GeoPacific Engineering, Inc.

Real-World Geotechnical Solutions
Investigation • Design • Construction Support

Preliminary Geotechnical Engineering Report

The Cove Garden Apartments
Oregon City, Oregon

GeoPacific Engineering, Inc. Job No. 15-3719
May 12, 2015

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May 12, 2015
Project No. 15-3719

Mr. Paul Herskowitz
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SUBJECT: Preliminary Geotechnical Engineering Report
The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

PROJECT INFORMATION

This report presents the results of a geotechnical engineering study conducted by GeoPacific Engineering, Inc. (GeoPacific) for the above-referenced project. The purpose of our investigation was to evaluate subsurface conditions at the site, and to provide preliminary geotechnical recommendations for site development. This geotechnical study was performed in accordance with GeoPacific Proposal No. P-5168, dated March 27, 2015, and your subsequent authorization of our proposal and *General Conditions for Geotechnical Services*.

Location:	Tax Parcel 05022763 Located due west of the intersection of Main Street and S Agnes Avenue Oregon City, Oregon 97045 (see Figures 1 and 2)
Property Owner:	Grand Peak Properties 4582 S Ulster Street, Ste. 1200 Denver, Colorado 80237 Phone: (720) 889-9209
Civil Engineer:	Cardno 5415 SW Westgate Drive, Ste. 100 Portland, Oregon 97221 Phone: (503) 419-2500
Jurisdictional Agency:	City of Oregon City, Oregon
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SITE AND PROJECT DESCRIPTION

As indicated on Figures 1 through 3, the subject site is located west of the intersection of Main Street and S Agnes Avenue in Oregon City, Oregon. The site is comprised of tax parcel 05022763 totaling approximately 11.46-acres, and is irregular in shape. The site is bordered by Main Street to the north and east, by the Oregon City Shopping Plaza to the west, and by Interstate 205 to the south. Clackamette Cove is located to the north of the site, opposite Main Street. The site is dominated by irregular, uneven terrain with site elevations ranging from approximately 35 feet to 55 feet above mean sea level (amsl). The site is located within the FEMA 100 year flood plain and was most recently inundated with flood waters during 1996. The approximate site latitude and longitude are N 45° 22' 07" and W 122° 35' 48", and the legal description is a portion of the SW ¼ of Section 9, T2S, R2E, Willamette Meridian. The regulatory jurisdictional agency is the City of Oregon City, Oregon.

Historically the site has was utilized for agricultural purposes until the 1950's. During the 1950's the site was utilized for aggregate mining by Pit Rock Products, which resulted in the excavation and creation of Clackamette Cove. The site is located at the southern end of the modern day limit of Clackamette Cove, however it appears that mining operations once extended to the approximate southern boundary of the site. From the 1960's to approximately 2007 a concrete production company operated at the site. Historical land use operations since the 1950's resulted in extensive topographic changes to the site which included the apparent removal of 30 to 50 feet of existing soil and rock, followed by infill with various soils, debris, and extensive concrete placement. Currently the site contains extensive undocumented fill including areas of gravel stockpiles, buried debris, asphalt, metal, and plastic. In addition, the majority of the site is surfaced with concrete which includes remnant building foundations, random concrete clean out piles, concrete surfaced drive areas, and piles of large concrete blocks. Two ponds are present at the site which were observed to be lined with concrete and filled with water during our site visit. One pond is located in the northern portion of the site and appears to have been used as a settling pond. The other pond is located in the east-central portion of the site and appears to have been used as a wheel wash for concrete trucks. Both ponds were observed to be filled with large, rectangular, concrete blocks. A drainage ravine is located along the western margin of the site which appears to flow north to the Clackamette Cove. Undocumented fill was observed to be present in the bottom of the drainage swale.

Several monitoring wells were installed in 2009 following closing of the concrete plant. Review of available well logs from the site indicate that concrete rubble and infill is present to depths of approximately 20 feet in the lower elevation portions of the site.

GeoPacific understands that final development planning for the site has not been completed at this time. However based upon review of preliminary site plans, and communication with the client, the civil engineer, and the architect, we understand that proposed development at the subject site will consist of site grading to achieve elevations above the FEMA 100 year flood plain elevation, and construction of 12, three to four-story apartment buildings, garages, parking and drive areas, and associated underground utility improvements. We understand that a proposed final grading elevation of approximately 52 feet amsl has been proposed, which will result in up to 17 feet of engineered fill placement at the site. We understand that in addition to utilization of onsite fill materials, import of several thousand yards of fill material will be obtained from soil stockpiles located to the northeast of the site. Prior to engineered fill placement, extensive demolition, concrete crushing, and unsuitable fill excavation will be conducted.

REGIONAL GEOLOGIC SETTING

Regionally, the subject site lies within the Willamette Valley/Puget Sound lowland, a broad structural depression situated between the Coast Range on the west and the Cascade Range on the east. A series of discontinuous faults subdivide the Willamette Valley into a mosaic of fault-bounded, structural blocks (Yeats et al., 1996). Uplifted structural blocks form bedrock highlands, while down-warped structural blocks form sedimentary basins.

According to the *Generalized Geologic Map of the Willamette Lowland, (U.S. Department of the Interior, U.S. Geological Survey, Marshal W. Gannett and Rodney R. Caldwell, 1998)* the site is underlain by upper-Pleistocene-aged, rhythmically bedded, fine-grained periglacial, silt and sand deposits derived from catastrophic outburst floods of Glacial Lake Missoula (Qs).

The Web Soil Survey (United States Department of Agriculture, Natural Resource Conservation Service (USDA NRCS 2015 Website), indicates that near-surface soils primarily consist of Urban Land Development. The designation of Urban Land Development soils indicate that the native soil conditions have been altered.

REGIONAL SEISMIC SETTING

At least four major fault zones capable of generating damaging earthquakes are thought to exist in the vicinity of the subject site. These include the Portland Hills Fault Zone, the Lacamas Creek/Sandy River Fault Zone, the Gales Creek-Newberg-Mt. Angel Structural Zone, and the Cascadia Subduction Zone.

Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that include the central Portland Hills Fault, the western Oatfield Fault, and the eastern East Bank Fault. These faults occur in a northwest-trending zone that varies in width between 3 and 5 miles. The combined three faults reportedly vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years) sediment (Madin, 1990). The Portland Hills Fault occurs along the Willamette River at the base of the Portland Hills, and is located approximately 1.7 miles northeast of the site. The Oatfield Fault occurs along the western side of the Portland Hills, and is located approximately 1 mile northeast of the site. The East Bank Fault occurs along the eastern margin of the Willamette River, and is located approximately 6.2 miles northeast of the site. The accuracy of the fault mapping is stated to be within 500 meters (Wong, et al., 2000).

According to the USGS Earthquake Hazards Program, the fault was originally mapped as a down-to-the-northeast normal fault, but has also been mapped as part of a regional-scale zone of right-lateral, oblique slip faults, and as a steep escarpment caused by asymmetrical folding above a south-west dipping, blind thrust fault. The Portland Hills fault offsets Miocene Columbia River Basalts, and Miocene to Pliocene sedimentary rocks of the Troutdale Formation. No fault scarps on surficial Quaternary deposits have been described along the fault trace, and the fault is mapped as buried by the Pleistocene aged Missoula flood deposits. No historical seismicity is correlated with the mapped portion of the Portland Hills Fault Zone, but in 1991 a M3.5 earthquake occurred on a NW-trending shear plane located 1.3 miles east of the fault (Yelin, 1992). Although there is no definitive evidence of recent activity, the Portland Hills Fault Zone is assumed to be potentially active (Geomatrix Consultants, 1995).

Lacamas Creek / Sandy River Fault Zone

The northwest trending Lacamas Creek Fault intersects the northeast trending Sandy River Fault north of Camas, Washington at Lacamas Lake, approximately 18 miles northeast of the subject site. According to the USGS Earthquake Hazards Program the fault has been mapped as a normal fault with down-to-the-southwest displacement, and has also been described as a steeply northeast or southwest-dipping, oblique, right-lateral, slip-fault. The trace of the Lacamas Lake fault is marked by the very linear lower reach of Lacamas Creek. No fault scarps on Quaternary surficial deposits have been described. The Lacamas Lake fault offsets Pliocene-aged sedimentary conglomerates generally identified as the Troutdale formation, and Pliocene to Pleistocene aged basalts generally identified as the Boring Lava formation. Recent seismic reflection data across the probable trace of the fault under the Columbia River yielded no unequivocal evidence of displacement underlying the Missoula flood deposits, however, recorded mild seismic activity during the recent past indicates this area may be potentially seismogenic.

Gales Creek-Newberg-Mt. Angel Structural Zone

The Gales Creek-Newberg-Mt. Angel Structural Zone is a 50-mile-long zone of discontinuous, NW-trending faults that lies about 19 miles southwest of the subject site. These faults are recognized in the subsurface by vertical separation of the Columbia River Basalt and offset seismic reflectors in the overlying basin sediment (Yeats et al., 1996; Werner et al., 1992). A geologic reconnaissance and photogeologic analysis study conducted for the Scoggins Dam site in the Tualatin Basin revealed no evidence of deformed geomorphic surfaces along the structural zone (Unruh et al., 1994). No seismicity has been recorded on the Gales Creek Fault or Newberg Fault (the fault closest to the subject site); however, these faults are considered to be potentially active because they may connect with the seismically active Mount Angel Fault and the rupture plane of the 1993 M5.6 Scotts Mills earthquake (Werner et al. 1992; Geomatrix Consultants, 1995).

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

Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year (Goldfinger et al., 1996). A growing body of geologic evidence suggests that prehistoric subduction zone earthquakes have occurred (Atwater, 1992; Carver, 1992; Peterson et al., 1993; Geomatrix Consultants, 1995). This evidence includes: (1) buried tidal marshes recording episodic, sudden subsidence along the coast of northern California, Oregon, and Washington, (2) burial of subsided tidal marshes by tsunami wave deposits, (3) paleoliquefaction features, and (4) geodetic uplift patterns on the Oregon coast. Radiocarbon dates on buried tidal marshes indicate a recurrence interval for major subduction zone earthquakes of 250 to 650 years with the last event occurring 300 years ago (Atwater, 1992; Carver, 1992; Peterson et al., 1993; Geomatrix Consultants, 1995). The inferred seismogenic portion of the plate interface lies approximately along the Oregon Coast at depths of between 20 and 40 kilometers below the surface.

FIELD EXPLORATION AND SUBSURFACE CONDITIONS

Our site-specific explorations for this report were conducted on April 17, 2015. A total of eighteen exploratory test pits (TP-1 through TP-18) were excavated at the site to a maximum depth of 15 feet below ground surface (bgs) using a rubber-tired excavator subcontracted by GeoPacific. In addition to the test pit explorations, GeoPacific reviewed available well logs from monitoring wells installed across the site during 2009. The approximate locations of the explorations are indicated on Figure 2. It should be noted that exploration locations were located in the field by pacing or taping distances from apparent property corners and other site features shown on the plans provided. As such, the locations of the explorations should be considered approximate. During the explorations, GeoPacific observed and recorded pertinent soil information such as color, stratigraphy, strength, and soil moisture content. Soils were classified in general accordance with the Unified Soil Classification System (USCS). At the completion of each test, the test pits were backfilled loosely with onsite soil. Soil conditions were found to be highly variable across the site. Extensive areas of undocumented fill are present, with highly variable conditions. Soil and groundwater conditions encountered in the explorations are summarized below.

Soil

Undocumented Fill: Undocumented fill was encountered in all subsurface explorations conducted at the site to beyond the depths explored. Fill soils were observed to consist of highly variable soil types which included Sandy SILT, Sand and Gravel, processed Sand and Gravel, Clayey Gravel with Sand, concrete, asphalt, metal, plastic, woody debris, and bricks. Much of the site is surfaced with concrete, particularly in the north and central portions. Concrete is present at locations of remnant building foundations, in areas where the concrete batch plant disposed of large quantities of apparent reject batch material, and apparent drive areas. The presence of concrete fill prohibited subsurface exploration with an excavator in much of the northern and central portions of the site, and limited the depths of exploration in adjacent areas. Photographic logs are attached in the appendix of the report. Figure 3 presents a generalized delineation showing similar types of undocumented fill present at the site, and geotechnical concerns associated with each type, based upon our site observations, review of historical aerial photography, and subsurface soils encountered during site investigation. The boundaries of soil types indicated on the map should be considered approximate.

In general the northern and central portions of the site are surfaced with concrete. Based upon review of historical aerial photography the concrete batch plant primarily operated in these portions of the site.

The west and southern margins of the site contained fine-grained fill soils consisting of silt and sandy silt, and contained various quantities of debris and trash. Based upon review of historical aerial photography, it appears that much of the fine grained soils were placed during operation of the concrete batch plant as many large concrete fragments and buried concrete slabs were encountered within these soils. These soils were observed to contain concrete, asphalt, bricks, metal debris, woody debris, paper, fabric, and basaltic boulders. The fine-grained soils varied greatly in soil strength from soft/loose, to stiff/dense. These soils will likely present poor foundational support for structures, roads, and underground utilities, and should be considered susceptible to static settlement.

The southern and eastern portion of the site contains areas which appeared to be remnant crushed aggregate stockpiles. The crushed aggregate was observed to generally consist of ¾”-0 to 1½-0 sand and gravel mixtures. In many locations, such as the southern portion of the site, the gravels were observed to be dense to very dense, and caused refusal of excavation. Based upon review of historical aerial photos it appears that some of the stockpiles were placed prior to the operation of the concrete plant, however, extensive earth movement from the concrete batch plant included placement of fill in the area (see historical aerial photograph from 1963).

Soils laboratory testing was conducted upon soil samples obtained from test pits TP-4, TP-5, and TP-9.

Soils tested from a depth of 5 feet at the location of test pit TP-4 indicated that soils consist of Silty SAND with Gravel. Sieve analysis indicated approximately 14.3 percent by weight passing the No. 200 sieve, and an in-situ moisture content of 7.5 percent. Atterberg testing indicated the soil type is non-plastic. The soil type classified as SM, Silty SAND with GRAVEL according to USCS specifications, and A-1(a) according to AASHTO specifications.

Soils tested from a depth of 6 feet at the location of test pit TP-5 indicated that soils consist of Clayey GRAVEL with Sand. Sieve analysis indicated approximately 44.1 percent by weight passing the No. 200 sieve, and an in-situ moisture content of 22.3 percent. Atterberg testing indicated a liquid limit of 41 and a plasticity index of 22. The soil type classified as GC, Clayey GRAVEL with Sand according to USCS specifications, and A-7-6(5) according to AASHTO specifications.

Soils tested from a depth of 12 feet at the location of test pit TP-9 indicated that soils consist of Clayey GRAVEL with Sand. Sieve analysis indicated approximately 46.7 percent by weight passing the No. 200 sieve, and an in-situ moisture content of 19.8 percent. Atterberg testing indicated a liquid limit of 47 and a plasticity index of 21. The soil type classified as GC, Clayey GRAVEL with Sand according to USCS specifications, and A-7-6(7) according to AASHTO specifications.

Groundwater and Soil Moisture

On April 17, 2015, observed soil moisture conditions were generally moist to very moist. Groundwater was not encountered within our test pit explorations. According to our review of available well logs, groundwater is commonly encountered at depths of approximately 35 feet bgs in the vicinity of the subject site. According to the *Estimated Depth to Groundwater in the Portland, Oregon Area, (United States Geological Survey, Snyder, 2015 website)*, groundwater is expected to be present at an approximate depth of 10 feet below the ground surface. It is anticipated that groundwater conditions will vary depending on the season, local subsurface conditions, changes in site utilization, and other factors. Perched groundwater may be encountered in localized areas. Seeps and springs may exist in areas not explored, and may become evident during site grading. Piezometer installation and long-term monitoring, which is beyond the scope of this investigation, would be needed to provide additional groundwater information.

HISTORICAL AERIAL PHOTOGRAPHY REVIEW

GeoPacific conducted a review of historical aerial photography of the site obtained from the Army Corp. of Engineers, and Google Earth. Photographs were reviewed from 1936, 1944, 1955, 1963, 1972, 1980, 1996, 2001, 2007, and 2010. A brief summary of our observations is provided below.

1936 to 1955

The site was primarily used for agricultural purposes.

1955 to 1960's

The site was mined for sand and gravel resulting in excavation across the site, potentially to depths of 30 to 40 feet below the original ground surface. During this time period several stockpiles were moved around at the site. The mining operations created Clackamette Cove located north of the site.

1963

A concrete batch plant is present at the site and several aggregate piles are present across the site. The batch plant equipment is primarily located at the northern portion of the site. The drainage swale currently located along the western site boundary is not present. The southern portion of the site is quite different than today and consists of aggregate stockpiles and a fill berm along the southern boundary of the site. The Oregon City Shopping Plaza is present adjacent to the west of the site. Main Street has not yet been constructed along the sites northern boundary, and a haul road is present extending from the Clackamette Cove area into the site at the northwestern property corner.

1972

The concrete batch plant is in operation at the site and the stockpiles have been dramatically shifted as opposed to 1963. The current highest elevation areas in the southern portion of the site which were observed to contain fine-grained fill soils with debris appear, although not quite as extensive as the current topography. Construction of I-205 is underway in the photograph and haul roads from the construction zone are present at the southern site boundary extending into the site across the fill. It is possible that the fine grained fill soils present in the southern portion of the site today were placed during construction of I-205. Additional concrete equipment is present at the site.

1980

The concrete batch plant is in operation at the site and the stockpiles in the southern portion of the site have increased in size, more closely resembling the topography existing today. Several concrete trucks are visible. Main Street has been constructed to its present day location. Construction of I-205 is complete. The northeastern portion of the site appears to contain a conveyor belt and is in the location where extensive layering of random concrete pours was observed during our site investigation. It is likely that the area was used as a disposal location for test batches and reject batches of concrete.

1996

The aerial photography from 1996 was taken during a 100-year flood event in February. The photograph shows the entire site underwater, with some of the concrete batch plant equipment can be seen extending out of the water. It is our understanding that the high water level at the site reached an approximate elevation of 50 feet amsl during the flood event.

2001

The concrete batch plant is still in operation. The southern portion of the site where fine-grained fill soils and remnant crushed aggregate stockpiles were encountered was being used as a parking area. The drive entrances into the batch plant are in the locations we observed during our site investigation. The pond in the northern portion of the site is present.

2007

The concrete batch plant appears to be in operation. The drainage swale along the western margin of the site appears. A roadway appears along the western margin of the site adjacent to the drainage swale. The parking areas in the southern portion of the site have been expanded. The batch plant configuration appears to be relatively unchanged.

2010

The concrete batch plant is gone from the site. The site appears to resemble its current condition.

CONCLUSIONS AND RECOMMENDATIONS

Our site investigation indicates that the proposed construction is geotechnically feasible, provided that the recommendations of this report are incorporated into the design and construction phases of the project. The primary geotechnical concern associated with development at the subject site is the presence of large quantities of highly variable undocumented fill at the site. Removal of some undocumented fill at the site should be conducted to depths necessary to limit potential settlement of engineered fill and structures. Undocumented fill was observed to extend to greater depths than our test pit explorations, and as a result, the subsurface stratum across the site is not thoroughly understood at this time. Several additional subsurface explorations consisting of deep soils borings are recommended for the site in order to gain a better understanding of the extent, and depth of the undocumented fill soils. The installation of settlement plates during site grading and placement of engineered fill may be required.

Initial Site Preparation Recommendations

Areas of proposed construction and areas to receive fill should be cleared of vegetation and unsuitable undocumented fill soils. Due to the complexity of the site conditions, and the limits of our initial subsurface investigation, at this time the ultimate depth of removal of undocumented fill soils which will be required prior to placement of engineered fill and structures cannot fully be determined. In order to gain a better understanding of the magnitude of the removal of unsuitable fill soils which will ultimately be required at the site, we recommend that an initial phase of site demolition be conducted based upon the information currently available. A period of demolition and bulk removal of undocumented fill soils will allow soil boring drill rigs to more easily penetrate portions of the site which are surfaced with concrete rubble that limited excavation of test pits, and expose subsurface layers which are not currently visible.

During the initial demolition phase, grading operations should either remove areas of undocumented fill which are clearly unsuitable, or avoid them for structures. Figure 3 presents a generalized map of the types of fill materials encountered at the site during our preliminary subsurface investigation. The extent and boundaries of the types of fill soils indicated on the map should be considered approximate.

Portions of the site where fine-grained soils containing debris are present should be excavated to depths necessary to remove the soils. These materials were found to be soft and highly variable. These soils will likely present poor foundational support for structures, roads, and underground utilities, and should be considered susceptible to static settlement. Test pits conducted within these areas extended to a maximum depth of 15 feet bgs and were terminated in undocumented fill soils. Based upon review of well logs from the monitoring wells installed at the site, we anticipate that the fill soils may be present on the order of 20 feet thick or greater. Soils removed from these areas may be suitable for use as engineered fill provided that deleterious materials, debris, and highly organic soils are removed from the fill. The final extent of removal, and suitability for re-use as engineered fill of this soil type should be determined in the field during construction by the geotechnical engineer or designated representative.

As indicated on Figure 3, the site contains areas of apparent remnant sand and gravel stockpiles. The gravels were observed to vary in density and gradation. As indicated on the attached test pit logs, some of the sand and gravel fill soils were observed to be very dense and caused refusal of exploration. Uncertainty exists as to the subsurface conditions below the depths explored. Additional subsurface exploration is recommended in the areas proposed for structures. It is possible that some of the sand and gravel deposits may remain in place, particularly in areas where proposed fill depths are greater than 10 feet. In areas where less than 10 feet of fill has been proposed, soils may need to be excavated and the areas re-graded. The final extent of removal of this soil type should be determined in the field during bulk demolition and following additional subsurface exploration. It appeared that this soil type will largely be suitable for re-use as engineered fill.

The north, east, and central portions of the site contain remnant building foundations and extensive layers of randomly poured concrete debris. It is our understanding that a concrete crusher will be utilized during site grading and that the recycled concrete will be used as engineered fill. We recommend that large excavators be utilized to remove the precast concrete debris in as much of the site as is feasible, thereby exposing as much of the underlying soil layers as possible. There may be portions of the site where it is feasible to leave some of the concrete in place, particularly areas where proposed fill depths are greater than 10 feet. The low elevation central portions of the site are surfaced with concrete that consisted of remnant building slabs and apparent drive areas. During our site investigation, excavation was not possible in these areas, however it appears that some of the area may be suitable placement of engineered fill. Based upon review of preliminary grading plans, it is our understanding that up to 15 feet of fill is planned in the noted areas. In order to determine whether or not the existing concrete is suitable for engineered fill placement, GeoPacific should conduct additional soil borings in the area to determine if voids or other unsuitable soil types are present which may be susceptible to settlement. In addition, settlement plates may be installed at the base elevation prior to engineered fill placement, and monitored for settlement for a period determined suitable by the geotechnical engineer.

In general, in areas where structures have been proposed, greater depths of removal of unsuitable fill soils will need to be conducted. Additional subsurface exploration should be conducted in areas proposed for structures. In areas proposed for drive and parking areas, it may be feasible to limit over-excavation.

Inorganic debris and organic materials from clearing should be removed from the site. Organic-rich soils and root zones should then be stripped from construction areas of the site or where engineered fill is to be placed.

The final depth of soil removal will be determined on the basis of further subsurface explorations and site inspections during and after the excavation. Stripped topsoil should be removed from the site. Any remaining topsoil should be stockpiled only in designated areas and stripping operations should be observed and documented by the geotechnical engineer or his representative.

Engineered Fill

All grading for the proposed construction should be performed as engineered grading in accordance with the applicable building code at the time of construction with the exceptions and additions noted herein. Areas proposed for fill placement should be prepared as described in the site preparation section. Surface soils should then be scarified and recompacted prior to placement of structural fill. Proper test frequency and earthwork documentation usually requires daily observation and testing during stripping, rough grading, and placement of engineered fill. Imported fill material must be approved by the geotechnical engineer prior to being imported to the site. Oversize material greater than 6 inches in size should not be used within 3 feet of foundation footings, and material greater than 12 inches in diameter should not be used in engineered fill.

Engineered fill should be compacted in horizontal lifts not exceeding 8 inches using standard compaction equipment. We recommend that engineered fill be compacted to at least 90 percent of the maximum dry density determined by ASTM D1557 (Modified Proctor) or equivalent. Field density testing should conform to ASTM D2922 and D3017, or D1556. All engineered fill should be observed and tested by the project geotechnical engineer or his representative. Typically, one density test is performed for at least every 2 vertical feet of fill placed or every 500 yd^3, whichever requires more testing. Because testing is performed on an on-call basis, we recommend that the earthwork contractor be held contractually responsible for test scheduling and frequency. Site earthwork will be impacted by soil moisture and shallow groundwater conditions.

Excavating Conditions and Utility Trench Backfill

We anticipate that excavation of on-site soils will require heavy equipment in many portions of the site. During our site investigation subsurface exploration with a medium sized, rubber-tired back-hoe was greatly limited due to the presence of concrete fill and dense sand and gravel mixtures. The fine grained soils encountered at the site will likely present poor foundational support for underground utilities, and should be considered susceptible to static settlement. If underground utilities are proposed to be located within the areas designated as zone 1 on the attached Figure 3, subgrade stabilization of the utility systems will be a concern and require additional measures.

Groundwater seepage was not encountered in our subsurface explorations. Maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the contractor. Actual slope inclinations at the time of construction should be determined based on safety requirements and actual soil and groundwater conditions. All temporary cuts in excess of 4 feet in height should be sloped in accordance with U.S. Occupational Safety and Health Administration (OSHA) regulations (29 CFR Part 1926), or be shored. The existing soils classify as Type C Soil and temporary excavation side slope inclinations as steep as 1.5H:1V may be assumed for planning purposes. This cut slope inclination is applicable to excavations above the water table only.

Shallow, perched groundwater may be encountered during the wet weather season and should be anticipated in excavations and utility trenches. Vibrations created by traffic and construction equipment may cause some caving and raveling of excavation walls. In such an event, lateral support for the excavation walls should be provided by the contractor to prevent loss of ground support and possible distress to existing or previously constructed structural improvements.

PVC pipe should be installed in accordance with the procedures specified in ASTM D2321 and Oregon City standards. We recommend that structural trench backfill be compacted to at least 95 percent of the maximum dry density obtained by the Standard Proctor (ASTM D698) or equivalent. Initial backfill lift thicknesses for a ¾”-0 crushed aggregate base may need to be as great as 4 feet to reduce the risk of flattening underlying flexible pipe. Subsequent lift thickness should not exceed 1 foot. If imported granular fill material is used, then the lifts for large vibrating plate-compaction equipment (e.g. hoe compactor attachments) may be up to 2 feet, provided that proper compaction is being achieved and each lift is tested. Use of large vibrating compaction equipment should be carefully monitored near existing structures and improvements due to the potential for vibration-induced damage.

Adequate density testing should be performed during construction to verify that the recommended relative compaction is achieved. Typically, at least one density test is taken for every 4 vertical feet of backfill on each 200-lineal-foot section of trench.

Erosion Control Considerations

During our field exploration program, we did not observe soil conditions that would be considered highly susceptible to erosion. In our opinion, the primary concern regarding erosion potential will occur during construction in areas that have been stripped of vegetation. Erosion at the site during construction can be minimized by implementing the project erosion control plan, which should include judicious use of straw waddles, fiber rolls, and silt fences. If used, these erosion control devices should remain in place throughout site preparation and construction.

Erosion and sedimentation of exposed soils can also be minimized by quickly re-vegetating exposed areas of soil, and by staging construction such that large areas of the project site are not denuded and exposed at the same time. Areas of exposed soil requiring immediate and/or temporary protection against exposure should be covered with either mulch or erosion control netting/blankets. Areas of exposed soil requiring permanent stabilization should be seeded with an approved grass seed mixture, or hydroseeded with an approved seed-mulch-fertilizer mixture.

Wet Weather Earthwork

Soils underlying the site may be moisture sensitive and may be difficult to handle or traverse with construction equipment during periods of wet weather. Earthwork is typically most economical when performed under dry weather conditions. Earthwork performed during the wet-weather season may require expensive measures such as cement treatment or imported granular material to compact areas where fill may be proposed to the recommended engineering specifications. If earthwork is to be performed or fill is to be placed in wet weather or under wet conditions when soil moisture content is difficult to control, the following recommendations should be incorporated into the contract specifications.

- Earthwork should be performed in small areas to minimize exposure to wet weather. Excavation or the removal of unsuitable soils should be followed promptly by the placement and compaction of clean engineered fill. The size and type of construction equipment used may have to be limited to prevent soil disturbance. Under some circumstances, it may be necessary to excavate soils with a backhoe to minimize subgrade disturbance caused by equipment traffic;
- The ground surface within the construction area should be graded to promote run-off of surface water and to prevent the ponding of water;
- Material used as engineered fill should consist of clean, granular soil containing less than 5 percent passing the No. 200 sieve. The fines should be non-plastic. Alternatively, cement treatment of on-site soils may be performed to facilitate wet weather placement;
- The ground surface within the construction area should be sealed by a smooth drum vibratory roller, or equivalent, and under no circumstances should be left uncompacted and exposed to moisture. Soils which become too wet for compaction should be removed and replaced with clean granular materials;

- Excavation and placement of fill should be observed by the geotechnical engineer to verify that all unsuitable materials are removed and suitable compaction and site drainage is achieved; and
- Geotextile silt fences, straw waddles, and fiber rolls should be strategically located to control erosion.

If cement or lime treatment is used to facilitate wet weather construction, GeoPacific should be contacted to provide additional recommendations and field monitoring.

Seismic Design

Structures should be designed to resist earthquake loading in accordance with the methodology described in the 2012 International Building Code (IBC) with applicable Oregon Structural Specialty Code (OSSC) revisions (current 2014). We recommend Site Class D be used for design per the OSSC, Table 1613.5.2 and as defined in ASCE 7, Chapter 20, Table 20.3-1. Design values determined for the site using the USGS (United States Geological Survey) *2012 Seismic Design Maps Summary Report* are summarized in Table 1.

Table 1 - Recommended Earthquake Ground Motion Parameters (USGS 2015)

Parameter	Value
Location (Lat, Long), degrees	45.3689, -122.5976
Probabilistic Ground Motion Values, 2% Probability of Exceedance in 50 yrs	
Peak Ground Acceleration	0.406 g
Short Period, S_s	0.938 g
1.0 Sec Period, S_1	0.404 g
Soil Factors for Site Class D:	
F_a	1.125
F_v	1.596
$SD_s = 2/3 \times F_a \times S_s$	0.703 g
$SD_1 = 2/3 \times F_v \times S_1$	0.430 g
Seismic Design Category	D

Soil Liquefaction and Dynamic Settlement

Soil liquefaction is a phenomenon wherein saturated soil deposits temporarily lose strength and behave as a liquid in response to earthquake shaking. Soil liquefaction generally occurs where loose, sands and granular soils are located below the water table. Observed on-site soils consist predominantly of dense sands and gravels, and concrete fill soils located above the water table.

The *Oregon Department of Geology and Mineral Industries (DOGAMI), Oregon HazVu: Statewide Geohazards Viewer* indicates that the subject site is located in an area considered to be at risk for very strong ground shaking during an earthquake, and high risk for liquefaction during a seismic event.

According to review of well logs installed in 2009, subsurface soils underlying the concrete rubble consist of sandy SILT, and Gravelly Cobbles. The well logs indicate that groundwater was observed underlying the site at a depth of approximately 35 feet bgs. In our opinion, the soil profile we observed at the site did not appear to be susceptible to a high risk liquefaction. Placement of

15 feet of engineered fill would further reduce the risk of liquefaction. Additional subsurface exploration would provide information which will allow us to identify potentially liquefiable soil layers underlying the site in greater detail.

UNCERTAINTIES AND LIMITATIONS

We have prepared this report for the owner and his/her consultants for use in design of this project only. The conclusions and interpretations presented in this report should not be construed as a warranty of the subsurface conditions. Experience has shown that soil and groundwater conditions can vary significantly over small distances. Inconsistent conditions can occur between explorations that may not be detected by a geotechnical study. If, during future site operations, subsurface conditions are encountered which vary appreciably from those described herein, GeoPacific should be notified for review of the recommendations of this report, and revision of such if necessary.

Within the limitations of scope, schedule and budget, GeoPacific executed these services in accordance with generally accepted professional principles and practices in the fields of geotechnical engineering and engineering geology at the time the report was prepared. No warranty, express or implied, is made. The scope of our work did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous or toxic substances in the soil, surface water, or groundwater at this site.

We appreciate this opportunity to be of service.

Sincerely,

GEOPACIFIC ENGINEERING, INC.

REGISTERED GEOLOGIST
OREGON
BENJAMIN L COOK
2245

EXP 12-31-15

Benjamin L. Cook, R.G.
Senior Geologist

REGISTERED PROFESSIONAL ENGINEER
14748PE
OREGON
JAN. 23, 1990
JAMES D. IMBRIE

EXPIRES: 06/30/2017

James D. Imbrie, G.E., C.E.G.
Principal Geotechnical Engineer

REFERENCES

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CHECKLIST OF RECOMMENDED GEOTECHNICAL TESTING AND OBSERVATION

Item No.	Procedure	Timing	By Whom	Done
1	Preconstruction meeting	Prior to beginning site work	Contractor, Developer, Civil and Geotechnical Engineers	
2	Fill removal from site or sorting and stockpiling	Prior to mass stripping	Soil Technician/ Geotechnical Engineer	
3	Stripping, aeration, and root-picking operations	During stripping	Soil Technician	
4	Compaction testing of engineered fill (95% of Standard Proctor)	During filling, tested every 2 vertical feet	Soil Technician	
5	Compaction testing of trench backfill (95% of Standard Proctor)	During backfilling, tested every 4 vertical feet for every 200 lineal feet	Soil Technician	
6	Street Subgrade Inspection	Prior to placing base course	Soil Technician	
7	Base course compaction (95% of Modified Proctor)	Prior to paving, tested every 200 lineal feet	Soil Technician	
8	Final Geotechnical Engineer's Report	Completion of project	Geotechnical Engineer	

FIGURES

GeoPacific Engineering, Inc.
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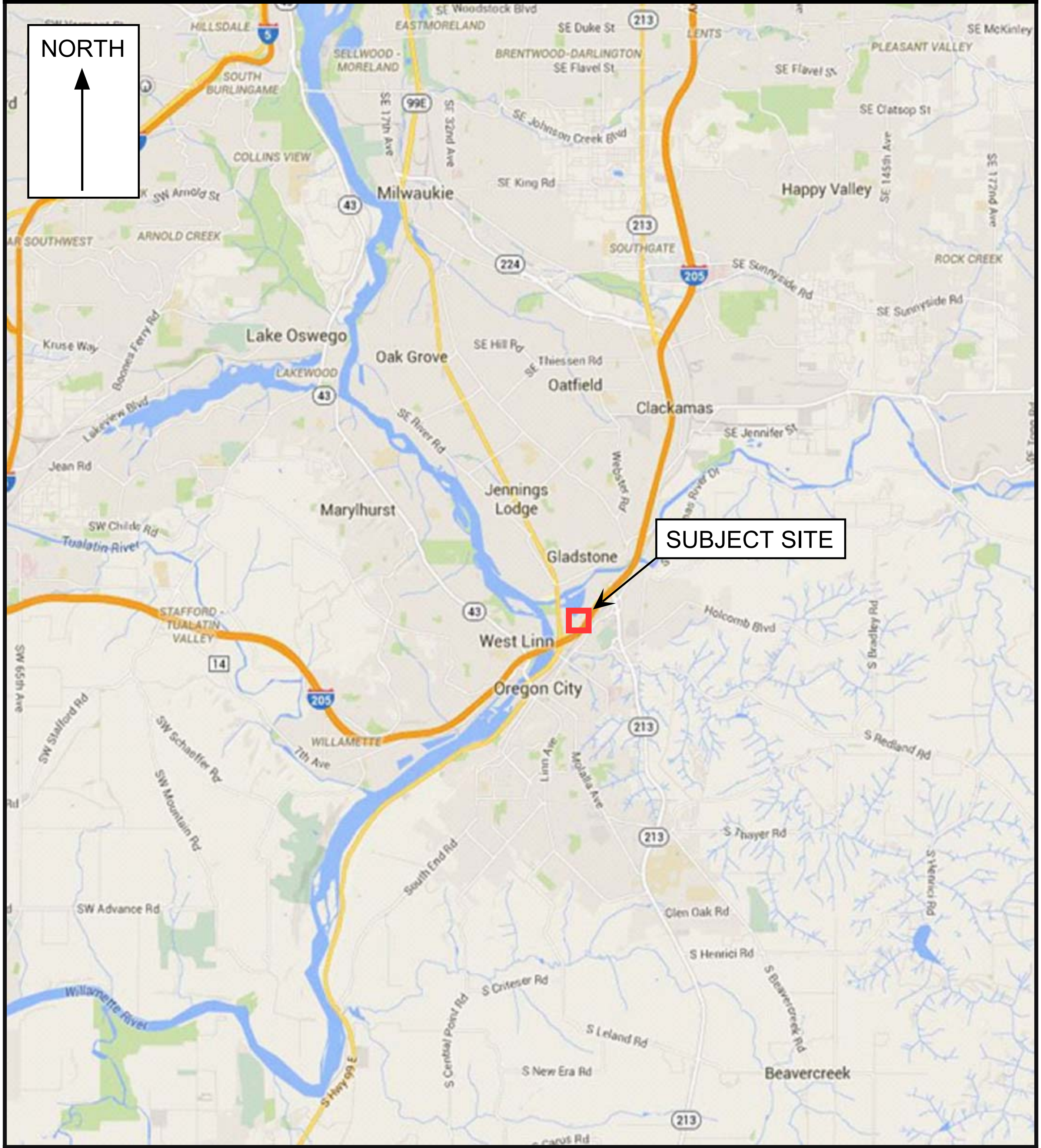
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

SITE VICINITY MAP



Base map: Google Maps, 2015

Date: 5/5/15
Drawn by: BLC

Project: The Cove Garden Apartments
Oregon City, Oregon

Project No. 15-3719

FIGURE 1

GeoPacific Engineering, Inc.

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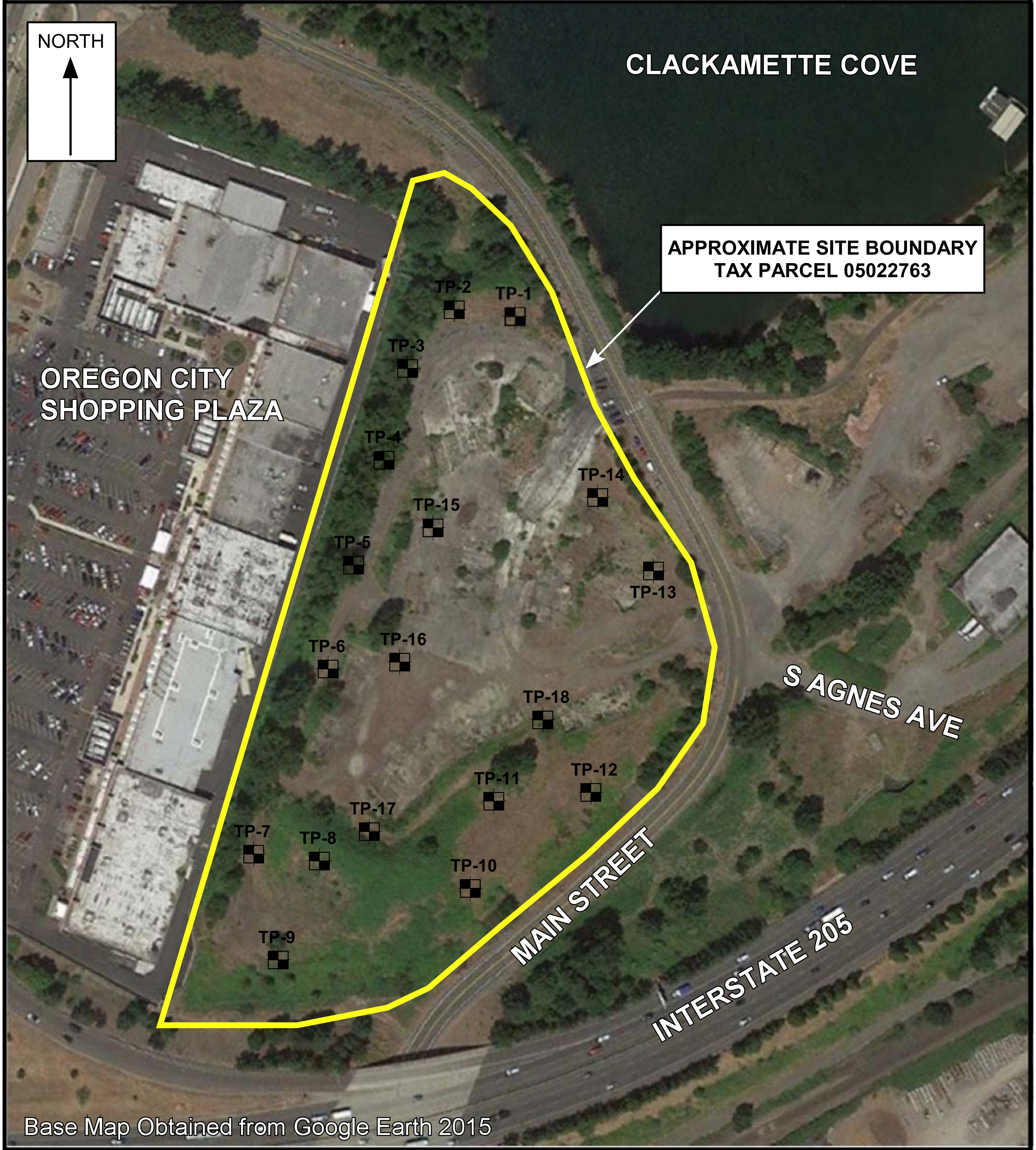
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

SITE AERIAL AND EXPLORATION LOCATIONS



Base Map Obtained from Google Earth 2015

Legend:

▚ **TP-1** Test Pit Designation and Approximate Location

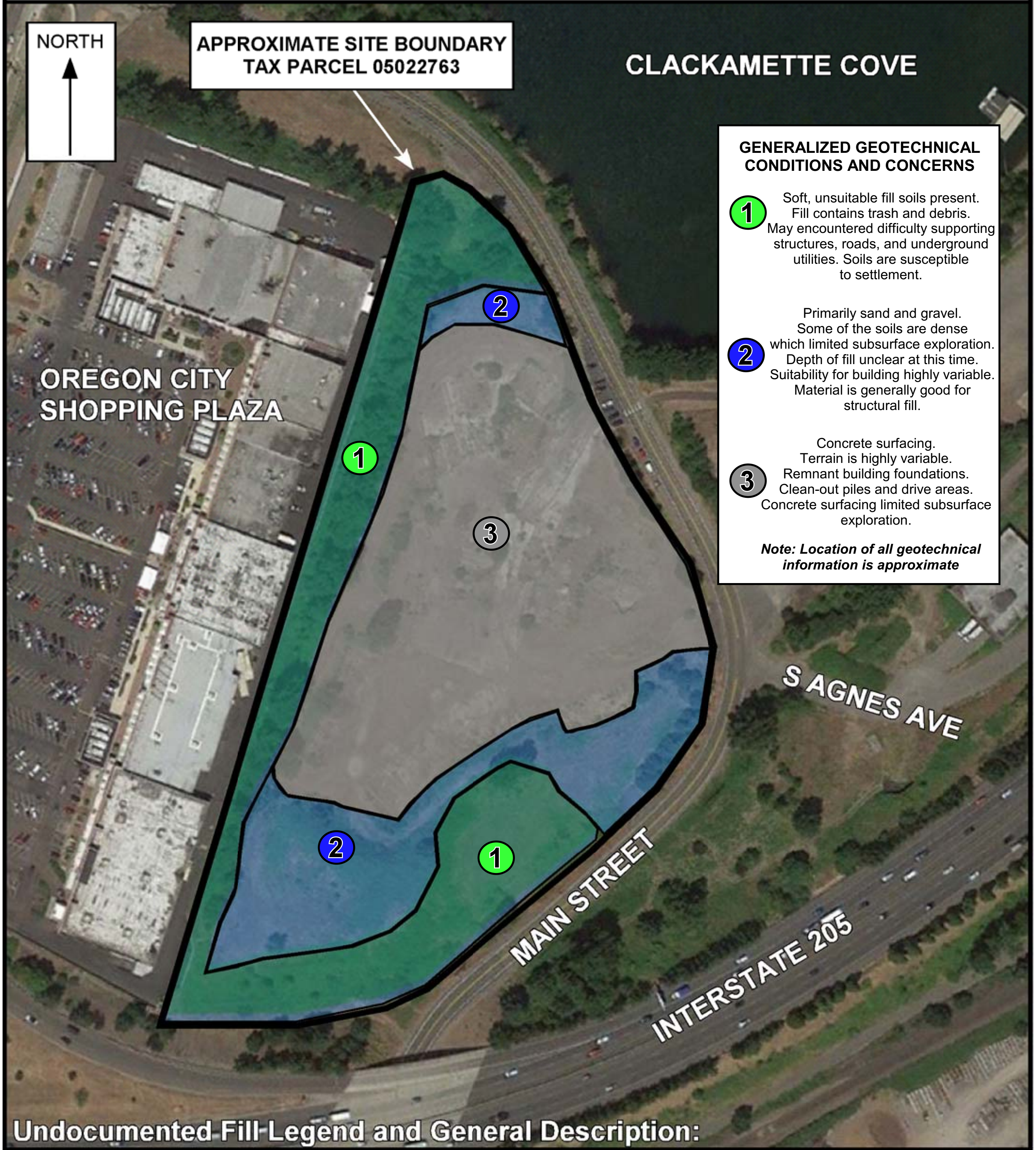
0 200'
APPROXIMATE SCALE 1"=200'

Date: 5/5/15
Drawn by: BLC

Project: The Cove Garden Apartments Oregon City, Oregon	Project No. 15-3719	FIGURE 2

GeoPacific Engineering, Inc.
14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

SITE AERIAL AND GENERALIZED UNDOCUMENTED FILL MAP



GENERALIZED GEOTECHNICAL CONDITIONS AND CONCERNS

① Soft, unsuitable fill soils present. Fill contains trash and debris. May encountered difficulty supporting structures, roads, and underground utilities. Soils are susceptible to settlement.

② Primarily sand and gravel. Some of the soils are dense which limited subsurface exploration. Depth of fill unclear at this time. Suitability for building highly variable. Material is generally good for structural fill.

③ Concrete surfacing. Terrain is highly variable. Remnant building foundations. Clean-out piles and drive areas. Concrete surfacing limited subsurface exploration.

Note: Location of all geotechnical information is approximate

Undocumented Fill Legend and General Description:

🟩 Fine-Grained Soil, Contains Debris
🟦 Granular Fill, Sand and Gravel
▨ Concrete Surfacing, Concrete Fill

0 200'
APPROXIMATE SCALE 1"=200'

Date: 5/5/15
Drawn by: BLC

Project: The Cove Garden Apartments
Oregon City, Oregon

Project No. 15-3719

FIGURE 3

EXPLORATION LOGS

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Sherwood, Oregon 97140
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TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-1**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
1	3.0	100 to 1,000 g				FILL. Brown, Silty SAND with subrounded gravel (SM-GM), moist, dense, containing various sizes of concrete fragments. .
2	3.0					
3	3.0	100 to 1,000 g				
4	4.0					
5		100 to 1,000 g				FILL. Concrete rubble. Various sizes. Refusal caused by a concrete slab at -6 feet bgs.
6						Test Pit Terminated at 6 feet bgs due to refusal on concrete fill. No Groundwater Seepage Observed.
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

LEGEND

- 100 to 1,000 g Bag Sample
- 5 Gal. Bucket Bucket Sample
- Shelby Tube Sample
- Seepage
- ▨ Water Bearing Zone
- Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 43 feet

GeoPacific Engineering, Inc.

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Sherwood, Oregon 97140
Tel: (503) 625-4455 Fax: (503) 625-4405

TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-2**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
1	3.0	100 to 1,000 g				FILL. Brown, Silty SAND with subrounded gravel (SM-GM), moist, dense, containing various sizes of concrete fragments.
2	3.0	100 to 1,000 g				FILL. Concrete rubble. Various sizes. Refusal caused by a concrete slab at -3 feet bgs.
3	4.0					
						Test Pit Terminated at 3 feet bgs due to refusal on concrete fill. No Groundwater Seepage Observed.
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

LEGEND

- 100 to 1,000 g — Bag Sample
- 5 Gal. Bucket — Bucket Sample
- Shelby Tube Sample
- Seepage
- ▨ Water Bearing Zone
- Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 47 feet

GeoPacific Engineering, Inc.
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Sherwood, Oregon 97140
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TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-3**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	Material Description
1	3.0	100 to 1,000 g				FILL. Brown, Silty SAND with subrounded gravel (SM-GM), moist, dense, containing various sizes of concrete fragments.
2	3.0	100 to 1,000 g				
3	4.0					FILL. Concrete rubble. Various sizes. Refusal caused by a concrete slab at -4 feet bgs.
4						Test Pit Terminated at 4 feet bgs due to refusal on concrete fill. No Groundwater Seepage Observed.
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

LEGEND

- 100 to 1,000 g — Bag Sample
- 5 Gal. Bucket — Bucket Sample
- Shelby Tube Sample
- Seepage
- ▨ Water Bearing Zone
- Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 45 feet

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Sherwood, Oregon 97140
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TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-4**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	Material Description
1	1.0	100 to 1,000 g				FILL. Dark brown, Silty SAND with subrounded gravel (SM-GM), moist, loose, containing various sizes of concrete fragments, metal, and plastic.
2	1.0	100 to 1,000 g				
3	1.0					
4	2.0	100 to 1,000 g				FILL. Brown, Silty SAND with subrounded gravel (SM-GM), moist, loose, non-plastic, containing concrete blocks, large roots, metal debris.
5		100 to 1,000 g	14.3	7.5		
6						
7						
8		100 to 1,000 g				FILL. Gray, concrete rubble and 3/4"-0 gravel, moist, dense. Refusal caused by a concrete slab at -11 feet bgs.
9						
10						
11						Test Pit Terminated at 11 feet bgs due to refusal on concrete fill. No Groundwater Seepage Observed.
12						
13						
14						
15						
16						
17						

LEGEND

- 100 to 1,000 g — Bag Sample
- 5 Gal. Bucket — Bucket Sample
- Shelby Tube Sample
- Seepage
- ▨ Water Bearing Zone
- Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 45 feet

GeoPacific Engineering, Inc.
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Sherwood, Oregon 97140
Tel: (503) 625-4455 Fax: (503) 625-4405

TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-5**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
1	1.0	100 to 1,000 g				FILL. Dark brown, Silty SAND with subrounded gravel (SM-GM), moist, loose, containing various sizes of concrete fragments, metal, and plastic debris.
2	1.0	100 to 1,000 g				
3	1.0					
4	1.0	100 to 1,000 g				
5						
6		100 to 1,000 g	44.1	22.3		FILL. Brown, Clayey GRAVEL with Sand (GC), very moist, soft, containing roots, concrete fragments, and asphalt fragments. Liquid Limit = 40.9, Plasticity Index = 22.1.
7						
8		100 to 1,000 g				FILL. Gray, silty SAND (SM), moist, loose becoming dense, containing large concrete fragments, 3/4"-0 gravel, 3 foot diameter basalt boulder encountered at -9 feet. Refusal caused by a concrete slab at -11 feet bgs.
9						
10						
11						Test Pit Terminated at 11 feet bgs due to refusal on concrete fill. No Groundwater Seepage Observed.
12						
13						
14						
15						
16						
17						

LEGEND

- 100 to 1,000 g Bag Sample
- 5 Gal. Bucket Bucket Sample
- ▯ Shelby Tube Sample
- 💧 Seepage
- ▨ Water Bearing Zone
- ▽ Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 45 feet

GeoPacific Engineering, Inc.

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Sherwood, Oregon 97140
Tel: (503) 625-4455 Fax: (503) 625-4405

TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-6**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	Material Description
1	2.0	100 to 1,000 g				FILL. Gray, well graded SAND with GRAVEL (SM-GM), 1"-0 crushed aggregate, moist to very moist, medium dense.
2	2.5					
3	3.0	100 to 1,000 g				
4	2.5					
5		100 to 1,000 g				
6						
7						
8		100 to 1,000 g				
9						FILL. Gray, well graded SAND with GRAVEL (SM-GM), containing cobble sized rock up to an 8-inch diameter, very moist, dense.
10						FILL. Concrete Slab, Refusal of excavation at - 11 feet bgs.
11						Test Pit Terminated at 11 feet bgs due to refusal on concrete fill. No Groundwater Seepage Observed.
12						
13						
14						
15						
16						
17						

LEGEND

- 100 to 1,000 g — Bag Sample
- 5 Gal. Bucket — Bucket Sample
- Shelby Tube Sample
- Seepage
- Water Bearing Zone
- Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 45 feet

GeoPacific Engineering, Inc.

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Sherwood, Oregon 97140
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TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-7**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
1	4.0					FILL. Gray, well graded SAND with GRAVEL (GW), 1"-0 crushed aggregate, moist to very moist, dense to very dense. Refusal of excavation at -3 feet bgs.
2	>4.5					
3	>4.5					
						Test Pit Terminated at 3 feet bgs due to refusal on dense gravel. No Groundwater Seepage Observed.
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

LEGEND

100 to 1,000 g	5 Gal. Bucket	▯	💧	▨	▽
Bag Sample	Bucket Sample	Shelby Tube Sample	Seepage	Water Bearing Zone	Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 49 feet

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TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-8**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
						TOPSOIL. Brown, medium stiff, moist, organic SILT (OL-ML), containing blackberry roots to a depth of approximately 8-inches bgs
1	4.0					FILL. Gray, crushed concrete and concrete rubble, dense to very dense. Caused refusal of excavation at approximately 3-feet bgs.
2	>4.5					
3	>4.5					Test Pit Terminated at 3 feet bgs due to refusal on concrete fill. No Groundwater Seepage Observed.
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

LEGEND

- 100 to 1,000 g — Bag Sample
- 5 Gal. Bucket — Bucket Sample
- ▯ Shelby Tube Sample
- 💧 Seepage
- ▨ Water Bearing Zone
- ▽ Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 55 feet

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TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-9**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
1	1.0					FILL. Dark brown, SILT (ML), very moist, soft, containing concrete fragments, asphalt fragments, bricks, plastic.
2	1.0	100 to 1,000 g				
3	1.0					
4	1.0	100 to 1,000 g				
5						FILL. Light brown to yellowish SILT (ML), very moist, soft, containing concrete fragments, asphalt fragments, bricks, plastic, paper.
6						
7						
8		100 to 1,000 g				
9						
10						FILL. Gray Clayey GRAVEL with Sand (GC), very moist, soft, containing concrete fragments, asphalt fragments, bricks, plastic, paper, fabric. Liquid Limit = 46.7, Plasticity Index = 21.4
11						
12		100 to 1,000 g	47.7	19.8		
13						Test Pit Terminated at 13 feet bgs in undocumented fill. No Groundwater Seepage Observed.
14						
15						
16						
17						

LEGEND

- 100 to 1,000 g Bag Sample
- 5 Gal. Bucket Bucket Sample
- Shelby Tube Sample
- Seepage
- ▨ Water Bearing Zone
- Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 53 feet

GeoPacific Engineering, Inc.

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TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-10**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	Material Description
1	1.0					FILL. Dark brown, SILT (ML), very moist, soft, containing cobble sized rock, concrete and asphalt fragments.
2	1.0	100 to 1,000 g				
3	1.0					FILL. Brown, Clayey GRAVEL with Sand (GC), very moist, soft, containing 3"-0 angular rock, and concrete fragments.
4	1.0	100 to 1,000 g				
5						FILL. Dark gray, Clayey GRAVEL with Sand (GC), very moist, soft, containing up to 8-inch diameter cobble-sized rock, concrete fragments, asphalt fragments, glass, and woody debris including boards.
6						
7						
8						
9						
10						
11						
12						Test Pit Terminated at 12 feet bgs in undocumented fill. No Groundwater Seepage Observed.
13						
14						
15						
16						
17						

LEGEND

- 100 to 1,000 g — Bag Sample
- 5 Gal. Bucket — Bucket Sample
- Shelby Tube Sample
- Seepage
- ▨ Water Bearing Zone
- Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 54 feet

GeoPacific Engineering, Inc.

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Sherwood, Oregon 97140
Tel: (503) 625-4455 Fax: (503) 625-4405

TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-11**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
						TOPSOIL. Brown, medium stiff, moist, organic SILT (OL-ML), containing blackberry roots to a depth of approximately 6-inches bgs
1	2.0					FILL. Gray, well graded SAND with GRAVEL (GW), 3/4"-0 crushed aggregate, moist, medium dense.
2	2.5					
3	1.0					FILL. Brown, Clayey GRAVEL with Sand (GC), very moist, soft, containing 3"-0 angular rock, and concrete fragments.
4	1.0					
5						
6						@ - 6 feet bgs, concrete post with re-bar and 2" to 4" brick fragments
7						
8						soft soil conditions, digs easily
9						
10						@ - 10 feet bgs, woody debris, paint cans, lathe, and painted boards
11						
12						
13						FILL. Brown, organic SILT (OL-ML), medium stiff, moist, soft, containing roots.
14						
15						Test Pit Terminated at 15 feet bgs in undocumented fill. No Groundwater Seepage Observed.
16						
17						

LEGEND

- 100 to 1,000 g — Bag Sample
- 5 Gal. Bucket — Bucket Sample
- Shelby Tube Sample
- Seepage
- ▨ Water Bearing Zone
- Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 52 feet

GeoPacific Engineering, Inc.

13910 SW Galbreath Drive, Suite 102
Sherwood, Oregon 97140
Tel: (503) 625-4455 Fax: (503) 625-4405

TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-12**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
						TOPSOIL. Brown, medium stiff, moist, organic SILT (OL-ML), containing roots to a depth of approximately 6-inches bgs
1	2.0					FILL. Brown, Silty SAND with subrounded gravel (SM-GM), moist, loose, containing various sizes of concrete and asphalt fragments.
2	2.5					
3	2.5					
4	3.0					
5						FILL. Basalt boulders encountered. Refusal of excavation at 6-feet bgs.
6						Test Pit Terminated at 6 feet bgs due to refusal on boulders. No Groundwater Seepage Observed.
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

LEGEND

- 100 to 1,000 g — Bag Sample
- 5 Gal. Bucket — Bucket Sample
- Shelby Tube Sample
- Seepage
- ▨ Water Bearing Zone
- Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 52 feet

GeoPacific Engineering, Inc.

13910 SW Galbreath Drive, Suite 102
Sherwood, Oregon 97140
Tel: (503) 625-4455 Fax: (503) 625-4405

TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-13**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
1	4.0					FILL. Gray, well graded SAND with GRAVEL (GW), 3/4"-0 crushed aggregate, moist to very moist, dense to very dense.
2	>4.5					FILL. Concrete. Refusal of excavation at -3 feet bgs.
3	>4.5					
4						Test Pit Terminated at 3 feet bgs due to refusal on concrete. No Groundwater Seepage Observed.
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

LEGEND

100 to 1,000 g	5 Gal. Bucket	▯	💧	▨	▽
Bag Sample	Bucket Sample	Shelby Tube Sample	Seepage	Water Bearing Zone	Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 38 feet

13910 SW Galbreath Drive, Suite 102
Sherwood, Oregon 97140
Tel: (503) 625-4455 Fax: (503) 625-4405

TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-14**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
1	4.0					FILL. Gray, well graded SAND with GRAVEL (GW), 3/4"-0 crushed aggregate, moist to very moist, dense to very dense. Refusal of excavation at -2 feet bgs.
2	>4.5					
						Test Pit Terminated at 2 feet bgs due to refusal on dense gravels. No Groundwater Seepage Observed.
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

LEGEND

- 100 to 1,000 g – Bag Sample
- 5 Gal. Bucket – Bucket Sample
- Shelby Tube Sample
- Seepage
- ▨ Water Bearing Zone
- Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 32 feet

GeoPacific Engineering, Inc.
13910 SW Galbreath Drive, Suite 102
Sherwood, Oregon 97140
Tel: (503) 625-4455 Fax: (503) 625-4405

TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-15**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	Material Description
1	4.0					FILL. Gray, well graded SAND with GRAVEL (GW), 3/4"-0 crushed aggregate, moist to very moist, dense to very dense.
2	>4.5					FILL. Concrete. Refusal of excavation at -3 feet bgs.
3	>4.5					
4						Test Pit Terminated at 3 feet bgs due to refusal on concrete. No Groundwater Seepage Observed.
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

LEGEND

100 to 1,000 g	5 Gal. Bucket			▨	
Bag Sample	Bucket Sample	Shelby Tube Sample	Seepage	Water Bearing Zone	Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 38 feet

13910 SW Galbreath Drive, Suite 102
Sherwood, Oregon 97140
Tel: (503) 625-4455 Fax: (503) 625-4405

TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-16**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
1	4.0					FILL. Gray, well graded SAND with GRAVEL (GW), 3/4"-0 crushed aggregate, moist to very moist, dense to very dense.
2	>4.5					
3	>4.5					
4						FILL. Concrete. Refusal of excavation at -3 feet bgs.
5						Test Pit Terminated at 4 feet bgs due to refusal on concrete. No Groundwater Seepage Observed.
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

LEGEND

100 to 1,000 g	Bag Sample
5 Gal. Bucket	Bucket Sample
▯	Shelby Tube Sample
💧	Seepage
▨	Water Bearing Zone
▽	Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 36 feet

GeoPacific Engineering, Inc.
13910 SW Galbreath Drive, Suite 102
Sherwood, Oregon 97140
Tel: (503) 625-4455 Fax: (503) 625-4405

TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-17**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
1	4.0					FILL. Gray, well graded SAND with GRAVEL (GW), 3/4"-0 crushed aggregate, moist to very moist, dense to very dense. Refusal of excavation caused by dense gravels at -5 feet bgs.
2	>4.5					
3						
	>4.5					
4						
	>4.5					
5						Test Pit Terminated at 5 feet bgs due to refusal on dense gravels. No Groundwater Seepage Observed. Test pit conducted at base of slope.
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

LEGEND

- 100 to 1,000 g — Bag Sample
- 5 Gal. Bucket — Bucket Sample
- Shelby Tube Sample
- Seepage
- ▨ Water Bearing Zone
- Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 40 feet

GeoPacific Engineering, Inc.
13910 SW Galbreath Drive, Suite 102
Sherwood, Oregon 97140
Tel: (503) 625-4455 Fax: (503) 625-4405

TEST PIT LOG

Project: The Cove Garden Apartments
Tax Parcel 05022763
Oregon City, Oregon

Project No. 15-3719

Test Pit No. **TP-18**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	Material Description
1	4.0					FILL. Gray, well graded SAND with GRAVEL (GW), 3/4"-0 crushed aggregate, moist to very moist, dense to very dense. Refusal of excavation caused by dense gravels at -5 feet bgs.
2	>4.5					
3						
	>4.5					
4						
	>4.5					
5						
6						Test Pit Terminated at 5 feet bgs due to refusal on dense gravels. No Groundwater Seepage Observed. Test pit conducted at base of slope.
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

LEGEND

100 to 1,000 g	5 Gal. Bucket	▯	💧	▨	▽
Bag Sample	Bucket Sample	Shelby Tube Sample	Seepage	Water Bearing Zone	Water Level at Abandonment

Date Excavated: 4/17/15
Logged By: B. Cook
Surface Elevation: 38 feet

SITE RESEARCH

USGS Design Maps Summary Report

User–Specified Input

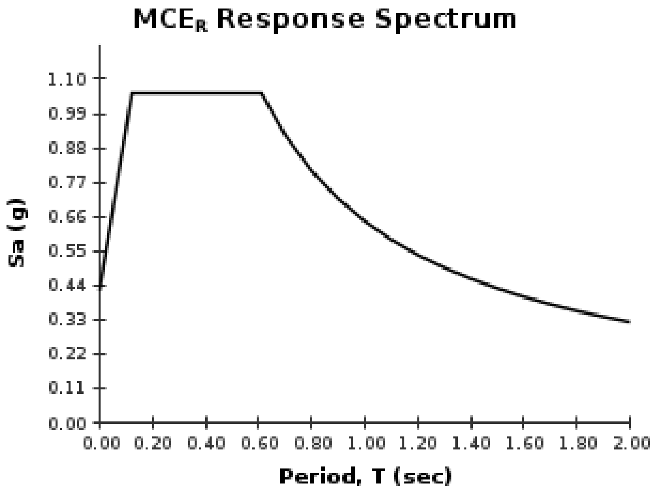
Report Title	15-3719, The Cove Garden Apartments Tue May 5, 2015 20:37:08 UTC
Building Code Reference Document	ASCE 7-10 Standard (which utilizes USGS hazard data available in 2008)
Site Coordinates	45.36899°N, 122.5976°W
Site Soil Classification	Site Class D – "Stiff Soil"
Risk Category	I/II/III

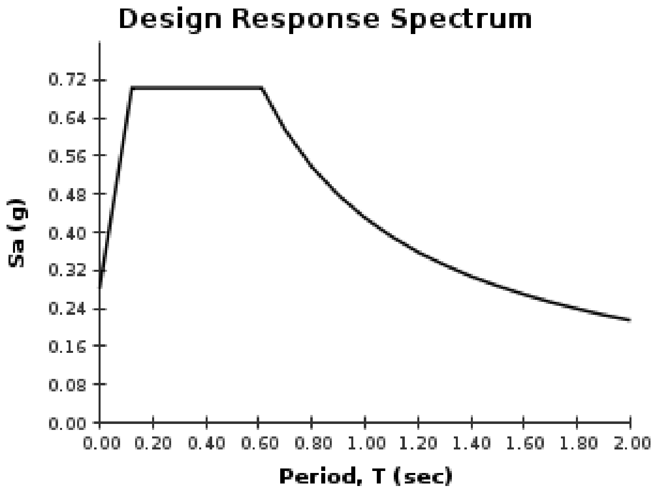
USGS–Provided Output

S_S = 0.938 g S_{MS} = 1.055 g S_{DS} = 0.703 g

S_1 = 0.404 g S_{M1} = 0.645 g S_{D1} = 0.430 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

USGS Design Maps Detailed Report

ASCE 7-10 Standard (45.36899°N, 122.5976°W)

Site Class D – "Stiff Soil", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1] $S_S = 0.938$ g

From Figure 22-2 [2] $S_1 = 0.404$ g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index $PI > 20$, • Moisture content $w \geq 40\%$, and • Undrained shear strength $\bar{s}_u < 500$ psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk–Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4–1: Site Coefficient F_a

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at Short Period				
	$S_S \leq 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \geq 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = D and S_S = 0.938 g, F_a = 1.125

Table 11.4–2: Site Coefficient F_v

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at 1–s Period				
	$S_1 \leq 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \geq 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 0.404 g, F_v = 1.596

Equation (11.4–1): $S_{MS} = F_a S_S = 1.125 \text{ x } 0.938 = 1.055$ g

Equation (11.4–2): $S_{M1} = F_v S_1 = 1.596 \text{ x } 0.404 = 0.645$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

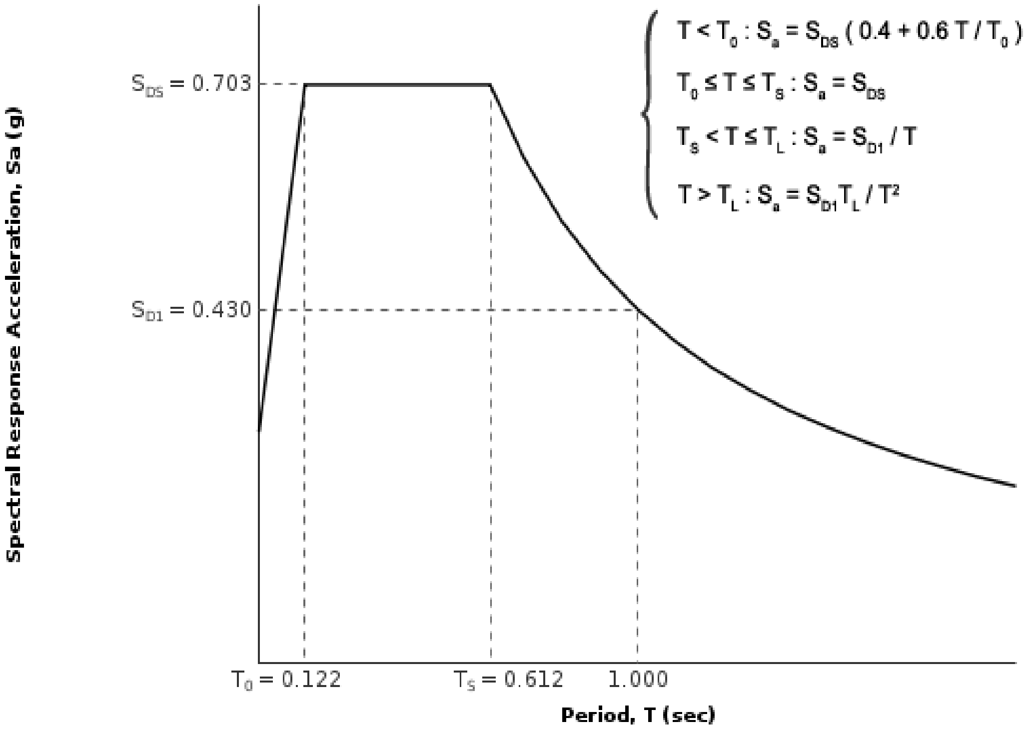
Equation (11.4–3): $S_{DS} = ⅔ S_{MS} = ⅔ \text{ x } 1.055 = 0.703$ g

Equation (11.4–4): $S_{D1} = ⅔ S_{M1} = ⅔ \text{ x } 0.645 = 0.430$ g

Section 11.4.5 — Design Response Spectrum

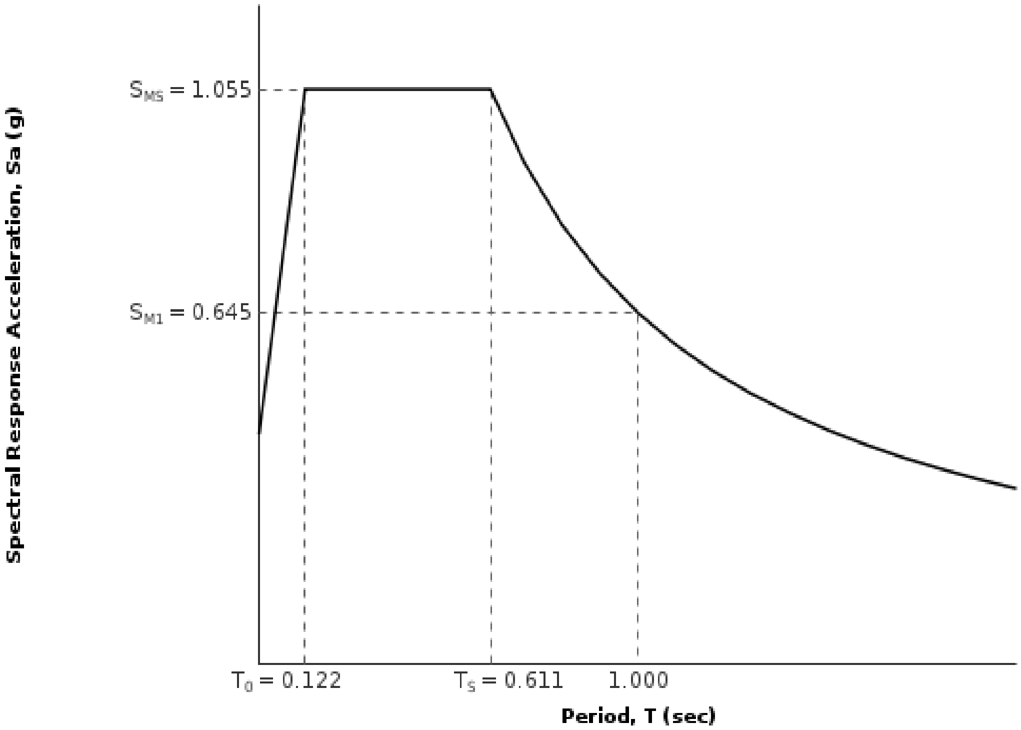
From Figure 22-12 [3] $T_L = 16$ seconds

Figure 11.4–1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.406

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.094 \times 0.406 = 0.444$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

For Site Class = D and PGA = 0.406 g, F_{PGA} = 1.094

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] C_{RS} = 0.906

From Figure 22-18 [6] C_{R1} = 0.875

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	**RISK CATEGORY**		
	I or II	**III**	**IV**
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 0.703 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	**RISK CATEGORY**		
	I or II	**III**	**IV**
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.430 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = D

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf

CLAC 66527

12-10-2009

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

WELL LABEL # L 98915

START CARD # 1006422

(1) LAND OWNER

Owner Well I.D. MW-2
First Name
Last Name P09084-3141
Company PARKER POND LLC SCOTT PARKER
Address PO BOX AF
City SCAPPOOSE State OR Zip 97056

(2) TYPE OF WORK

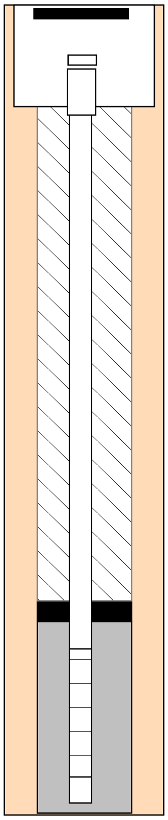
☒ New ☐ Deepening ☐ Conversion
☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☒ Hollow Stem Auger ☐ Cable Mud
☐ Reverse Rotary ☐ Other

(4) CONSTRUCTION

Piezometer Well ☐
Depth of Completed Well 50 ft. Special Standard ☐



MONUMENT/VAULT Below Ground
From 0 To 1

BORE HOLE
Diameter 11 From 0 To 50

CASING
Dia. 2 From ☐ 0 To 29.5
Gauge SCH 40 Wld Thrd
Material ○ Steel ● Plastic ☐ ☒

LINER
Dia. From ☐ To
Gauge Wld Thrd
Material ○ Steel ○ Plastic ☐ ☐

SEAL
From 0 To 27.5
Material Bentonite Chips
Amount 24.00 S Grout weight

SCREEN
Casing/Liner Material PVC
Diameter 2 From 29.5 To 49.5
Slot Size .010

FILTER
From 27.5 To 50 Material SAND Size of pack 10/20

(5) WELL TESTS

○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 56 °F Lab analysis ☐ Yes By
Supervising Geologist/Engineer
Water quality concerns? ☐ Yes (describe below)

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County Clackamas Twp 2.00 S N/S Range 2.00 E E/W WM
Sec 29 NE 1/4 of the NE 1/4 Tax Lot 1900
Tax Map Number Lot
Lat ° ' " or 45.36998600 DMS or DD
Long ° ' " or -122.59924500 DMS or DD
● Street address of well ○ Nearest address

16421 MAIN ST
OREGON CITY, OR

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well	07-30-2009		☐	34

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES

Depth water was first found 34

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
07-30-2009	34	50			☐	34
					☐	
					☐	
					☐	
					☐	

(8) WELL LOG

Ground Elevation

Material	From	To
CONCRETE	0	1
CONCRETE FILL	1	18
SAND SILT	18	31
GRAVELLY COBBLES	31	50

Date Started 07-30-2009 Completed 07-30-2009

(unbonded) Monitor Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 10328 Date 12-10-2009
Electronically Submitted
Signed JOEL R WELSH (E-filed)

(bonded) Monitor Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10357 Date 12-10-2009
Electronically Submitted
Signed TERRENCE JACQUES (E-filed)
Contact Info (optional)

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

MONITORING WELL REPORT -
Map with location identified must be attached and shall include an approximate scale and north arrow

CLAC 66527

12-10-2009

WELL I.D. # L 98915

START CARD # 1006422

Map of well

CLAC 66526

12-10-2009

Page 1 of 2

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

WELL LABEL # L 98914

START CARD # 1006421

(1) LAND OWNER

Owner Well I.D. MW-1

First Name
Last Name P09084-3141
Company PARKER POND LLC SCOTT PARKER
Address PO BOX AF
City SCAPPOOSE State OR Zip 97056

(2) TYPE OF WORK

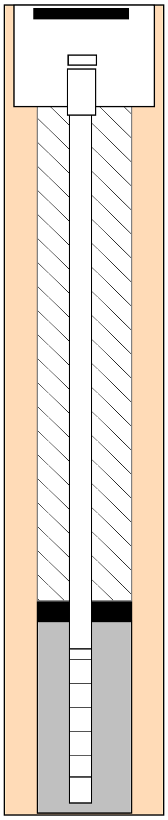
☒ New ☐ Deepening ☐ Conversion
☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☒ Hollow Stem Auger ☐ Cable Mud
☐ Reverse Rotary ☐ Other

(4) CONSTRUCTION

Piezometer Well ☐
Depth of Completed Well 50 ft. Special Standard ☐



MONUMENT/VAULT Below Ground
From 0 To 1

BORE HOLE
Diameter 11 From 0 To 50

CASING
Dia. 2 From ☐ 0 To 29.5
Gauge SCH 40 Wld Thrd
Material ○ Steel ● Plastic ☐ ☒

LINER
Dia. From ☐ To
Gauge Wld Thrd
Material ○ Steel ○ Plastic ☐ ☐

SEAL
From 0 To 27.5
Material Bentonite Chips
Amount 24.00 S Grout weight

SCREEN
Casing/Liner Material PVC
Diameter 2 From 29.5 To 49.5
Slot Size .010

FILTER
From 27.5 To 50 Material SAND Size of pack 10/20

(5) WELL TESTS

○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 56 °F Lab analysis ☐ Yes By
Supervising Geologist/Engineer
Water quality concerns? ☐ Yes (describe below)

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County **Clackamas** Twp **2.00** S N/S Range **2.00** E E/W WM
Sec **29** **NE** 1/4 of the **NE** 1/4 Tax Lot **1900**
Tax Map Number Lot
Lat ° ' " or **45.36998600** DMS or DD
Long ° ' " or **-122.59924500** DMS or DD
● Street address of well ○ Nearest address

16421 MAIN ST
OREGON CITY, OR

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well	07-29-2009		☐	34

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES

Depth water was first found 34

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
07-29-2009	34	50			☐	34
					☐	
					☐	
					☐	
					☐	

(8) WELL LOG

Ground Elevation

Material	From	To
CONCRETE	0	1
CONCRETE FILL	1	18
SAND SILT	18	31
GRAVELLY COBBLES	31	50

Date Started 07-29-2009 Completed 07-29-2009

(unbonded) Monitor Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 10328 Date 12-10-2009
Electronically Submitted
Signed JOEL R WELSH (E-filed)

(bonded) Monitor Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10357 Date 12-10-2009
Electronically Submitted
Signed TERRENCE JACQUES (E-filed)
Contact Info (optional)

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version: 0.95

MONITORING WELL REPORT -
Map with location identified must be attached and shall include an approximate scale and north arrow

CLAC 66526

12-10-2009

WELL I.D. # L 98914

START CARD # 1006421

Map of well

CLAC 66528

12-10-2009

Page 1 of 2

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

WELL LABEL # L 98916

START CARD # 1006423

(1) LAND OWNER

Owner Well I.D. MW-3

First Name ______ Last Name P09084-3141

Company PARKER POND LLC SCOTT PARKER

Address PO BOX AF

City SCAPPOOSE State OR Zip 97056

(2) TYPE OF WORK

☒ New ☐ Deepening ☐ Conversion
☐ Alteration (repair/recondition) ☐ Abandonment

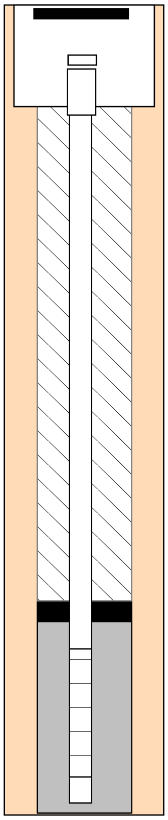
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☒ Hollow Stem Auger ☐ Cable Mud
☐ Reverse Rotary ☐ Other ______

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 47 ft. Special Standard ☐



MONUMENT/VAULT Below Ground
From 0 To 1

BORE HOLE
Diameter 11 From 0 To 47

CASING
Dia. 2 From ☐ 0 To 26.5
Gauge SCH 40 Wld Thrd
Material ○ Steel ● Plastic ☐ ☒

LINER
Dia. ______ From ☐ ______ To ______
Gauge ______ Wld Thrd
Material ○ Steel ○ Plastic ☐ ☐

SEAL
From 0 To 23.5
Material Bentonite Chips
Amount 21.00 S Grout weight ______

SCREEN
Casing/Liner ______ Material PVC
Diameter 2 From 26.5 To 46.5
Slot Size .010

FILTER
From 23.5 To 47 Material SAND Size of pack 10/20

(5) WELL TESTS

○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 56 °F Lab analysis ☐ Yes By ______

Supervising Geologist/Engineer ______

Water quality concerns? ☐ Yes (describe below)

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County **Clackamas** Twp **2.00** S N/S Range **2.00** E E/W WM

Sec **29** **NE** 1/4 of the **NE** 1/4 Tax Lot **1900**

Tax Map Number ______ Lot ______

Lat ___° ___' ___" or **45.36998600** DMS or DD

Long ___° ___' ___" or **-122.59924500** DMS or DD

● Street address of well ○ Nearest address

16421 MAIN ST
OREGON CITY, OR

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well	07-31-2009		☐	34

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES

Depth water was first found 34

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
07-31-2009	34	47			☐	34
					☐	
					☐	
					☐	
					☐	

(8) WELL LOG

Ground Elevation ______

Material	From	To
CONCRETE	0	1
CONCRETE FILL	1	18
SAND SILT	18	31
GRAVELLY COBBLES	31	47

Date Started 07-31-2009 Completed 07-31-2009

(unbonded) Monitor Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 10328 Date 12-10-2009

Electronically Submitted

Signed JOEL R WELSH (E-filed)

(bonded) Monitor Well Constructor Certification

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License Number 10357 Date 12-10-2009

Electronically Submitted

Signed TERRENCE JACQUES (E-filed)

Contact Info (optional) ______

ORIGINAL - WATER RESOURCES DEPARTMENT

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Form Version: 0.95

MONITORING WELL REPORT -
Map with location identified must be attached and shall include an approximate scale and north arrow

CLAC 66528

12-10-2009

WELL I.D. # L 98916

START CARD # 1006423

Map of well

CLAC 66529

12-10-2009

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

WELL LABEL # L 98917

START CARD # 1006424

(1) LAND OWNER

Owner Well I.D. MW-4

First Name ______ Last Name P09084-3141

Company PARKER POND LLC SCOTT PARKER

Address PO BOX AF

City SCAPPOOSE State OR Zip 97056

(2) TYPE OF WORK

☒ New ☐ Deepening ☐ Conversion
☐ Alteration (repair/recondition) ☐ Abandonment

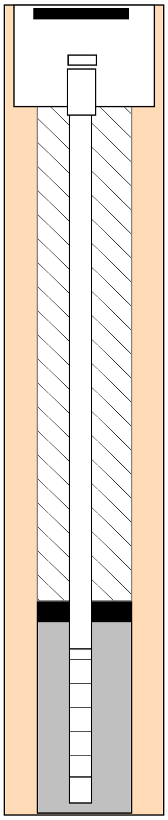
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☒ Hollow Stem Auger ☐ Cable Mud
☐ Reverse Rotary ☐ Other ______

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 47 ft. Special Standard ☐



MONUMENT/VAULT Below Ground
From 0 To 1

BORE HOLE
Diameter 11 From 0 To 47

CASING
Dia. 2 From ☐ 0 To 26.5
Gauge SCH 40 Wld Thrd
Material ○ Steel ● Plastic ☐ ☒

LINER
Dia. ______ From ☐ ______ To ______
Gauge ______ Wld Thrd
Material ○ Steel ○ Plastic ☐ ☐

SEAL
From 0 To 23.5
Material Bentonite Chips
Amount 21.00 S Grout weight ______

SCREEN
Casing/Liner ______ Material PVC
Diameter 2 From 26.5 To 46.5
Slot Size .010

FILTER
From 23.5 To 47 Material SAND Size of pack 10/20

(5) WELL TESTS

○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 56 °F Lab analysis ☐ Yes By ______

Supervising Geologist/Engineer ______

Water quality concerns? ☐ Yes (describe below)

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County Clackamas Twp 2.00 S N/S Range 2.00 E E/W WM

Sec 29 NE 1/4 of the NE 1/4 Tax Lot 1900

Tax Map Number ______ Lot ______

Lat ___°___'___" or 45.36998600 DMS or DD

Long ___°___'___" or -122.59924500 DMS or DD

● Street address of well ○ Nearest address

16421 MAIN ST
OREGON CITY, OR

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well	07-31-2009		☐	34

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES

Depth water was first found 34

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
07-31-2009	34	47			☐	34
					☐	
					☐	
					☐	
					☐	

(8) WELL LOG

Ground Elevation ______

Material	From	To
CONCRETE	0	1
CONCRETE FILL	1	18
SAND SILT	18	31
GRAVELLY COBBLES	31	47

Date Started 07-31-2009 Completed 07-31-2009

(unbonded) Monitor Well Constructor Certification

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License Number 10328 Date 12-10-2009

Electronically Submitted

Signed JOEL R WELSH (E-filed)

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Electronically Submitted

Signed TERRENCE JACQUES (E-filed)

Contact Info (optional) ______

ORIGINAL - WATER RESOURCES DEPARTMENT

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MONITORING WELL REPORT -
Map with location identified must be attached and shall include an approximate scale and north arrow

CLAC 66529

12-10-2009

WELL I.D. # L 98917

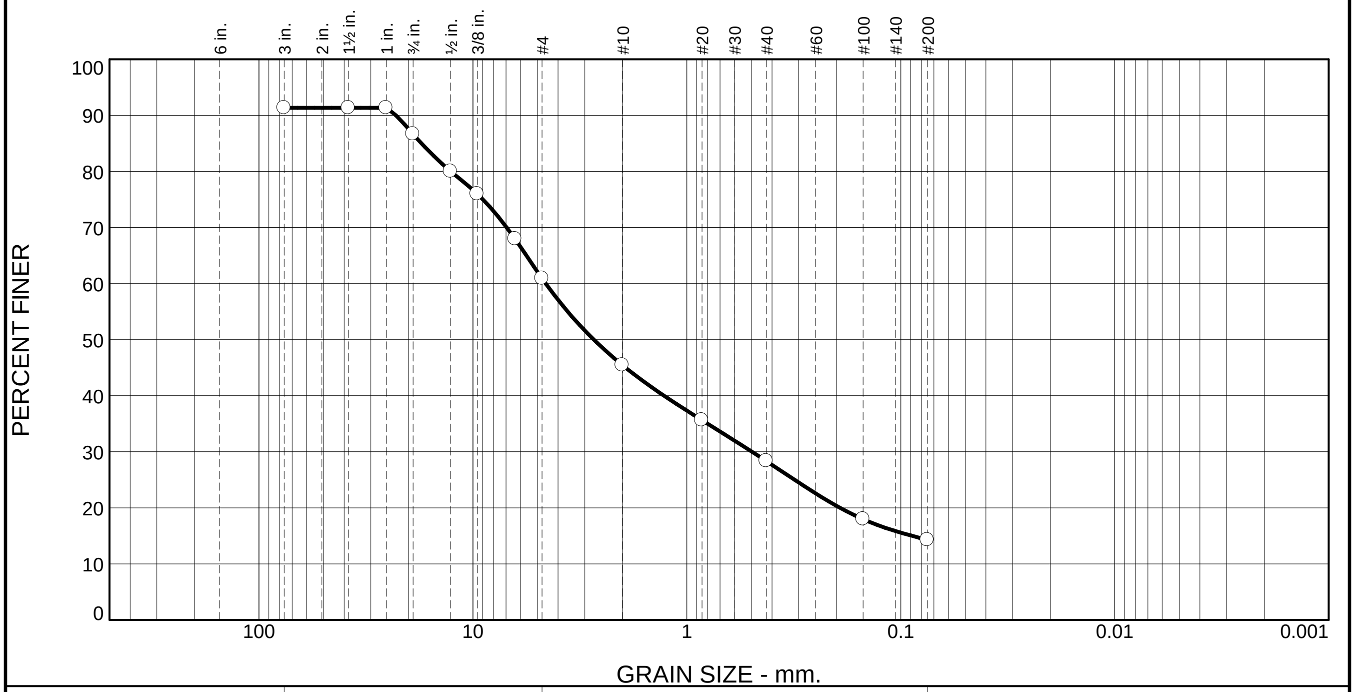
START CARD # 1006424

Map of well

Real-World Geotechnical Solutions
Investigation • Design • Construction Support

LABORATORY ANALYSIS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	4.7	25.7	15.5	17.1	14.0	14.3	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	91.3		
1.5	91.3		
1	91.3		
.75	86.6		
.5	80.0		
.375	76.0		
.25	67.9		
#4	60.9		
#10	45.4		
#20	35.6		
#40	28.3		
#100	18.0		
#200	14.3		

* (no specification provided)

Material Description

Silty Sand with Gravel

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 22.9220	D_{85}= 17.4092	D_{60}= 4.5705
D_{50}= 2.7231	D_{30}= 0.4965	D_{15}= 0.0884
D_{10}=	C_u=	C_c=

Remarks

Moisture 7.5%
S15-46

Date Received: **Date Tested:** 4.25.2015

Tested By: MTB

Checked By:

Title:

Sample Number: TP-4 **Depth:** 5' **Date Sampled:** 4.17.2015

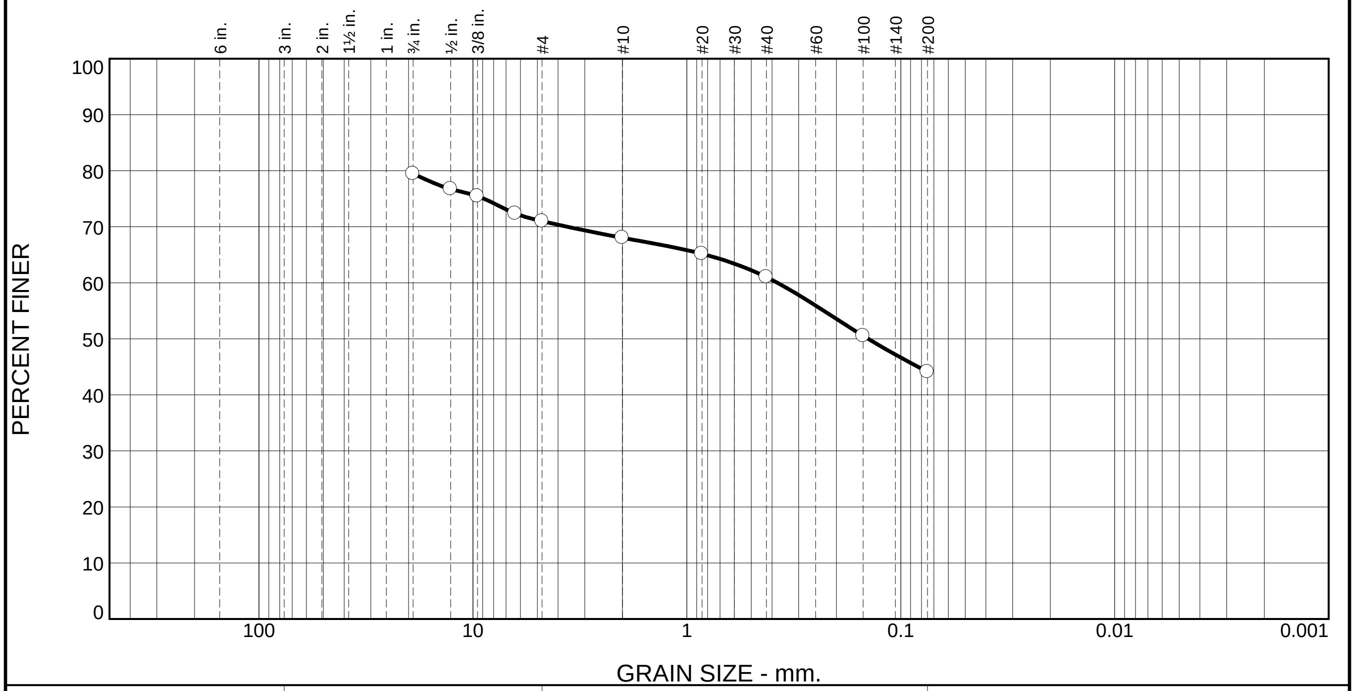
GEOPACIFIC ENGINEERING, INC.

Client: Grand Peak Properties

Project: The Cove Garden Apts

Project No: 15-3719 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
		8.5	3.0	7.0	16.9	44.1	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	79.5		
.5	76.7		
.375	75.5		
.25	72.4		
#4	71.0		
#10	68.0		
#20	65.2		
#40	61.0		
#100	50.5		
#200	44.1		

* (no specification provided)

Material Description

Clayey Gravel with Sand

Atterberg Limits (ASTM D 4318)

PL= 18.8 **LL=** 40.9 **PI=** 22.1

Classification

USCS (D 2487)= GC **AASHTO (M 145)=** A-7-6(5)

Coefficients

D_{90}=	D_{85}=	D_{60}= 0.3772
D_{50}= 0.1421	D_{30}=	D_{15}=
D_{10}=	C_u=	C_c=

Remarks

Moisture 22.3%
S15-47

Date Received: **Date Tested:** 4.25.2015
Tested By: MTB
Checked By:
Title:

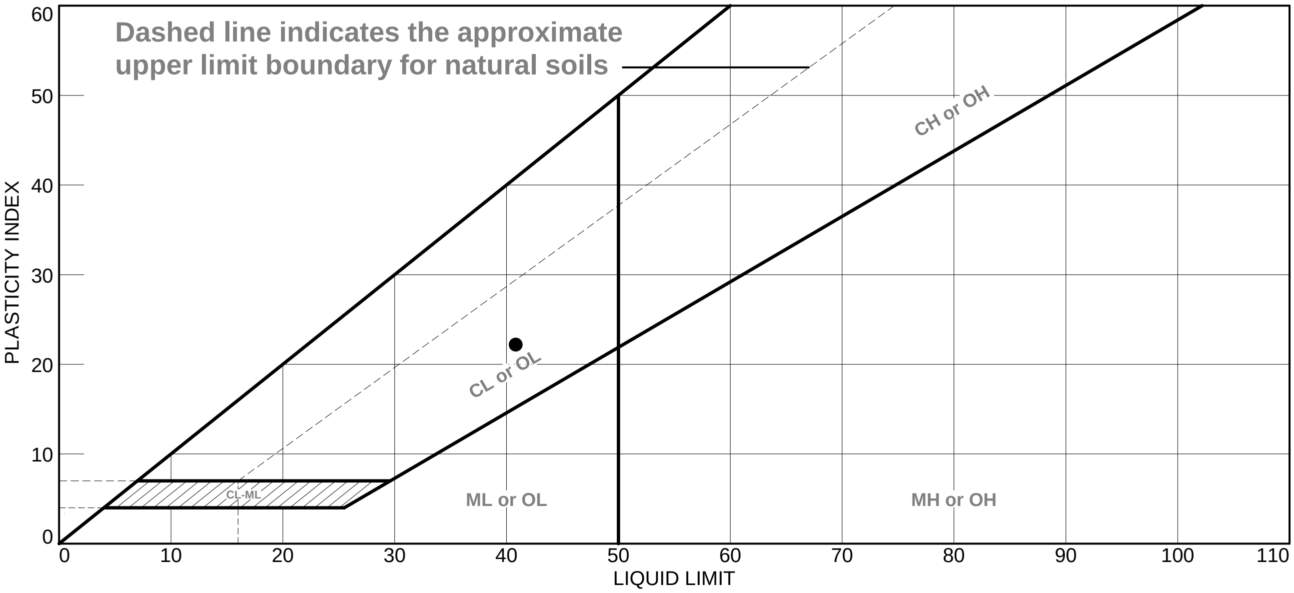
Sample Number: TP-5 5.1 **Depth:** 6' **Date Sampled:** 4.17.2015

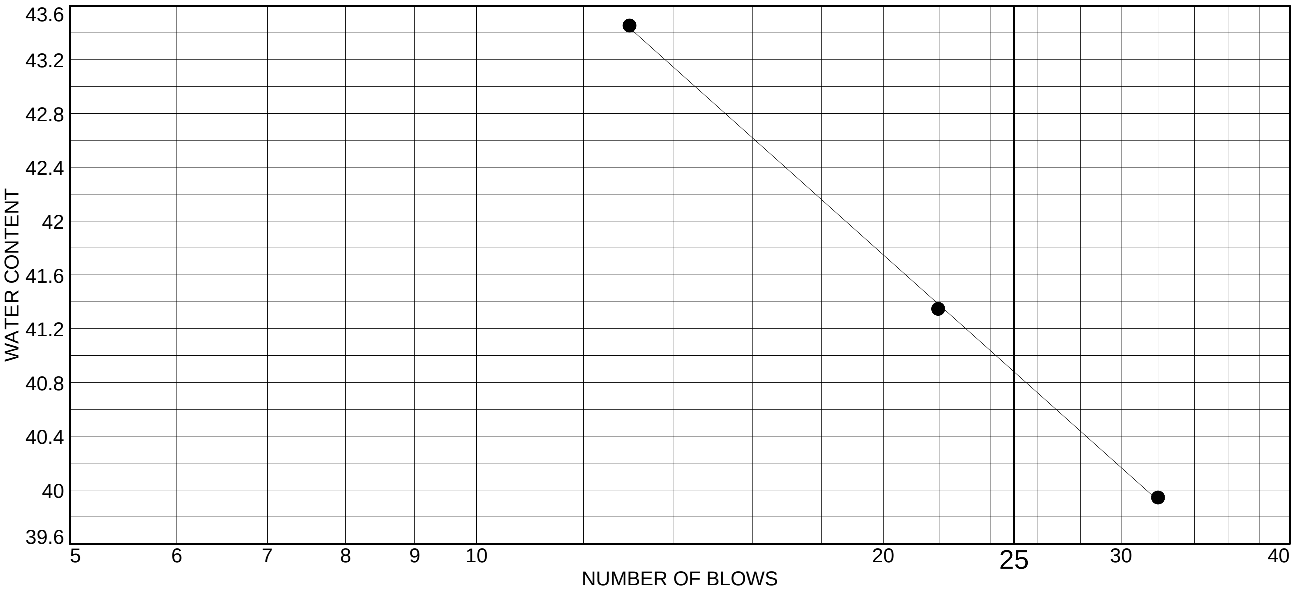
GEOPACIFIC ENGINEERING, INC.

Client: Grand Peak Properties
Project: The Cove Garden Apts

Project No: 15-3719 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Clayey Gravel with Sand	40.9	18.8	22.1	61.0	44.1	GC

Project No. 15-3719 **Client:** Grand Peak Properties

Project: The Cove Garden Apts

Sample Number: TP-5 5.1 **Depth:** 6'

Remarks:

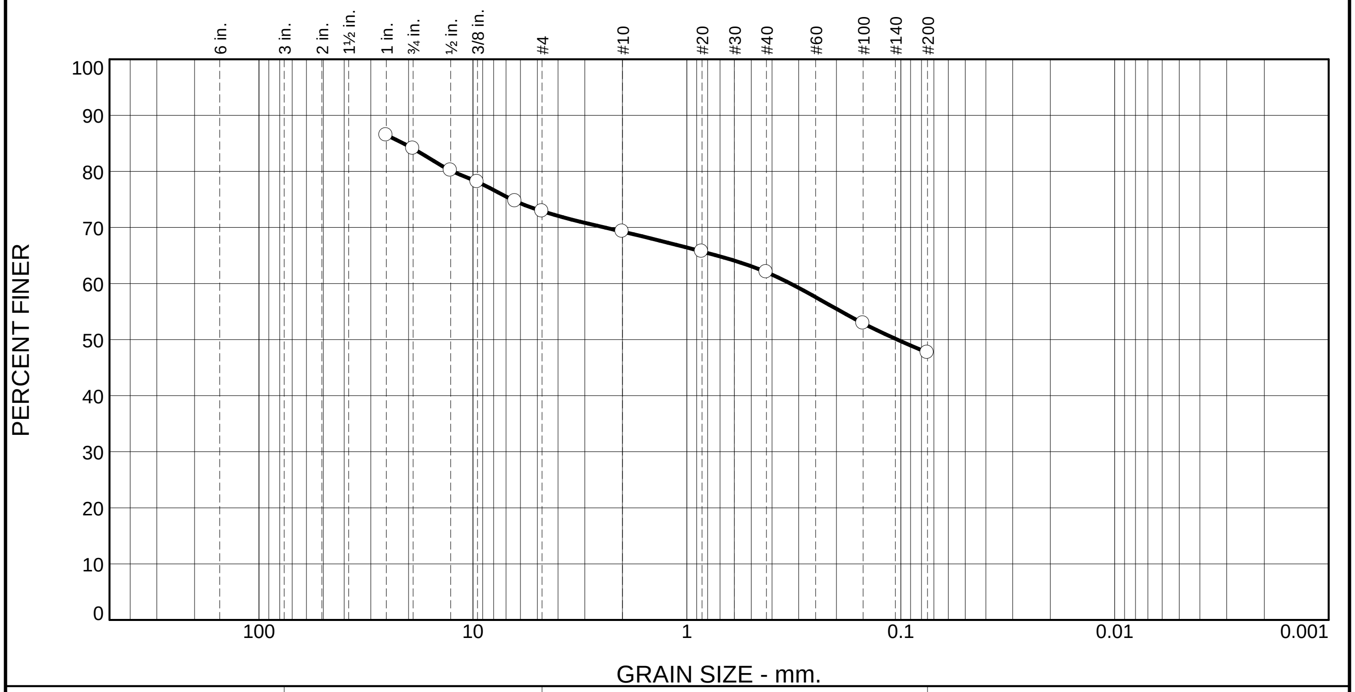
●S15-47

GEOPACIFIC ENGINEERING, INC.

Figure

Tested By: MTB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
		11.2	3.6	7.3	14.3	47.7	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1	86.5		
.75	84.1		
.5	80.2		
.375	78.1		
.25	74.7		
#4	72.9		
#10	69.3		
#20	65.7		
#40	62.0		
#100	52.9		
#200	47.7		

* (no specification provided)

Material Description

Clayey Gravel with Sand

Atterberg Limits (ASTM D 4318)

PL= 25.3 **LL=** 46.7 **PI=** 21.4

Classification

USCS (D 2487)= GC **AASHTO (M 145)=** A-7-6(7)

Coefficients

D_{90}=	D_{85}= 21.1614	D_{60}= 0.3279
D_{50}= 0.1039	D_{30}=	D_{15}=
D_{10}=	C_u=	C_c=

Remarks

Moisture 19.8%
S15-48

Date Received: **Date Tested:** 4.25.2015

Tested By: MTB

Checked By:

Title:

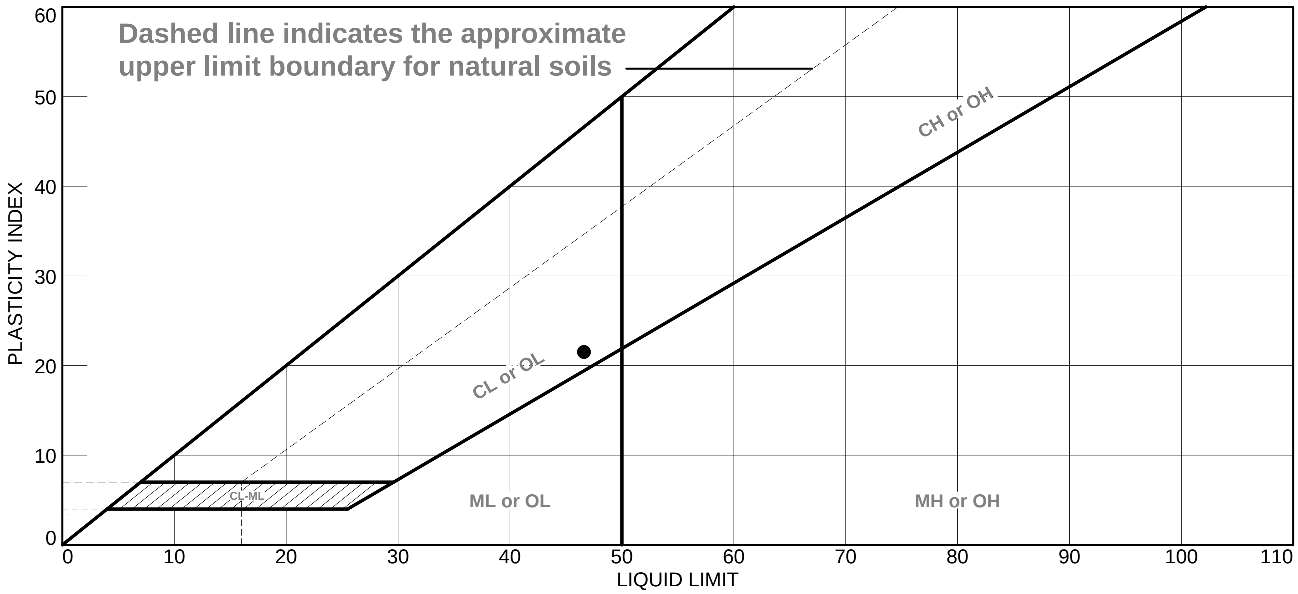
Sample Number: TP-9 **Depth:** 12' **Date Sampled:** 4.17.2015

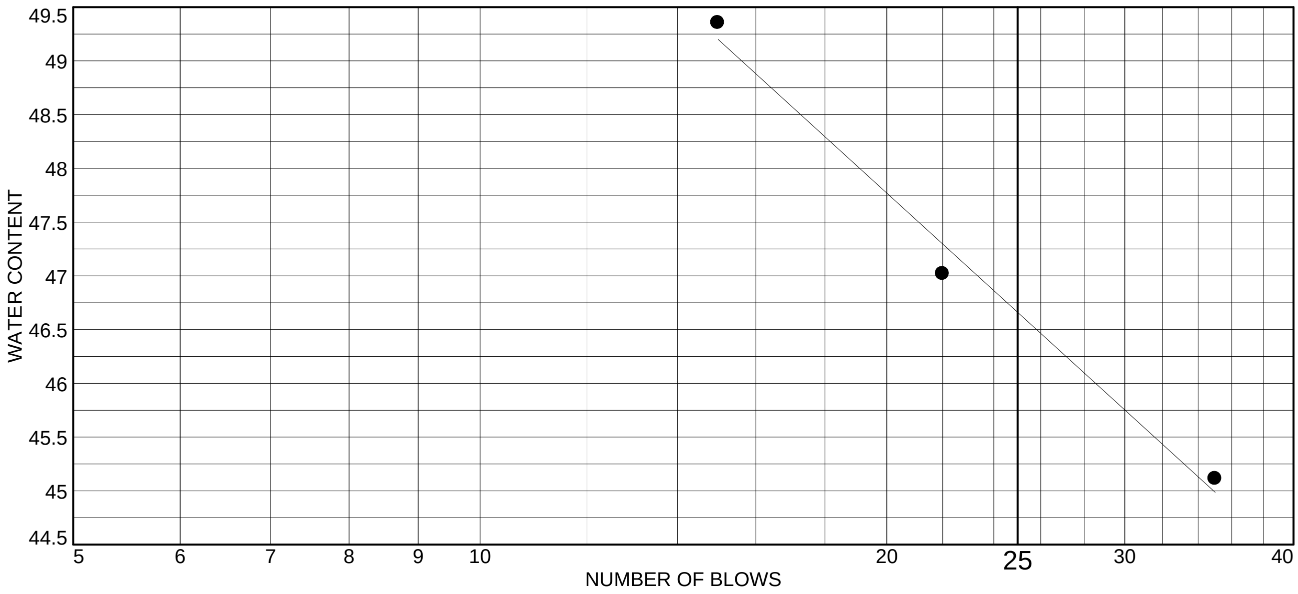
GEOPACIFIC ENGINEERING, INC.

Client: Grand Peak Properties
Project: The Cove Garden Apts

Project No: 15-3719 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Clayey Gravel with Sand	46.7	25.3	21.4	62.0	47.7	GC

Project No. 15-3719 **Client:** Grand Peak Properties

Project: The Cove Garden Apts

Sample Number: TP-9 **Depth:** 12'

Remarks:

●S15-48

GEOPACIFIC ENGINEERING, INC.

Figure

Tested By: MTB

Real-World Geotechnical Solutions
Investigation • Design • Construction Support

PHOTOGRAPHIC LOG

THE COVE GARDEN APARTMENTS
PHOTOGRAPHIC LOG

Aerial Photo, Facing Southeast

Aerial Photo, Facing North

THE COVE GARDEN APARTMENTS
PHOTOGRAPHIC LOG

Aerial Photo, Facing Northeast

Aerial Photo, North End of Site, Facing Southeast

THE COVE GARDEN APARTMENTS
PHOTOGRAPHIC LOG

Aerial Photo, Showing Pond and Concrete Debris, North End of Site

Aerial Photo, Showing Old Building Foundations and Concrete Fill

THE COVE GARDEN APARTMENTS
PHOTOGRAPHIC LOG


Aerial Photo, Facing West, Showing Concrete Fill


Aerial Photo, Facing West, Showing Concrete Fill

THE COVE GARDEN APARTMENTS
PHOTOGRAPHIC LOG

Test Pit TP-2

Facing Northwest

East Side of Site, Facing South

THE COVE GARDEN APARTMENTS
PHOTOGRAPHIC LOG

Facing North, Test Pit TP-3, Excavating Fill and Garbage

Facing South, Test Pit TP-3, Excavating Fill and Garbage

THE COVE GARDEN APARTMENTS
PHOTOGRAPHIC LOG

Facing South, Test Pit TP-6

Facing West, Test Pit TP-9

THE COVE GARDEN APARTMENTS
PHOTOGRAPHIC LOG

Facing South, Test Pit TP-10

Test Pit TP-10

THE COVE GARDEN APARTMENTS
PHOTOGRAPHIC LOG

Facing East, Test Pit TP-11

Test Pit TP-11, Depth = 3 Feet

THE COVE GARDEN APARTMENTS
PHOTOGRAPHIC LOG

East Side of Site, Facing South, Pond with Concrete Debris

Northeast Portion of Site, Facing East, Showing Layering of Concrete Pours

THE COVE GARDEN APARTMENTS
PHOTOGRAPHIC LOG

North End of Site, Old Building Foundation

Test Pit TP-17

HISTORICAL AERIAL PHOTOGRAPHY

THE COVE GARDEN APARTMENTS
HISTORICAL AERIAL PHOTOGRAPHY

1936, North at Right

THE COVE GARDEN APARTMENTS
HISTORICAL AERIAL PHOTOGRAPHY

1944, North at Right

THE COVE GARDEN APARTMENTS
HISTORICAL AERIAL PHOTOGRAPHY

1955, North at Right

THE COVE GARDEN APARTMENTS
HISTORICAL AERIAL PHOTOGRAPHY

1963, North at Right

THE COVE GARDEN APARTMENTS
HISTORICAL AERIAL PHOTOGRAPHY

1972, North at Right

THE COVE GARDEN APARTMENTS
HISTORICAL AERIAL PHOTOGRAPHY

1980, North at Right

THE COVE GARDEN APARTMENTS
HISTORICAL AERIAL PHOTOGRAPHY

1996, North at Right, During 100-Year Flood Event

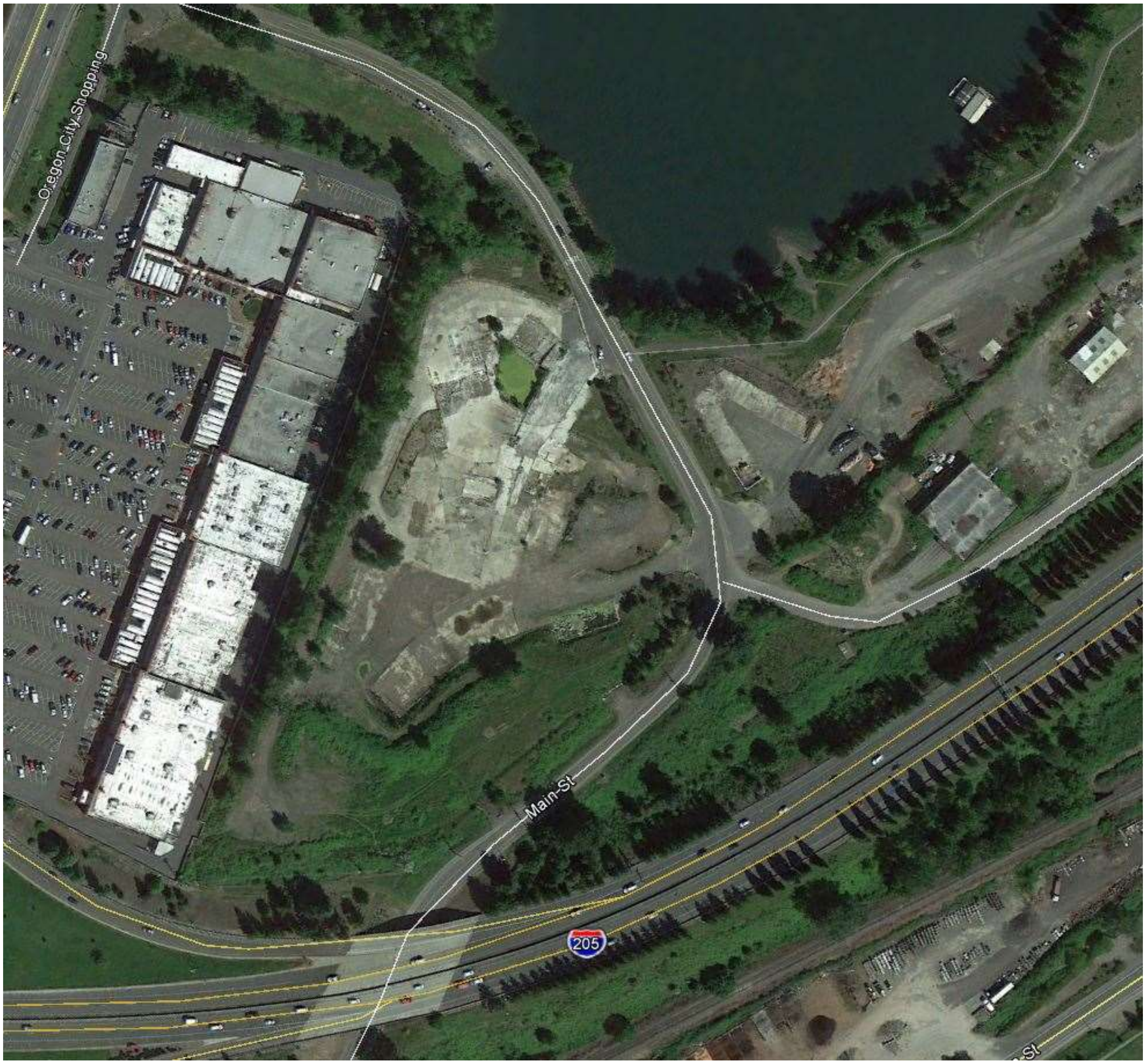
THE COVE GARDEN APARTMENTS
HISTORICAL AERIAL PHOTOGRAPHY

2001, North at Top

THE COVE GARDEN APARTMENTS
HISTORICAL AERIAL PHOTOGRAPHY

2007, North at Top

THE COVE GARDEN APARTMENTS
HISTORICAL AERIAL PHOTOGRAPHY



2010, North at Top