration.
60.0					

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LOGGED BY: MAR

COMPLETED: 08/15/07

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

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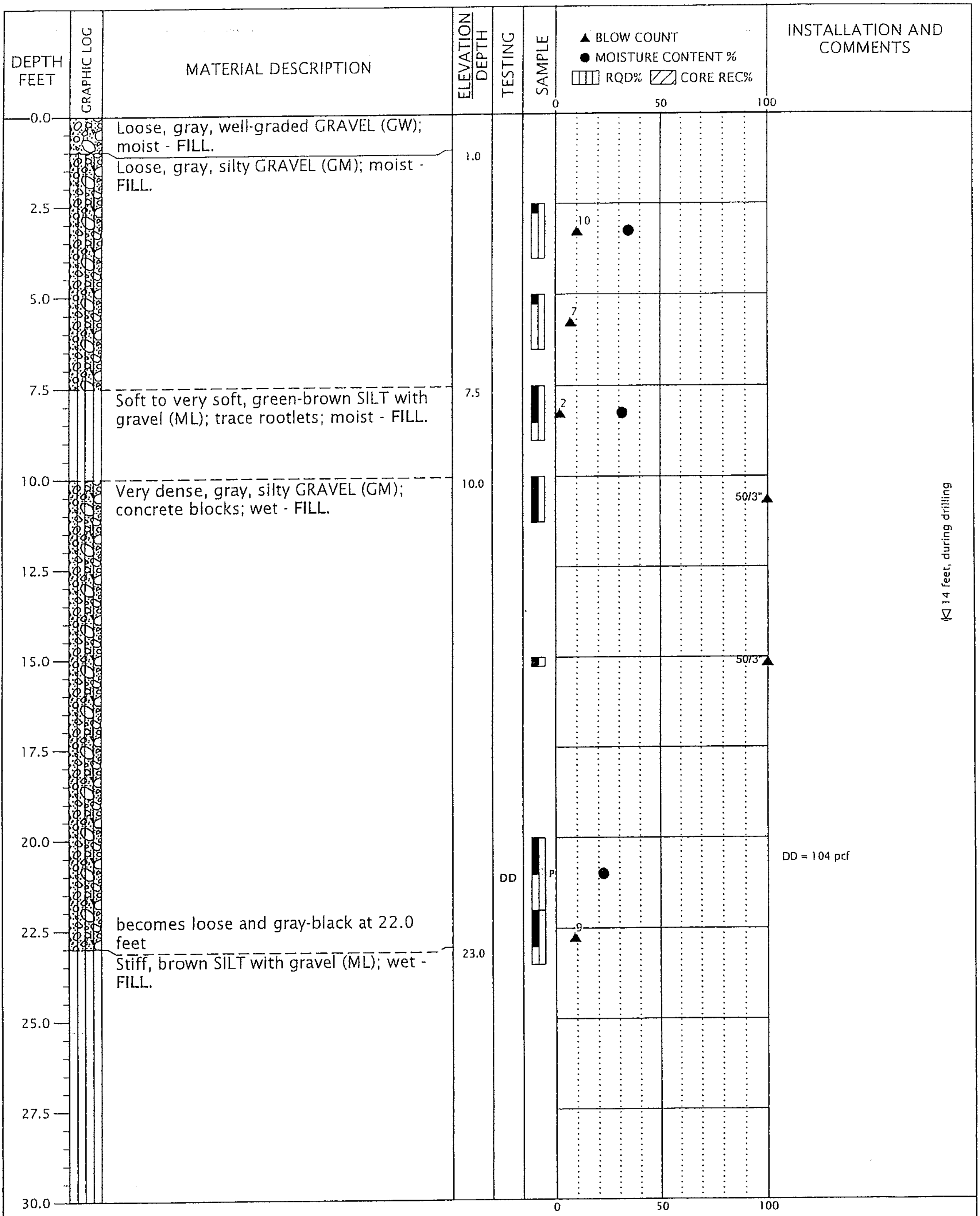
BORING B-1
(continued)

PROPOSED INDUSTRIAL BUILDING
SCAPPOOSE, OR

FIGURE A-1



INSTALLATION AND COMMENTS

Loose, gray, well-graded GRAVEL (GW); moist - FILL.

Loose, gray, silty GRAVEL (GM); moist - FILL.

Soft to very soft, green-brown SILT with gravel (ML); trace rootlets; moist - FILL.

Very dense, gray, silty GRAVEL (GM); concrete blocks; wet - FILL.

becomes loose and gray-black at 22.0 feet

Stiff, brown SILT with gravel (ML); wet - FILL.

▽ 14 feet, during drilling

DD = 104 pcf

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BORING METHOD: mud rotary (see report text)

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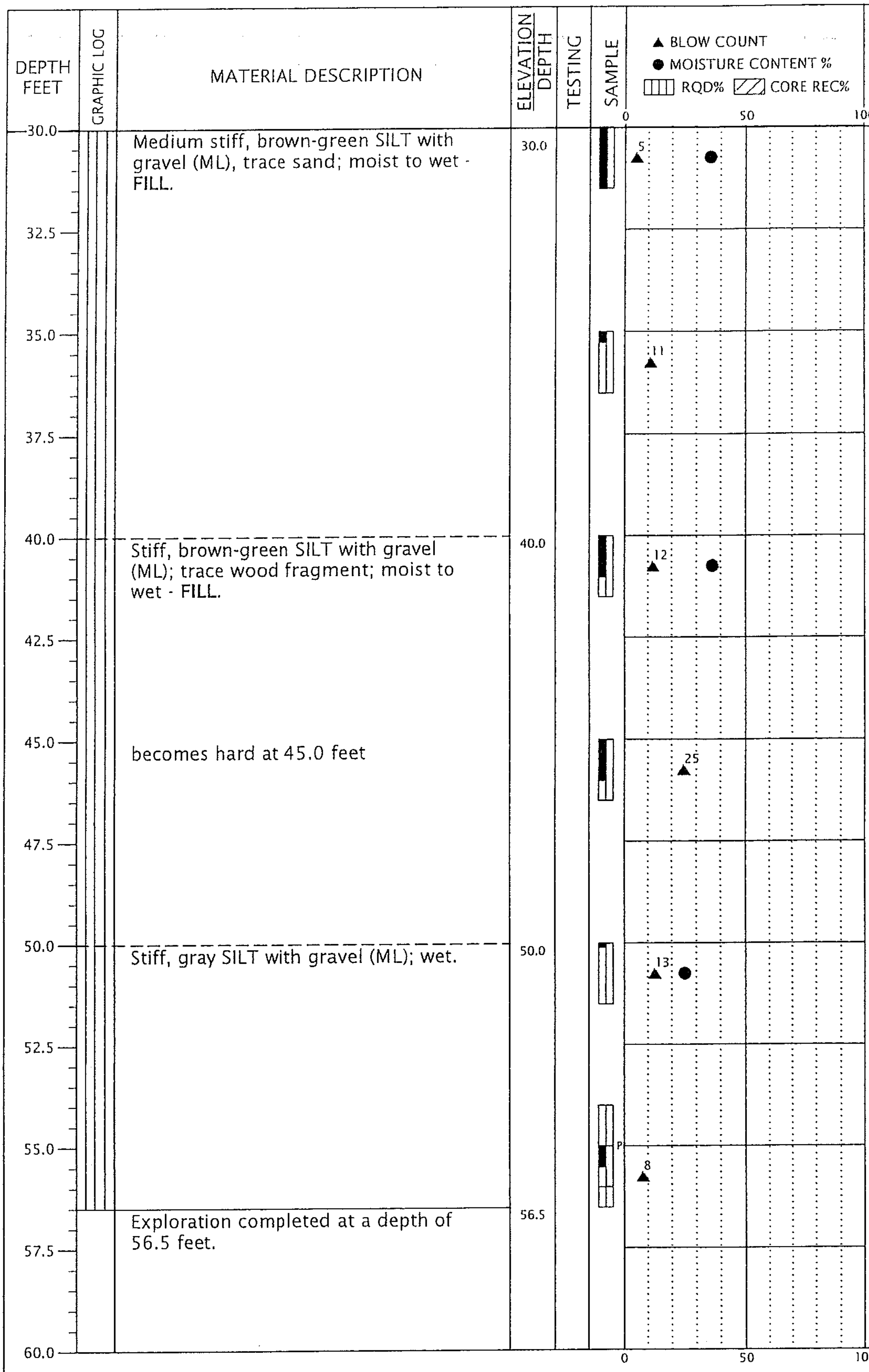
BORING B-2

PROPOSED INDUSTRIAL BUILDING
SCAPPOOSE, OR

FIGURE A-2

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	INSTALLATION AND COMMENTS
30.0	Medium stiff, brown-green SILT with gravel (ML), trace sand; moist to wet - FILL.	30.0	
40.0	Stiff, brown-green SILT with gravel (ML); trace wood fragment; moist to wet - FILL.	40.0	
45.0	becomes hard at 45.0 feet		
50.0	Stiff, gray SILT with gravel (ML); wet.	50.0	
56.5	Exploration completed at a depth of 56.5 feet.	56.5	Surface elevation was not measured at the time of exploration.



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: MAR

COMPLETED: 08/15/07

BORING METHOD: mud rotary (see report text)

BORING BIT DIAMETER:

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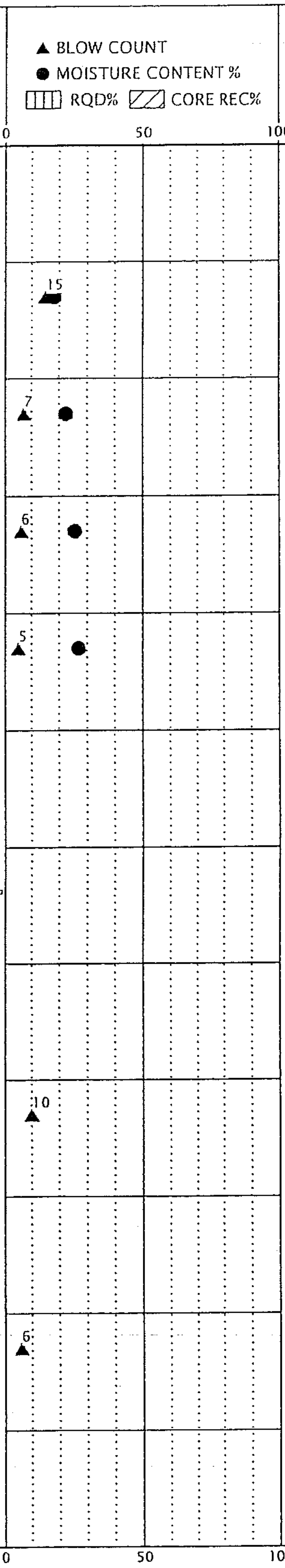
BORING B-2
(continued)

PROPOSED INDUSTRIAL BUILDING
SCAPPOOSE, OR

FIGURE A-2

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	BLOW COUNT	INSTALLATION AND COMMENTS
0.0	Loose, gray, well-graded GRAVEL (GW); moist - FILL.					
	Medium dense, gray, silty GRAVEL (GM); wet - FILL.	1.0				
2.5					15	
5.0	becomes loose at 5.0 feet				7	
7.5	Medium stiff, brown SILT with gravel (ML), trace sand; wet - FILL.	7.0	DD CON		6	DD = 93 pcf
10.0					5	
12.5						
15.0				P		
17.5						
	Loose to medium dense, brown, silty GRAVEL (GM); wet - FILL.	19.0				
20.0					10	
22.5						
25.0	becomes loose and black-green at 25.0 feet				6	
27.5						
	Medium stiff, green-black SILT with gravel (ML); moist to wet - FILL.	28.5				
30.0						



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BORING METHOD: mud rotary (see report text)

BORING BIT DIAMETER:

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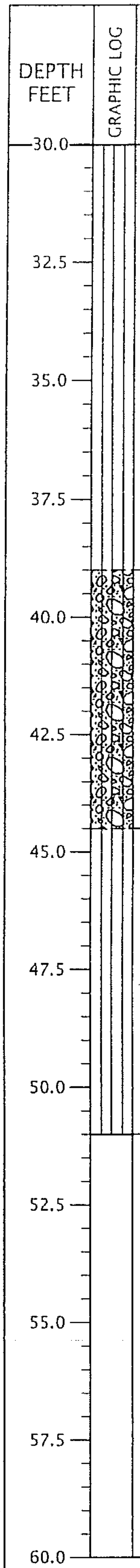
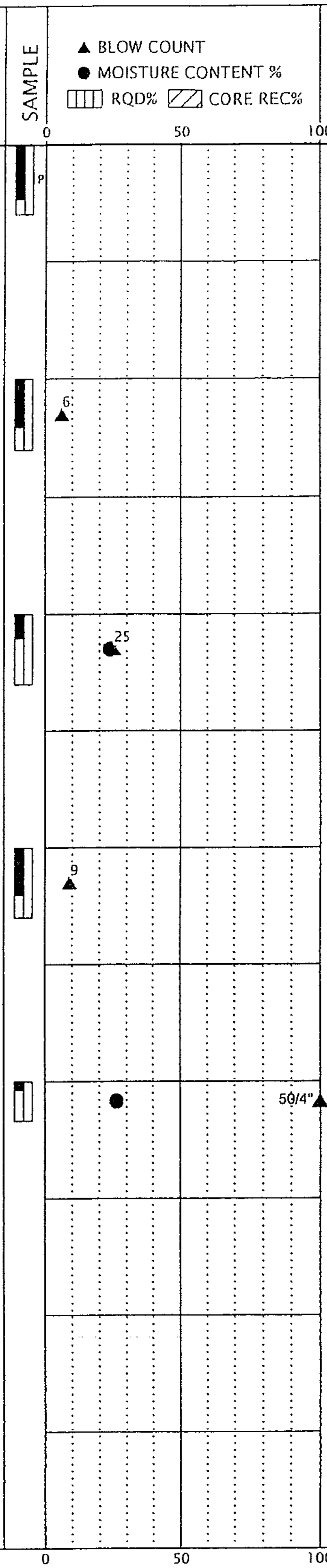
BORING B-3

PROPOSED INDUSTRIAL BUILDING
SCAPPOOSE, OR

FIGURE A-3



MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	INSTALLATION AND COMMENTS
(continued from previous page)			
Medium dense, green, silty GRAVEL (GM), trace red rock; wet - **FILL**.	39.0		
Stiff, black-green SILT with gravel (ML), trace concrete debris and aluminum foil; wet - **FILL**.	44.5		
Exploration completed at a depth of 51.0 feet.	51.0		Surface elevation was not measured at the time of exploration.



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COMPLETED: 08/16/07

BORING METHOD: mud rotary (see report text)
BORING BIT DIAMETER:

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BORING B-3
(continued)

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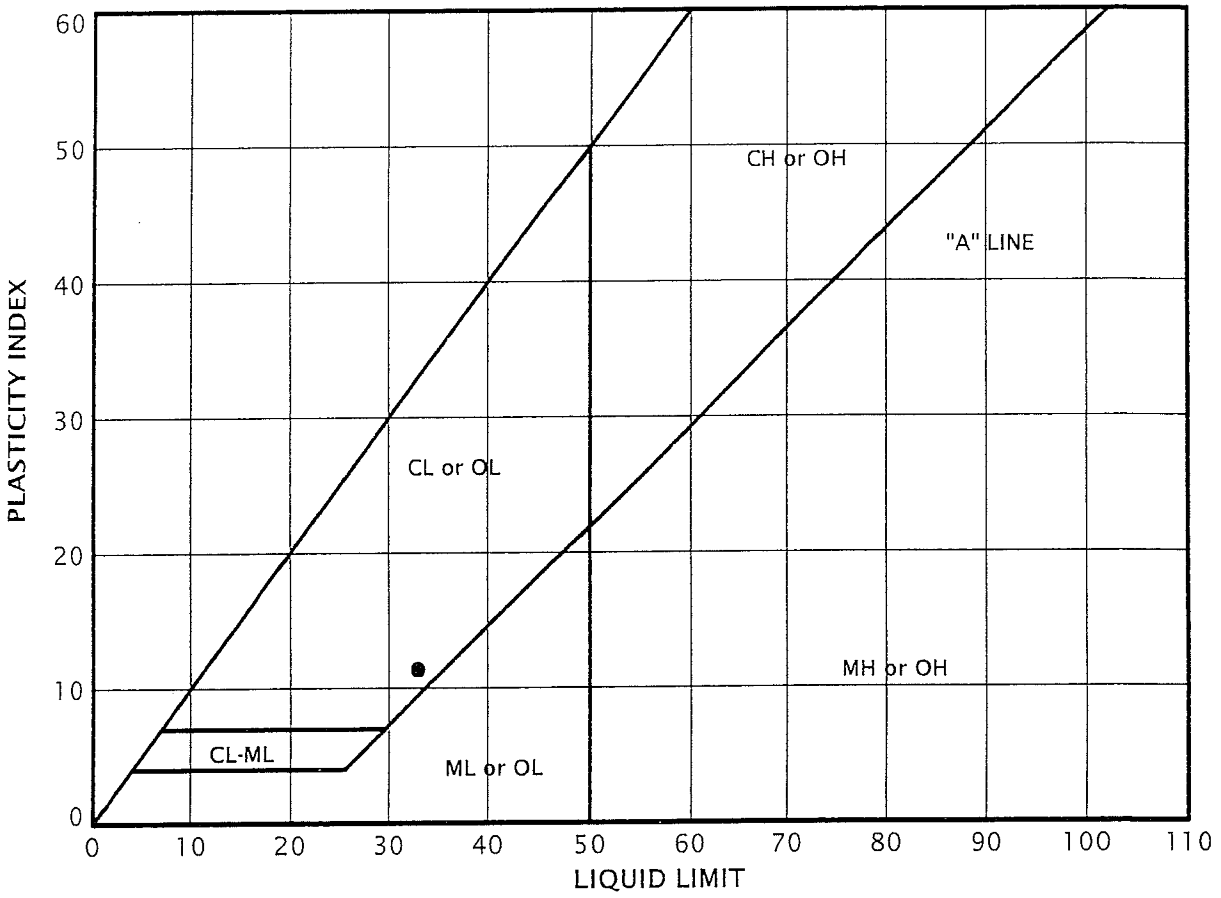
PROPOSED INDUSTRIAL BUILDING
SCAPPOOSE, OR

FIGURE A-3



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
●	B-1	15.0	19	33	22	11

ATTERBERG_LIMITS 7 HEDGESCM-1-01-B1-3.GPJ GEODESIGN.GDT PRINT DATE: 9/27/07:08

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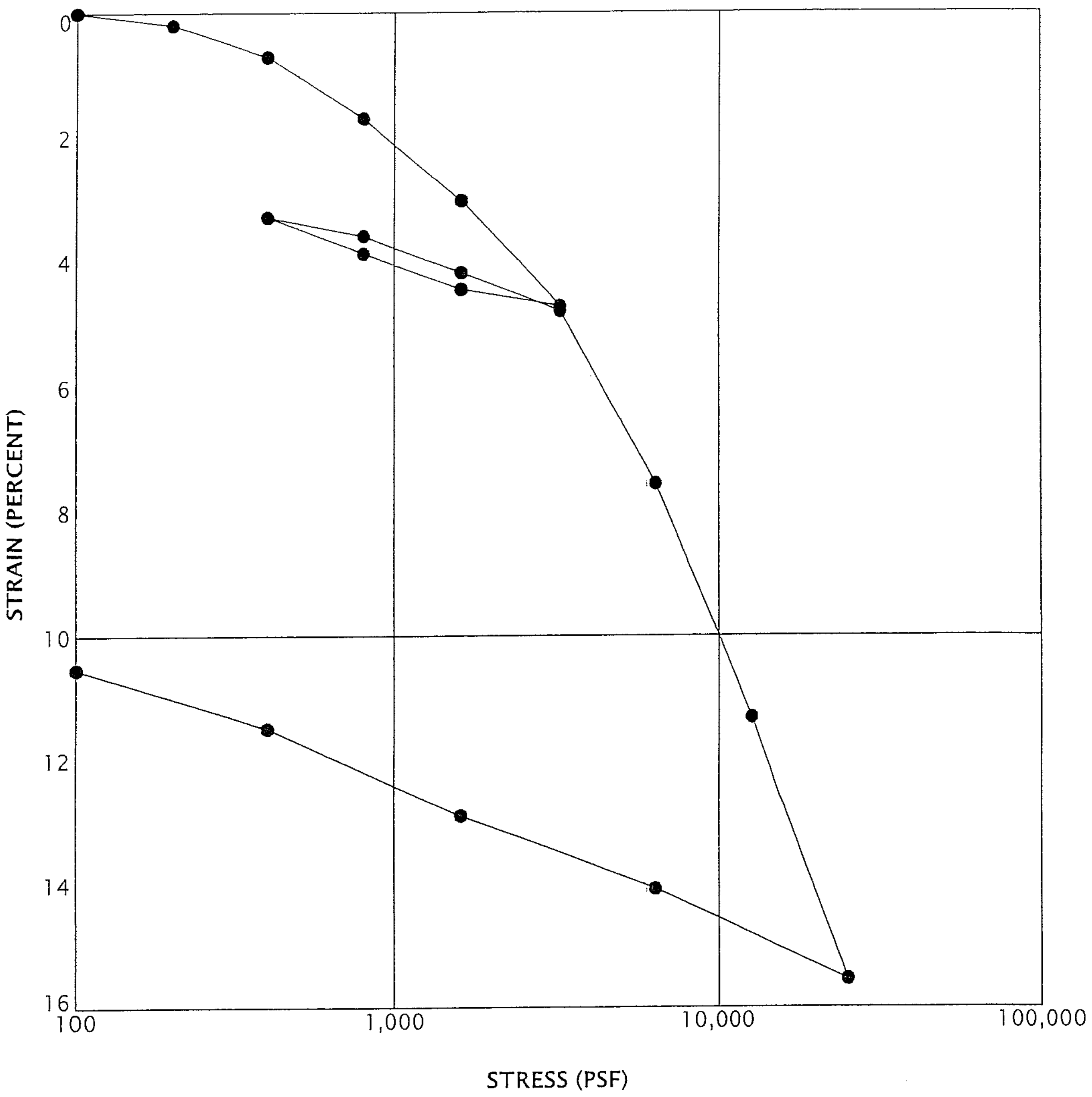
ATTERBERG LIMITS TEST RESULTS

PROPOSED INDUSTRIAL BUILDING
SCAPPOOSE, OR

FIGURE A-4



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)
●	B-3	7.5	26	93

CONSOL_STRAIN_100K HEDGESCM-1-01-B1-3.GPJ GEODESIGN.GDT PRINT DATE: 9/27/07:08

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	SEPTEMBER 2007	PROPOSED INDUSTRIAL BUILDING SCAPPOOSE, OR

FIGURE A-5

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	2.5		22							
B-1	5.0		20							
B-1	7.5		25							
B-1	15.0		19				42	33	22	11
B-1	25.0		26							
B-1	35.0		20							
B-1	45.0		18							
B-2	2.5		34							
B-2	7.5		32							
B-2	20.0		22	104						
B-2	30.0		36							
B-2	40.0		37							
B-2	50.0		25							
B-3	2.5		18							
B-3	5.0		22							
B-3	7.5		26	93						
B-3	10.0		27							
B-3	40.0		24							
B-3	50.0		26							

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SUMMARY OF LABORATORY DATA

PROPOSED INDUSTRIAL BUILDING
SCAPPOOSE, OR

FIGURE A-6

ACRONYMS