REDMOND GEOTECHNICAL SERVICES

December 11, 2014

Mr. Eric Rouse
Bonaventure Senior Living
3425 Boone Road SE
Salem, Oregon 97317

Dear Mr. Rouse:

Re: Preliminary Geotechnical Investigation Services, Proposed Boone Road SE Commercial and/or Mixed Use Development Site, Tax Lot No's, 100, 200 and 300, 3290 Boone Road SE, Salem (Marion County), Oregon

Submitted herewith is our report entitled "Preliminary Geotechnical Investigation Services, Proposed Boone Road SE Commercial and/or Mixed Use Development Site, Tax Lot No's. 100, 200 and 300, 3290 Boone Road SE, Salem (Marion County), Oregon". The scope of our services was outlined in our formal proposal to Mr. Eric Rouse of Bonaventure Senior Living dated October 28, 2014. Written authorization of our services was provided by Mr. Eric Rouse of Bonaventure Senior Living on October 31, 2014.

During the course of our investigation, we have kept you and/or others advised of our schedule and preliminary findings. We appreciate the opportunity to assist you with this phase of the project. Should you have any questions regarding this report, please do not hesitate to call.

Sincerely,

Daniel M. Redmond, P.E., G.E.
President/Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
12,309
OREGON
July 15, 1983
DANIEL M. REDMOND
Exp. 12-31-16

Cc: Mr. Mark D. Grenz
Multi/Tech Engineering Services, Inc.

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SALEM (MARION COUNTY), OREGON

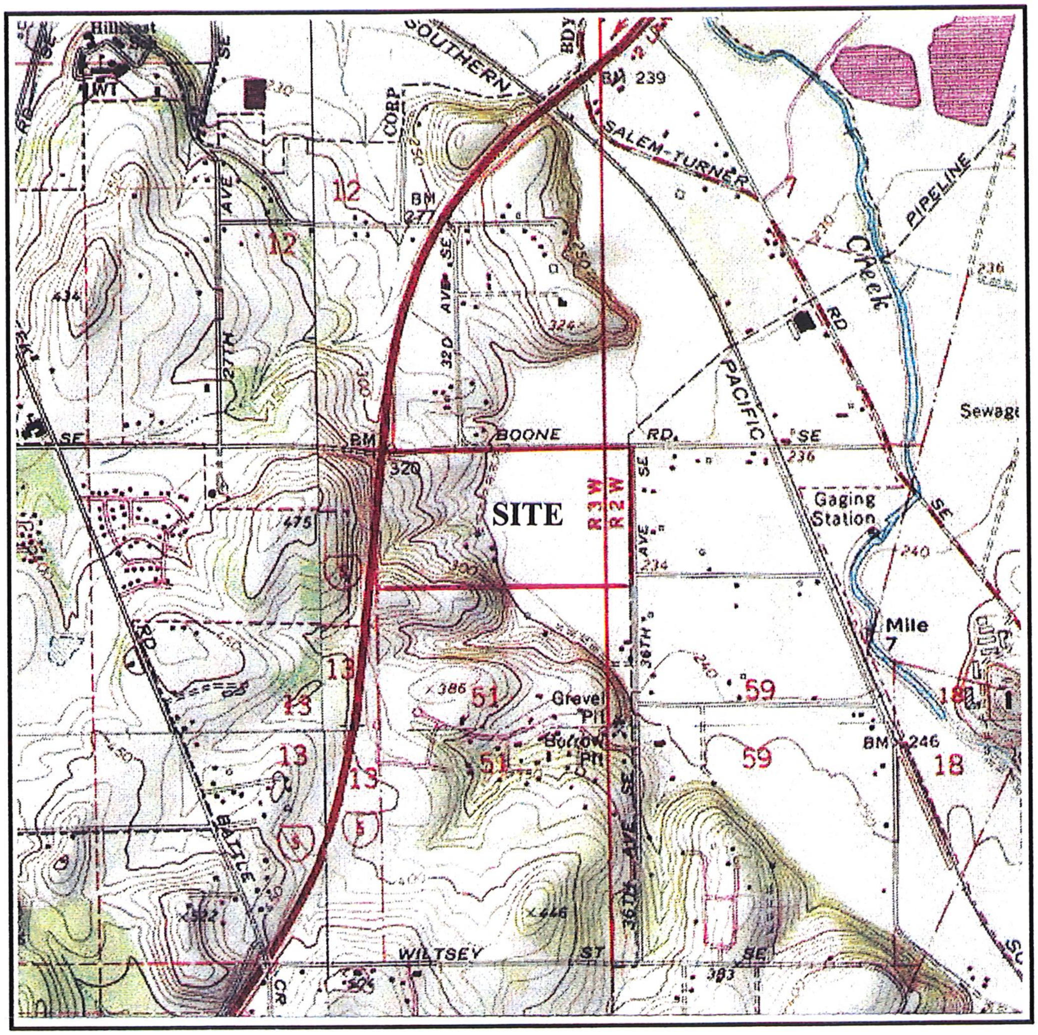
INTRODUCTION

Redmond Geotechnical Services, LLC is please to submit to you the results of our Preliminary Geotechnical Investigation at the site of the proposed new commercial and/or mixed use development site located to the south of Boone Road SE and east of 36th Avenue SE in Salem (Marion County), Oregon. The general location of the subject site is shown on the Site Vicinity Map, Figure No. 1. The purpose of our preliminary geotechnical investigation services at this time was to explore the existing subsurface soils and/or groundwater conditions across the subject site and to develop and/or provide appropriate preliminary geotechnical design and construction recommendations for the proposed new commercial and/or mixed use development project.

PROJECT DESCRIPTION

Although the project is still in the preliminary planning stages, we understand that present plans are to develop the subject site with several new commercial and/or mixed use type structures and/or properties. In general, we understand that the current and/or planned future zoning of the subject property will allow for a variety of commercial improvements and/or structures including office, multi-family, retail, restaurant as well as senior living and/or assisted care. While specific building plans are not available at this time, we envision that the new commercial structures will range from about 2,000 to greater than 25,000 square feet in size. Additionally, we anticipate that the new commercial structures will be of single- and/or three-story construction with wood and/or metal framing and either a raised wooden post and beam and/or concrete slab-on-grade floor system.

Support for the proposed commercial structures is anticipated to consist primarily of conventional shallow continuous (strip) footings although the larger commercial structures will likely include individual (spread) column-type footings. Structural loading information is presently unavailable for the project. However, based on our past experience with similar types of single- and/or three-story wood and/or metal frame commercial structures, we anticipate that maximum dead plus live continuous (strip) and individual (spread) column-type footing loads will be on the order of about 1.5 to 3.5 kips per lineal foot (klf) and 10 to 75 kips, respectively.



SALEM EAST QUADRANGLE
OREGON—MARION CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 STAYTON 15' QUADRANGLE

SCALE 1:24 000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

SITE VICINITY MAP

Project No. 1004.017.G	TAX LOT NO'S. 100, 200 AND 300 3290 BOONE ROAD SE	Figure No. 1

Earthwork and grading operations associated with bringing the subject property to finish site and/or design grades are unknown at this time. However, we envision that development of the relatively flat-lying easterly portion of the subject property may result in the placement of from one (1) to three (3) feet of structural fill to bring the site up to the existing adjacent street grades. However, development the moderately sloping westerly portion of the subject property is anticipated to result in both cuts and fills on the order of about five (5) to ten (10) feet.

Other associated site improvements for the proposed new commercial project will include new underground utility services as well as new paved parking and drive areas. Additionally, we anticipate that portions of the project will included concrete curbs and sidewalks.

SCOPE OF WORK

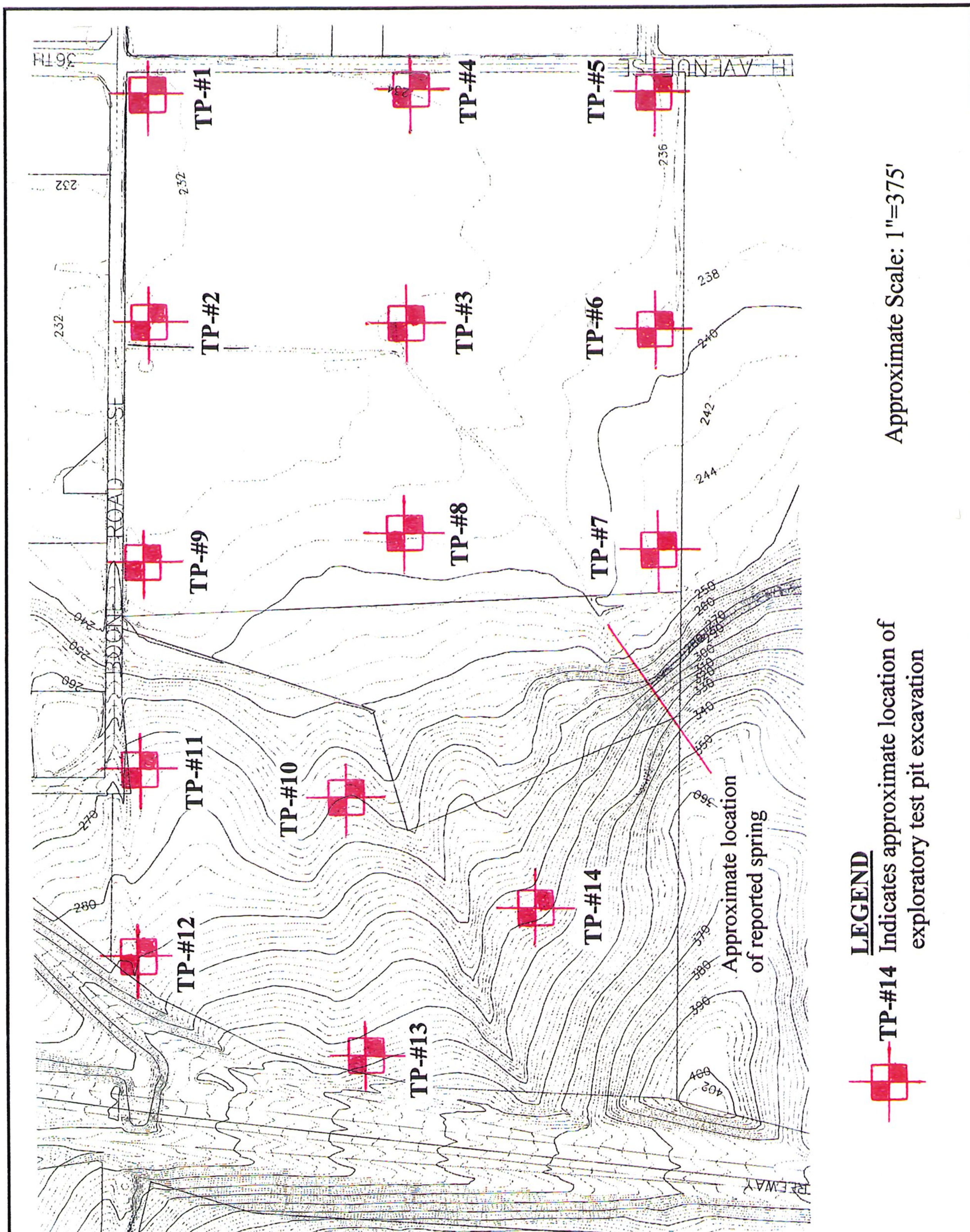
The purpose of our preliminary geotechnical studies was to evaluate the site subsurface soil and/or groundwater conditions underlying the site with regard to the proposed new commercial and/or mixed use construction and development at the site as well as any apparent associated impacts or concerns with respect to the new commercial structures. Additionally, our geotechnical studies are intended to provide appropriate preliminary geotechnical design and construction recommendations for the project. Specifically, our preliminary geotechnical investigation included the following scope of work items:

1. Review of available and relevant geologic and/or geotechnical investigation reports for the subject site and/or area.

2. A detailed field reconnaissance and subsurface exploration program of the soil and ground water conditions underlying the site by means of fourteen (14) exploratory test pit excavations. The exploratory test pits were excavated to depths ranging from about five (5) to seven (7) feet beneath existing site grades at the approximate locations as shown on the Site Exploration Map, Figure No. 2.

3. Laboratory testing to evaluate and identify pertinent physical and engineering properties of the subsurface soils encountered relative to the planned site development and construction at the site. The laboratory testing program included tests to help evaluate the natural (field) moisture content and dry density, maximum dry density and optimum moisture content, expansion index, gradational characteristics, Atterberg Limits and gradational analysis as well as direct shear strength, consolidation and "R"-value testing.

4. A literature review and engineering evaluation and assessment of the regional seismicity to evaluate the potential ground motion hazard(s) at the subject site. The evaluation and assessment included a review of the regional earthquake history and sources such as potential seismic sources, maximum credible earthquakes, and reoccurrence intervals as well as a discussion of the possible ground response to the selected design earthquake(s), fault rupture, landsliding, liquefaction, and tsunami and seiche flooding.



SITE EXPLORATION PLAN

Project No. 1004.017.G	**TAX LOT NO'S. 100, 200 AND 300** **3290 BOONE ROAD SE**	Figure No. 2

5. Engineering analyses utilizing the field and laboratory data as a basis for furnishing preliminary recommendations for foundation support of the proposed new commercial structures. Preliminary recommendations include maximum design allowable contact bearing pressure(s), depth of footing embedment, estimates of foundation settlement, lateral soil resistance, and foundation subgrade preparation. Additionally, construction and/or permanent subsurface water drainage considerations have also been prepared. Further, our report includes recommendations regarding site preparation, placement and compaction of structural fill materials, suitability of the on-site soils for use as structural fill, criteria for import fill materials, and preparation of foundation, pavement and/or floor slab subgrades.

6. Development of various flexible pavement design sections for private on-site improvements.

SITE CONDITIONS

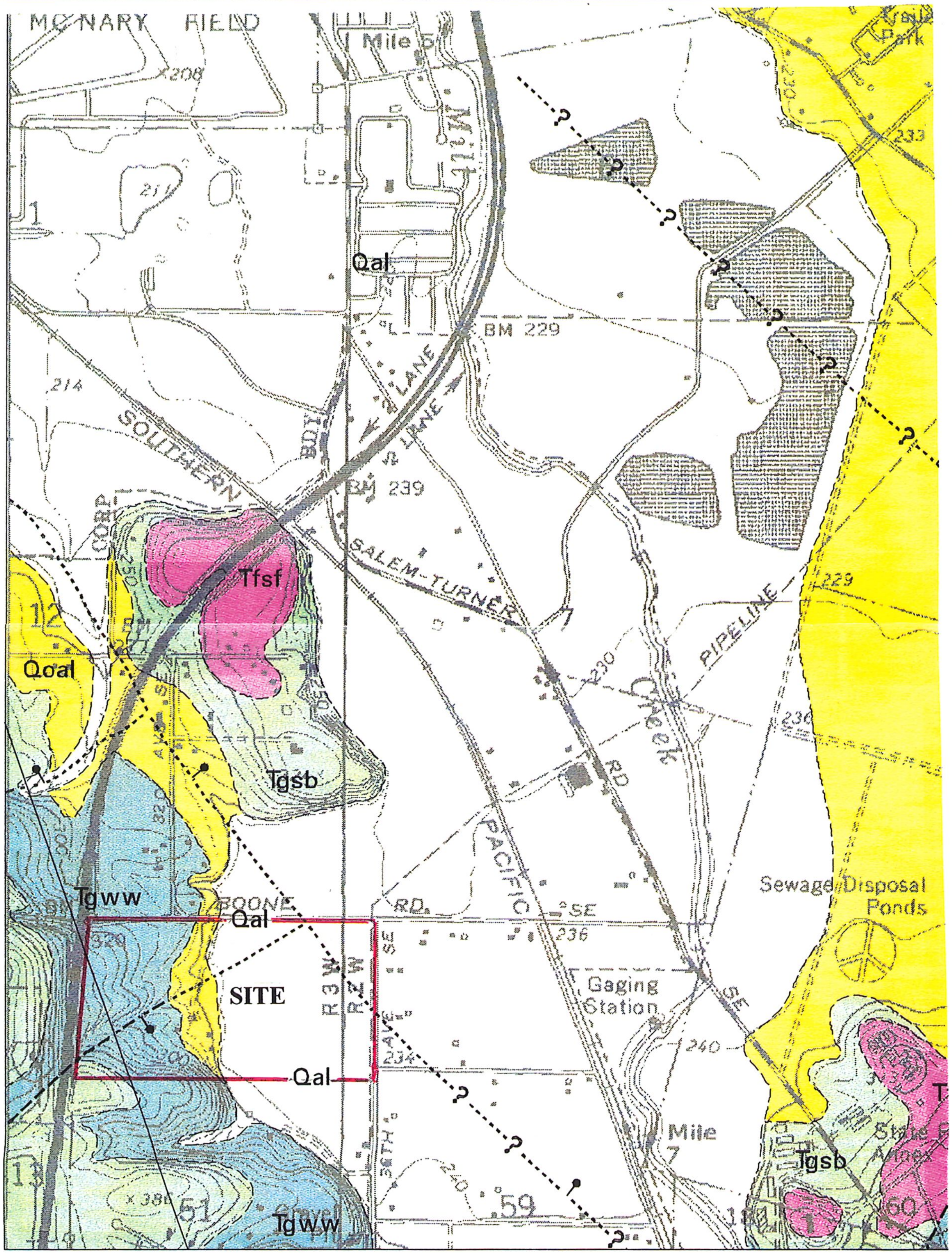
Site Geology

Available geologic mapping of the area and/or subject site (Geologic Map of the Salem East 7.5 Minute Quadrangle, 2000, Figure No. 3) indicates that the near surface and/or subsurface soils consist of three (3) separate map units comprised of Alluvial deposits (Qal) of Holocene age, Older alluvial deposits (Qoal) of Pleistocene age, and the Winter Water member (Tgww) of the Grande Ronde Basalt group of middle Miocene age. The following is a general description of each of the mapped units located at and/or beneath the subject property:

Alluvial deposits (Qal) - Unconsolidated silt, sand, and gravel largely confined to stream bottoms and adjacent flood plains. May include local lacustrine and paludal deposits. Unit ranges from 0 to 15 feet thick.

Older alluvial deposits (Qoal) - Includes poorly to moderately indurated siltstones, sandstones, and conglomerates that comprise older alluvial terrace/fan deposits and poorly indurated glaciofluvial clays and silts deposited by the catastrophic (Missoula Floods). Unit ranges from 0 to 90 feet thick.

Winter Water member (Tgww) - This unit consists of up to two flows within the map area. Both flows typically display entablature/colonnade jointing style. Fresh exposures are dark gray to black; weathered surfaces are generally greenish gray to grayish black. Both flows are commonly glassy to fine-grained, microphyric, phyric to abundantly phyric with small (less than 0.3 cm) plagioclase glomerocrysts that often display a distinctive radial or spoke-shaped habit. Distribution of plagioclase gomerocrysts is often uneven and they tend to be less abundant in the basal portions of the flows. Winter water flows are distinguished from other Grande Ronde units on the combined basis of stratigraphic position, lithology, geochemical composition, and paleomagnetic polarity (see Reidel and others, 1989 and Beeson and others, 1989). Unit thickness within the map area is variable, ranging from 0 to greater than 120 feet.



GEOLOGIC MAP

Project No. 1004.017.G	**TAX LOT NO'S. 100, 200 AND 300** **3290 BOONE ROAD SE**	Figure No. 3

Site and Surface Conditions

The subject property consists of three (3) separate tax lots (Tax Lot No's. 100, 200 and 300) which encompass a total area of approximately 79.09 acres. The site is bounded to the north by Boone Road SE, to the east by 36th Avenue SE, to the west by the existing Interstate I-5 Freeway, and to the south by undeveloped farm and/or agricultural land. The easterly portion of the subject site is characterized as relatively flat-lying to gently sloping terrain (i.e., less than 5 percent) descending downward towards the northeast and lies between about Elevation 232 feet and Elevation 244 feet. However, the westerly portion of the subject property is characterized as moderately sloping terrain (i.e., greater than 20 percent) descending downward towards the northeast and lies between about Elevation 245 feet and Elevation 400 feet. Additionally, the subject property contains one (1) well developed and two (2) or more smaller existing drainage basins and/or features traversing across the site from the southwest to the northeast as well as a reported spring (see Site Exploration Plan, Figure No. 2). At the time of our site and/or field work, the southerly most drainage basin, which is reported to be spring fed, was flowing water. Further, the northerly portion of the easterly portion of the site is reported to contain a wetland.

The subject site is primarily void of structures and/or improvements. However, the site contains an existing two-story residential structure as a small cottage as well as two outbuildings. Vegetation across much of the site consists of an existing grass and/or hay farm crop. However, the southwesterly portion of the site contains a heavy growth of trees (old tree farm) and underbrush.

Subsurface Soil Conditions

Our understanding of the subsurface soil conditions underlying the site was developed by means of fourteen (14) exploratory test pits excavated to depths ranging from about five (5) to seven (7) feet beneath existing site grades on November 11, 2014 with a John Deere 200C track-mounted excavator. The location of the exploratory test pits were located in the field by marking off distances from existing and/or known site features and are shown in relation to the existing site and/or topographic features on the Site Exploration Map, Figure No. 2. Detailed logs of the test pit explorations, presenting conditions encountered at each location explored, are presented in the Appendix, Figure No's. A-5 through A-11.

The exploratory test pit excavations were observed by staff from Redmond Geotechnical Services, LLC who logged each of the test pit explorations and obtained representative samples of the subsurface soils encountered across the site. Additionally, the elevation of the exploratory test pit excavations were referenced from a City of Salem Topographic Map and may be considered as approximate. All subsurface soils encountered at the site and/or within the exploratory test pit excavations were logged and classified in general conformance with the Unified Soil Classification System (USCS) which is outlined on Figure No. A-4.

The test pit explorations revealed that the subject site is underlain by native soil deposits comprised of fine-grained soil deposits of Holocene to Pleistocene age across the relatively flat-lying easterly portion of the site and by residual soils and/or highly weathered basalt bedrock deposits of Miocene age across the westerly moderately sloping portion of the site. Specifically, the subsurface soils underlying the easterly portion of the project area consists of a surficial layer of topsoil materials comprised of dark brown, very moist to wet and/or saturated, soft, organic, clayey and sandy silt which extend to depths of approximately 12 to 18 inches. These topsoil materials were inturn underlain by medium to gray-brown with grey and/or orange mottling, very moist to wet, medium stiff to medium dense, clayey, sandy silt to silty fine sand subgrade soils to depths of about two (2) to three (3) feet beneath the existing site and/or surface grades. These sandy silt to silty fine sand subgrade soils are best characterized by relatively low to moderate strength and moderate compressibility. Additionally, localized deposits of gray to light gray, wet to saturated, soft, slightly sandy, silty clay to clay silt subgrade soils were encountered in test pits TP-#2, TP-#3 and TP-#9 to depths of about 2.5 to 3.5 feet beneath the existing site and/or surface grades. These silty clay to clayey silt subgrade soils possess low expansion potential and are best characterized by relatively low strength and moderate to high compressibility. All soils were inturn underlain by gray-brown, wet to saturated, medium dense to dense, silty, gravelly sand to sandy gravel to cobble size to the maximum depth explored of about seven (7) feet beneath existing site grades. These silty, gravelly sand to sandy gravel subgrade soil deposits are best characterized by relatively moderate to high strength and low compressibility. The subsurface soils underlying the westerly moderately sloping portion of the site consist of surficial topsoil materials comprised of dark brown, very moist to wet, soft, organic, sandy, clayey silt to depths of about 12 to 16 inches. These topsoil materials were inturn underlain by residual soils comprised of medium to reddish-brown, very moist to wet, medium stiff to stiff, sandy, clayey silt to the maximum depth explored of about seven (7) feet beneath the existing site and/or surface grades. These clayey silt residual soils were found to becomes stiff to very stiff and highly weathered basalt bedrock below a depth of about 5 to 6 feet and are best characterized by relatively moderate strength and low to moderate compressibility.

Groundwater

Groundwater was encountered within several of the exploratory test pit explorations across the relatively flat-lying easterly portion of the site (TP-#1 through TP-#5 , TP-#8 and TP-#9) at the time of excavation to depths of about two (2) to four (4) feet beneath existing site grades. Additionally, the near surface subgrade soils are characterized as mottled and contain localized deposits of clay. As such, the mottled soil conditions and/or localized clay soil deposits encountered across the easterly portion of the subject site are believed to be the result of and/or represent seasonally ponded and/or surface water runoff down and/or through the surficial clayey, sandy silt subgrade soils. In this regard, groundwater elevations at the site are expected to fluctuate seasonally in accordance with rainfall conditions and/or site utilization and may approach to near surface elevations during periods of heavy and/or prolonged rainfall.

LABORATORY TESTING

Representative samples of the on-site subsurface soils were collected at selected depths and intervals from various test pit excavations and returned to our laboratory for further examination and testing and/or to aid in the classification of the subsurface soils as well as to help evaluate and identify their engineering strength and compressibility characteristics. The laboratory testing consisted of visual and textural sample inspection, moisture content and dry density determinations, maximum dry density and optimum moisture content, expansion index, gradation analyses and Atterberg Limits tests as well as direct shear strength, consolidation and "R"-value tests. Results of the various laboratory tests are presented in the Appendix, Figure No's. A-11 through A-19.

SEISMICITY AND EARTHQUAKE SOURCES

The seismicity of the southwest Washington and northwest Oregon area, and hence the potential for ground shaking, is controlled by three separate fault mechanisms. These include the Cascadia Subduction Zone (CSZ), the mid-depth intraplate zone, and the relatively shallow crustal zone. Descriptions of these potential earthquake sources are presented below.

The CSZ is located offshore and extends from northern California to British Columbia. Within this zone, the oceanic Juan de Fuca Plate is being subducted beneath the continental North American Plate to the east. The interface between these two plates is located at a depth of approximately 15 to 20 kilometers (km). The seismicity of the CSZ is subject to several uncertainties, including the maximum earthquake magnitude and the recurrence intervals associated with various magnitude earthquakes. Anecdotal evidence of previous CSZ earthquakes has been observed within coastal marshes along the Washington and Oregon coastlines. Sequences of interlayered peat and sands have been interpreted to be the result of large Subduction zone earthquakes occurring at intervals on the order of 300 to 500 years, with the most recent event taking place approximately 300 years ago. A recent study by Geomatrix (1995) suggests that the maximum earthquake associated with the CSZ is moment magnitude (Mw) 8 to 9. This is based on an empirical expression relating moment magnitude to the area of fault rupture derived from earthquakes that have occurred within Subduction zones in other parts of the world. An Mw 9 earthquake would involve a rupture of the entire CSZ. As discussed by Geomatrix (1995) this has not occurred in other subduction zones that have exhibited much higher levels of historical seismicity than the CSZ, and is considered unlikely. For the purpose of this study an earthquake of Mw 8.5 was assumed to occur within the CSZ.

The intraplate zone encompasses the portion of the subducting Juan de Fuca Plate located at a depth of approximately 30 to 50 km below western Washington and western Oregon. Very low levels of seismicity have been observed within the intraplate zone in western Oregon and western Washington. However, much higher levels of seismicity within this zone have been recorded in Washington and California. Several reasons for this seismic quiescence were suggested in the Geomatrix (1995) study and include changes in the direction of Subduction between Oregon, Washington, and British Columbia as well as the effects of volcanic activity along the Cascade Range.

Historical activity associated with the intraplate zone includes the 1949 Olympia magnitude 7.1 and the 1965 Puget Sound magnitude 6.5 earthquakes. Based on the data presented within the Geomatrix (1995) report, an earthquake of magnitude 7.25 has been chosen to represent the seismic potential of the intraplate zone.

The third source of seismicity that can result in ground shaking within the Vancouver and southwest Washington area is near-surface crustal earthquakes occurring within the North American Plate. The historical seismicity of crustal earthquakes in this area is higher than the seismicity associated with the CSZ and the intraplate zone. The 1993 Scotts Mills (magnitude 5.6) and Klamath Falls (magnitude 6.0), Oregon earthquakes were crustal earthquakes.

Liquefaction

Seismic induced soil liquefaction is a phenomenon in which lose, granular soils and some silty soils, located below the water table, develop high pore water pressures and lose strength due to ground vibrations induced by earthquakes. Soil liquefaction can result in lateral flow of material into river channels, ground settlements and increased lateral and uplift pressures on underground structures. Buildings supported on soils that have liquefied often settle and tilt and may displace laterally. Soils located above the ground water table cannot liquefy, but granular soils located above the water table may settle during the earthquake shaking.

Our review of the subsurface soil test pit logs from our exploratory field explorations (TP-#10 through TP-#14) and laboratory test results indicates that the westerly portion of the subject site is generally underlain by medium stiff to stiff, slightly sandy, clayey silt becoming stiff to very stiff highly weathered basalt bedrock deposits to depths of at least 7.0 feet beneath existing site grades. Additionally, groundwater was not encountered across the westerly portion of the site during our field exploration work to depths of up to seven (7) feet beneath existing site grades. As such, due to the medium stiff to very stiff and/or cohesive nature of the subgrade slightly sandy, clayey silt soils beneath the westerly portion of the site, it is our opinion that the native residual slightly sandy, clayey silt subgrade soil deposits do not have the potential for liquefaction during the design earthquake motions previously described. With regard t the easterly portion of the subject site, our review of the subsurface test pit logs from our field explorations (TP-#1 through TP-#9) and the laboratory test results indicates that the easterly portion of the subject site is underlain by medium stiff to medium dense, clayey, sandy silt to silty fine sand to depths of about two (2) to three (3) feet inturn underlain by medium dense to dense, silty, gravelly sand to sandy gravel to the maximum depth explored of about seven (7) feet beneath the existing site and/or surface grades. Additionally, ground water was generally encountered across the easterly portion of the site during our field exploration work between a depth of about two (2) to four (4) feet beneath the existing site and/or surface grades. However, due to the relatively shallow deposit of medium dense to dense gravelly sand to sandy gravel beneath the site, it is our opinion that the subgrade soil deposits located beneath the easterly portion of the site have a relatively low potential for liquefaction during the design earthquake motions previously described.

Landslides

No ancient and/or active landslides were observed or are known to be present on the subject site. A review of available Lidar imagery for the area found no visible anomalies and/or landslide features within the moderately sloping westerly portion of the site. Additionally, due to the relatively flat-lying to gently sloping nature of the easterly portion of the subject site, the risk of seismic induced slope instability at the site resulting in landslides and/or lateral earth movements do not appear to present a serious potential geologic hazard.

Surface Rupture

Although the site is generally located within a region of the country known for seismic activity, no known faults exist on and/or immediately adjacent to the subject site. The closest known fault is the Mount Angel Fault which is located approximately 5.5 miles to the northeast of the subject site. However, an inferred and/or suspected (concealed) fault is believed to be present near the northeast corner of the subject property. However, the age and/or potential activity of the inferred fault is unknown. As such, the risk of surface rupture due to faulting should be considered.

Tsunami and Seiche

A tsunami, or seismic sea wave, is produced when a major fault under the ocean floor moves vertically and shifts the water column above it. A seiche is a periodic oscillation of a body of water resulting in changing water levels, sometimes caused by an earthquake. Tsunami and seiche are not considered a potential hazard at this site because the site is not near to the coast and/or there are no adjacent significant bodies of water.

Flooding and Erosion

Stream flooding is a potential hazard that should be considered in lowland areas of Marion County and Salem. The FEMA (Federal Emergency Management Agency) flood maps should be reviewed as part of the design for the proposed new residential structures and site improvements. Elevations of structures on the site should be designed based upon consultants reports, FEMA (Federal Emergency Management Agency), and Marion County requirements for the 100-year flood levels of any nearby creeks and/or streams such as the nearby Mill Creek.

CONCLUSIONS AND RECOMMENDATIONS

General

Based on the results of our field explorations, laboratory testing, and engineering analyses, it is our opinion that the site is generally suitable for the proposed new commercial and/or mixed use development and its associated site improvements provided that the recommendations contained within this report are properly incorporated into the design and construction of the project.

The primary features of concern at the site are 1) the presence of an organic topsoil layer across the site, 2) the presence of relatively shallow groundwater across the easterly portion of the site, 3) the presence of the localized deposits of plastic and expansive silty clay subgrade soils across portions of the easterly portion of the site, 4) the moderately steep sloping site grades across the westerly portion of the site, 5) the presence of two (2) or more existing drainage basins and reported spring located across the westerly portion of the site, and 6) the moisture sensitivity of the native clayey, sandy silt subgrade soils.

With regard to the organic layer of topsoil materials across the site, we anticipate that clearing and stripping depths of between 12 to 18 inches should be anticipated across the site with deeper stripping and clearing depths required where tree stumps and/or heavy to dense vegetation are present. In regards to the presence of relatively shallow groundwater beneath the easterly portion of the site, we are of the opinion that site excavations to depths greater than about two (2) feet will likely encounter groundwater during wetter months of the year. With regard to the presence of localized deposits of plastic and expansive silty clay subgrade soils across portions of the easterly portion of the site, we are of the opinion that these clayey soils possess low strength and moderate to high compressibility characteristics. Additionally, these clayey subgrade soils were found to possess low expansion potential. As such, settlement sensitive structures and/or surface improvements such as concrete curbs and sidewalks should not be constructed directly above the clayey subgrade soils. In regards to the moderately steep sloping site grades across the westerly portion of the subject property, we are generally of the opinion that permanent cuts and/or fills of up to ten (10) feet in height can be made at a finish slope gradient (inclination) no steeper than about 2H:1V. Additionally, where structural fills are required, proper benching and keying of the structural fills will also be required. With regard to the existing drainage basins and reported spring located within the westerly portion of the site, we are generally of the opinion that some form of permanent surface and/or subsurface dewatering drainage provision will likely be required to collect and properly control the surface and/or subsurface groundwater within the existing drainage basins and reported spring. In general and depending on the site grading selected for the project, we envision a drainage system consisting of one (1) or more perforated PVC drain pipes embedded near (within about 4 inches) the bottom of a minimum 24 inch wide by 36 inch deep trench excavated longitudinally down the center (bottom) of the existing drainage basin(s). The subsurface drain trench should be lined with an approved geotextile filter fabric and backfilled with an approved crushed aggregate drain rock. The filter fabric shall completely surround (burrito wrap) the crushed aggregate drain rock backfill material.

In regards to the moisture sensitive clayey, sandy silt subgrade soils, we are generally of the opinion that all site grading and earthwork operations would benefit if scheduled for the drier summer months which is typically June through September.

The following sections of this report provide preliminary recommendations regarding subgrade preparation and grading as well as foundation and floor slab design and construction for the new commercial and/or mixed use development project.

Site Preparation

As an initial step in site preparation, we recommend that the proposed new commercial and/or mixed use development area(s) and/or its associated structural and/or site improvement area(s) be stripped and cleared of all existing improvements, any existing undocumented fill materials, surface debris, existing vegetation, topsoil materials, and/or any other deleterious materials present at the time of construction. In general, we envision that the site stripping to remove existing vegetation and topsoil materials will generally be about 12 to 18 inches. However, localized areas requiring deeper removals, such as any existing undocumented fill materials and/or tree stumps, may be encountered and should be evaluated at the time of construction by the Geotechnical Engineer. The stripped and cleared materials should be properly disposed of as they are generally considered unsuitable for use/reuse as fill materials.

Following the completion of the site stripping and clearing work and prior to the placement of any required structural fill materials and/or structural improvements, the exposed subgrade soils within the planned structural improvement area(s) should be inspected and approved by the Geotechnical Engineer and possibly proof-rolled with a half and/or fully loaded dump truck. Areas found to be soft or otherwise unsuitable should be overexcavated and removed or scarified and recompacted as structural fill. During wet and/or inclement weather conditions, proof rolling and/or scarification and recompaction as noted above may not be appropriate.

The on-site native sandy and clayey silt subgrade soil materials are generally considered suitable for use/reuse as structural fill materials provided that they are free of organic materials, debris, and rock fragments in excess of about 6 inches in dimension. However, if site grading is performed during wet or inclement weather conditions, the use of the on-site native soil materials which contain significant silt and clay sized particles will be difficult at best. In this regard, during wet or inclement weather conditions, we recommend that an import structural fill material be utilized which should consist of a free-draining (clean) granular fill (sand & gravel) containing no more than about 5 percent fines. Representative samples of the materials which are to be used as structural fill materials should be submitted to the Geotechnical Engineer and/or laboratory for approval and determination of the maximum dry density and optimum moisture content for compaction.

In general, all site earthwork and grading activities should be scheduled for the drier summer months (late June through September) if possible. However, if wet weather site preparation and grading is required, it is generally recommended that the stripping of topsoil materials be accomplished with a tracked excavator utilizing a large smooth-toothed bucket working from areas yet to be excavated. Additionally, the loading of strippings into trucks and/or protection of moisture sensitive subgrade soils will also be required during wet weather grading and construction. In this regard, we recommend that areas in which construction equipment will be traveling be protected by covering the exposed subgrade soils with a geotextile fabric such as Mirafi 600nx followed by at least 12 inches or more of crushed aggregate base rock. Further, the geotextile fabric should have a minimum Mullen burst strength of at least 250 pounds per square inch for puncture resistance and an apparent opening size (AOS) between the U.S. Standard No. 70 and No. 100 sieves.

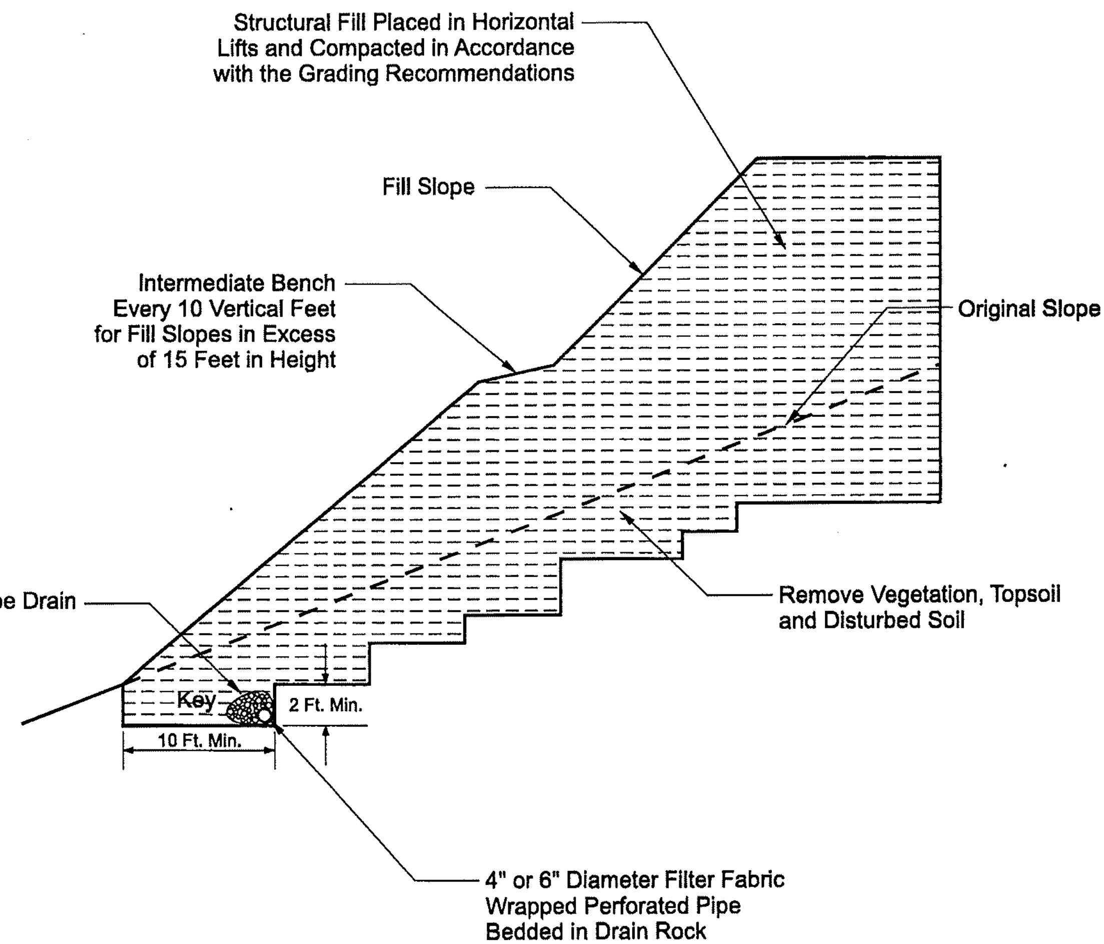
All structural fill materials placed within the new building and/or pavement areas should be moistened or dried as necessary to near (within 3 percent) optimum moisture conditions and compacted by mechanical means to a minimum of 92 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. Structural fill materials should be placed in lifts (layers) such that when compacted do not exceed about 8 inches. Additionally, all fill materials placed within five (5) lineal feet of the perimeter (limits) of the proposed residential structures and/or pavements should be considered structural fill. Further, structural fills placed on sloping ground which exceeds a gradient of about 20 percent (i.e., 1V:5H) should be properly benched and keyed. A typical key and bench fill slope detail is shown on Figure No. 4. All aspects of the site grading should be monitored and approved by a representative of Redmond Geotechnical Services, LLC.

Foundation Support

Based on the results of our investigation, it is our opinion that the site of the proposed new commercial and/or mixed use development is suitable for support of the single- and/or three-story wood- and/or metal-framed structures provided that the following foundation design recommendations are followed. The following sections of this report present specific foundation design and construction recommendations for the planned new commercial and/or mixed use structures.

Shallow Foundations

In general, conventional shallow continuous (strip) footings and individual (spread) column-type footings for the commercial and/or mixed use project may be supported by approved medium stiff to stiff, native (untreated) subgrade soil materials and/or properly placed and compacted sandy silt structural fill soils based on an allowable contact bearing pressure of about 2,500 pounds per square foot (psf). However, we point out that the existing near surface medium stiff native clayey, sandy silt to silty fine sand subgrade soils located across the relatively flat-lying easterly portion of the site are presently only suitable for an allowable contact bearing pressure of about 2,000 psf. However, we anticipate that the easterly portion of the site may be filled with about one (1) to three (3) feet of structural fill.



TYPICAL FILL SLOPE GRADING DETAIL

Project No. 1004.017.G	**TAX LOT NO'S. 100, 200 AND 300** **3290 BOONE ROAD**	Figure No. 4

As such, where higher allowable contact bearing pressures are desired and/or required across the easterly portion of the site, an allowable contact bearing pressure of up to 2,500 psf may be used for design where the foundation is supported by at least 12 inches or more of properly structural fill material. These recommended allowable contact bearing pressures are intended for dead loads and sustained live loads and may be increased by one-third for the total of all loads including short-term wind or seismic loads. In general, continuous strip footings should have a minimum width of at least 16 inches and be embedded at least 18 inches below the lowest adjacent finish grade (includes frost protection). Individual column footings (where required) should be embedded at least 18 inches below grade and have a minimum width of at least 24 inches. Additionally, foundations constructed on sloping ground steeper than about 25 percent should be constructed no closer than about ten (10) feet to the top of any existing and/or constructed cut and/or fill slope without the approval of the Geotechnical Engineer.

Total and differential settlements of foundations constructed as recommended above and supported by approved native subgrade soils or by properly compacted structural fill materials are expected to be well within the tolerable limits for these types of single- and/or three-story wood- and/or metal-frame structures and should generally be less than about 1-inch and 1/2-inch, respectively.

Allowable lateral frictional resistance between the base of the footing element and the supporting subgrade bearing soil can be expressed as the applied vertical load multiplied by a coefficient of friction of 0.30 and 0.45 for native sandy silt subgrade soils and/or import gravel fill materials, respectively. In addition, lateral loads may be resisted by passive earth pressures on footings poured "neat" against in-situ (native) subgrade soils or properly backfilled with structural fill materials based on an equivalent fluid density of 250 pounds per cubic foot (pcf). This recommended value includes a factor of safety of approximately 1.5 which is appropriate due to the amount of movement required to develop full passive resistance.

Floor Slab Support

In order to provide uniform subgrade reaction beneath concrete slab-on-grade floors, we recommend that the floor slab area be underlain by a minimum of 6 inches of free-draining (less than 5 percent passing the No. 200 sieve), well-graded, crushed rock. The crushed rock should help provide a capillary break to prevent migration of moisture through the slab. Additional moisture protection, where needed, can be provided by using a 15-mil polyolefin geo-membrane sheeting such as StegoWrap.

The base course materials should be compacted to at least 95 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. Where floor slab subgrade materials are undisturbed, firm and stable and where the underslab aggregate base rock section has been prepared and compacted as recommended above, we recommend that a modulus of subgrade reaction of 200 pci be used for design.

Retaining/Below Grade Walls

Retaining and/or below grade walls should be designed to resist lateral earth pressures imposed by native soils or granular backfill materials as well as any adjacent surcharge loads. For walls which are unrestrained at the top and free to rotate about their base, we recommend that active earth pressures be computed on the basis of the following equivalent fluid densities:

Non-Restrained Retaining Wall Pressure Design Recommendations

Slope Backfill (Horizontal/Vertical)	Equivalent Fluid Density/Sand (pcf)	Equivalent Fluid Density/Gravel (pcf)
Level	35	30
3H:1V	60	50
2H:1V	90	80

For walls which are fully restrained at the top and prevented from rotation about their base, we recommend that at-rest earth pressures be computed on the basis of the following equivalent fluid densities:

Restrained Retaining Wall Pressure Design Recommendations

Slope Backfill (Horizontal/Vertical)	Equivalent Fluid Density/Sand (pcf)	Equivalent Fluid Density/Gravel (pcf)
Level	45	35
3H:1V	65	60
2H:1V	95	90

The above recommended values assume that the walls will be adequately drained to prevent the buildup of hydrostatic pressures. Where wall drainage will not be present and/or if adjacent surcharge loading is present, the above recommended values will be significantly higher.

Backfill materials behind walls should be compacted to 90 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. Special care should be taken to avoid overcompaction near the walls which could result in higher lateral earth pressures than those indicated herein. In areas within three (3) to five (5) feet behind walls, we recommend the use of hand-operated compaction equipment.

Pavements

Flexible pavement design for this project was determined on the basis of projected (anticipated) traffic volume and loading conditions relative to laboratory subgrade soil strength characteristics. Based on an average laboratory subgrade "R"-value of 26 (Resilient Modulus = 5,000 to 10,000) and utilizing the Asphalt Institute Flexible Pavement Design Procedures and/or the American Association of State Highway and Transportation Officials (AASHTO) 1993 "Design of Pavement Structures" manual, we have developed the following flexible pavement sections for the proposed commercial and/or mixed use project:

	Asphaltic Concrete Thickness (inches)	**Aggregate Base Rock Thickness (inches)**
Automobile Parking Areas	3.0	8.0
Automobile Drive Areas	3.5	9.0

Note: Where wet and/or inclement weather is anticipated during construction, we recommend a minimum crushed aggregate base rock section of at least 12.0 inches. Additionally, where heavy vehicle and/or truck traffic is anticipated and/or required, we recommend that the automobile drive areas be increased by adding an additional 0.5 inches of asphaltic concrete and 3.0 inches of aggregate base rock. Further, the above recommended flexible pavement section(s) assumes a design life of 20 years.

Pavement Subgrade, Base Course & Asphalt Materials

The above recommended pavement section(s) were based on the design assumptions listed herein and on the assumption that construction of the pavement section(s) will be completed during an extended period of reasonably dry weather. However, if construction of the paved site improvements is performed during wet and/or inclement weather conditions, we recommend that the aggregate base rock section be at least 12.0 inches. All thicknesses given are intended to be the minimum acceptable. Increased base rock sections and the use of geotextile fabric may be required during wet and/or inclement weather conditions and/or in order to adequately support construction traffic and protect the subgrade during construction. Additionally, the above recommended pavement section(s) assume that the subgrade will be prepared as recommended herein, that the exposed subgrade soils will be properly protected from rain and construction traffic, and that the subgrade is firm and unyielding at the time of paving. Further, it assumes that the subgrade is graded to prevent any ponding of water which may tend to accumulate in the base course.

Pavement base course materials should consist of well-graded 1-1/2 inch and/or 3/4-inch minus crushed base rock having less than 5 percent fine materials passing the No. 200 sieve. The base course and asphaltic concrete materials should conform to the requirements set forth in the latest edition of the Oregon Department of Transportation, Standard Specifications for Highway Construction.

The base course materials should be compacted to at least 95 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. The asphaltic concrete paving materials should be compacted to at least 92 percent of the theoretical maximum density as determined by the ASTM D-2041 (Rice Gravity) test method.

Excavation/Slopes

Temporary excavations of up to about four (4) feet in depth may be constructed with near vertical inclinations. Temporary excavations greater than about four (4) feet but less than eight (8) feet should be excavated with inclinations of at least 1 to 1 (horizontal to vertical) or properly braced/shored. Where excavations are planned to exceed about eight (8) feet, this office should be consulted. All shoring systems and/or temporary excavation bracing for the project should be the responsibility of the excavation contractor.

Permanent cut and/or fill slopes should be constructed no steeper than about 2H:1V. Additionally, permanent cut slopes should be constructed to a maximum height no greater than about ten (10) feet without consultation by the Geotechnical Engineer. Further, fill slopes constructed on existing and/or natural grades steeper than 20 percent (i.e., 1V:5H) should be properly benched and keyed (see Figure No. 4).

Depending on the time of year in which trench excavations occur, trench dewatering may be required in order to maintain dry working conditions if the invert elevations of the proposed utilities are located at and/or below the groundwater level. If groundwater is encountered during utility excavation work, we recommend placing trench stabilization materials along the base of the excavation. Trench stabilization materials should consist of 1-foot of well-graded gravel, crushed gravel, or crushed rock with a maximum particle size of 4 inches and less than 5 percent fines passing the No. 200 sieve. The material should be free of organic matter and other deleterious material and placed in a single lift and compacted until well keyed.

Surface Drainage/Ground Water

We recommend that positive measures be taken to properly finish grade the site so that drainage waters from building and landscaping areas as well as adjacent properties and/or buildings are directed away from the new commercial and/or mixed use structures foundations and/or floor slabs. All roof drainage should be directed into conduits that carry runoff water away from the commercial and/or mixed use structures to a suitable outfall. Roof downspouts should not be connected to foundation drains. A minimum ground slope of about 2 percent is generally recommended in unpaved areas around the buildings.

Groundwater was generally not encountered during our field work across the westerly moderately sloping portion of the site. However, springs may be present across the westerly portion of the site. Additionally, groundwater was encountered across the relatively flat-lying easterly portion of the site within several of the exploratory test pits (TP-#1 through TP-#5, TP-#8 and TP-#9) at the time of excavation to depths of between two (2) and four (4) feet beneath existing site grades. Further, although groundwater elevations in the area may fluctuate seasonally and may temporarily pond/perch near the ground surface during periods of prolonged rainfall, based on our current understanding of the project as well as the anticipated site grading required to bring the subject site to finish design grades, we are of the opinion that an underslab drainage system will not be required for the proposed new commercial and/or mixed use structures. However, we are generally of the opinion that a footing/foundation drainage system should be utilized around the perimeter of the proposed new commercial and/or mixed use structures. Additionally, a foundation drain is recommended for any below grade and/or retaining walls. A typical recommended retaining/footing drain detail is shown on Figure No. 5.

Seismic Design Considerations

Structures at the site should be designed to resist earthquake loading in accordance with the methodology described in the latest edition (2014) of the State of Oregon Structural Specialty Code and/or Amendments to the 2012 International Building Code (IBC). The maximum considered earthquake ground motion for short period and 1.0 period spectral response may be determined from the Oregon Structural Specialty Code and/or Figures 1613 (1) and 1613 (2) of the 2008 National Earthquake Hazard Reduction Program (NEHRP) "Recommended Provisions for Seismic Regulations for New Buildings and Other Structures" published by the Building Seismic Safety Council. We recommend Site Class "C" be used for design per Table 1613.5.2.

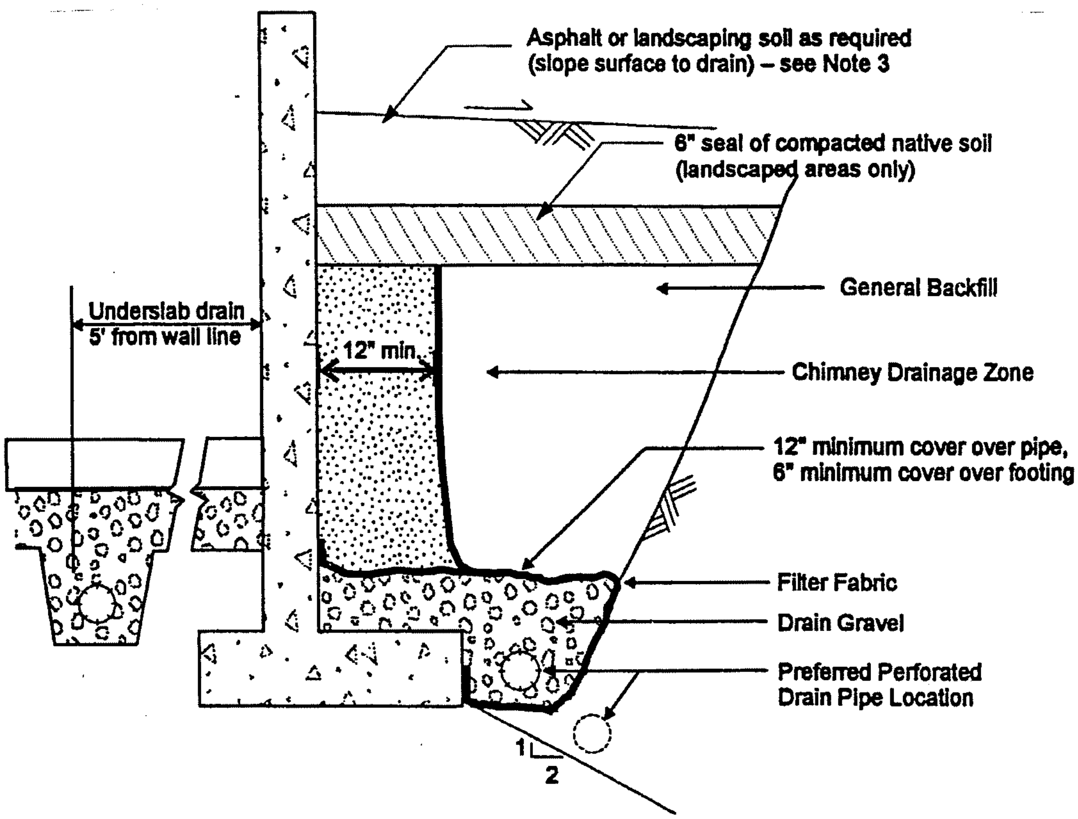
Using this information, the structural engineer can select the appropriate site coefficient values (F_a and F_v) from Tables 1613.5.3 (1) and 1613.5.3 (2) of the 2009 IBC to determine the maximum considered earthquake spectral response acceleration for the project. However, we have assumed the following response spectrum for the project:

Table 1. Recommended Seismic Design Parameters

Site Class	S_s	S_1	F_a	F_v	S_{ms}	S_{m1}	S_{DS}	S_{D1}
C	0.882	0.353	1.047	1.447	0.924	0.511	0.616	0.341

Notes: 1. S_s and S_1 were established based on the USGS 2002 mapped maximum considered earthquake spectral acceleration maps for 2% probability of exceedence in 50 years.

2. F_a and F_v were established based on IBC 2006 tables 1613.5.3 (1) and 1613.5.3 (2) using the selected S_s and S_1 values.



SCHEMATIC - NOT TO SCALE

NOTES:

1. Filter Fabric to be non-woven geotextile (Amoco 4545, Mirafi 140N, or equivalent)
2. Lay perforated drain pipe on minimum 0.5% gradient, widening excavation as required. Maintain pipe above 2:1 slope, as shown.
3. All-granular backfill is recommended for support of slabs, pavements, etc. (see text for structural fill).
4. Drain gravel to be clean, washed ¾" to 1½" gravel.
5. General backfill to be on-site gravels, or ¾"-0 or 1½"-0 crushed rock compacted to 92% Modified Proctor (AASHTO T-180).
6. Chimney drainage zone to be 12" wide (minimum) zone of clean washed, medium to coarse sand or drain gravel if protected with filter fabric. Alternatively, prefabricated drainage structures (Miradrain 6000 or similar) may be used.

PERIMETER FOOTING/RETAINING WALL DRAIN DETAIL		
Project No. 1004.017.G	TAX LOT NO'S. 100, 200 AND 300 3290 BOONE ROAD	Figure No. 5

CONSTRUCTION MONITORING AND TESTING

We recommend that **Redmond Geotechnical Services, LLC** be retained to provide construction monitoring and testing services during all earthwork operations for the proposed new commercial and/or mixed use development. The purpose of our monitoring services would be to confirm that the site conditions reported herein are as anticipated, provide field recommendations as required based on the actual conditions encountered, document the activities of the grading contractor and assess his/her compliance with the project specifications and recommendations. It is important that our representative meet with the contractor prior to grading to help establish a plan that will minimize costly overexcavation and site preparation work. Of primary importance will be observations made during site preparation, structural fill placement, footing excavations and construction as well as retaining wall backfill.

CLOSURE AND LIMITATIONS

This report is intended for the exclusive use of the addressee and/or their representative(s) to use to design and construct the proposed new commercial and/or mixed use structures and their associated site improvements described herein as well as to prepare any related construction documents. The conclusions and recommendations contained in this report are based on site conditions as they presently exist and assume that the explorations are representative of the subsurface conditions between the explorations and/or across the study area. The data, analyses, and recommendations herein may not be appropriate for other structures and/or purposes. We recommend that parties contemplating other structures and/or purposes contact our office. In the absence of our written approval, we make no representation and assume no responsibility to other parties regarding this report. Additionally, the above recommendations are contingent on Redmond Geotechnical Services, LLC being retained to provide all site inspections and construction monitoring services associated with all earthwork and foundation preparation for the project. Redmond Geotechnical Services, LLC will not assume any responsibility and/or liability for any engineering judgment, inspection and/or testing services performed by others.

It is the owners/developers responsibility for insuring that the project designers and/or contractors involved with this project implement our recommendations into the final design plans, specifications and/or construction activities for the project. Further, in order to avoid delays during construction, we recommend that the final design plans and specifications for the project be reviewed by our office to evaluate as to whether our recommendations have been properly interpreted and incorporated into the project.

If during any future site grading and construction, subsurface conditions different from those encountered in the explorations are observed or appear to be present beneath excavations, we should be advised immediately so that we may review these conditions and evaluate whether modifications of the design criteria are required. We also should be advised if significant modifications of the proposed site development are anticipated so that we may review our conclusions and recommendations.

LEVEL OF CARE

The services performed by the Geotechnical Engineer for this project have been conducted with that level of care and skill ordinarily exercised by members of the profession currently practicing in the area under similar budget and time restraints. No warranty or other conditions, either expressed or implied, is made.

ADDITIONAL SERVICES

We recommend that we be retained to review the proposed site grading and development plan(s) for the project in order to evaluate as to whether our recommendations presented herein have been properly interpreted and incorporated into the design of the project as well as to assess whether the proposed site grading and earthwork for the proposed commercial and/or mixed use project will adversely affect the stability of the moderately sloping westerly portion of the site. Additionally, we recommend that we be retained to review the building and foundation plans for the proposed new commercial and/or mixed use structures to evaluate whether the proposed site grading and earthwork operations have adequately prepared the grade for support of the building foundations and/or whether other supplemental design and/or construction recommendations are required.

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Appendix A

Test Pit Logs and Laboratory Test Data

APPENDIX

FIELD EXPLORATIONS AND LABORATORY TESTING

FIELD EXPLORATION

Subsurface conditions at the site were explored by excavating fourteen (14) exploratory test pits on November 11, 2014. The approximate location of the test pit explorations are shown in relation to the existing site topographic features and/or site improvements on the Site Exploration Map, Figure No. 2.

The test pits were excavated using track-mounted excavating equipment in general conformance with ASTM Methods in Vol. 4.08, D-1586-94 and D-1587-83. The test pits were excavated to depths ranging from about 5.0 to 7.0 feet beneath existing site grades. Detailed logs of the test pits are presented on the Log of Test Pits, Figure No's. A-5 through A-11. The soils were classified in accordance with the Unified Soil Classification System (USCS), which is outlined on Figure No. A-4.

The exploration program was coordinated by a field engineer who monitored the excavating and exploration activity, obtained representative samples of the subsurface soils encountered, classified the soils by visual and textural examination, and maintained continuous logs of the subsurface conditions. Disturbed and/or undisturbed samples of the subsurface soils were obtained at appropriate depths and/or intervals and placed in plastic bags and/or with a thin walled ring sample.

Groundwater was encountered across the easterly portion of the site within several of the exploratory test pits at the time of excavating to depths of between two (2) and four (4) feet beneath existing site grades.

LABORATORY TESTING

Pertinent physical and engineering characteristics of the soils encountered during our subsurface investigation were evaluated by a laboratory testing program to be used as a basis for selection of soil design parameters and for correlation purposes. Selected tests were conducted on representative soil samples. The program consisted of tests to evaluate the existing (in-situ) moisture-density, maximum dry density and optimum moisture content, gradational characteristics, and Atterberg Limits tests as well as direct shear strength, consolidation and "R"value testing.

Dry Density and Moisture Content Determinations

Density and moisture content determinations were performed on both disturbed and relatively undisturbed samples from the test pit explorations in general conformance with ASTM Vol. 4.08 Part D-216. The results of these tests were used to calculate existing overburden pressures and to correlate strength and compressibility characteristics of the soils. Test results are shown on the test pit logs at the appropriate sample depths.

Maximum Dry Density

Two (2) Maximum Dry Density and Optimum Moisture Content tests were performed on representative samples of the on-site clayey, sandy silt and clayey silt subgrade soils in accordance with ASTM Vol. 4.08 Part D-1557. The tests were conducted to help establish various engineering properties for use as structural fill. The test results are presented on Figure No. A-12.

Expansion Index

One Expansion Index (EI) test was performed on a remolded sample of the near surface clayey subgrade soils in accordance with ASTM Vol. 4.08 Part D-4829-95. The test results were used to help identify potentially expansive soils. The test results appear on Figure No. A-12.

Atterberg Limits

Liquid Limit (LL) and Plastic Limit (PL) tests were performed on representative samples of the clayey, sandy silt subgrade soils in accordance with ASTM Vol. 4.08 Part D-4318-85. These tests were conducted to facilitate classification of the soils and for correlation purposes. Test results appear on Figure No. A-13.

Gradation Analysis

Gradation analyses were performed on representative samples of the subsurface soils in accordance with ASTM Vol. 4.08 Part D-422. The test results were used to classify the soil in accordance with the Unified Soil Classification System (USCS). The test results are shown graphically on Figure No's. A-14 and A-15.

Direct Shear Strength Test

Two (2) Direct Shear Strength tests were performed on remolded samples at a continuous rate of shearing deflection (0.02 inches per minute) in accordance with ASTM Vol. 4.09 Part D-3080-79. The test results were used to determine engineering strength properties and are shown graphically on Figure No's. A-16 and A-17.

Consolidation Test

One (1) Consolidation test was performed on an undisturbed soil sample to help assess the compressibility characteristics of the near surface sandy silt suibgrade soils in general conformance with ASTM Vol. 4.09 Part D-2435-96.

Conventional loading increments of 100, 200, 400, ... 12,800 psf were applied after the 100 percent time of primary consolidation was identified for each loading increment. The sample was unloaded and allowed to rebound after completion of the loading sequence. Deflection versus time readings were recorded for all load increments from 100 through 12,800 psf.

The deflection corresponding to 100 percent primary consolidation was plotted on the consolidation strain versus consolidation pressure curve, which is presented on Figure No. A-18.

"R"-Value Test

Two (2) "R"-value tests were performed on remolded subgrade soil samples in accordance with ASTM Vol. 4.08 Part D-2844. The test results were used to help evaluate the subgrade soils supporting and performance capabilities when subjected to traffic loading. The test results are shown graphically on Figure No. A-19.

The following figures are attached and complete the Appendix:

Figure No. A-4	Key to Exploratory Test Pit Logs
Figure No's. A-5 through A-11	Log of Test Pits
Figure No. A-12	Maximum Dry Density Test Results
Figure No. A-12	Expansion Index Test Results
Figure No. A-13	Atterberg Limits Test Results
Figure No's. A-14 and A-15	Gradation Test Results
Figure No's. A-16 and A-17	Direct Shear Strength Test Results
Figure No. A-18	Consolidation Test Results
Figure No. A-19	"R"value Test Results

PRIMARY DIVISIONS			GROUP SYMBOL	SECONDARY DIVISIONS
COARSE GRAINED SOILS — MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVELS — MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LESS THAN 5% FINES)	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GRAVEL WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
	SANDS — MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LESS THAN 5% FINES)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS — MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS — LIQUID LIMIT IS LESS THAN 50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS — LIQUID LIMIT IS GREATER THAN 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils.

DEFINITION OF TERMS

U.S. STANDARD SERIES SIEVE: 200, 40, 10, 4 — CLEAR SQUARE SIEVE OPENINGS: 3/4", 3", 12"

SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

GRAIN SIZES

SANDS, GRAVELS AND NON-PLASTIC SILTS	BLOWS/FOOT†
VERY LOOSE	0 - 4
LOOSE	4 - 10
MEDIUM DENSE	10 - 30
DENSE	30 - 50
VERY DENSE	OVER 50

RELATIVE DENSITY

CLAYS AND PLASTIC SILTS	STRENGTH‡	BLOWS/FOOT†
VERY SOFT	0 - 1/4	0 - 2
SOFT	1/4 - 1/2	2 - 4
FIRM	1/2 - 1	4 - 8
STIFF	1 - 2	8 - 16
VERY STIFF	2 - 4	16 - 32
HARD	OVER 4	OVER 32

CONSISTENCY

†Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1-3/8 inch I.D.) split spoon (ASTM D-1586).
‡Unconfined compressive strength in tons/sq. ft. as determined by laboratory testing or approximated by the standard penetration test (ASTM D-1586), pocket penetrometer, torvane, or visual observation.

REDMOND GEOTECHNICAL SERVICES
PO Box 20547 • PORTLAND, OREGON 97294

KEY TO EXPLORATORY TEST PIT LOGS
Unified Soil Classification System (ASTM D-2487)

3290 BOONE ROAD SE
Salem, Oregon

PROJECT NO.	DATE	Figure A-4
1004.017.G	12/11/14	

BACKHOE COMPANY: Gene S. McMurrin BUCKET SIZE: 24 inches DATE: 11/11/14

TEST PIT NO. TP-#1 **ELEVATION** 232'±

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
	X			22.4	ML	Dark brown, wet to saturated, soft, organic, clayey, sandy SILT to silty SAND with occasional gravels (Topsoil)
5	X			17.8	ML/ SM	Medium to gray-brown, very moist to wet, medium stiff to medium densem clayey, sandy SILT to silty fine SAND with occasional gravels
					SM/ Gm	Gray-brown, wet to saturated, medium dense to dense, silty, gravelly SAND to sandy GRAVEL to cobble size
10						Total Depth = 5.0 feet Groundwater encountered at a depth of 4.0 feet at time of exploration
15						

TEST PIT NO. TP-#2 **ELEVATION** 232'±

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
					ML	Dark brown, wet to saturated, soft, organic, clayey, sandy SILT to silty SAND with occasional gravels (Topsoil)
5					ML/ SM	Medium to gray-brown, very moist to wet, medium stiff to medium dense, clayey, sandy SILT to silty fine SAND with occasional gravels
					ML/ CL	Light gray-brown, wet, soft, sandy, clayey SILT to silty CLAY
					SM/ GM	Gray-brown, wet to saturated, medium dense to dense, silty, gravelly SAND to sandy GRAVEL to cobble size
10						Total Depth = 5.0 feet Groundwater encountered at a depth of 3.5 feet at time of exploration
15						

LOG OF TEST PITS

PROJECT NO. 1004.017.G | 3290 BOONE ROAD SE | FIGURE NO. A-5

REDMOND GEOTECHNICAL SERVICES

BACKHOE COMPANY: Gene S. McMurrin BUCKET SIZE: 24 inches DATE: 11/11/14

SOIL DESCRIPTION

TEST PIT NO. TP-#3 ELEVATION 234'±

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
	X			29.9	ML	Dark brown, wet to saturated, soft, organic, clayey, sandy SILT to silty SAND with occasional gravels (Topsoil)
	X			23.4	ML/ CL	Light gray-brown with orange mottling, wet, soft, sandy, clayey SILT to silty CLAY
5					ML/ SM	Medium brown with gray-mottling, wet, medium stiff to medium dense, clayey, sandy SILT to silty fine SAND with occasional gravels
10					SM/ GM	Gray-brown, wet to saturated, medium dense to dense, silty, gravelly SAND to sandy GRAVEL to cobble size
15						Total Depth = 6.0 feet Groundwater encountered at a depth of 4.0 feet at time of exploration

TEST PIT NO. TP-#4 ELEVATION 234'±

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
					ML	Dark brown, very moist to wet, soft, organic, clayey, sandy SILT to silty SAND with occasional gravels (Topsoil)
5					ML/ SM	Medium to gray-brown, very moist to wet, medium stiff to medium dense, clayey, sandy SILT to silty fine SAND with occasional gravels
					SM/ GM	Gray-brown, very moist to wet, medium dense to dense, silty, gravelly SAND to sandy GRAVEL to cobble size
10						Total Depth = 5.0 feet Groundwater encountered at a depth of 5.0 feet at time of exploration
15						

LOG OF TEST PITS

PROJECT NO. 1004.017.G | 3290 BOONE ROAD SE | FIGURE NO. A-6

REDMOND GEOTECHNICAL SERVICES

BACKHOE COMPANY: Gene S. McMurrin | BUCKET SIZE: 24 inches | DATE: 11/11/14

SOIL DESCRIPTION

TEST PIT NO. TP-#5 ELEVATION 236'±

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
					ML	Dark brown, very moist to wet, soft, organic, clayey, sandy SILT to silty SAND with occasional gravels (Topsoil)
5					ML/ SM	Medium to gray-brown, very moist to wet, medium stiff to medium dense, clayey, sandy SILT to silty fine SAND with occasional gravels
					SM/ GM	Gray-brown, very moist to wet, medium dense to dense, silty, gravelly SAND to sandy GRAVEL to cobble size
10						Total Depth = 5.0 feet Groundwater e3ncountered at a depth of 4.0 feet at time of exploration
15						

TEST PIT NO. TP-#6 ELEVATION 238'±

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
					ML	Dark brown, very moist to wet, soft, organic, clayey, sandy SILT to silty SAND with occasional gravels (Topsoil)
	X			21.7		
5					ML/ SM	Medium to gray-brown, very moist to wet, medium stiff to medium dense, clayey, sandy SILT to silty fine SAND with occasional gravels
					SM/ GM	Gray-brown, very moist to wet, medium dense to dense, silty, gravelly SAND to sandy GRAVEL to cobble size
10						Total Depth = 6.0 feet No groundwater encountered at time of exploration
15						

LOG OF TEST PITS

PROJECT NO. 1004.017.G | 3290 BOONE ROAD SE | FIGURE NO. A-7

REDMOND GEOTECHNICAL SERVICES

BACKHOE COMPANY: Gene S. McMurrin BUCKET SIZE: 24 inches DATE: 11/11/14

SOIL DESCRIPTION

TEST PIT NO. TP-#7 ELEVATION 242'±

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
	X			24.5	ML	Dark brown, very moist to wet, soft, organic, clayey, sandy SILT to silty SAND with occasional gravels (Topsoil)
5	X			20.8	ML/SM	Medium to gray-brown, very moist to wet, medium stiff to medium dense, clayey, sandy SILT to silty fine SAND with occasional gravels
					SM/GM	Gray-brown, very moist, medium dense to dense, silty, gravelly SAND to sandy GRAVEL to cobble size
10						Total Depth = 7.0 feet Mo groundwater encountered at time of exploration
15						

TEST PIT NO. TP-#8 ELEVATION 238'±

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
					ML	Dark brown, very moist to wet, soft, organic, clayey, sandy SILT to silty SAND with occasional gravels (Topsoil)
5					ML/SM	Dark gray-brown, wet to saturated, medium stiff to loose, clayey, sandy SILT to silty fine SAND with occasional gravel
					ML	Gray-brown, wet to saturated, medium stiff to stiff, clayey, sandy SILT
10						Total Depth = 5.0 feet Groundwater encountered at a depth of 2.0 feet at time of exploration
15						

LOG OF TEST PITS

PROJECT NO. 1004.017.G | 3290 BOONE ROAD SE | FIGURE NO. A-8

REDMOND GEOTECHNICAL SERVICES

BACKHOE COMPANY: Gene S. McMurrin BUCKET SIZE: 24 inches DATE: 11/11/14

TEST PIT NO. TP-#9 **ELEVATION** 234'±

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
					ML	Dark brown, wet to saturated, soft, organic, sandy, clayey SILT (Topsoil)
	X			35.5	CL/ML	Gray to light gray, wet, soft, slightly sandy, silty CLAY to clayey SILT
5					ML/Sm	Medium to gray-brown with orangish-mottling, wet, medium stiff, clayey, sandy SILT to silty fine SAND
					SM/GM	Gray-brown, wet to saturated, medium dense, silty, gravelly SAND to sandy GRAVEL to cobble size
10						Total Depth = 6.0 feet Groundwater encountered at a depth of 5.0 feet at time of exploration
15						

TEST PIT NO. TP-#10 **ELEVATION** 270'±

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
					ML	Dark brown, very moist to wet, soft, organic, clayey, sandy SILT (TOPSOIL)
	X			26.6	ML	Medium to reddish-brown, very moist, medium stiff to stiff, sandy, clayey SILT
5	X			28.4		Becomes stiff to very stiff highly weathered bedrock at 4 to 5 feet
						Total Depth = 6.0 feet No groundwater encountered at time of exploration
10						
15						

LOG OF TEST PITS

PROJECT NO. 1004.017.G | 3290 BOONE ROAD SE | FIGURE NO. A-9

REDMOND GEOTECHNICAL SERVICES

BACKHOE COMPANY: Gene S. McMurrin BUCKET SIZE: 24 inches DATE: 11/11/14

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION TEST PIT NO. TP_#11 ELEVATION 274'±
					ML	Dark brown, very moist, soft, organic, sandy, clayey SILT (Topsoil)
5					ML	Medium to reddish-brown, very moist, medium stiff to stiff, sandy, clayey SILT Becomes stiff to very stiff highly weathered bedrock at 5 to 6 feet
10						Total Depth = 7.0 feet No groundwater encountered at time of exploration
15						

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	TEST PIT NO. TP-#12 ELEVATION 290'±
					ML	Dark brown, very moist, soft, organic, sandy, clayey SILT (Topsoil)
5					ML	Medium to reddish-brown, very moist, medium stiff to stiff, sandy, clayey SILT Becomes stiff to very stiff highly weathered bedrock at 5 to 6 feet
10						Total Depth = 6.5 feet No groundwater encountered at time of exploration
15						

LOG OF TEST PITS

PROJECT NO. 1004.017.G | 3290 BOONE ROAD SE | FIGURE NO. A-10

REDMOND GEOTECHNICAL SERVICES

BACKHOE COMPANY: Gene S. McMurrin BUCKET SIZE: 24 inches DATE: 11/11/14

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION — TEST PIT NO. TP-#13 ELEVATION 328'±
					ML	Dark brown, very moist, soft, organic, sandy, clayey SILT (Topsoil)
					ML	Medium to reddish-brown, very moist, medium stiff to stiff, sandy, clayey SILT
5						Becomes stiff to very stiff highly weathered bedrock at 5 to 6 feet
						Total Depth = 6.0 feet No groundwater encountered at time of exploration
10						
15						

TEST PIT NO. TP-#14 ELEVATION 308'±

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
					ML	Dark brown, very moist to wet, soft, organic, sandy, clayey SILT (Topsoil)
					ML	Medium to reddish-brown, very moist, medium stiff to stiff, sandy, clayey SILT
5						Becomes stiff to very stiff highly weathered bedrock at 5 to 6 feet
						Total Depth = 6.0 feet No groundwater encountered at time of exploration
10						
15						

LOG OF TEST PITS

PROJECT NO. 1004.017.G | 3290 BOONE ROAD SE | FIGURE NO. A-11

REDMOND GEOTECHNICAL SERVICES

MAXIMUM DENSITY TEST RESULTS

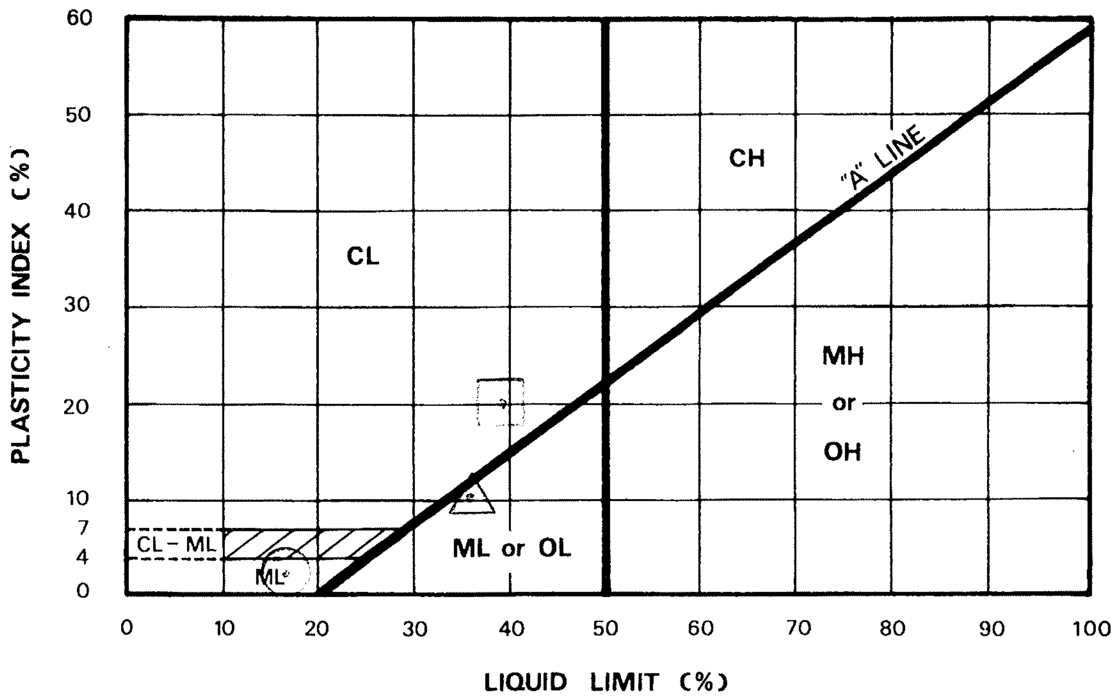
SAMPLE LOCATION	SOIL DESCRIPTION	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
TP-#1 @ 2.0'	Medium to gray-brown, clayey, sandy SILT to silty SAND (ML/SM)	104.0	16.0
TP-#10 @ 2.0'	Medium to reddish-brown, sandy, clayey SILT (ML)	98.0	24.0

EXPANSION INDEX TEST RESULTS

SAMPLE LOCATION	INITIAL MOISTURE (%)	COMPACTED DRY DENSITY (pcf)	FINAL MOISTURE (%)	VOLUMETRIC SWELL (%)	EXPANSION INDEX	EXPANSIVE CLASS.
TP-#9	35.5	80.0	34.0	0.048	48.0	Low

MAXIMUM DENSITY & EXPANSION INDEX TEST RESULTS

PROJECT NO.: 1004.017.G | 3290 BOONE ROAD SE | FIGURE NO.: A-12



KEY SYMBOL	BORING NO.	SAMPLE DEPTH (feet)	NATURAL WATER CONTENT %	LIQUID LIMIT %	PLASTICITY INDEX %	PASSING NO. 200 SIEVE %	LIQUIDITY INDEX	UNIFIED SOIL CLASSIFICATION SYMBOL
○	TP-#1	2.0	22.4	17.7	3.3	81.8		ML
□	TP-#9	2.5	35.5	39.2	20.1	95.9		CL
△	TP-#10	2.0	26.6	35.2	10.2	87.3		ML

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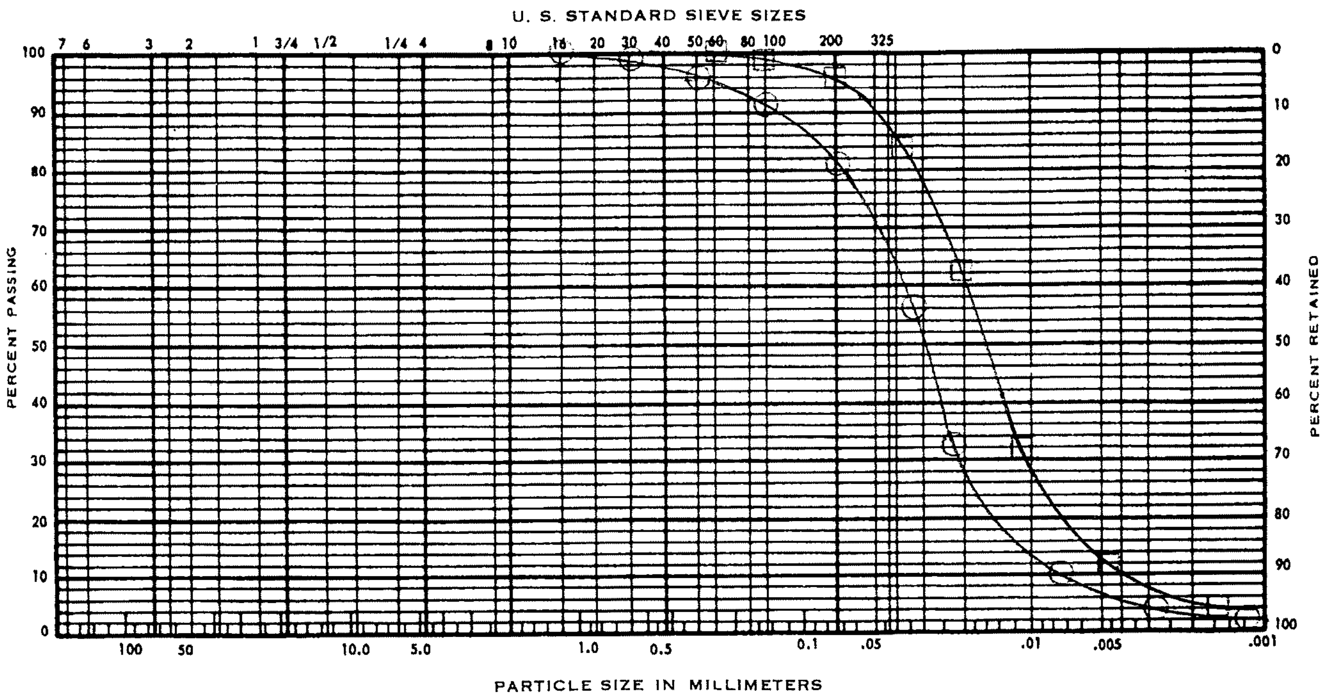
PLASTICITY CHART AND DATA

3290 BOONE ROAD SE
Salem, Oregon

PROJECT NO.	DATE	
1004.017.G	12/11/14	Figure A-13

UNIFIED SOIL CLASSIFICATION SYSTEM

(ASTM D 422-72)



COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

KEY SYMBOL	BORING NO.	SAMPLE DEPTH (feet)	ELEV. (feet)	UNIFIED SOIL CLASSIFICATION SYMBOL	SAMPLE DESCRIPTION
-○-	TP-#1	2.0		ML	Medium to gray-brown, clayey, sandy SILT
-□-	TP-#9	2.5		CL	Gray to light gray, slightly sandy, silty CLAY

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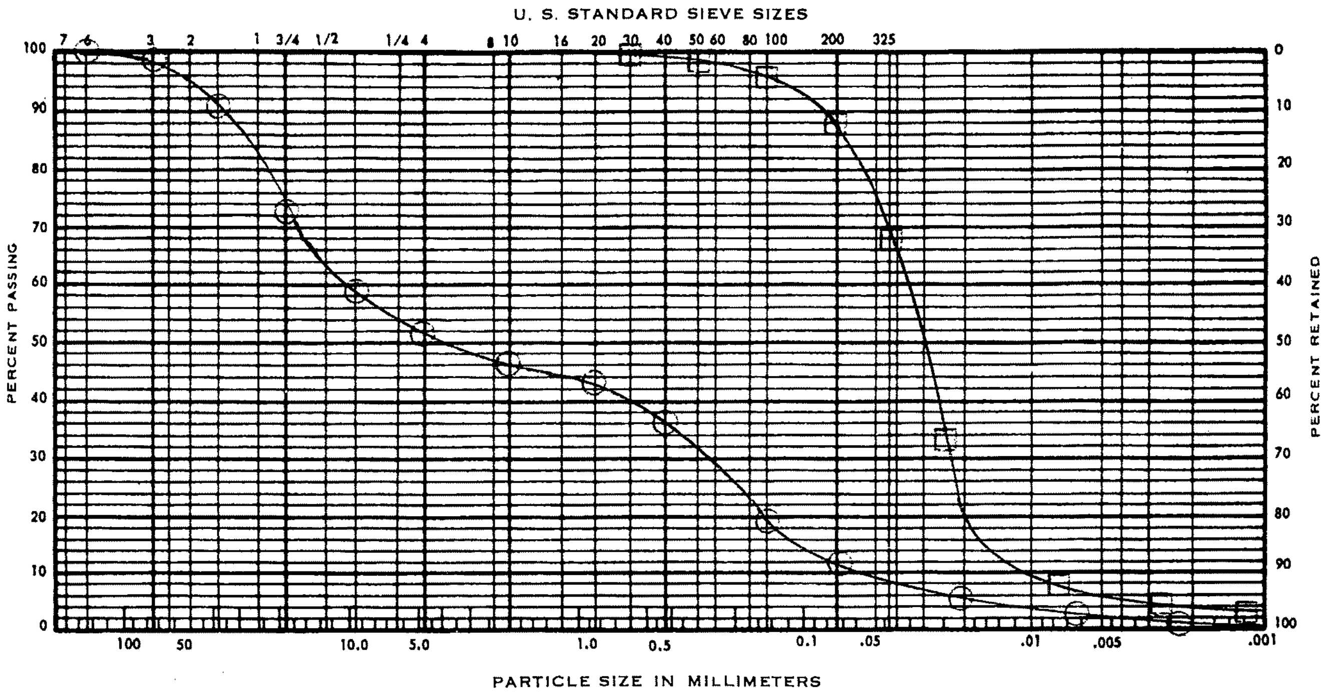
GRADATION TEST DATA		
3290 BOONE ROAD SE Salem, Oregon		
PROJECT NO.	DATE	FIGURE A-14
1004.017.G	12/11/14	

UNIFIED SOIL CLASSIFICATION SYSTEM

(ASTM D 422-72)



COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

KEY SYMBOL	BORING NO.	SAMPLE DEPTH (feet)	ELEV. (feet)	UNIFIED SOIL CLASSIFICATION SYMBOL	SAMPLE DESCRIPTION
□	TP-#10	2.0		ML	Medium to reddish-brown, sandy, clayey SILT
○	TP-#1	4.0		SM/GM	Gray-brown, silty, gravelly SAND to sandy GRAVEL

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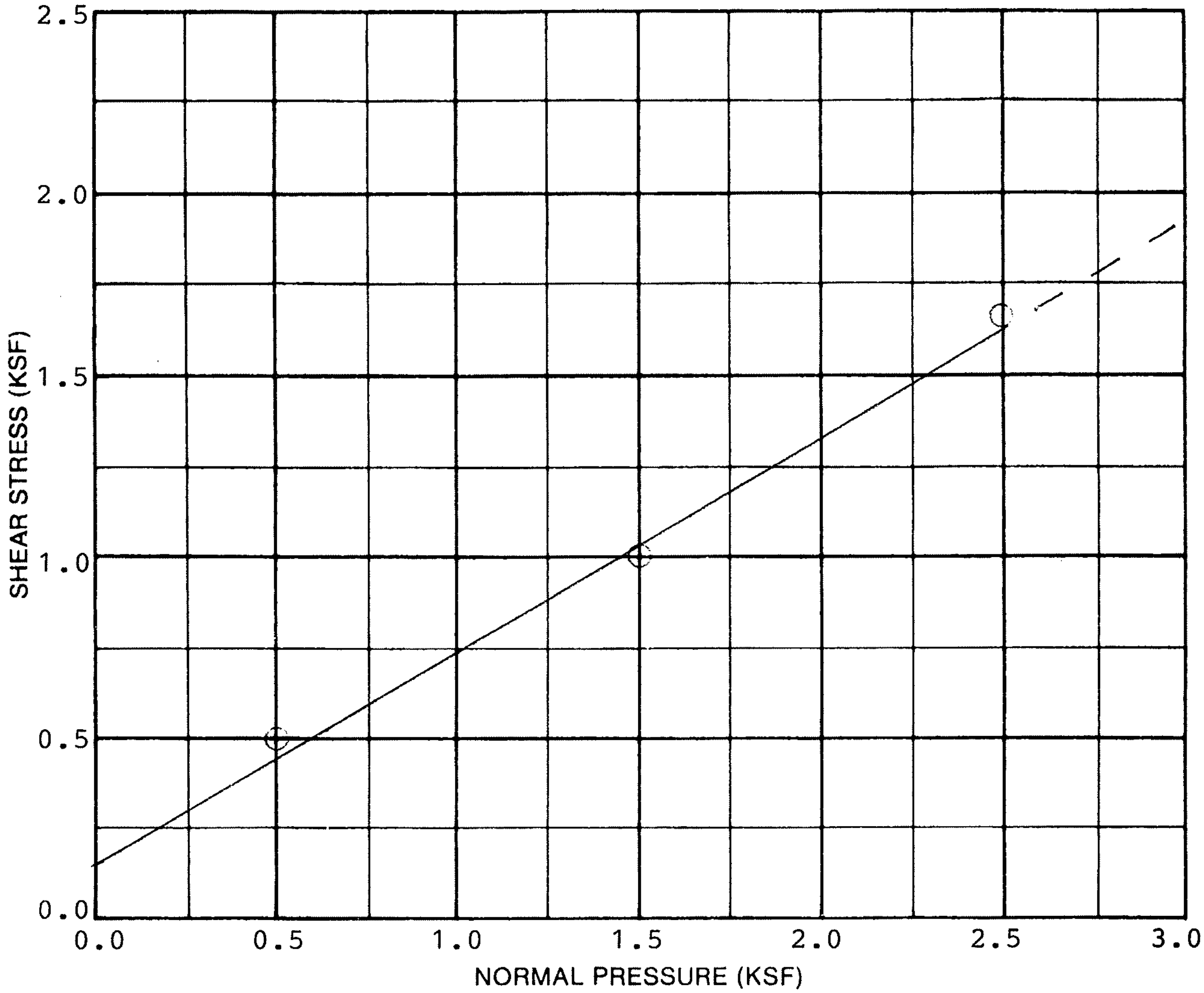
GRADATION TEST DATA

3290 BOONE ROAD SE
Salem, Oregon

PROJECT NO.	DATE	FIGURE
1004.017.G	12/11/14	A-15



SAMPLE DATA	
DESCRIPTION:	Medium to gray-brown, clayey, sandy SILT (ML)
BORING NO.:	TP-#1
DEPTH (ft.): 2.0	ELEVATION (ft):

TEST RESULTS	
APPARENT COHESION (C):	150 psf
APPARENT ANGLE OF INTERNAL FRICTION (ϕ):	30°

TEST DATA				
TEST NUMBER	1	2	3	4
NORMAL PRESSURE (KSF)	0.5	1.5	2.5	
SHEAR STRENGTH (KSF)	0.5	1.0	1.6	
INITIAL H_2O CONTENT (%)	16.0	16.0	16.0	
FINAL H_2O CONTENT (%)	15.8	12.2	8.9	
INITIAL DRY DENSITY (PCF)	93.0	93.0	93.0	
FINAL DRY DENSITY (PCF)	93.6	95.7	99.2	
STRAIN RATE: 0.02 inches per minute				

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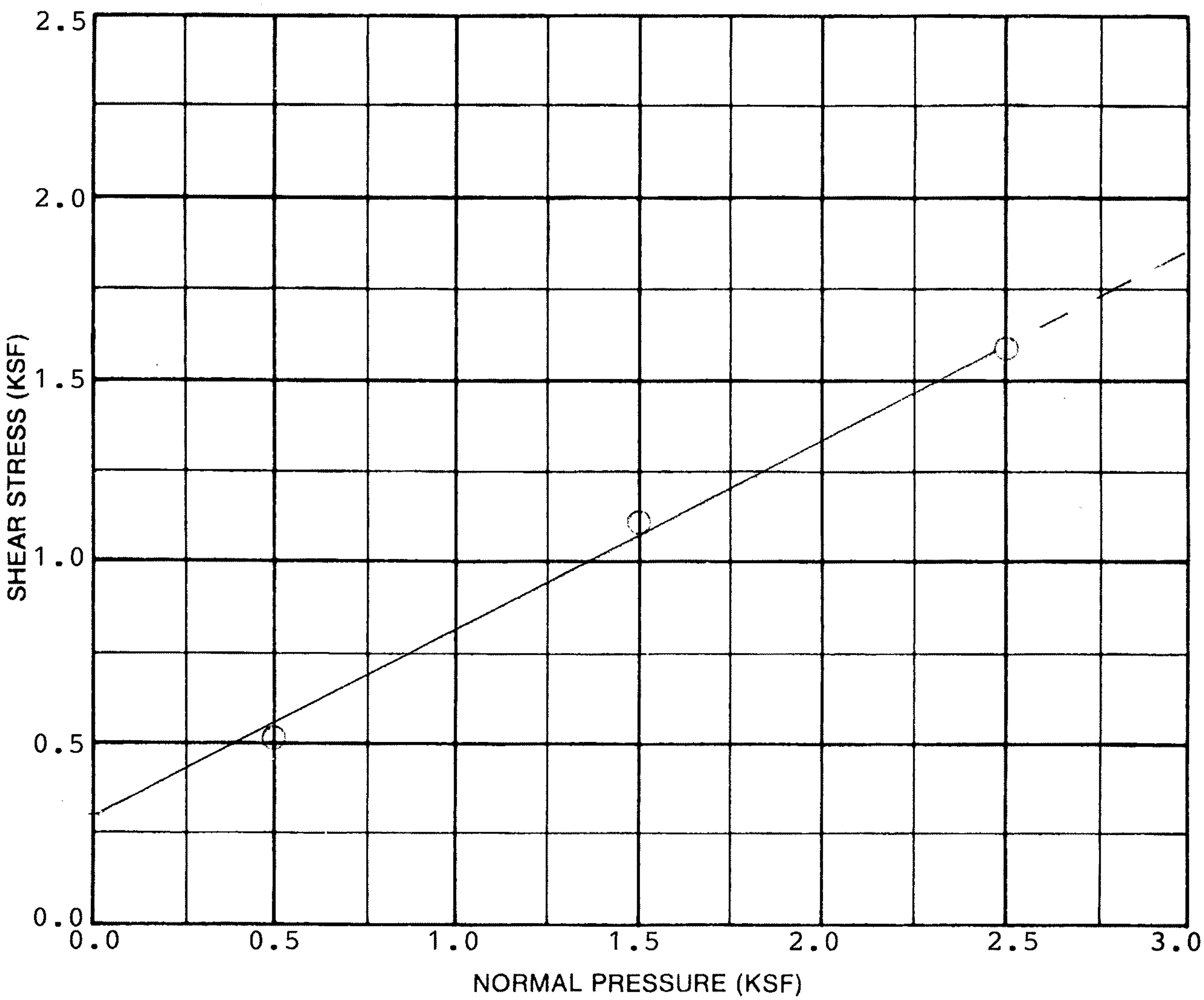
DIRECT SHEAR TEST DATA

3290 BOONE ROAD SE
Salem, Oregon

PROJECT NO.	DATE	Figure A-16
1004.017.G	12/11/14	



SAMPLE DATA	
DESCRIPTION:	Medium to reddish-brown sandy, clayey SILT (ML)
BORING NO.:	TP-#10
DEPTH (ft.): 2.0	ELEVATION (ft):

TEST RESULTS	
APPARENT COHESION (C):	300 psf
APPARENT ANGLE OF INTERNAL FRICTION (ϕ):	26°

TEST DATA				
TEST NUMBER	1	2	3	4
NORMAL PRESSURE (KSF)	0.5	1.5	2.5	
SHEAR STRENGTH (KSF)	0.5	1.1	1.6	
INITIAL H_2O CONTENT (%)	24.0	24.0	24.0	
FINAL H_2O CONTENT (%)	24.4	21.1	16.9	
INITIAL DRY DENSITY (PCF)	85.0	85.0	85.0	
FINAL DRY DENSITY (PCF)	85.4	97.9	91.1	
STRAIN RATE: 0.02 inches per minute				

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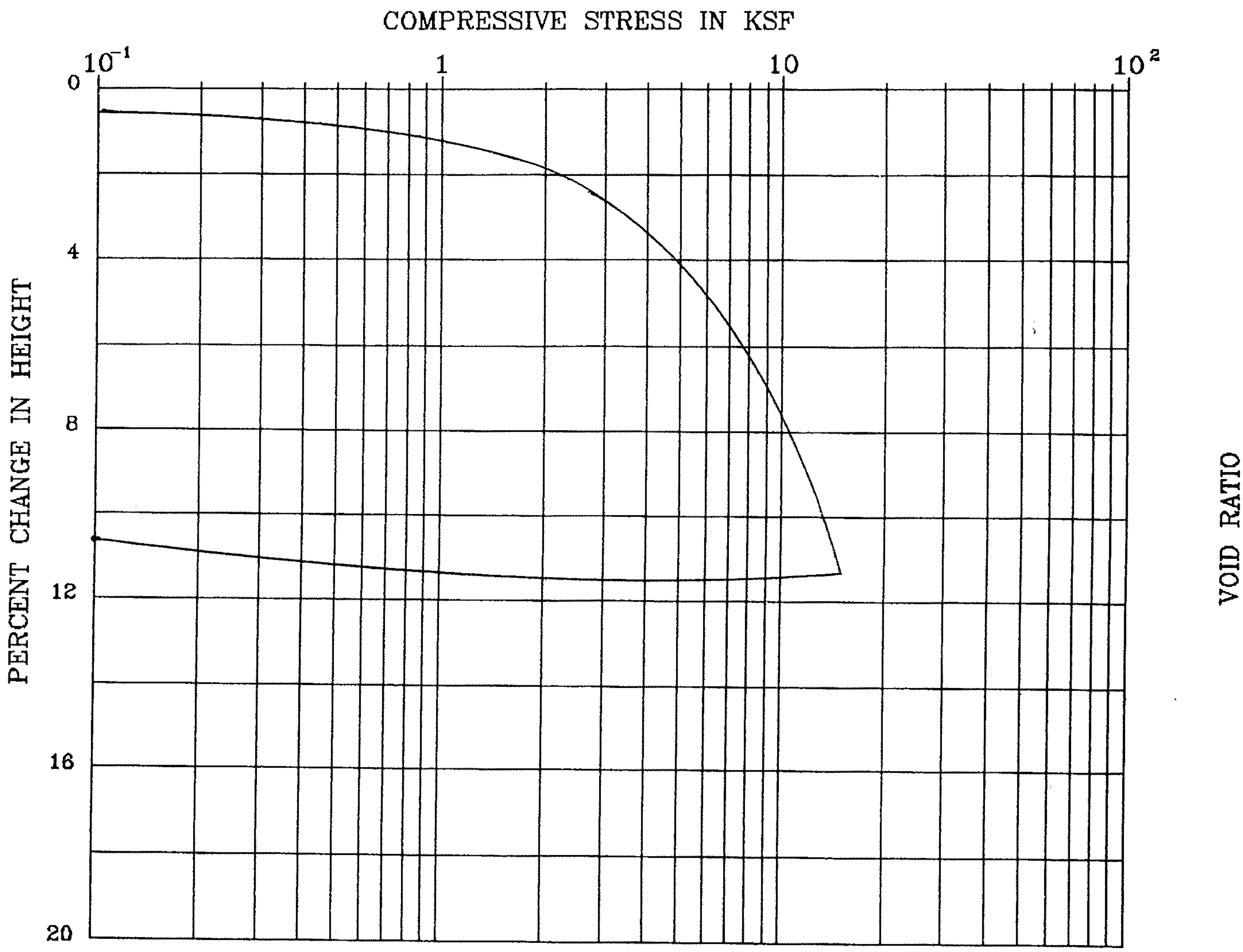
DIRECT SHEAR TEST DATA

3290 BOONE ROAD SE
Salem, Oregon

PROJECT NO.	DATE	
1004.017.G	12/11/14	Figure A-17



BORING : TP-#1
DEPTH (ft) : 2.0
SPEC. GRAVITY : 2.5 (assumed)

DESCRIPTION : clayey, sandy SILT (ML)
LIQUID LIMIT : 17.7
PLASTIC LIMIT : 14.4

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	22.2	91.1	88,4	
FINAL	14.4	97.6	95.7	

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CONSOLIDATION TEST DATA

3290 BOONE ROAD SE
Salem, Oregon

PROJECT NO.	DATE	
1004.017.G	12/11/14	Figure A-18

RESULTS OF R (RESISTANCE) VALUE TESTS

SAMPLE LOCATION: TP-#1

SAMPLE DEPTH: 2.0 feet bgs

Specimen	A	B	C
Exudation Pressure (psi)	213	326	441
Expansion Dial (o.ooo1")	0	1	2
Expansion Pressure (psf)	0	3	8
Moisture Content (%)	20.3	17.5	14.4
Dry Density (pcf)	91.9	93.6	96.7
Resistance Value, "R"	13	24	32
"R"-Value at 300 psi Exudation Pressure = 28			

SAMPLE LOCATION: TP-#10

SAMPLE DEPTH: 2.0 feet bgs

Specimen	A	B	C
Exudation Pressure (psi)	202	316	423
Expansion Dial (0.0001")	2	7	12
Expansion Pressure (psf)	7	24	41
Moisture Content (%)	31.1	26.9	23.6
Dry Density (pcf)	86.2	89.8	92.5
Resistance Value "R"	11	22	31
"R"-Value at 300 psi Exudation Pressure = 24			