GeoPacific Engineering, Inc.

Real-World Geotechnical Solutions
Investigation • Design • Construction Support

Soils Investigation Report

6123 Skyline Drive Partition
West Linn, Oregon 97068

GeoPacific Engineering, Inc. Project No. 19-5206
April 29, 2019

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SUBJECT: **GEOTECHNICAL ENGINEERING REPORT**
6123 SKYLINE DRIVE PARTITION
WEST LINN, OREGON 97068

1.0 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 geotechnical recommendations for site development. This geotechnical study was performed in accordance with GeoPacific Proposal No. P-6958, dated April 15, 2019, and your subsequent authorization of our proposal and *General Conditions for Geotechnical Services*.

Site Location:	6123 Skyline Drive West Linn, Oregon 97068 Clackamas County Parcel No. 00377666 (see Figures 1 through 3)
Developer:	ICON Construction 1980 Willamette Falls Drive, #200 West Linn, Oregon 97068 Phone: (503) 657-0406
Jurisdictional Agency:	City of West Linn, Oregon
Geotechnical Engineer:	GeoPacific Engineering, Inc 14835 SW 72nd Avenue Portland, Oregon 97224 Tel (503) 598-8445 Fax (503) 941-9281

2.0 SITE AND PROJECT DESCRIPTION

As indicated on Figures 1 through 3, the subject site is located at 6123 Skyline Drive in West Linn, Oregon. The site consists of Clackamas County Parcel No. 00377666, totaling approximately 0.75-acres in size. The site latitude and longitude are 45.368147, -122.625978, and the legal description is the SE ¼ NE ¼ of Section 25, T2S, R1E, Willamette Meridian. The site is bordered by Skyline Drive to the south, by existing residential properties to the north and west, and by the City of West Linn Bolton Reservoir to the east. Historically the property contained a residential home which was located in the southern portion of the property adjacent Skyline Drive. The remainder of the property was primarily surfaced with lawn and landscaping. A garden was present in the approximate center of the site. The northern and western portion of the property contained large trees. The home was removed in 2016 during re-construction of Bolton Reservoir to the east. The property was utilized as a construction staging area which included placement of soil, gravel, and various equipment. A gravel pad was constructed extending from Skyline Drive to the approximate center of the property and a rectangular shaped working pad area was created encompassing the central and southern portion of the property. Following completion of the reservoir reconstruction the site was cleared, leveled, and revegetated with grass. Currently vegetation at the site primarily consists of grasses, weeds, and other brush, with trees still present in the northwestern portion of the site. Topography at the site is relatively level to gently sloping to the north with site elevations ranging from approximately 439 to 462 feet above mean sea level (amsl). Beyond the property line to the north/northwest topography becomes moderately to steeply sloping to the north and northwest, extending to Firwood Court below. Firwood Court is at an elevation of approximately 410 feet amsl.

Based upon communication with the client and review of a preliminary site and grading plan prepared by Theta LLC, GeoPacific understands that the proposed development at the site will consist of a three-lot property partition to support construction of new residential homes, construction of a private access drive extending from Skyline Drive to the lots, construction of individual lot stormwater swales, and installation of associated underground utilities. The site plan indicates the approximate locations of the proposed building footprints (see Figure 3). We anticipate that the homes will be two-stories, constructed with typical spread foundations and wood framing, with maximum structural loading on column footings and continuous strip footings on the order of 10 to 35 kips, and 2 to 6 kips respectively. Based on review of the grading plan we understand that cuts and fills on the order of three feet or less have been proposed.

2.1 State of Oregon Landslide Hazard Mapping

We have reviewed the State of Oregon Department of Geology and Mineral Industries (DOGAMI) landslide hazard and inventory mapping, and SLIDO LiDAR imagery which indicates that the site is located within a large ancient landslide area mapped and identified as landslide No. Canby 133. The DOGAMI mapping indicates that the landslide consists of a rock slide or translational slide with an average slope of 15 percent, and a failure depth of 38.6 feet. The direction of failure is reported to be approximately N45°E. Many homes, roads, and public infrastructure are built across the slide area including the Bolton Reservoir.

Detailed geotechnical evaluation of the Canby 133 landslide is beyond the scope of this study, however we have reviewed available public literature regarding the slide. We reviewed a technical memorandum prepared for the City of West Linn regarding reservoir siting alternatives for the Bolton Reservoir, prepared by Murray, Smith & Associates, Inc., of Portland, Oregon, dated September 24, 2014. The memorandum and subsequent information posted to the public on City of West Linn websites indicates that the city was aware of the DOGAMI landslide mapping during planning phase of the reservoir re-construction and considered alternative sites due to potential risk of future sliding at the existing site. We understand that after over ninety other sites were assessed, it was determined that the existing site was the most suitable for re-construction of the reservoir. Measures were apparently implemented to reduce risks associated with future sliding which included achieving greater slope setbacks from localized sloping areas to the north and constructing deep foundation ground improvements consisting of 812 rammed aggregate piers to depths of approximately 27 feet bgs. In addition, we understand that soil was removed from steep slopes at the site and extensive drainage was installed around and beneath the reservoir structure to allow ground and surface water seepage to flow through. The image below indicates the DOGAMI landslide mapping and the location of the subject site.

Image: SLIDO Statewide Landslide Information Layer for Oregon, DOGAMI

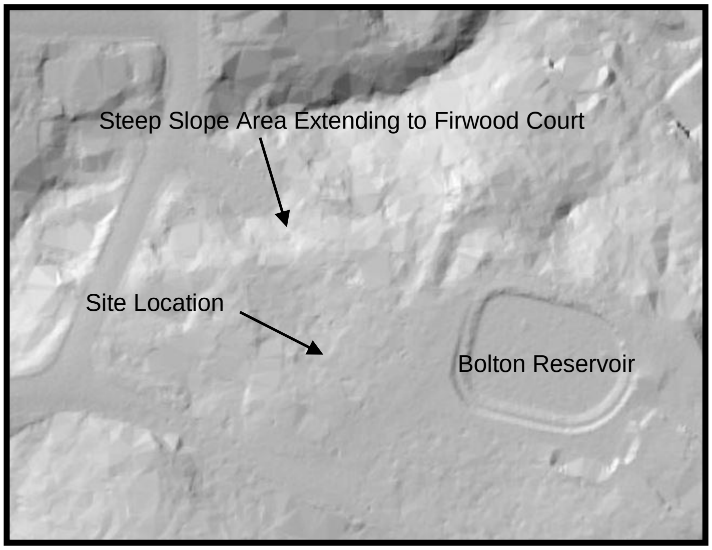

Image: LiDAR HAZVU Statewide Landslide Information Layer for Oregon, DOGAMI

3.0 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.

The *Generalized Geologic Map of the Willamette Lowland, Marshall W. Gannett and Rodney R. Caldwell, (U.S. Department of the Interior, U.S. Geological Survey, 1998)*, indicates that the site is underlain by Miocene-aged (approximately 23 to 11 million years ago) Columbia River basalt flows, which consist of phyric basalt and basaltic-andesite flows erupted eastern Oregon, Washington, and Idaho, (Tcr). The basalts are generally composed of dense, finely crystalline rock that is commonly fractured along blocky and columnar vertical joints.

The *Web Soil Survey (United States Department of Agriculture, Natural Resource Conservation Service (USDA NRCS 2019 Website)*, indicates that near-surface soils consist of the Cascade Silt Loam soil series. Cascade series soils generally consist of moderately deep to a fragipan, poorly drained soils that formed in silty materials.

4.0 REGIONAL SEISMIC SETTING

At least three 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 Gales Creek-Newberg-Mt. Angel Structural Zone, and the Cascadia Subduction Zone.

4.1 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 3.5 and 5.0 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 3 miles northeast of the site. The Oatfield Fault occurs along the western side of the Portland Hills and is located approximately 2.3 miles northeast of the site. The East Bank Fault occurs along the eastern margin of the Willamette River, and is located approximately 7.3 miles southeast 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).

4.2 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 17.7 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.

4.3 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.

5.0 FIELD EXPLORATION AND SUBSURFACE CONDITIONS

Our subsurface explorations for this report were conducted on April 19, 2019. Four exploratory test pits (TP-1 through TP-4) were excavated at the site using a track-mounted excavator provided by the client to a maximum depth of approximately 11 feet bgs. Explorations were conducted under the full-time observation of a GeoPacific engineer. The primary purpose of the explorations was to determine depths and soil consistency of undocumented fill soils known to be present on the parcel by the developer who had previously conducted several excavator test pits at the property and identified up to 9 feet of undocumented fill soils. It appears that the undocumented fill soils were likely placed at the site during re-construction of the Bolton Reservoir.

During our explorations, pertinent information including soil sample depths, stratigraphy, soil engineering characteristics, and groundwater occurrence were recorded. Soils were classified in accordance with the Unified Soil Classification System (USCS). Soil samples obtained from the explorations were placed in relatively air-tight plastic bags. The test pits were loosely backfilled with onsite soils. The approximate locations of the explorations are indicated on Figures 2 and 3. 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. Summary exploration logs are attached. The stratigraphic contacts shown on the individual test pit logs represent the approximate boundaries between soil types. The actual transitions may be more gradual. The soil and groundwater conditions depicted are only for the specific dates and locations reported, and therefore, are not necessarily representative of other locations and times. Soil and groundwater conditions encountered in the explorations are summarized below.

5.1 Soil Descriptions

Topsoil: At the locations of our test pits, the ground surface was generally vegetated by grass and weeds. The top soil horizon was primarily observed to consist of dark brown, very moist, organic SILT (OL-ML), with roots extending to approximately 6 to 8 inches bgs.

Undocumented Fill: At the locations of our test pits, the grassy topsoil layers were found to be underlain by approximately 1 to 9 feet of undocumented fill soils consisting of a range of materials.

- At the location of Parcel 1, undocumented fill soils were observed to be present on the order of 1 to 3 feet thick consisting of stiff, reddish brown, moist, Clayey SILT (ML), containing trace concrete debris.
- At the location of Parcel 2, undocumented fill soils were observed to be present on the order of 9 feet thick, consisting of medium stiff, dark brown, moist, Clayey SILT (ML), containing subrounded cobble sized rock, wood debris, and a buried drain field.
- At the location of Parcel 3, undocumented fill soils were observed to be present on the order of 2 to 2.5 feet thick, consisting of loose, dark brown, moist, SILT (ML), containing roots.

SILT (Loess): Underlying the undocumented fill soils at the site, apparent native soils were encountered consisting of very stiff, brown to light brown, moist, micaceous, SILT (ML). The soil type appears to represent wind-blown loess which likely blanketed clayey residual soils and bedrock mapped as being present at the site. The soil type extended to the maximum depth of exploration within our test pits. Review of available well logs indicates that the loess has been found to range in thickness from 10 to 40 feet in other drilling explorations conducted on Skyline Drive (see Site Research Appendix).

5.2 Shrink-Swell Potential

Fine-grained SILT displaying low-plasticity characteristics was encountered within our subsurface explorations. The shrink-swell potential of near surface soils are considered to be low and is not anticipated to require special design measures where structures are proposed.

5.3 Groundwater and Soil Moisture

On April 19, 2019, the observed soil moisture conditions were generally moist. Groundwater seepage was not encountered within our explorations which extended to a maximum depth of 11 feet bgs. Based upon review of available well logs obtained from the State of Oregon Water Resources Department Well Log Query Report, static groundwater is commonly encountered at depths of 20 to 40 feet bgs in the vicinity of the subject site. Perched groundwater may be encountered in localized areas. Seeps and springs may exist in areas not explored and may become evident during site grading.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Our site investigation indicates that the proposed development appears to be geotechnically feasible, provided that the recommendations of this report are incorporated into the design and construction phases of the project. The primary geotechnical concerns associated with development at this site are:

1. The presence of 1 to 9 feet of variable undocumented fill soils at the site. It appears that the fill soils are present up to 3 feet thick on Parcels 1 and 3, and up to 9 feet thick on Parcel 2. The existing undocumented fill soils are not considered to be suitable to provide adequate bearing support for construction of foundations. Differential settlement is a concern due to variable soil conditions. At building lots where the undocumented fill soils are shallow it may be feasible to remove, scarify, sort, and replace the soils in the upper 2 to 3 feet as engineered fill. Alternatively, foundations may extend through the fill soils to bear directly on competent native soils. Where the fill soils were observed to be present to depths greater than 3 or 4 feet, either full removal of the fill and replacement as engineered fill should be conducted, or deep foundations such as rammed aggregate piers may be considered. See Section 6.1, Site Preparation Recommendations, and Section 6.6, Spread Foundations, for more detail.

2. The site is located on a large ancient landslide identified by DOGAMI as Canby 133. Extensive development is present across the landslide. Detailed evaluation of the Canby 133 landslide and the affect it may have on the proposed development is beyond the scope of this study. It appears that with consideration to the degree of surrounding development, the understanding that the landside is considered to be ancient, and the long history of residential homes on the property, the overall landslide mass may be relatively stable. However, given the noted information and mapping, if additional study is determined to be needed by the client or local building official, we would recommend conducting soil borings and a quantitative slope stability of the sloping areas on the north end of the property to determine if additional stabilization measures may be desired or needed for the homesites.

3. A moderate to steep slope is present beyond the northwestern property line that extends to Firwood Court below. Parcel 3 will be located above the slope as shown on Figure 3. The hillside is heavily vegetated and showed no signs of recent erosion or instability at the time of our study. Based on review of the site plan and the indicated building envelope for Parcel 3 it appears that 20 to 30 feet of setback is proposed from the top of the slope which is approximately 30 feet high. Recommendations regarding adequate footing-to-slope setback distances for foundations are presented below in Section 6.6, Spread Foundations.

4. Due to the site being located on a large ancient landslide, and the presence of a steep slope area to the north of the property, we recommend that the grading plan be adjusted to eliminate any raising of grades or additional soil surcharges on the building lots. Grade adjustments within the proposed drive and driveways appear to be feasible.

5. Proposed stormwater ponds near the tops of steep slope areas should be lined with an appropriate liner so that the ponds are impermeable. In no case shall stormwater be directed or allowed to flow freely over the slope faces.

6.1 Site Preparation Recommendations

Areas of proposed construction and areas to receive fill should be cleared of any organic and inorganic debris, and loose stockpiled soils. Inorganic debris and organic materials from clearing should be removed from the site or spread back over the lots as topsoil. Organic-rich soils and root zones should then be stripped from construction areas of the site or where engineered fill is to be placed. Depth of stripping of existing grassy organic topsoil is estimated to be approximately 6 to 8 inches across the majority of the site, however depth of organic soil layers may increase to 24 to 30 inches in areas where trees and vegetation are present.

As previously noted, undocumented fill soils were encountered within our subsurface explorations:

- At the location of Parcel 1, undocumented fill soils were observed to be present on the order of 1 to 3 feet thick consisting of stiff, reddish brown, moist, Clayey SILT (ML), containing trace concrete debris. The fill soils are underlain by stiff native silts. We recommend either: 1) excavating and recompacting the undocumented fill soils to achieve 95 percent compaction relative to ASTM D698; or 2) leave the fill material in place and over-excavate and extend foundation elements through the fill soils to bear directly on firm native soil.

- At the location of Parcel 2, undocumented fill soils were observed to be present on the order of 9 feet thick, consisting of medium stiff, dark brown, moist, Clayey SILT (ML), containing subrounded cobble sized rock, wood debris, and a buried drain field. The fill soils are underlain by stiff native silts. We recommend either: 1) excavating and recompacting the undocumented fill soils to achieve 95 percent compaction relative to ASTM D698; or 2) leave the fill material in place and install rammed aggregate piers to support the proposed home foundation.

- At the location of Parcel 3, undocumented fill soils were observed to be present on the order of 2 to 2.5 feet thick, consisting of loose, dark brown, moist, SILT (ML), containing roots. The fill soils are underlain by stiff native silts. We recommend either: 1) excavating and recompacting the undocumented fill soils to achieve 95 percent compaction relative to ASTM D698; or 2) leave the fill material in place and over-excavate and extend foundation elements through the fill soils to bear directly on firm native soil.

The final depth of soil removal should be determined by the geotechnical engineer or designated representative during site inspection while stripping/excavation is being performed. Stripped topsoil should be removed from areas proposed for placement of engineered fill. 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.

Where/if encountered, undocumented fills and any subsurface structures (dry wells, basements, driveway and landscaping fill, old utility lines, septic leach fields, etc.) should be completely removed and the excavations backfilled with engineered fill. Understanding of the extent and types of undocumented fill is based on the observed conditions within our subsurface explorations. Experience has shown that soil conditions can change greatly over short distances. It is possible fill exists in areas and extents other than those identified in our subsurface explorations.

Site earthwork may be impacted by wet weather conditions. Stabilization of subgrade soils may require aeration and recompaction. If subgrade soils are found to be difficult to stabilize, over-excavation, placement of granular soils, or cement treatment of subgrade soils may be feasible options. GeoPacific should be onsite to observe preparation of subgrade soil conditions prior to placement of engineered fill.

6.2 Engineered Fill

Due to the site being located on a large ancient landslide, and the presence of a steep slope area to the north of the property, we recommend that the grading plan be adjusted to eliminate any raising of grades or additional soil surcharges on the building lots. Grade adjustments within the proposed drive and driveways appear to be feasible. Engineered fill recommendations below are specific to removal and replacement of the existing undocumented fill back to existing grades.

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. Site grading should be conducted in accordance with the requirements outlined in the 2015 International Building Code (IBC), Chapter 18 and Appendix J. Areas proposed for fill placement should be prepared as described in Section 6.1, Site Preparation Recommendations. Surface soils should then be scarified and recompacted prior to placement of structural fill. Site preparation, soil stripping, and grading activities should be observed and documented by a geotechnical engineer or his representative. Proper test frequency and earthwork documentation usually requires daily observation and testing during stripping, rough grading, and placement of engineered fill.

Onsite native soils consisting of Clayey SILT/SILT (ML), appear to be suitable for use as engineered fill assuming any inorganic or organic debris is removed. Soils containing greater than 3 percent organic content should not be used as structural 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 12 inches using standard compaction equipment. We recommend that engineered fill be compacted to at least 95 percent of the maximum dry density determined by ASTM D698 (Standard 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 may be impacted by shallow groundwater, soil moisture and wet weather conditions. Earthwork in wet weather would likely require extensive use of additional crushed aggregate, cement or lime treatment, or other special measures, at considerable additional cost compared to earthwork performed under dry-weather conditions.

6.3 Excavating Conditions and Utility Trench Backfill

We anticipate that onsite soils can generally be excavated using conventional heavy equipment. Bedrock was not encountered within our subsurface explorations which extended to a maximum depth of 11 feet bgs, however we encountered cobble-sized rock. 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 native soils classify as Type B Soil and temporary excavation side slope inclinations as steep as 1H:1V may be assumed for planning purposes. These cut slope inclinations are applicable to excavations above the water table only.

Shallow, perched groundwater may be encountered at the site 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.

Underground utility pipes should be installed in accordance with the procedures specified in ASTM D2321 and City of West Linn standards. We recommend that structural trench backfill be compacted to at least 95 percent of the maximum dry density obtained by the Modified Proctor (ASTM D1557) 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 100-lineal-foot section of trench.

6.4 Erosion Control Considerations

During our field exploration program, we did not observe soil conditions that may 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.

6.5 Wet Weather Earthwork

Soils underlying the site are likely to be moisture sensitive and will 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 will 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.

6.6 Spread Foundations

Based upon communication with the client and review of a preliminary site and grading plan prepared by Theta LLC, GeoPacific understands that the proposed development at the site will consist of a three-lot property partition to support construction of new residential homes. The site plan indicates the approximate building footprints of the proposed homes. We anticipate that the homes will be two-stories, constructed with typical spread foundations and wood framing, with maximum structural loading on column footings and continuous strip footings on the order of 10 to 35 kips, and 2 to 6 kips respectively.

6.6.1 Recommendations Regarding Undocumented Fill Soil

- At the location of Parcel 1, undocumented fill soils were observed to be present on the order of 1 to 3 feet thick, consisting of stiff, reddish brown, moist, Clayey SILT (ML), containing trace concrete debris. The existing undocumented fill soils are not considered to be suitable to provide adequate bearing support for construction of foundations. Differential settlement is a concern due to variable soil conditions. The fill soils are underlain by stiff native silts. We recommend either: 1) excavating and recompacting the undocumented fill soils to achieve 95 percent compaction relative to ASTM D698; or 2) leave the fill material in place and over-excavate and extend foundation elements through the fill soils to bear directly on firm native soil.

- At the location of Parcel 2, undocumented fill soils were observed to be present on the order of 9 feet thick, consisting of medium stiff, dark brown, moist, Clayey SILT (ML), containing subrounded cobble sized rock, wood debris, and a buried drain field. The fill soils are underlain by stiff native silts. We recommend either: 1) excavating and recompacting the undocumented fill soils to achieve 95 percent compaction relative to ASTM D698; or 2) leave the fill material in place and install rammed aggregate piers to support the foundation.

- At the location of Parcel 3, undocumented fill soils were observed to be present on the order of 2 to 2.5 feet thick, consisting of loose, dark brown, moist, SILT (ML), containing tree roots. The fill soils are underlain by stiff native silts. We recommend either: 1) excavating and recompacting the undocumented fill soils to achieve 95 percent compaction relative to ASTM D698; or 2) leave the fill material in place and over-excavate and extend foundation elements through the fill soils to bear directly on firm native soil.

6.6.2 Recommended Footing-to-Slope Setbacks

As described above, a moderate to steep slope is present beyond the northwestern property line that extends to Firwood Court below. Parcel 3 will be located above the slope as shown on Figure 3. The overall slope height is approximately 30 feet. The hillside is heavily vegetated and showed no clear signs of recent erosion or instability at the time of our study. Based on review of the site plan and the indicated building envelope for Parcel 3 it appears that 20 to 30 feet of setback is proposed from the top of the slope to the home foundation. The noted setback distance appears to be adequate, however we recommend that a minimum footing-to-slope setback distance of at least 20 feet be maintained for foundations, engineered fill, and any structures or slabs. Reductions in setback distance should not be conducted without supporting soil boring explorations, and detailed quantitative slope stability assessment and calculations. Based on our review of the proposed locations of foundation envelopes of Parcels 1 and 2 it appears that each will be located at least 80 to 100 feet from steeply sloping areas.

Foundation design, construction, and setback requirements should conform to the applicable building code at the time of construction. For maximization of bearing strength and protection against frost heave, spread footings should be embedded at a minimum depth of 12 inches below exterior grade. Foundations should be designed by a licensed structural engineer.

The anticipated allowable soil bearing pressure is 1,500 lbs/ft^2 for footings bearing on competent, native soil and/or engineered fill, adequately prepared as described above. If over-excavation is needed, it should be conducted under the direction and supervision of the geotechnical engineer or designated representative. The recommended maximum allowable bearing pressure may be increased by 1/3 for short-term transient conditions such as wind and seismic loading. For heavier loads, the geotechnical engineer should be consulted. The coefficient of friction between on-site soil and poured-in-place concrete may be taken as 0.42, which includes no factor of safety. The maximum anticipated total and differential footing movements (generally from soil expansion and/or settlement) are 1 inch and ¾ inch over a span of 20 feet, respectively. We anticipate that the majority of the estimated settlement will occur during construction, as loads are applied. Excavations near structural footings should not extend within a 1H:1V plane projected downward from the bottom edge of footings.

Footing excavations should penetrate through topsoil and any disturbed soil to competent subgrade that is suitable for bearing support. All footing excavations should be trimmed neat, and all loose or softened soil should be removed from the excavation bottom prior to placing reinforcing steel bars. Due to the moisture sensitivity of on-site native soils, foundations constructed during the wet weather season may require over-excavation of footings and backfill with compacted, crushed aggregate.

Our recommendations are for residential construction incorporating raised wood floors and conventional spread footing foundations. After site development, a Final Soil Engineer's Report should either confirm or modify the above recommendations.

6.7 Concrete Slabs-on-Grade

Preparation of areas beneath concrete slab-on-grade floors should be performed as described in Section 6.1, Site Preparation Recommendations and Section 6.6, Spread Foundations. Care should be taken during excavation for foundations and floor slabs, to avoid disturbing subgrade soils. If subgrade soils have been adversely impacted by wet weather or otherwise disturbed, the surficial soils should be scarified to a minimum depth of 8 inches, moisture conditioned to within about 3 percent of optimum moisture content and compacted to engineered fill specifications. Alternatively, disturbed soils may be removed and the removal zone backfilled with additional crushed rock.

For evaluation of the concrete slab-on-grade floors using the beam on elastic foundation method, a modulus of subgrade reaction of 150 kcf (87 pci) should be assumed for the medium dense, fine to coarse-grained soils anticipated to be present at foundation subgrade elevation following adequate site preparation as described above. This value assumes the concrete slab system is designed and constructed as recommended herein, with a minimum thickness of 8 inches of 1½”-0 crushed aggregate beneath the slab. The total thickness of crushed aggregate will be dependent on the subgrade conditions at the time of construction and should be verified visually by proof-rolling. Under-slab aggregate should be compacted to at least 95 percent of its maximum dry density as determined by ASTM D1557 (Modified Proctor) or equivalent.

In areas where moisture will be detrimental to floor coverings or equipment inside the proposed structure, appropriate vapor barrier and damp-proofing measures should be implemented. A commonly applied vapor barrier system consists of a 10-mil polyethylene vapor barrier placed directly over the capillary break material. Other damp/vapor barrier systems may also be feasible. Appropriate design professionals should be consulted regarding vapor barrier and damp proofing systems, ventilation, building material selection and mold prevention issues, which are outside GeoPacific’s area of expertise.

6.8 Footing and Roof Drains

Construction should include typical measures for controlling subsurface water beneath the structures, including positive crawlspace drainage to an adequate low-point drain exiting the foundation, visqueen covering the exposed ground in the crawlspace, and crawlspace ventilation (foundation vents). The client should be informed and educated that some slow flowing water in the crawlspaces is considered normal and not necessarily detrimental to the structures given these other design elements incorporated into construction. Appropriate design professionals should be consulted regarding crawlspace ventilation, building material selection and mold prevention issues, which are outside GeoPacific’s area of expertise.

Down spouts and roof drains should collect roof water in a system separate from the footing drains to reduce the potential for clogging. Roof drain water should be directed to an appropriate discharge point and storm system well away from structural foundations. Grades should be sloped downward and away from buildings to reduce the potential for ponded water near structures.

Perimeter footing drains are considered necessary for this building. Perimeter footing drains should consist of 3 or 4-inch diameter, perforated plastic pipe embedded in a minimum of 1 ft^3 per lineal foot of clean, free-draining drain rock. The drain pipe and surrounding drain rock should be wrapped in non-woven geotextile (Mirafi 140N, or approved equivalent) to minimize the potential for clogging and/or ground loss due to piping. A minimum 0.5 percent fall should be maintained throughout the drain and non-perforated pipe outlet. Figure 4 presents a typical perimeter footing drain detail. In our opinion, footing drains may outlet at the curb, or on the back sides of lots where sufficient fall is not available to allow drainage to meet the street. In no case shall collected stormwater be allowed to flow freely over slope faces.

6.9 Permanent Below-Grade Walls

Lateral earth pressures against below-grade retaining walls will depend upon the inclination of any adjacent slopes, type of backfill, degree of wall restraint, method of backfill placement, degree of backfill compaction, drainage provisions, and magnitude and location of any adjacent surcharge loads. At-rest soil pressure is exerted on a retaining wall when it is restrained against rotation. In contrast, active soil pressure will be exerted on a wall if its top is allowed to rotate or yield a distance of roughly 0.001 times its height or greater.

If the subject retaining walls will be free to rotate at the top, they should be designed for an active earth pressure equivalent to that generated by a fluid weighing 35 pcf for level backfill against the wall. For restrained wall, an at-rest equivalent fluid pressure of 55 pcf should be used in design, again assuming level backfill against the wall. These values assume that the recommended drainage provisions are incorporated, and hydrostatic pressures are not allowed to develop against the wall.

During a seismic event, lateral earth pressures acting on below-grade structural walls will increase by an incremental amount that corresponds to the earthquake loading. Based on the Mononobe-Okabe equation and peak horizontal accelerations appropriate for the site location, seismic loading should be modeled using the active or at-rest earth pressures recommended above, plus an incremental rectangular-shaped seismic load of magnitude 6.5H, where H is the total height of the wall.

We assume relatively level ground surface below the base of the walls. As such, we recommend passive earth pressure of 320 pcf for use in design, assuming wall footings are cast against competent native soils or engineered fill. If the ground surface slopes down and away from the base of any of the walls, a lower passive earth pressure should be used and GeoPacific should be contacted for additional recommendations.

A coefficient of friction of 0.42 may be assumed along the interface between the base of the wall footing and subgrade soils. The recommended coefficient of friction and passive earth pressure values do not include a safety factor, and an appropriate safety factor should be included in design. The upper 12 inches of soil should be neglected in passive pressure computations unless it is protected by pavement or slabs on grade.

The above recommendations for lateral earth pressures assume that the backfill behind the subsurface walls will consist of properly compacted structural fill, and no adjacent surcharge loading. If the walls will be subjected to the influence of surcharge loading within a horizontal distance equal to or less than the height of the wall, the walls should be designed for the additional horizontal pressure. For uniform surcharge pressures, a uniformly distributed lateral pressure of 0.3 times the surcharge pressure should be added. Traffic surcharges may be estimated using an additional vertical load of 250 psf (2 feet of additional fill), in accordance with local practice.

The recommended equivalent fluid densities assume a free-draining condition behind the walls so that hydrostatic pressures do not build-up. This can be accomplished by placing a 12 to 18-inch wide zone of sand and gravel containing less than 5 percent passing the No. 200 sieve against the walls. A 3-inch minimum diameter perforated, plastic drain pipe should be installed at the base of the walls and connected to a suitable discharge point to remove water in this zone of sand and gravel. The drain pipe should be wrapped in filter fabric (Mirafi 140N or other as approved by the geotechnical engineer) to minimize clogging.

Wall drains are recommended to prevent detrimental effects of surface water runoff on foundations – not to dewater groundwater. Drains should not be expected to eliminate all potential sources of water entering a basement or beneath a slab-on-grade. An adequate grade to a low point outlet drain in the crawlspace is required by code. Underslab drains are sometimes added beneath the slab when placed over soils of low permeability and shallow, perched groundwater.

Water collected from the wall drains should be directed into the local storm drain system or other suitable outlet. A minimum 0.5 percent fall should be maintained throughout the drain and non-perforated pipe outlet. Down spouts and roof drains should not be connected to the wall drains in order to reduce the potential for clogging. The drains should include clean-outs to allow periodic maintenance and inspection. Grades around the proposed structure should be sloped such that surface water drains away from the building.

GeoPacific should be contacted during construction to verify subgrade strength in wall keyway excavations, to verify that backslope soils are in accordance with our assumptions, and to take density tests on the wall backfill materials.

Structures should be located a horizontal distance of at least 1.5H away from the back of the retaining wall, where H is the total height of the wall. GeoPacific should be contacted for additional foundation recommendations where structures are located closer than 1.5H to the top of any wall.

6.10 Proposed Stormwater Ponds

Stormwater detention ponds are proposed near the top of steep slope areas for Parcels 2 and 3. We recommend that the stormwater ponds are constructed to be impermeable. A typical liner should be placed in the pond. In no case shall stormwater be directed or allowed to flow freely over the slope faces.

7.0 SEISMIC DESIGN

The Oregon Department of Geology and Mineral Industries (DOGAMI), Oregon HazVu: 2019 Statewide GeoHazards Viewer indicates that the site is in an area where *very strong* ground shaking is anticipated during an earthquake. Structures should be designed to resist earthquake loading in accordance with the methodology described in the 2015 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 7-10, Chapter 20, Table 20.3-1. Design values determined for the site using the ATC Hazards by Location 2019 Seismic Design Maps Summary Report are summarized in Table 1 and are based upon observed existing soil conditions.

Table 1: Recommended Earthquake Ground Motion Parameters (USGS 2019)

Parameter	Value
Location (Lat, Long), degrees	45.368, -122.626
Probabilistic Ground Motion Values, 2% Probability of Exceedance in 50 yrs	
Peak Ground Acceleration PGA_M	0.448 g
Short Period, S_s	0.948 g
1.0 Sec Period, S_1	0.408 g
Soil Factors for Site Class D:	
F_a	1.121
F_v	1.592
$SD_s = 2/3 \times F_a \times S_s$	0.708 g
$SD_1 = 2/3 \times F_v \times S_1$	0.433 g
Seismic Design Category	D

7.1 Soil Liquefaction

The Oregon Department of Geology and Mineral Industries (DOGAMI), Oregon HazVu: 2019 Statewide GeoHazards Viewer indicates that the site is in an area considered to be at *low* risk for soil liquefaction during an earthquake. Soil liquefaction is a phenomenon wherein saturated soil deposits temporarily lose strength and behave as a liquid in response to ground shaking caused by strong earthquakes. Soil liquefaction is generally limited to loose, sands and granular soils located below the water table, and fine-grained soils with a plasticity index less than 15. According to our review of geologic mapping the site is underlain by fine-grained soil deposits underlain by basaltic bedrock. Review of available well logs indicates static groundwater is commonly encountered at depths of 20 to 40 feet bgs in the vicinity of the subject site. Based upon the results of our study, it is our opinion that the risk of soil liquefaction at the site during a seismic event at the subject site should be considered to be low.

8.0 UNCERTAINTIES AND LIMITATIONS

We have prepared this report for the owner and their consultants for use in design of this project only. This report should be provided in its entirety to prospective contractors for bidding and estimating purposes; however, 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.

Sufficient geotechnical monitoring, testing and consultation should be provided during construction to confirm that the conditions encountered are consistent with those indicated by explorations. The checklist attached to this report outlines recommended geotechnical observations and testing for the project. Recommendations for design changes will be provided should conditions revealed during construction differ from those anticipated, and to verify that the geotechnical aspects of construction comply with the contract plans and specifications.

Within the limitations of scope, schedule and budget, GeoPacific attempted to execute 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, expressed 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 12/31/19

REGISTERED PROFESSIONAL ENGINEER
14743PE
OREGON
JAN. 23, 1990
JAMES D. IMBRIE

EXPIRES: 06/30/2019

Benjamin L. Cook, R.G.
Senior Geologist

James D. Imbrie, P.E.
Principal Geotechnical Engineer

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CHECKLIST OF RECOMMENDED GEOTECHNICAL TESTING AND OBSERVATION

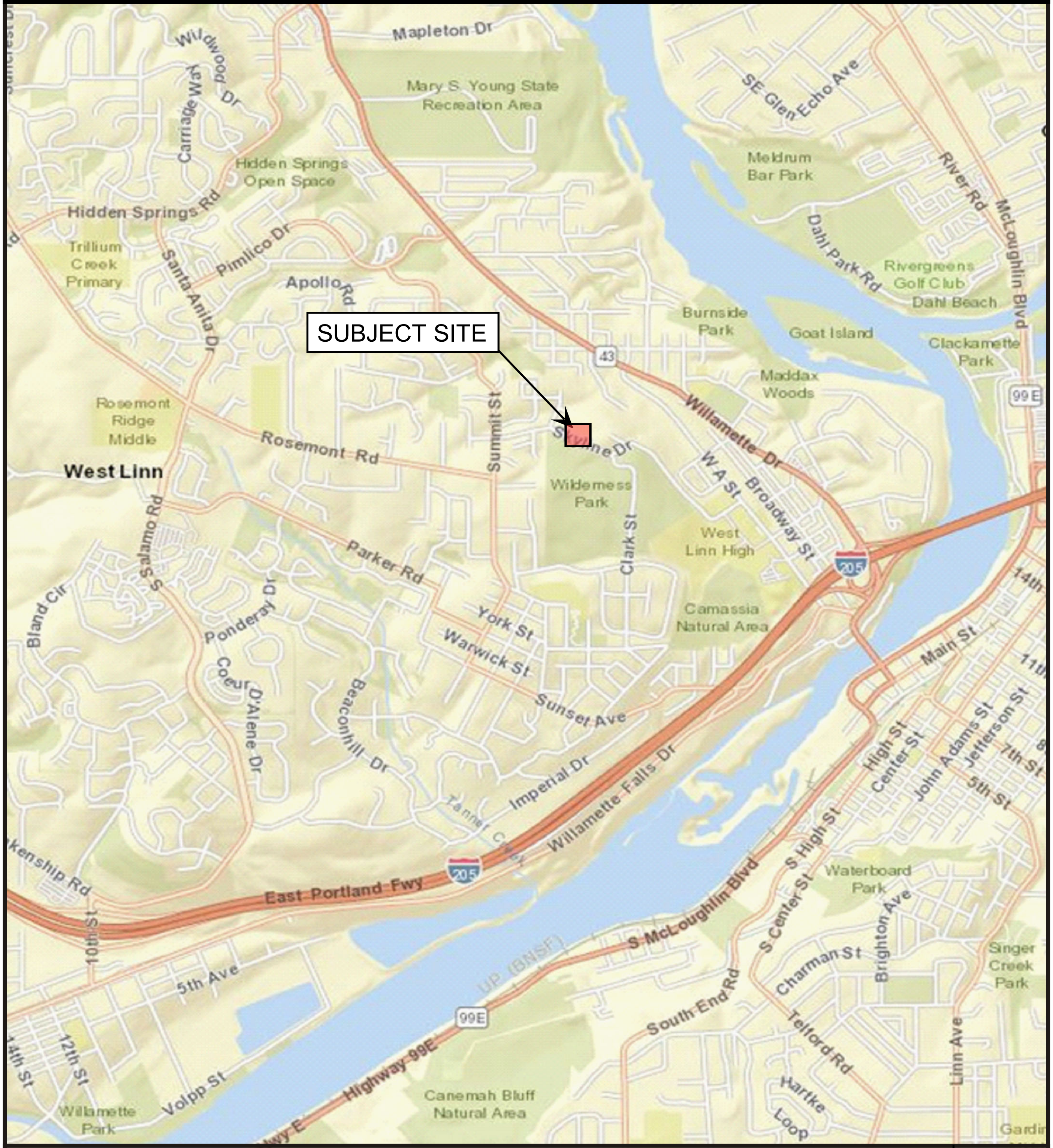
Item No.	Procedure	Timing	By Whom	Done
1	Preconstruction meeting	Prior to beginning site work	Contractor, Developer, Civil and Geotechnical Engineers	
2	Fill removal from site or sorting and stockpiling	Prior to mass stripping	Soil Technician/ Geotechnical Engineer	
3	Stripping, aeration, and root-picking 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	Foundation Subgrade Compaction (95% of Modified Proctor)	During Foundation Preparation, Prior to Placement of Reinforcing Steel	Soil Technician/ Geotechnical Engineer	
6	Compaction testing of trench backfill (95% of Modified Proctor)	During backfilling, tested every 4 vertical feet for every 200 linear feet	Soil Technician	
7	Street Subgrade Inspection (95% of Standard Proctor)	Prior to placing base course	Soil Technician	
8	Base course compaction (95% of Modified Proctor)	Prior to paving, tested every 200 linear feet	Soil Technician	
9	Asphalt Compaction (92% Rice Value)	During paving, tested every 100 linear feet	Soil Technician	
10	Final Geotechnical Engineer's Report	Completion of project	Geotechnical Engineer	

FIGURES

GeoPacific Engineering, Inc.

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

SITE VICINITY MAP



Base Map: DOGAMI HAZVU STREET VIEW, 2019
Date: 4/25/2019
Drawn by: BLC

North

Project: 6123 Skyline Drive Partition
West Linn, Oregon 97068

Project No. 19-5167

FIGURE 1

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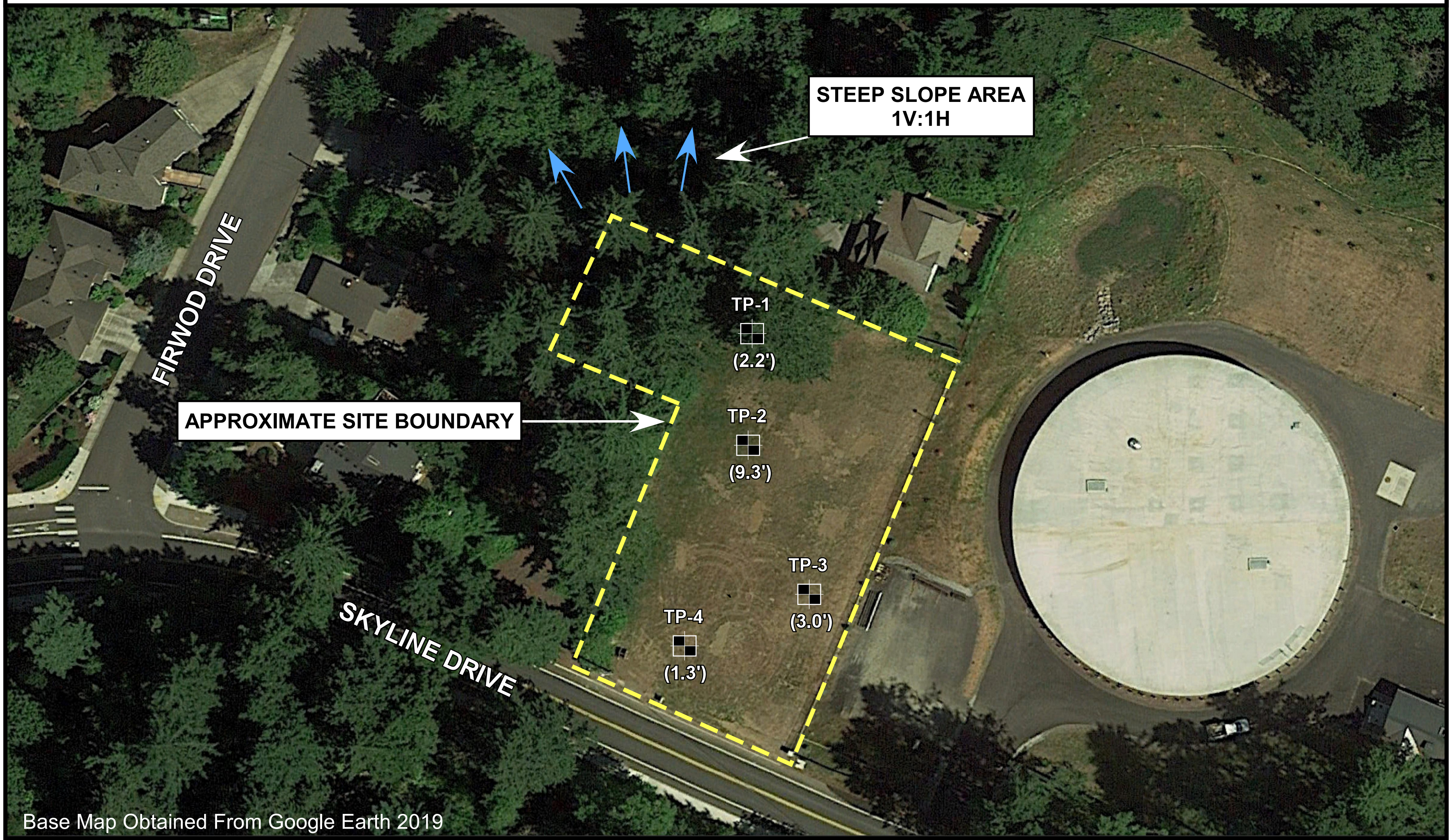
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

SITE AERIAL AND EXPLORATION LOCATIONS



Base Map Obtained From Google Earth 2019

Legend:

TP-1
▣ Test Pit Designation and Approximate Location
(2.0') Depth of Undocumented Fill, Feet

APPROXIMATE SCALE (FEET)

Drawn by: TJT
Date: 04/22/2019

↑ **North**

Project: 6123 Skyline Drive Partition
West Linn, Oregon 97068

Project No. 19-5206

FIGURE 2

GeoPacific Engineering, Inc.
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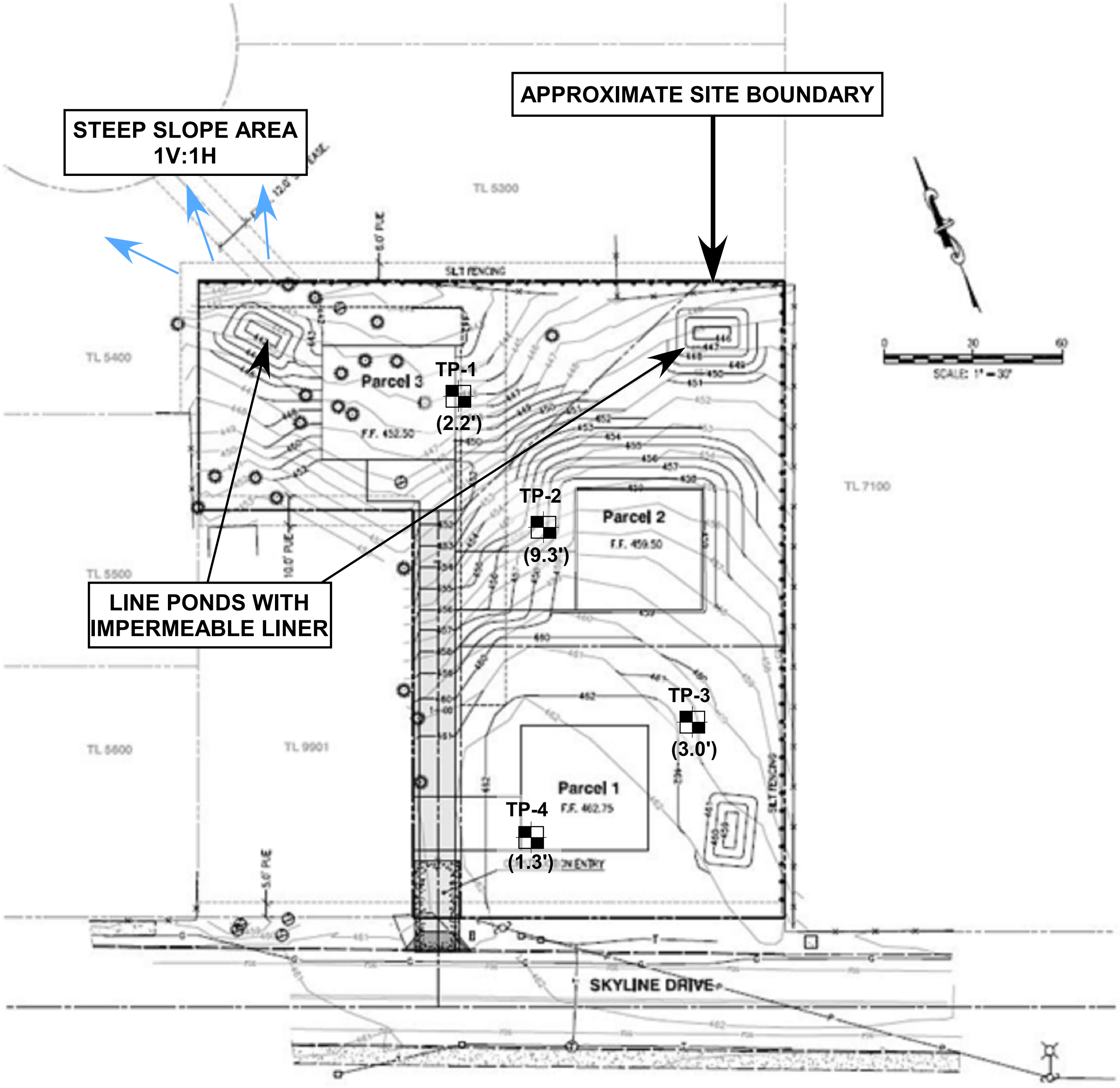
SITE PLAN AND EXPLORATION LOCATIONS



Legend: **TP-1**
▚ Test Pit Designation and Approximate Location
(2.0') Depth of Undocumented Fill, Feet

Base Map: Preliminary Grading Plan, 6123 Skyline Drive Partition, Theta, LLC Sheet 4/4

APPROXIMATE SCALE
(AS NOTED)

Date: 4/22/19
Drawn by: TJT

North

Project: 6123 Skyline Drive Partition
West Linn, Oregon 97068

Project No. 19-5206

FIGURE 3

14835 SW 72nd Avenue
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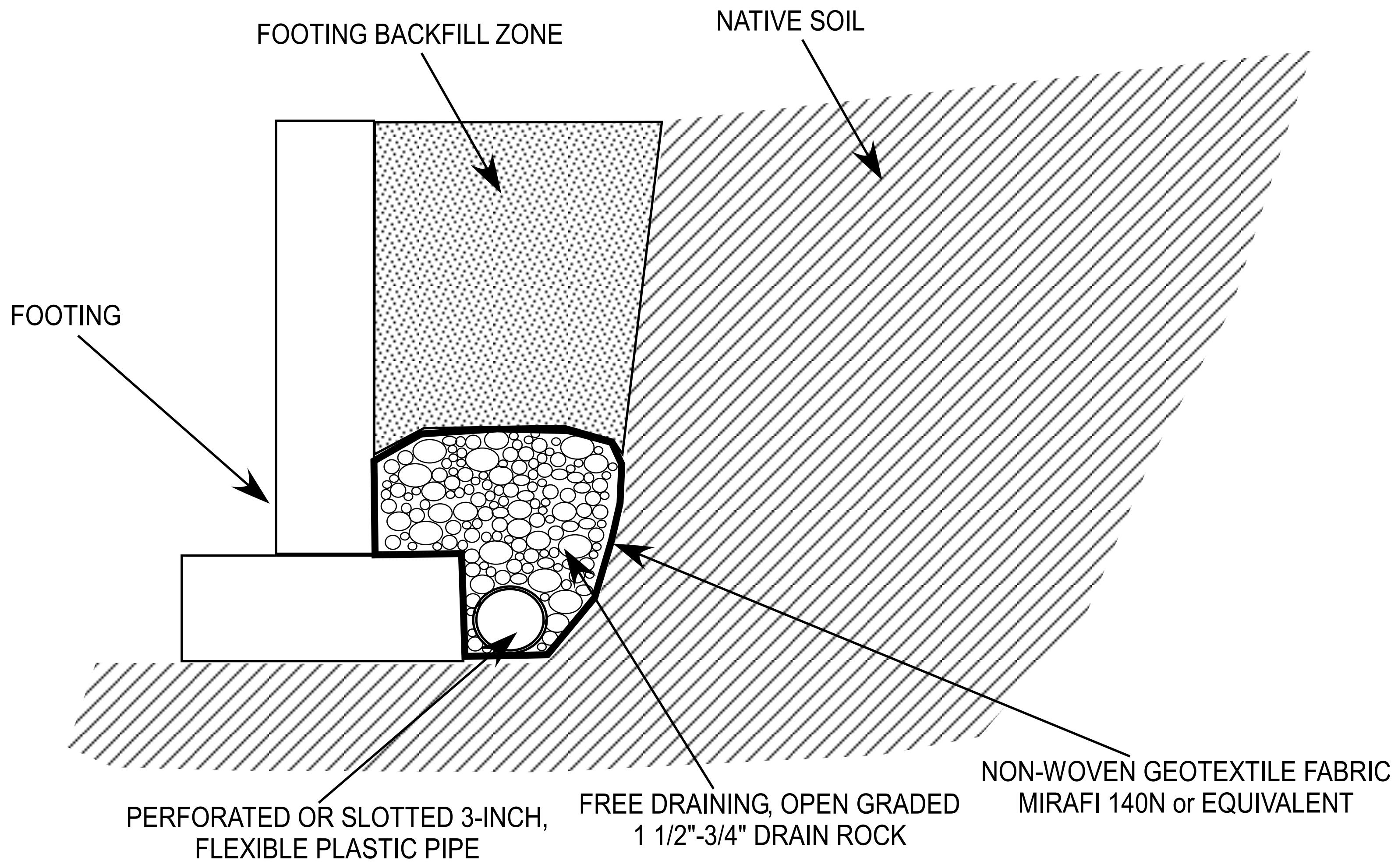
TYPICAL PERIMETER FOOTING DRAIN DETAIL



Notes:
1) Drain rock should contain no more than 5 percent fines passing the U.S. No. 200 Sieve.
2) Trench bottom and drain pipe should be sloped to drain to approved discharge location.

Date: 4/26/2019
Drawn by: BLC

Project: 6123 Skyline Drive
West Linn, Oregon 97068

Project No. 19-5142

FIGURE 4

EXPLORATION LOGS

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TEST PIT LOG

Project: 6123 Skyline Drive Partition
West Linn, Oregon 97068

Project No. 19-5206

Test Pit No. **TP- 1**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	**Material Description**
1	1.0					FILL. SILT (ML), loose, dark brown, with fine and medium roots throughout, 6 inch thick layer of moderately organic topsoil developed on the surface, with trace angular gravel and coarse sand, moist.
2	0.75					
3	4.0					Apparent Native Soil. SILT (ML), very stiff, brown to light brown, with trace black staining, low plasticity, micaceous, moist. (Loess).
4	3.75					
5						Test Pit Terminated at 4.5 feet bgs. No seepage or groundwater encountered.
6						
7						
8						
9						
10						
11						
12						

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: 04/19/2019
Logged By: T. Torkelson
Surface Elevation: 444 feet amsl

GeoPacific Engineering, Inc.

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TEST PIT LOG

Project: 6123 Skyline Drive Partition
West Linn, Oregon 97068

Project No. 19-5206

Test Pit No. **TP- 2**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	In-Situ Dry Density (lb/ft^3)	Moisture Content (%)	Water Bearing Zone	**Material Description**
						FILL. Clayey SILT (ML), stiff, reddish brown with dark brown mottling, 4 inch thick layer of moderately organic topsoil developed on the ground surface, disturbed texture, moist.
1	2.5					
2	4.0					Grades to very stiff at 2 feet bgs.
3	3.0					
						Grades to medium stiff and dark brown below 3.5 feet bgs.
4	2.0					Grades to with subrounded, cobble sized rock and trace wood debris below 4 feet bgs.
5		100 to 1,000 g				
6						
7						
8		100 to 1,000 g				
9						Drain field consisting of drain rock encountered at 9 feet bgs.
						Apparent Native Soil. Clayey SILT (ML), very stiff, brown, low plasticity, micaceous, moist. (Loess).
10						
		100 to 1,000 g				
11						Test Pit Terminated at 11 feet bgs. No seepage or groundwater encountered.
12						

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: 04/19/2019
Logged By: T. Torkelson
Surface Elevation: 456 feet amsl

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Tel: (503) 598-8445 Fax: (503) 941-9281

TEST PIT LOG

Project: 6123 Skyline Drive Partition
West Linn, Oregon 97068

Project No. 19-5206

Test Pit No. **TP- 3**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	In-Situ Dry Density (lb/ft^3)	Moisture Content (%)	Water Bearing Zone	Material Description
						FILL. Clayey SILT (ML), very stiff, reddish brown with trace black staining, 4 inch thick layer of moderately organic topsoil developed on the ground surface, with trace angular gravel, moist.
1	4.5+					
2	4.5+					
3	4.5+					Apparent Native Soil. SILT (ML), very stiff, brown, very low plasticity, micaceous, very moist. (Loess).
	3.5	100 to 1,000 g				
4						Test Pit Terminated at 4 feet bgs. No seepage or groundwater encountered.
5						
6						
7						
8						
9						
10						
11						
12						

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: 04/19/2019
Logged By: T. Torkelson
Surface Elevation: 460 feet amsl

GeoPacific Engineering, Inc.

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

TEST PIT LOG

Project: 6123 Skyline Drive Partition West Linn, Oregon 97068	Project No. 19-5206	Test Pit No. **TP- 4**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	In-Situ Dry Density (lb/ft^3)	Moisture Content (%)	Water Bearing Zone	**Material Description**
1	3.0					FILL. Clayey SILT (ML), loose, dark brown, 6 inch thick layer of moderately organic topsoil developed on the ground surface, contains trace gravel and concrete debris, very moist. Grades to stiff at 6 inches bgs.
2	3.5					Apparent Native Soil. SILT (ML), very stiff, brown, very low plasticity, with trace black staining, micaceous, very moist. (Loess).
3	4.0 4.5					
4						Test Pit Terminated at 3.5 feet bgs. No seepage or groundwater encountered.
5						
6						
7						
8						
9						
10						
11						
12						

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: 04/19/2019
Logged By: T. Torkelson
Surface Elevation: 462 feet amsl

SOIL DESCRIPTION AND CLASSIFICATION GUIDELINES

Particle-Size Classification

COMPONENT	ASTM/USCS		AASHTO	
	size range	sieve size range	size range	sieve size range
Cobbles	> 75 mm	greater than 3 inches	> 75 mm	greater than 3 inches
Gravel	75 mm – 4.75 mm	3 inches to No. 4 sieve	75 mm – 2.00 mm	3 inches to No. 10 sieve
Coarse	75 mm – 19.0 mm	3 inches to 3/4-inch sieve	-	-
Fine	19.0 mm – 4.75 mm	3/4-inch to No. 4 sieve	-	-
Sand	4.75 mm – 0.075 mm	No. 4 to No. 200 sieve	2.00 mm – 0.075 mm	No. 10 to No. 200 sieve
Coarse	4.75 mm – 2.00 mm	No. 4 to No. 10 sieve	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve
Medium	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve	-	-
Fine	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve
Fines (Silt and Clay)	< 0.075 mm	Passing No. 200 sieve	< 0.075 mm	Passing No. 200 sieve

Consistency for Cohesive Soil

CONSISTENCY	SPT N-VALUE (BLOWS PER FOOT)	POCKET PENETROMETER (UNCONFINED COMPRESSIVE STRENGTH, tsf)
Very Soft	2	less than 0.25
Soft	2 to 4	0.25 to 0.50
Medium Stiff	4 to 8	0.50 to 1.0
Stiff	8 to 15	1.0 to 2.0
Very Stiff	15 to 30	2.0 to 4.0
Hard	30 to 60	greater than 4.0
Very Hard	greater than 60	-

Relative Density for Granular Soil

RELATIVE DENSITY	SPT N-VALUE (BLOWS PER FOOT)
Very Loose	0 to 4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	more than 50

Moisture Designations

TERM	FIELD IDENTIFICATION
Dry	No moisture. Dusty or dry.
Damp	Some moisture. Cohesive soils are usually below plastic limit and are moldable.
Moist	Grains appear darkened, but no visible water is present. Cohesive soils will clump. Sand will bulk. Soils are often at or near plastic limit.
Wet	Visible water on larger grains. Sand and silt exhibit dilatancy. Cohesive soil can be readily remolded. Soil leaves wetness on the hand when squeezed. Soil is much wetter than optimum moisture content and is above plastic limit.

AASHTO SOIL CLASSIFICATION SYSTEM

TABLE 1. Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35 Percent or Less Passing .075 mm)			Silt-Clay Materials (More than 35 Percent Passing 0.075)			
Group Classification	A-1	A-3	A-2	A-4	A-5	A-6	A-7
Sieve analysis, percent passing:							
2.00 mm (No. 10)	-	-	-				
0.425 mm (No. 40)	50 max	51 min	-	-	-	-	-
0.075 mm (No. 200)	25 max	10 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)							
Liquid limit				40 max	41 min	40 max	41 min
Plasticity index	6 max	N.P.		10 max	10 max	11 min	11 min
General rating as subgrade	Excellent to good			Fair to poor			

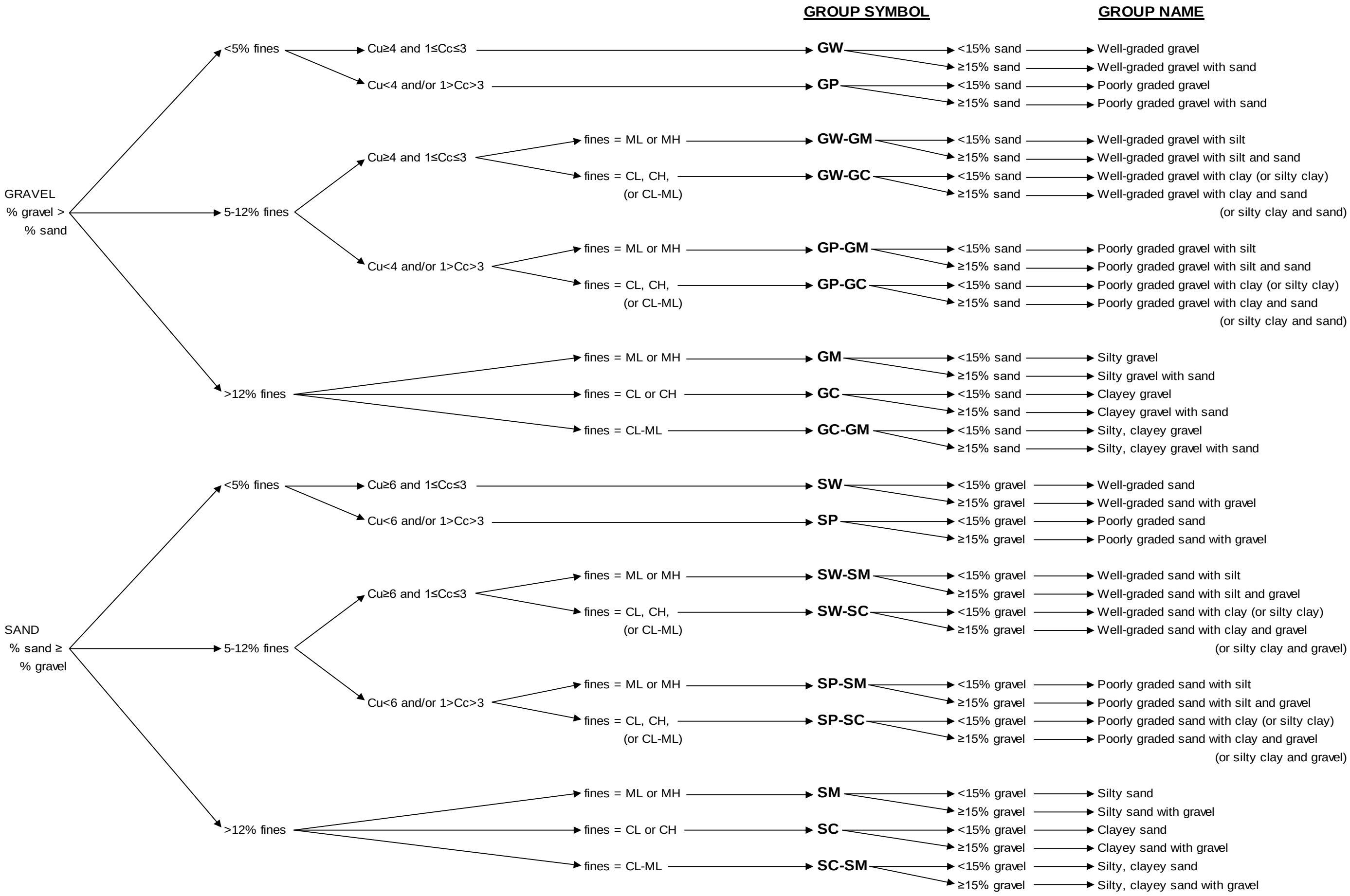
Note: The placing of A-3 before A-2 is necessary in the "left to right elimination process" and does not indicate superiority of A-3 over A-2.

TABLE 2. Classification of Soils and Soil-Aggregate Mixtures

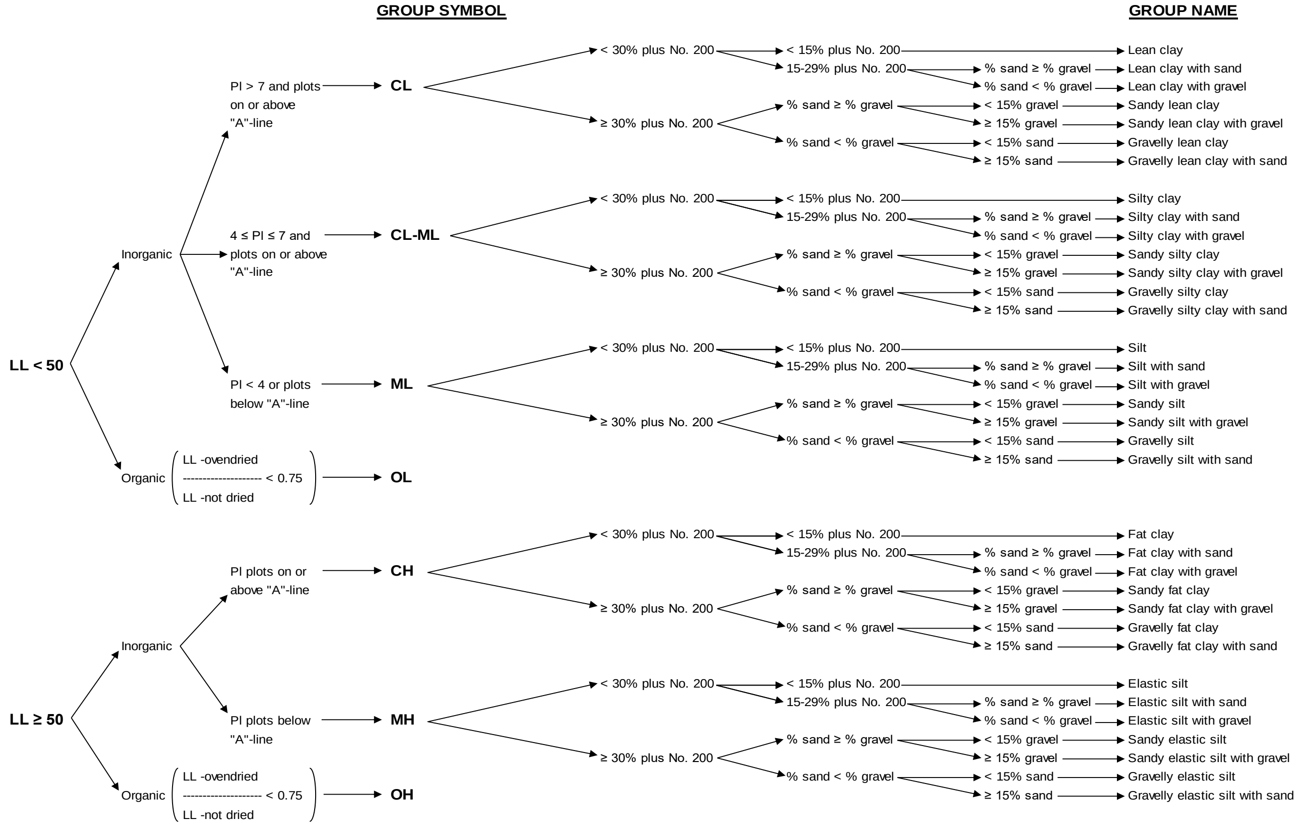
General Classification	Granular Materials (35 Percent or Less Passing 0.075 mm)							Silt-Clay Materials (More than 35 Percent Passing 0.075 mm)			
	A-1			A-2							A-7
Group Classification	A-1-a	A-1-b	A-3	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7-5, A-7-6
Sieve analysis, percent passing:											
2.00 mm (No. 10)	50 max	-	-	-	-	-	-	-	-	-	-
0.425 mm (No. 40)	30 max	50 max	51 min	-	-	-	-	-	-	-	-
0.075 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)											
Liquid limit				40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11min
Usual types of significant constituent materials	Stone fragments, gravel and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
General ratings as subgrade	Excellent to Good							Fair to poor			

Note: Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30 (see Figure 2).

AASHTO = American Association of State Highway and Transportation Officials



Flow Chart for Classifying Coarse-Grained Soils (More Than 50% Retained on No. 200 Sieve)



Flow Chart for Classifying Fine-Grained Soil (50% or More Passes No. 200 Sieve)

SITE RESEARCH

Soil Map—Clackamas County Area, Oregon

Map Scale: 1:1,300 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 14, Sep 18, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 26, 2014—Sep 5, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

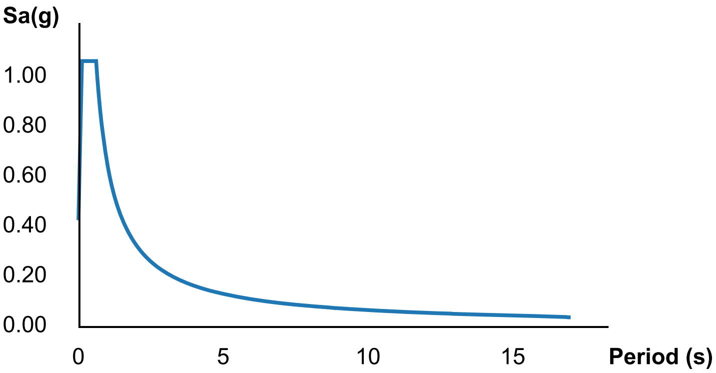
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
13B	Cascade silt loam, 3 to 8 percent slopes	3.2	50.9%
23C	Cornelius silt loam, 8 to 15 percent slopes	1.4	21.2%
92F	Xerochrepts and Haploxerolls, very steep	1.8	27.9%
Totals for Area of Interest		**6.4**	**100.0%**

ATC Hazards by Location

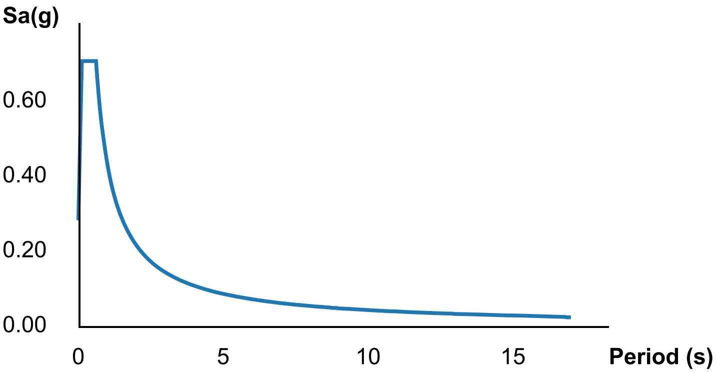
Search Information

Coordinates:	45.368199, -122.625767
Elevation:	460 ft
Timestamp:	2019-04-25T19:52:55.550Z
Hazard Type:	Seismic
Reference Document:	ASCE7-10
Risk Category:	III
Site Class:	D

MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S_S	0.948	MCE_R ground motion (period=0.2s)
S_1	0.408	MCE_R ground motion (period=1.0s)
S_{MS}	1.063	Site-modified spectral acceleration value
S_{M1}	0.649	Site-modified spectral acceleration value
S_{DS}	0.708	Numeric seismic design value at 0.2s SA
S_{D1}	0.433	Numeric seismic design value at 1.0s SA

▾Additional Information

Name	Value	Description
SDC	D	Seismic design category
F_a	1.121	Site amplification factor at 0.2s
F_v	1.592	Site amplification factor at 1.0s
CR_S	0.906	Coefficient of risk (0.2s)

CR_1	0.874	Coefficient of risk (1.0s)
PGA	0.411	MCE_G peak ground acceleration
F_{PGA}	1.089	Site amplification factor at PGA
PGA_M	0.448	Site modified peak ground acceleration
T_L	16	Long-period transition period (s)
SsRT	0.948	Probabilistic risk-targeted ground motion (0.2s)
SsUH	1.047	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	3.037	Factored deterministic acceleration value (0.2s)
S1RT	0.408	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.467	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	1.034	Factored deterministic acceleration value (1.0s)
PGAd	1.159	Factored deterministic acceleration value (PGA)

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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STATE OF OREGON

WATER WELL REPORT

(as required by ORS 537.765)

RECEIVED
APR 30 1986
WATER RESOURCES DEPT
SALEM, OREGON

CLAC 03378

2S/1E-25dc

(1) OWNER:

Owner's Well Number 03

Name Daniel S. Lee

Address 3726 S.E. Tenine

City Portland State Oregon Zip 97202

(2) TYPE OF WORK:

☒ New Well ☐ Deepen ☐ Recondition ☐ Abandon

(3) DRILL METHOD:

☒ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Other

(4) PROPOSED USE:

☒ Domestic ☐ Community ☐ Industrial ☐ Irrigation

☐ Thermal ☐ Injection ☐ Other

(5) BORE HOLE CONSTRUCTION:

Depth of Completed Well 104 ft.

Special Standards date of approval

HOLE			SEAL			Amount
Diameter	From	To	Material	From	To	sacks or pounds
10	0	18	GrBen	0	18	9 Sacks

How was seal placed? Method ☐ A ☐ B ☐ C ☐ D ☐ E

☒ Other Granuler Bentonite placed dry

Backfill placed from ft. to ft. Material

Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	6"	+1	19	.250	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Final location of shoe(s)

(7) PERFORATIONS/SCREENS:

☐ Perforations Method

☐ Screens Type Material

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
						☐	☐
						☐	☐
						☐	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour

☐ Pump ☐ Bailer ☒ Air ☐ Flowing Artesian

Yield gal/min	Pumping level	Drill stem at	Time
80		100'	½ hr
25		42'	1 hr

Temperature of water Depth Artesian Flow Found

Was a water analysis done? ☐ Yes By whom

Did any strata contain water not suitable for intended use? ☐ Too little

☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other

Depth of strata:

(9) LOCATION OF WELL by legal description:

County Clack. Latitude ' " Longitude ' "

Township 2 South N or S, Range 1 East E or W, WM.

Section 25 SE ¼ SW ¼

Tax Lot 3900 Lot Block Subdivision

Street Address of Well (or nearest address) 2929 Lancaster St.
West Linn, OR 97068

(10) STATIC WATER LEVEL:

27 ft. below land surface. Date 4-21-86

Artesian pressure lb. per square inch. Date

(11) WELL LOG:

Ground elevation

Material	From	To	WB?	SWL
Clay brown	0	6		
Basalt brown	6	12		
Basalt grey	12	42		
Basalt black	42	68		
Basalt grey fractured	68	74		
Basalt brown	74	82	X	27
Basalt brown fractured	82	104	X	27

Date started 4-21-86 Completed 4-21-86

(unbonded) Water Well Constructor Certification:

I constructed this well in compliance with Oregon well construction standards. Materials used and information reported above are true to my best knowledge and belief.

Signed Date

(bonded) Water Well Constructor Certification:

I accept responsibility for construction of this well and its compliance with all Oregon water well standards. This report is true to the best of my knowledge and belief.

Signed Marvin D Skyles Date 22 Apr 1986

Company SKYLES DRILLING, INC Co. Job No. 1486

9809C 10/85

2S/1E-25dc

RECEIVED
FEB 6 - 1986
WATER RESOURCES DEPT
SALEM, OREGON

CLAC
03379

STATE OF OREGON
WATER WELL REPORT
(as required by ORS 537.765)

(1) OWNER:
Owner's Well Number: 2
Name Daniel S. Lee
Address 2929 Lancaster
City West Linn State Oregon Zip 97068

(2) TYPE OF WORK:
☒ New Well ☐ Deepen ☐ Recondition ☐ Abandon

(3) DRILL METHOD:
☒ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Other

(4) PROPOSED USE:
☒ Domestic ☐ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other

BORE HOLE CONSTRUCTION:
Depth of Completed Well 104 ft.
Special Standards date of approval

HOLE			SEAL			Amount
Diameter	From	To	Material	From	To	sacks or pounds
10"	0	18	Cem.	0	18'	5 Sacks
6"	18	104				

How was seal placed? Method ☐ A ☐ B ☒ C ☐ D ☐ E
☐ Other
Backfill placed from ft. to ft. Material
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	6"	+1	19	.250	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Final location of shoe(s)

PERFORATIONS/SCREENS:
☐ Perforations Method
☐ Screens Type Material

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
						☐	☐
						☐	☐
						☐	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☐ Pump ☐ Bailer ☒ Air ☐ Flowing Artesian

Yield gal/min	Pumping level	Drill stem at	Time
80		100'	½ hr
25		42'	1 hr

Temperature of water Depth Artesian Flow Found
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL by legal description:
County Clack. Latitude ' " Longitude ' "
Township 2 South N or S, Range 1 East E or W, WM.
Section 25 SE ¼ SW ¼
Tax Lot Lot Block Subdivision
Street Address of Well (or nearest address) 2929 Lancaster
West Linn, OR

(10) STATIC WATER LEVEL:
30 ft. below land surface. Date 1-21-86
Artesian pressure lb. per square inch. Date

(11) WELL LOG:
Ground elevation

Material	From	To	WB?	SWL
Clay brown	0	6		
Basalt brown	6	13		
Basalt grey	13	38		
Basalt grey & brown	38	42		
Basalt grey (softer)	42	50	X	
Basalt black	50	62		
Basalt brown fractured	62	67		
Basalt grey fractured	67	71		
Basalt brown	71	82		
Basalt brown fractured	82	96	X	
Basalt grey porous	96	104	X	30

Date started 01-21-86 Completed 01-21-86

(unbonded) Water Well Constructor Certification:

I constructed this well in compliance with Oregon well construction standards. Materials used and information reported above are true to my best knowledge and belief.

Signed Date

(bonded) Water Well Constructor Certification:

I accept responsibility for construction of this well and its compliance with all Oregon water well standards. This report is true to the best of my knowledge and belief.

Signed Marvin D Skyles Date 01-21-86
Company SKYLES DRILLING, INC Co. Job No. 0286

9809C 10/85

RECEIVED
DEC 17 1997
WATER RESOURCES DEPT.
SALEM, OREGON

CLAC
S2908

STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-035)

(1) OWNER/PROJECT: Hole Number LT-1
Name City of West Linn
Address 2042 8th Ave.
City West Linn State OR Zip 97068

(2) TYPE OF WORK
☒ New ☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment

(3) CONSTRUCTION:
☐ Rotary Air ☐ Hand Auger ☒ Hollow Stem Auger
☒ Rotary Mud ☐ Cable Tool ☐ Push Probe ☒ Other HQ Core

(4) TYPE OF HOLE:
☐ Uncased Temporary ☐ Cased Permanent
☐ Uncased Permanent ☒ Slope Stability ☒ Other Inclinometer

(5) USE OF HOLE: Geotechnical Data, soil descriptions & install inclinometer full depth of hole

(6) BORE HOLE CONSTRUCTION:
Special Construction approval ☐ Yes ☒ No Depth of Completed Hole 57½ ft.

HOLE			SEAL			
Diameter	From	To	Material	From	To	Sacks or pounds
8"	0	54½	Bent. Grout	0	57½'	Two batches
4 7/8"	54½	57½				

Backfill placed from ______ ft. to ______ ft. Material ______
Filter Pack placed from ______ ft. to ______ ft. Size of pack ______

(7) CASING/SCREEN:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	2 7/8	0	57½		☐	☒	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Screen:					☐	☐	☐	☐
					☐	☐	☐	☐

Slot size N/A

(8) WELL TEST:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ______ Yield ______ GPM ______
Conductivity ______ PH ______
Temperature of water ______ °F/C Depth artesian flow found ______ ft.
Was water analysis done? ☐ Yes ☐ No
By whom? ______
Depth of strata analyzed. From ______ ft. to ______ ft.
Remarks: ______

(9) LOCATION OF HOLE by legal description:
County Clakamas Latitude 45°22'7" Longitude 122°37'23"
Township 2 or [✓ S] Range 1 [✓ E] or W. WM.
Section 25 SE 1/4 NE 1/4
Tax Lot ______ Lot ______ Block ______ Subdivision ______
Street Address of Well (or nearest address) Skyline Dr West Linn

Map with location indentified must be attached

(10) STATIC WATER LEVEL:
N/A ft. below land surface. Date ______
Artesian pressure ______ lb. per square inch. Date ______

(11) SUBSURFACE LOG:
Ground Elevation ~430 ft.

Material Description	From	To	SWL
Clayey SILT	0	50	
decomp. BASALT	50	57½	

Date Started 12-5-97 Date Completed 12-5-97

(12) ABANDONMENT LOG:

Material Description	From	To	Sacks or Pounds

Date started ______ Date Completed ______

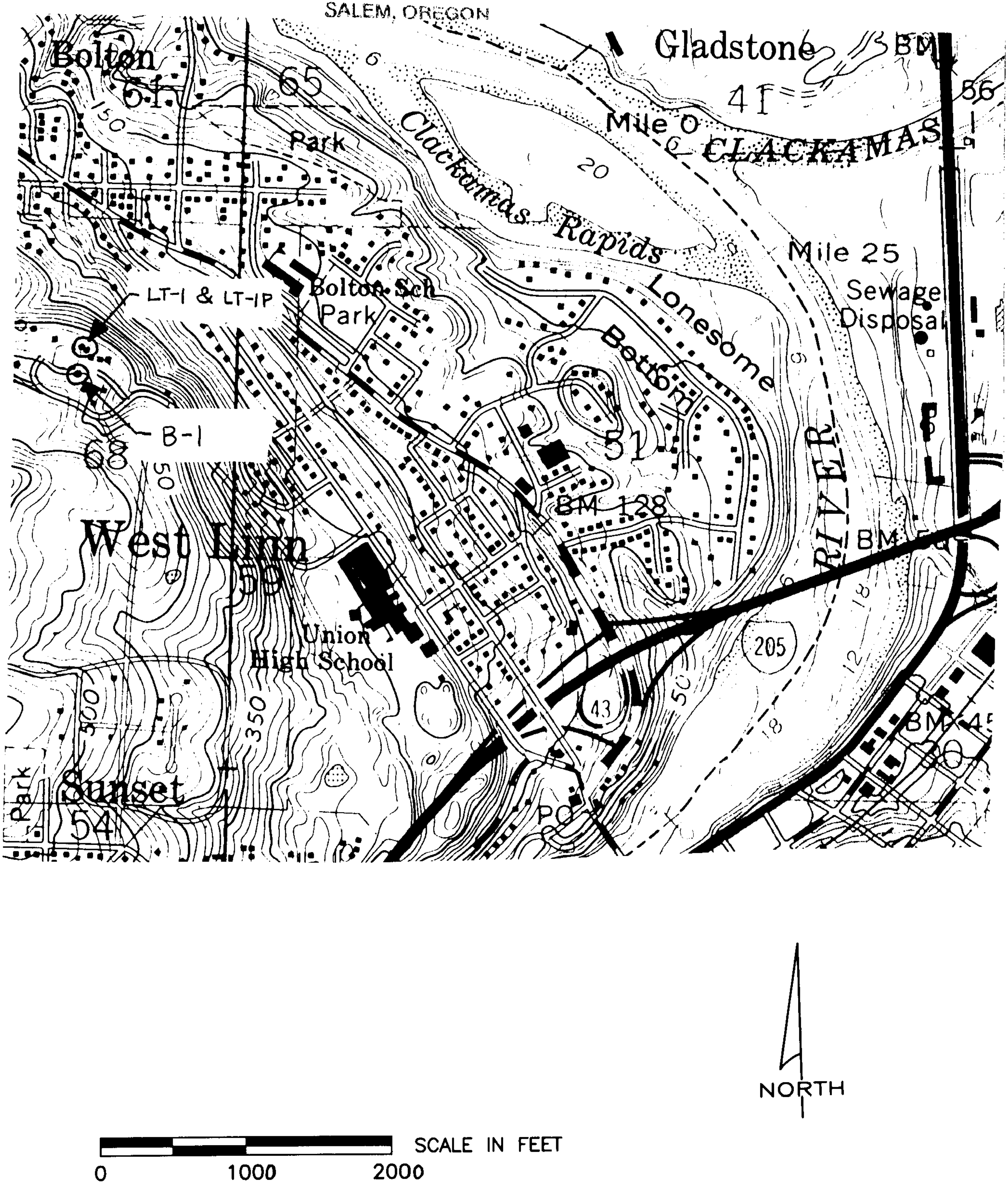
Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or registered geologist or civil engineer).

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

License or Registration Number PE 15,548
Signed D. A. Vessely Date 12/16/97
Affiliation Landslide Technology

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

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER



Cornforth Consultants, Inc.
10250 S.W. Greenburg Rd.
Suite 111
Portland, OR 97223

TITLE LOCATION MAP

DATE 12-16-97

JOB NO.

JOB Bolton Pump Station, West Linn, OR

FIG. 1

DEC 17 1997
WATER RESOURCES DEPT.
SALEM, OREGON

CLAC
52909

STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-035)

(1) OWNER/PROJECT: Hole Number LT-1P
Name City of West Linn
Address 2042 8th Ave.
City West Linn State OR Zip 97068

(2) TYPE OF WORK
☒ New ☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment

(3) CONSTRUCTION:
☐ Rotary Air ☐ Hand Auger ☒ Hollow Stem Auger
☐ Rotary Mud ☐ Cable Tool ☐ Push Probe ☐ Other

(4) TYPE OF HOLE:
☐ Uncased Temporary ☐ Cased Permanent
☐ Uncased Permanent ☒ Slope Stability ☐ Other

(5) USE OF HOLE: Geotechnical Data, Grondwata measurement.

(6) BORE HOLE CONSTRUCTION:
Special Construction approval ☐ Yes ☒ No Depth of Completed Hole ______ ft.

HOLE			SEAL			
Diameter	From	To	Material	From,	To,	Sacks or pounds
8"	0	40'	Bent. chip	0'	35'	11 sacks
			~~8-12 SAND~~			

Backfill placed from ______ ft. to ______ ft. Material 8-12 SAND
Filter Pack placed from 35' ft. to 40' ft. Size of pack ______

(7) CASING/SCREEN:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	1"	0	37.5		☐	☒	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Screen:	2"	37.5	39.5		☐	☒	☐	☐
					☐	☐	☐	☐

Slot size 10 slot

(8) WELL TEST:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ______ Yield ______ GPM ______
Conductivity ______ PH ______
Temperature of water ______ °F/C Depth artesian flow found ______ ft.
Was water analysis done? ☐ Yes ☐ No
By whom? ______
Depth of strata analyzed. From ______ ft. to ______ ft.
Remarks: ______

(9) LOCATION OF HOLE by legal description:
County Clakamas Latitude 45°22'7" Longitude 122° 37'25"
Township 2 N or [✓ S] Range 1 [✓ E] or W. WM.
Section 25 SE 1/4 NE 1/4
Tax Lot ______ Lot ______ Block ______ Subdivision ______
Street Address of Well (or nearest address) Skyline Dr. West Linn

Map with location indentified must be attached

(10) STATIC WATER LEVEL:
20 ft. below land surface. Date 12-10-97
Artesian pressure ______ lb. per square inch. Date ______

(11) SUBSURFACE LOG:
Ground Elevation ______

Material Description	From	To	SWL
Clayey Silt	0'	40'	

Date Started 12-8-97 Date Completed 12-8-97

(12) ABANDONMENT LOG:

Material Description	From	To	Sacks or Pounds

Date started ______ Date Completed ______

Professional Certification

(to be signed by a licensed water supply or monitoring well constructor, or registered geologist or civil engineer).

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

License or Registration Number PE 15548
Signed D. A. Vessely Date 12/16/97
Affiliation Landslide Technology

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

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

Cornforth Consultants, Inc.
10250 S.W. Greenburg Rd.
Suite 111
Portland, OR 97223

TITLE LOCATION MAP	DATE 12-16-97
	JOB NO.
JOB Bolton Pump Station, West Linn, OR	FIG. 1

GeoPacific Engineering, Inc.
Real-World Geotechnical Solutions
Investigation • Design • Construction Support

PHOTOGRAPHIC LOG

6123 SKYLINE DRIVE
GEOTECHNICAL SITE INVESTIGATION
PHOTOGRAPHIC LOG

View of Property Facing North

Test Pit TP-1, View of Property Facing South

6123 SKYLINE DRIVE
GEOTECHNICAL SITE INVESTIGATION
PHOTOGRAPHIC LOG

View of Site Facing North

Undocumented Fill Soil Containing Organic Material

6123 SKYLINE DRIVE
GEOTECHNICAL SITE INVESTIGATION
PHOTOGRAPHIC LOG

Native Soils Below the Undocumented Fill

Undocumented Fill in Test Pit TP-2

6123 SKYLINE DRIVE
GEOTECHNICAL SITE INVESTIGATION
PHOTOGRAPHIC LOG

Undocumented Fill and Exposed Native Soils in Test Pit TP-2

South Side of Property Where House was Demolished

Skyline Drive Partition

Compliance with Grading Criteria of CDC 85.200E

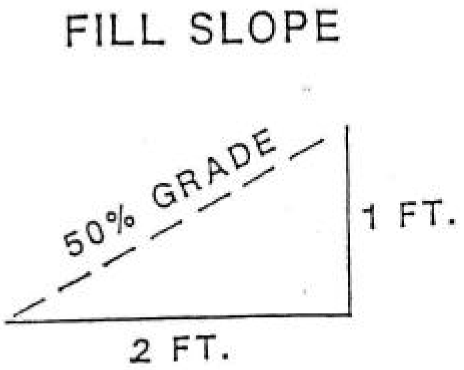
E. Grading. Grading of building sites shall conform to the following standards unless physical conditions demonstrate the propriety of other standards:

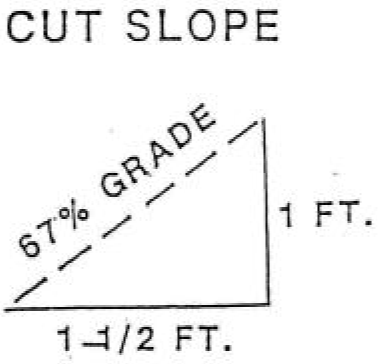
1. All cuts and fills shall comply with the excavation and grading provisions of the Uniform Building Code and the following:

a. Cut slopes shall not exceed one and one-half feet horizontally to one foot vertically (i.e., 67 percent grade).

Comment: As shown on the Grading Plan submitted with this application, all cut slopes will not exceed the 1.5:1 ratio.

b. Fill slopes shall not exceed two feet horizontally to one foot vertically (i.e., 50 percent grade). Please see the following illustration.





Comment: The Grading Plan illustrates the cut and fill slopes proposed in conjunction with the development of this property. All slopes proposed comply with these standards.

2. The character of soil for fill and the characteristics of lot and parcels made usable by fill shall be suitable for the purpose intended.

Comment: Major portions of Parcels 1 and 2 and a small area of Parcel 3 contain non-engineered fill materials associated with the development of the water reservoir on the property to the east. Per the recommendations of the GeoPacific Engineering geotechnical report for this site, these materials will either be excavated to native soil level and replaced with engineered fill or footings will be excavated to be placed on native soil. Soils imported for replacement will be installed as an engineered fill. The final grading plan for each lot will be submitted for review with the building permit application.

3. If areas are to be graded (more than any four-foot cut or fill), compliance with CDC 85.170(C) is required.

Comment: The depth of the proposed cuts and fills are four feet or less, as shown on the Grading Plan.

4. The proposed grading shall be the minimum grading necessary to meet roadway standards, and to create appropriate building sites, considering maximum allowed driveway grades.

Comment: As shown on the Grading Plan, the grading for the proposed private driveway is minimal with no more than a foot of cut or fill. The grading proposed for the building pads conforms as closely to native grade as possible. All fills are less than four feet in depth.

5. Type I lands shall require a report submitted by an engineering geologist, and Type I and Type II lands shall require a geologic hazard report.

Comment: No Type I lands exist on the subject property. There is a small area of Type II land in the northwest corner of Parcel 3, but this area will not be developed.

6. Per the submittals required by CDC 85.170(C)(3), the applicant must demonstrate that the proposed methods of rendering known or potential hazard sites safe for development, including proposed geotechnical remediation, are feasible and adequate to prevent landslides or other damage to property and safety. The review authority may impose conditions, including limits on type or intensity of land use, which it

> *determines are necessary to mitigate known risks of landslides or property damage.*

Comment: The applicant relies upon the geotechnical analysis prepared by GRI for the Bolton Reservoir site adjacent to the subject property for the broader geotechnical issues affecting the site area. The GRI report notes that there are faults in the area, notably the Bolton Fault, and that this site is located in an ancient (15,000-20,000 years old) landslide area. The report notes, "reconnaissances by GRI as part of this study and during our 2012 study did not disclose indications of recent landslide movement. A reconnaissance recently completed by Cornforth Consultants (December 2014) also did not identify signs of active movement. It is our opinion the risk of significant future movement of the large, ancient landslide is low."

Regarding seismic considerations, the report notes, "Based on preliminary evaluations, there is some risk of seismically induced soil strength loss in relatively thin zones in the decomposed basalt that have weathered to the consistency of soft soil that were encountered locally between depths of about 25 to 40 ft below the existing ground surface. In our opinion, the risk of significant post-earthquake settlement due to soil strength loss in these isolated layers is low."

Given this information, we conclude that there are no broad general geologic hazards that require geologic mitigation. The site does have non-engineered fill materials in the area of Parcels 1 and 2. The applicant has retained GeoPacific Engineering, Inc. to provide an analysis of these fill materials and make recommendations as to how to properly deal with them. Please refer to pages 8 to 10 of that report for more detail.

> *7. On land with slopes in excess of 12 percent, cuts and fills shall be regulated as follows:*
>
> > *a. Toes of cuts and fills shall be set back from the boundaries of separate private ownerships at least three feet, plus one-fifth of the vertical height of the cut or fill. Where an exception is required from that requirement, slope easements shall be provided.*
> >
> > *b. Cuts shall not remove the toe of any slope where a severe landslide or erosion hazard exists.*

c. Any structural fill shall be designed by a registered engineer in a manner consistent with the intent of this code and standard engineering practices, and certified by that engineer that the fill was constructed as designed.

d. Retaining walls shall be constructed pursuant to Section 2308(b) of the Oregon State Structural Specialty Code.

e. Roads shall be the minimum width necessary to provide safe vehicle access, minimize cut and fill, and provide positive drainage control.

Comment: As shown on the Grading Plan, all cuts and fills are set back at least three feet from adjacent properties. Only minimal grading is proposed and no cuts would impact landslide potential. Any structural fills will be designed by a registered engineer and will be designed so as to meet the intent and requirements of the code and standard engineering practices. No retaining walls are proposed or required. The proposed shared private drive has been designed to conform to City code and to provide clearances required for safe vehicular access. As shown on the Grading Plan, the driveway grading is minimal, conforming within approximately one foot of native grade. Positive drainage is provided. Storm water from the driveway drains to a lined rain garden on Parcel 3, with an overflow to the storm detention facility at the water reservoir site. As discussed in the storm report dated 4/30/2019, there is adequate capacity at that facility to accommodate the runoff from the subject property.

8. Land over 50 percent slope shall be developed only where density transfer is not feasible. The development will provide that:

a. At least 70 percent of the site will remain free of structures or impervious surfaces.

b. Emergency access can be provided.

c. Design and construction of the project will not cause erosion or land slippage.

d. Grading, stripping of vegetation, and changes in terrain are the minimum necessary to construct the development in accordance with subsection J of this section.

Comment: No land over 50 percent slope is proposed for development in this application.

Preliminary Drainage Report

Skyline Partition

Address: 6123 Skyline, West Linn, Oregon

Date: April 29, 2019

NARRATIVE:

This is a vacant property that is proposed to be divided into 3-lots by partition. This tract that slopes easterly away from Skyline Drive. There isn't a storm sewer system in Skyline Drive and no access to a public storm to the North. The USDA Web Soil Survey reports the soils as being 13B Cascade silt loam and 92F Xerochrepts and Haploxerools. Cascade has is a hydrologic group C and Xerochrepts is hydrologic group B. Two geotechnical reports have been prepared for this Bolton reservoir site which includes this property. Evidence has been provided that an ancient and currently inactive landslide condition exists on the property. The Bolton reservoir site includes both water quality and quantity storm water facilities for the new reservoir site. This residential site was mapped by Centerline Concepts to include illustrating 1-foot contours. This was compared with the West Linn GIS contour map and found to be substantially the same. It is clear the almost 8000 SF of the residential property naturally drains to the Bolton Reservoir site. It does not appear that this area was included in the storm management report for the reservoir.

The GeoPacific report recommends that any storm water facility does not use on-site infiltration as a solution for storm water disposal. Based on this report all rain gardens are to be lined.

ASSUMPTION:

Above ground facilities: flow through lined raingardens
2500 SF roof areas = 0.057acres for individual parcels
7500 SF impervious area total = 0.17 acres
25-year event = 3.9 inches/hour

REFERENCE:

Murray Smith & Associates – Storm water Management Report, September 2015

GRI – Geotechnical Investigation report # 5338, September 10, 2015

GeoPacific – Soils investigation Report # 19-5206, April 29, 2019

City of Portland Storm Water Management Manual

The King County Department of Public Works, Hydrographic Program, ver 4.21B

CALCULATIONS:

```
STORM OPTIONS:
1 – S.C.S. TYPE -1A
2- 7-DAY DESIGN STPRM
3 – STORM DATA FILE
SPECIFY STORM OPTION:
1
S.C.S. TYPE 1-A RAINFALL DISTRIBUTION
ENTER:
FREQ(YEAR), DURATION(HOUR), PRECIP(INCHES)
25,24.3.9
Xxxxxxxxxxxxxxxxxxxxxxx S.C.S.TYPE-1A DISTRIBUTION xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
XXXXXXXXXXX   25-YEAR   24-HOUR STORM   xxxx   3.90" TOTAL PRECIP.   Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

```
ENTER: A(PERV),CN(PERV),A(IMPERV),CN(IMPERV),TC FOR BASIN NO. 1
0.0,86,0.057,98,5
DATA PRINT OUT:
AREA(ACRES)          PERVIOUS            IMPERVIOUS          TC(MINUTES)
                     A       CN          A       CN
    .1               .1      86.0        .0      98.0        5.0
PEAK-Q(CFS)          T-PEAK(HRS)         VOL(CU-FT)
    .06                7.67                  758
ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
C:sky
SPECIFY:  C - CONTINUE,  N - NEWSTORM,  P - PRINT,  S – STOP
C
```

```
ENTER: A(PERV),CN(PERV),A(IMPERV),CN(IMPERV),TC FOR BASIN NO. 1
0.057,86,0.0,98,5
DATA PRINT OUT:
AREA(ACRES)          PERVIOUS            IMPERVIOUS          TC(MINUTES)
                     A       CN          A       CN
    .1               .0      86.0        .1      98.0        5.0
PEAK-Q(CFS)          T-PEAK(HRS)         VOL(CU-FT)
    .04                7.67                  508
ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
C:sky25
SPECIFY:  C - CONTINUE,  N - NEWSTORM,  P - PRINT,  S – STOP
C
```

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ENTER: A(PERV),CN(PERV),A(IMPERV),CN(IMPERV),TC FOR BASIN NO. 1
```

```
0.0,86,0.17,98,5
DATA PRINT OUT:
AREA(ACRES)            PERVIOUS               IMPERVIOUS             TC(MINUTES)
                       A       CN             A       CN
    .2                 .0      86.0           .2      98.0           5.0
PEAK-Q(CFS)            T-PEAK(HRS)            VOL(CU-FT)
   .17                   7.67                     2261
ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
C:ALL25
SPECIFY:  C - CONTINUE,  N - NEWSTORM,  P - PRINT,  S – STOP
S
10
R/D FACILITY DESIGN ROUTINE
SPECIFY TYPE OF R/D FACILITY:
1 – POND               4 – INFILTRATION POND
2 – TANK               5 – INFILTRATION TANK
3 – VAULT              6 – GRAVEL TRENCH/BED
1
ENTER: POND SIDE SLOPE (HORIZ. COMPONENT)
3
ENTER: EFFECTIVE STORAGE DEPTH (ft) BEFORE OVERFLOW
1
ENTER [d:][pathfilename[.ext} OF PRIMARY DESIGN INFLOW HYDROGRAPH
C: SKY
PRIMARY DESIGN INFLOW PEAK =      .06 CFS
ENTER PRIMARY DESIGN RELEASE RATE (cfs)
0.04
ENTER NUMBER OF INFLOW HYDROGRAPHS TO BE TESTED FOR PERFORMANCE (5 MAXIMUM):
0
ENTER: NUMBER OF ORIFICES,  RISER-HEAD(ft),  RISER-DIAMETER(in)
0,1,6
RISER OVERFLOW DEPTH FOR PRIMARY PEAK INFLOW =  0.05
SPECIFY ITERATION DISPLAY:  Y – YES,  N – NO
N
SPECIFY:   R – REVIEW/REVISE INPUT,  C – CONTINUE
C
INITIAL STORAGE VALUE FOR ITERATION PURPOSES:       285 CU-FT
SINGLE ORIFICE RESTRICTOR:  DIA= 1.21 "
PERFORMANCE:   INFLOW    TARGET-OUTFLOW    ACTUAL-OUTFLOW    PK-STAGE    STORAGE
   DESIGN HYD:      .06              .04                .04        1.00          22
```

SIZING:

A raingarden with outside dimensions of 10 X 15feet and 3:1 slopes with 1-foot of surface storage, 1.5-feet of medium, and 1-foot of drain rock has a storage capacity of approximately 248 CF, and 150 SF of surface area. Pursuant to the City of Portland Storm Water Management

Manual, using the simplified approach water quality is 6% of the impervious area or 150 SF. An orifice placed in each flow through rain garden will control the outflow to the pre-developed condition for the 25-year event with an orifice of 1.21". Limiting flow for other storm events would be difficult because the orifices would become too small to maintain.

The Murray Smith report for the Bolton reservoir reports a detention pond with a top elevation of 435 and with the emergency overflow set at elevation 434. There are three orifices at the facility (1.5" @ 432, 1.0" @ 430, 1.0" @ 425.5) The 2,5,10,25, & 100 year storm events were calculated and indicate a corresponding detention pond elevation of 428.87 (2yr), 429.82 (5yr), 430.62 (10yr), 432.34 (25yr), and 432.04 (100yr) thus showing additional capacity within the detention point of 434-432.34 = 1.7 feet.

CONCLUSION:

The site specific soils report recommends that infiltration not be used to dispose of storm water generated from the new impervious surfaces. Calculations show that it is feasible to provide water quality and quantity flow through lined rain gardens for each parcel and direct the flow to the Bolton reservoir facility. A portion of this residential site appears to have been unaccounted for in the Murry Smith report and in comparing the GSI contours and the current field contours it evident that some of the property does slope to the reservoir site. A review of the Murry Smith report finds additional capacity available in the detention pond and it is practical to convey storm water from the new impervious surfaces to the detention pond.

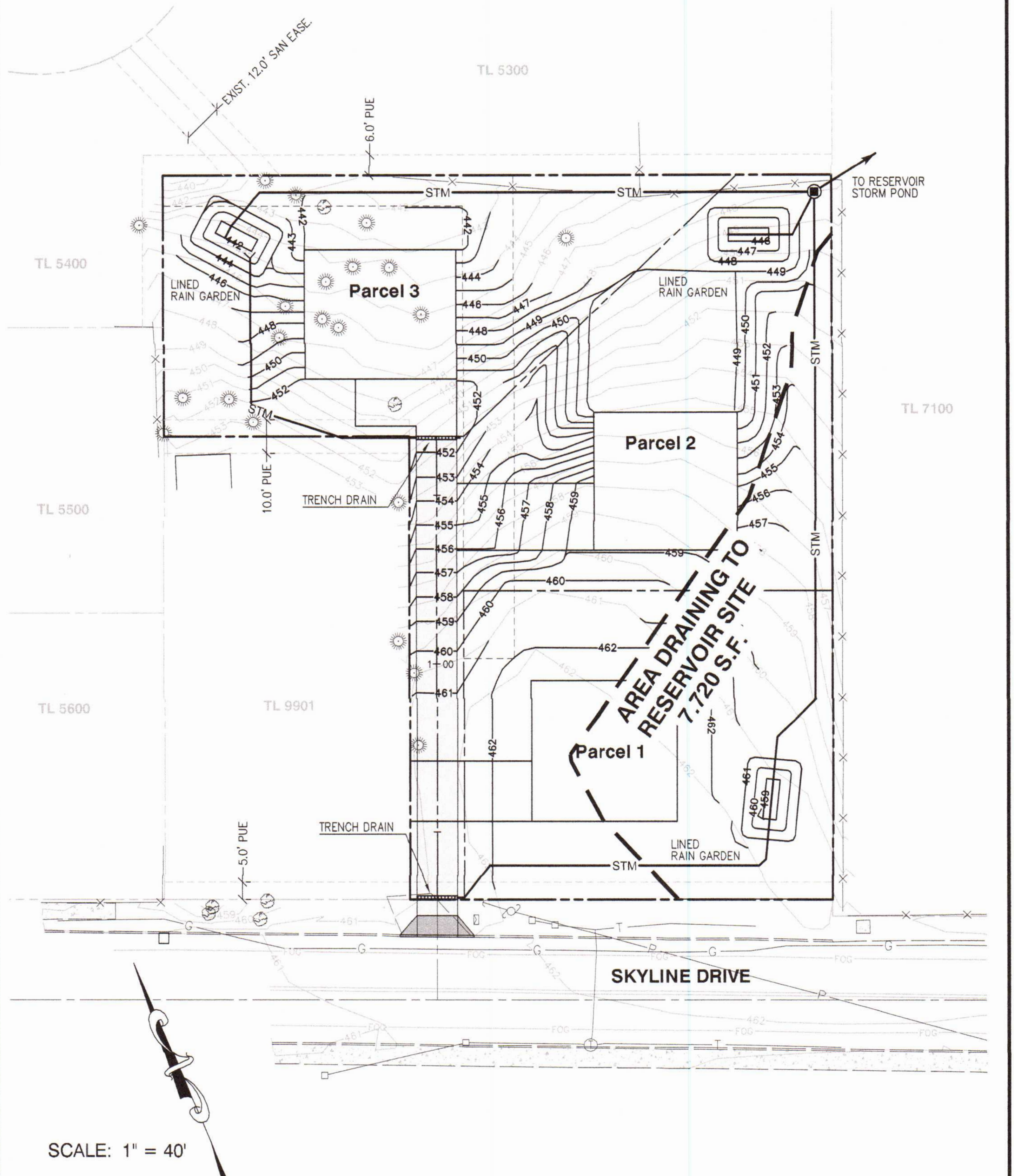
Prepared by:

Bruce D. Goldson, PE

Theta,LLC
PO Box 1345
Lake Oswego, Oregon 97035

REGISTERED PROFESSIONAL ENGINEER
7120
OREGON
July 16, 1971
BRUCE D. GOLDSON

EXPIRES: 06/30/2019
SIGNATURE DATE: 4/30/19



2014-129U

STORM DRAINAGE REPORT

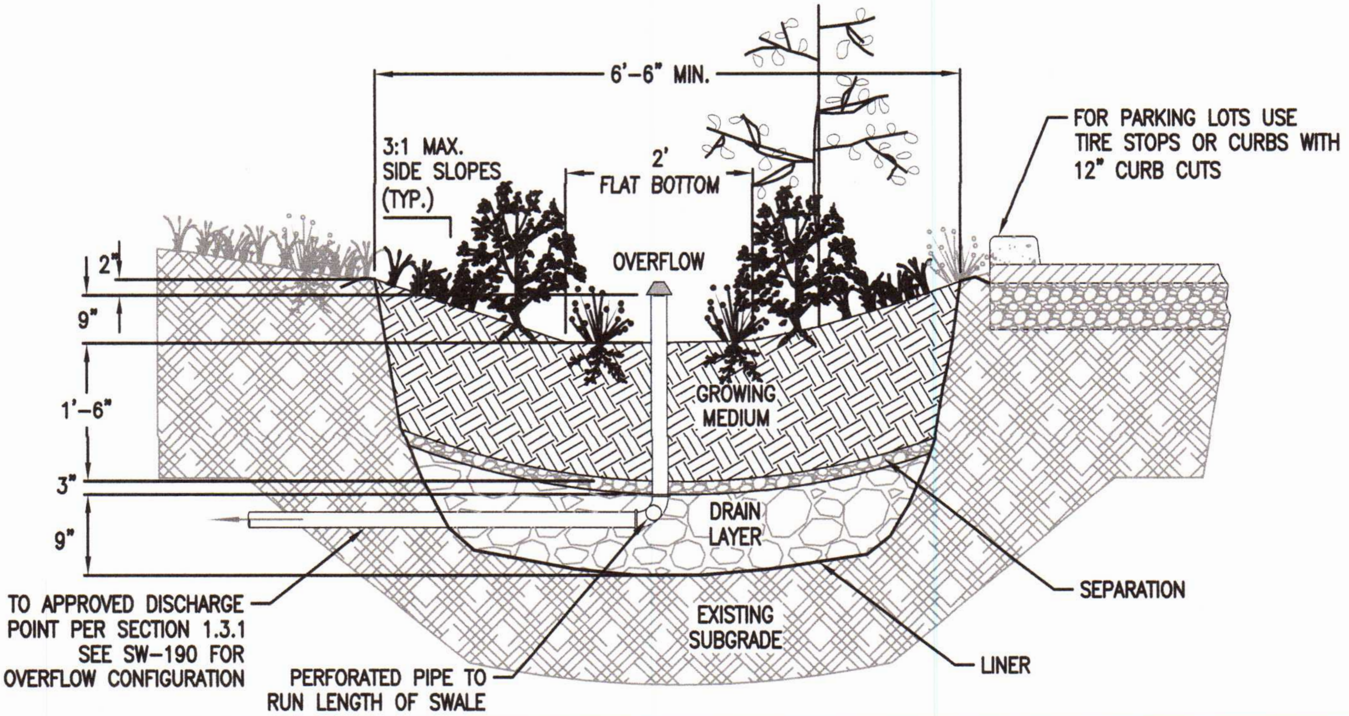
Theta, llc

ENGINEERING - SURVEYING - PLANNING

PO Box 1345
Lake Oswego, Oregon 97035

503-481-8822
email: thetaeng@comcast.net

Partition Site Plan
6123 Skyline Drive
West Linn, Oregon



1. Dimensions:
   Width of swale: 6'-6" minimum
   Depth of swale (from top of growing medium to overflow elevation): 9".
   Longitudinal slope of swale: 6.0% or less.
   Flat bottom width: 2' recommended.
   Side slopes of swale: 3:1 maximum.

2. Overflow: Swales must connect to approved discharge point according to SWMM Section 1.3.1 and detail SW-190.
   Inlet elevation must allow for 2" of freeboard, minimum.
   Protect from debris and sediment with strainer or grate.

3. Piping must be cast iron, ABS or PVC. 3" pipe required for facilities draining up to 1500 s.f., otherwise 4" minimum pipe. Uniform Plumbing Code also applies.

4. Drain Layer:
   3/4" - 1 ½" washed round rock. Depth: 9".
   Separation between drain rock and growing medium:
   Pea gravel lens, 2 to 3 inches deep.

5. Growing Medium:
   18" minimum depth. Use sand/loam/compost 3-way mix, or approved mix that will support healthy plants.
   24" minimum depth is required if the lined facility is also meeting BDS landscape requirements.

6. Vegetation: Follow landscape plans otherwise refer to plant list in SWMM section 2.4.1. Minimum container size is #1. # of plantings per 100sf of facility area:
   Zone A (wet): 80 herbaceous plants OR 72 herbaceous plants and 4 small shrubs.
   Zone B (moderate to dry): 7 large or small shrubs AND 70 groundcover plants.
   The delineation between Zone A and B must be either at the outlet elevation or the check dam elevation, whichever is lowest.
   If project area is over 200sf consider adding a tree.

7. Check Dams: Must be placed every 10' where slope exceeds 4% and be equal to the width of the planter.

8. Waterproof Liner: 30 mil EPDM, HDPE or approved equivalent.

9. Splash Block: Install 4-6" washed river rock or splash pad for erosion control at inlets and downspout.

10. Inspections: Call BDS IVR Inspection Line, (503) 823-7000, request 487. 3 inspections required.

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT TYPICAL DETAILS

\- Simplified Design Approach -

Swale - lined

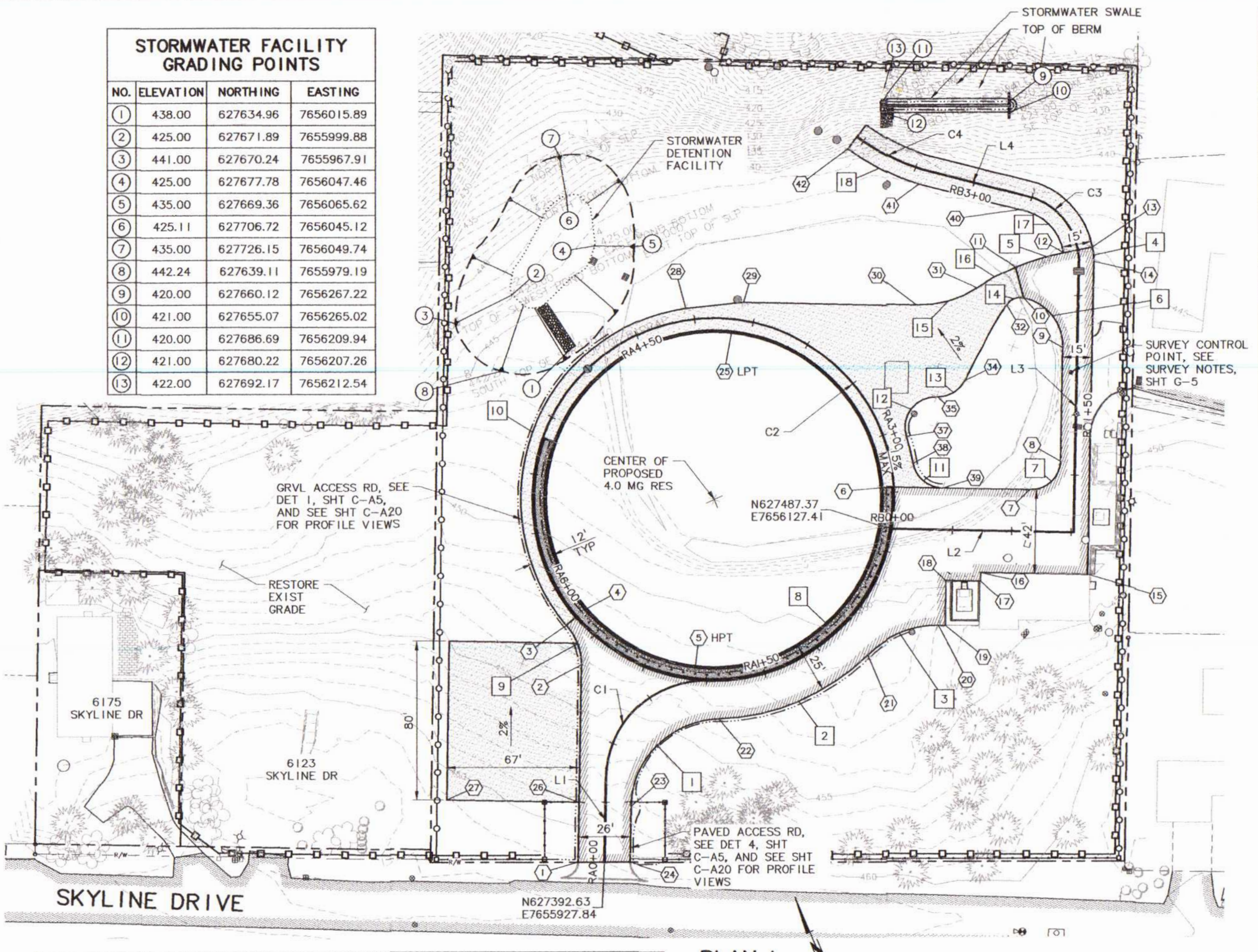
NUMBER

SW-130

7-1-16

Bureau of Environmental Services

CITY OF PORTLAND OREGON 1851



PLAN △

SCALE: 1"=30'

STORMWATER FACILITY GRADING POINTS

NO.	ELEVATION	NORTHING	EASTING
①	438.00	627634.96	7656015.89
②	425.00	627671.89	7655999.88
③	441.00	627670.24	7655967.91
④	425.00	627677.78	7656047.46
⑤	435.00	627669.36	7656065.62
⑥	425.11	627706.72	7656045.12
⑦	435.00	627726.15	7656049.74
⑧	442.24	627639.11	7655979.19
⑨	420.00	627660.12	7656267.22
⑩	421.00	627655.07	7656265.02
⑪	420.00	627686.69	7656209.94
⑫	421.00	627680.22	7656207.26
⑬	422.00	627692.17	7656212.54

ACCESS ROAD ALIGNMENT AND CURVE TABLE

LINE/CURVE NO.	START POINT	END POINT	RADIUS	LENGTH	BEARING	Δ
L1	STA RA0+00	STA RA0+42	N/A	42.00	N24°34'27"E	N/A
C1	STA RA0+42	STA RA1+21	50.00	79.30	N/A	90°52'03"
C2	STA RA1+21	STA RA6+93	91.00	571.75	N/A	360°00'00"
L2	STA RB0+00	STA RB0+91	N/A	91.25	S65°11'02"E	N/A
L3	STA RB0+91	STA RB2+27	N/A	136.22	N24°48'58"E	N/A
C3	STA RB2+27	STA RB2+74	34.93	46.96	N/A	77°01'58"
L4	STA RB2+74	STA RB3+27	N/A	52.11	N52°13'59"W	N/A
C4	STA RB3+27	STA RB3+64	119.48	37.25	N/A	17°51'46"

EDGE OF PAVEMENT ELEVATION TABLE

POINT	ELEVATION	POINT	ELEVATION
1	460.68	14	440.00
2	451.00	15	448.25
3	448.17	16	447.35
4	448.89	17	447.43
5	451.00	18	447.29
6	451.00	19	448.05
7	446.16	20	448.03
8	446.95	21	448.32
9	440.05	22	451.50
10	439.95	23	457.86
11	439.95	24	460.43
12	439.90	25	440.30
13	439.85		

EDGE OF GRAVEL ELEVATION TABLE

POINT	ELEVATION	POINT	ELEVATION
26	457.75	35	442.65
27	456.99	36	NOT USED
28	440.67	37	441.74
29	439.01	38	444.50
30	439.59	39	444.95
31	439.80	40	435.00
32	439.95	41	429.10
33	NOT USED	42	425.50
34	441.97		

EDGE OF PAVEMENT CURVE TABLE

NO.	PC	PT	DELTA	RADIUS	LENGTH
1	N627435.61 E7656009.40	N627412.72 E7655951.33	87°49'53"	45.00'	68.98'
2	N627498.15 E7656154.13	N627435.61 E7656009.40	91°33'20"	110.00'	175.77'
3	N627433.70 E7656129.17	N627434.67 E7656090.89	45°02'00"	50.00'	39.30'
4	N627570.23 E7656274.48	N627574.29 E7656275.83	5°47'03"	42.43'	4.28'
5	N627579.57 E7656261.69	N627582.57 E7656236.74	11°47'45"	122.29'	25.18'
6	N627536.19 E7656242.24	N627566.90 E7656234.25	78°47'54"	25.00'	34.38'
7	N627477.58 E7656198.62	N627484.90 E7656218.53	90°00'00"	15.00'	23.56'
8	N627512.58 E7655970.01	N627508.68 E7656131.36	143°24'20"	85.00'	212.75'
9	N627487.88 E7655957.11	N627509.08 E7655958.53	41°29'17"	30.00'	21.72'

EDGE OF GRAVEL CURVE TABLE

NO.	PC	PT	DELTA	RADIUS	LENGTH
10	N627630.98 E7656076.52	N627509.08 E7655958.53	121°57'51"	97.00'	206.48'
11	N627513.19 E7656150.44	N627496.03 E7656158.72	78°51'30"	15.00'	20.65'
12	N627538.91 E7656174.26	N627526.94 E7656152.80	110°00'57"	15.00'	28.80'
13	N627538.91 E7656174.26	N627540.78 E7656190.34	64°58'19"	15.07'	17.09'
14	N627566.90 E7656234.25	N627566.97 E7656224.95	71°08'30"	8.00'	9.93'
15	N627585.18 E7656183.84	N627580.95 E7656214.81	34°16'51"	53.04'	31.73'
16	N627580.95 E7656214.81	N627582.57 E7656236.74	10°18'51"	122.29'	22.01'
17	N627579.57 E7656261.69	N627608.29 E7656250.37	68°29'49"	27.43'	32.79'
18	N627640.26 E7656209.11	N627671.31 E7656183.69	18°30'00"	124.83'	40.31'

MSA Murray, Smith & Associates, Inc.
Engineers/Planners
121 S.W. Salmon, Suite 900 PHONE 503-225-9010
Portland, Oregon 97204 FAX 503-225-9022

MSA PROJECT: 14-1586
DATE: SEPTEMBER 2015

PROJECT NAME: CITY OF WEST LINN, OREGON
BOLTON RESERVOIR REPLACEMENT
PROJECT NO. PW 14-06

SHEET TITLE:
RESERVOIR SITE GRADING AND
ACCESS ROAD PAVING PLAN

SCALE: VERT: AS SHOWN
HORIZ: AS SHOWN

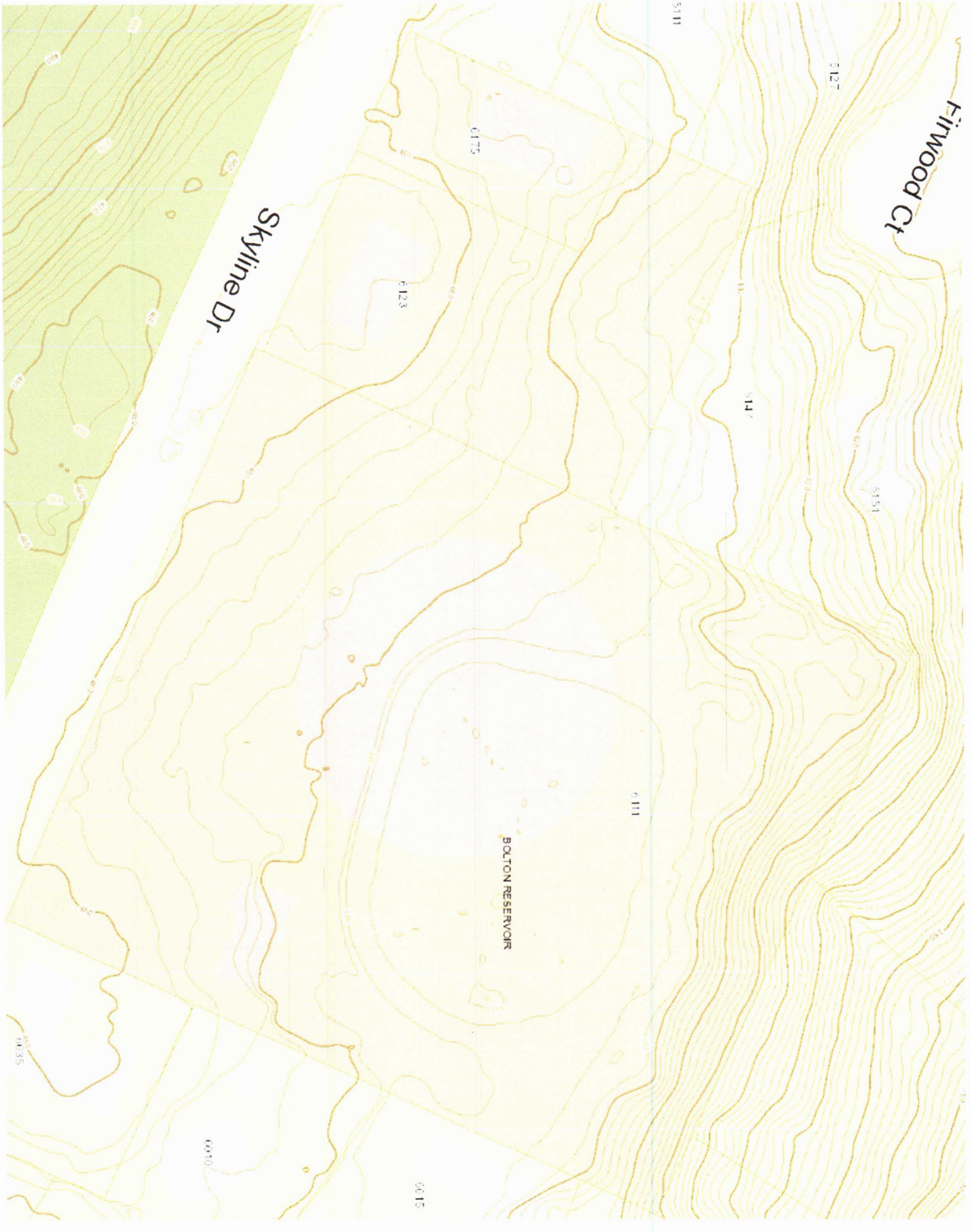
NOTICE
0 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

RECORD DRAWING
SEE DISCLAIMER, SHEET 1.
VERSION 4.1
12-9-97

NO	DATE	REVISION	BY
△	3/20/17	SITE ACCESS REVISIONS	ANB
△	7/13/17	SITE GRADING REVISIONS	ANB
△		RECORD DRAWING	ANB

DESIGNED: MLM
DRAWN: DKH
CHECKED: TPB
APPROVED: TPB

SHEET
C-A4
20 of 169


Skyline Dr
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BOLTON RESERVOIR
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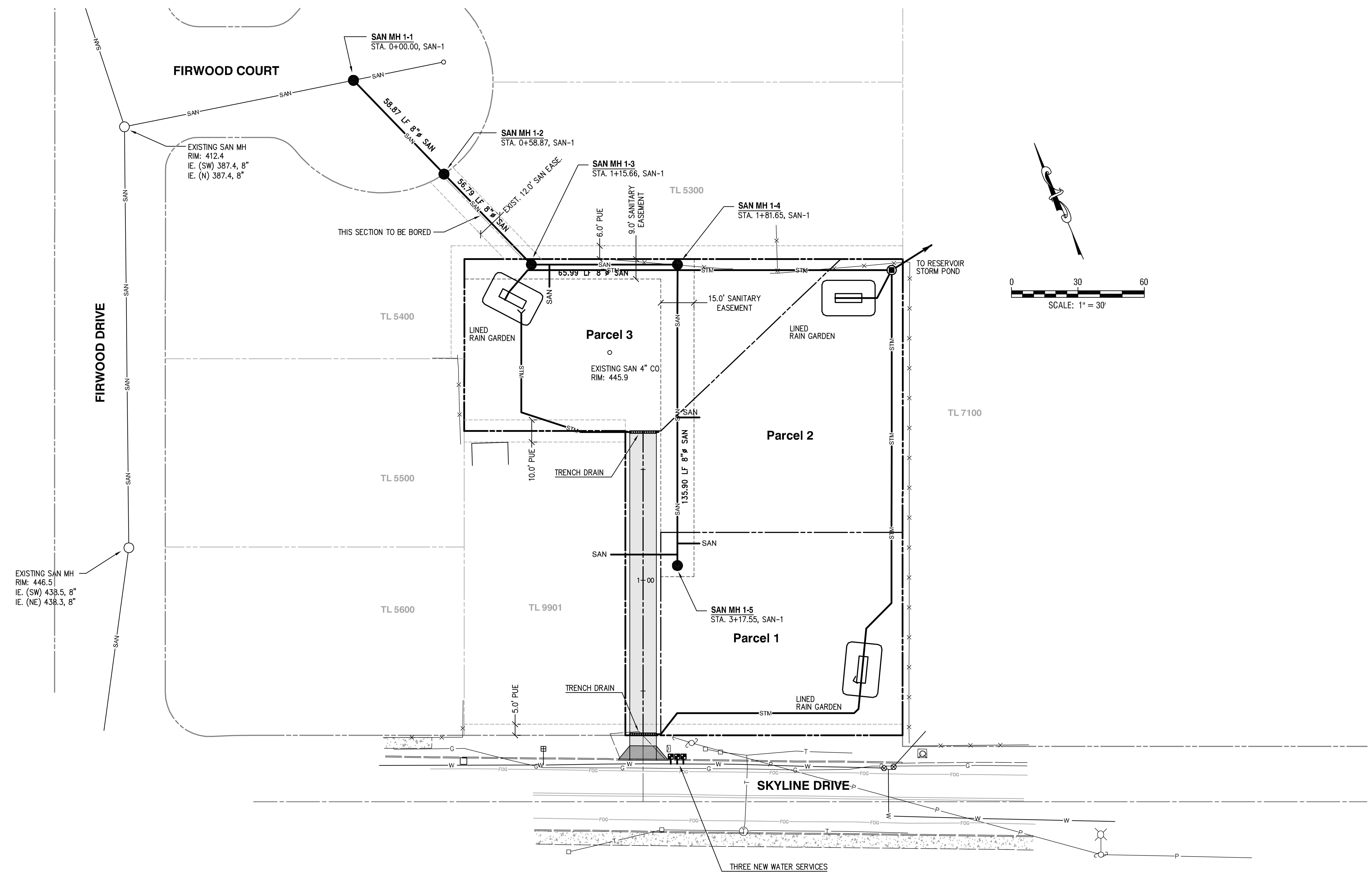
5127
6175
6123
5147
5151
6111
6035
6010
6015



PRELIMINARY UTILITY PLAN

2014-129U

DESIGNED:	BDG			
DRAWN:	BJS			
SCALE:	As Noted			
DATE:	September, 2018			
FILE:	Skyline Partition Prelim1	DATE	NO.	REVISION

Theta, llc
ENGINEERING - SURVEYING - PLANNING
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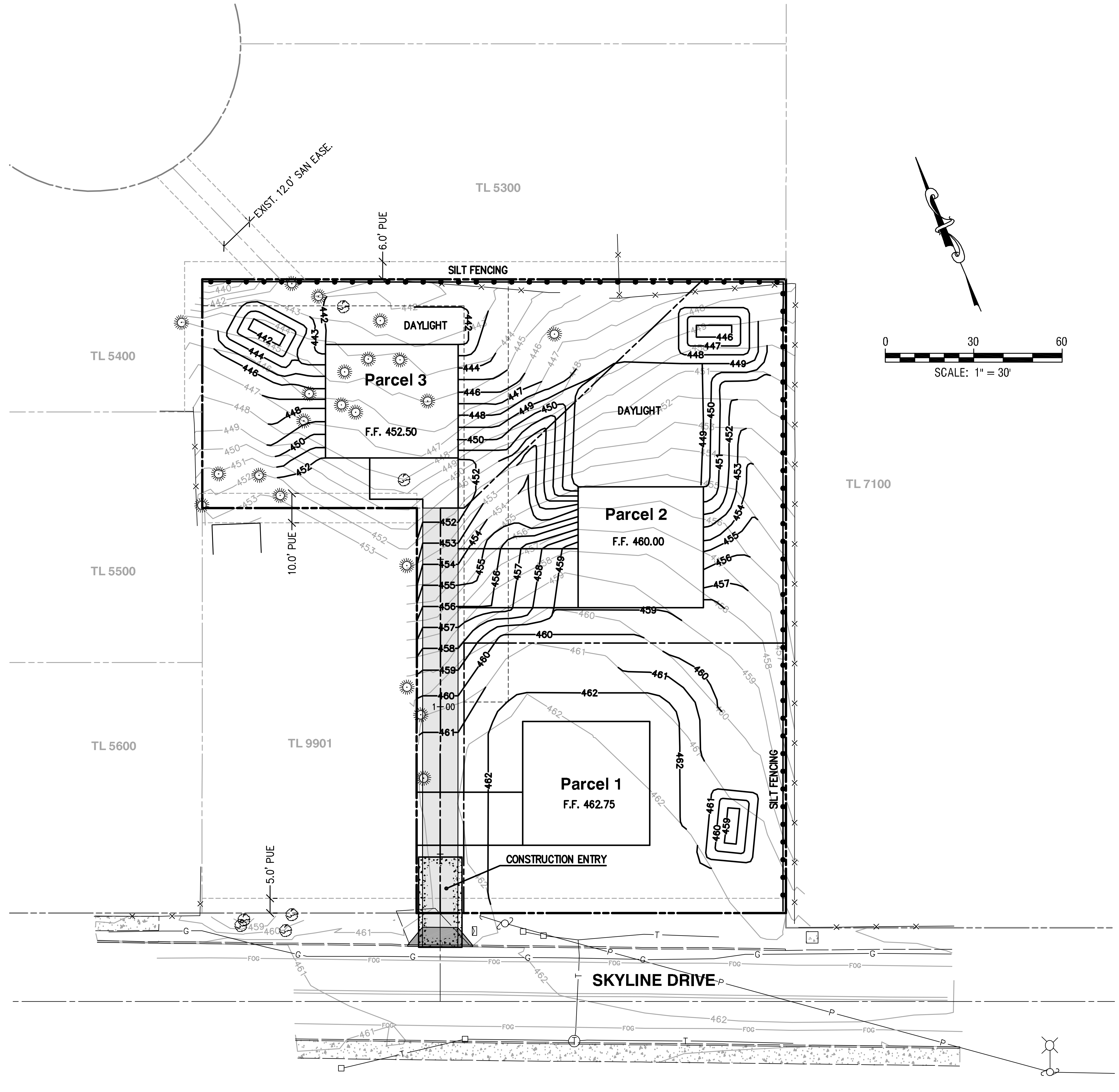
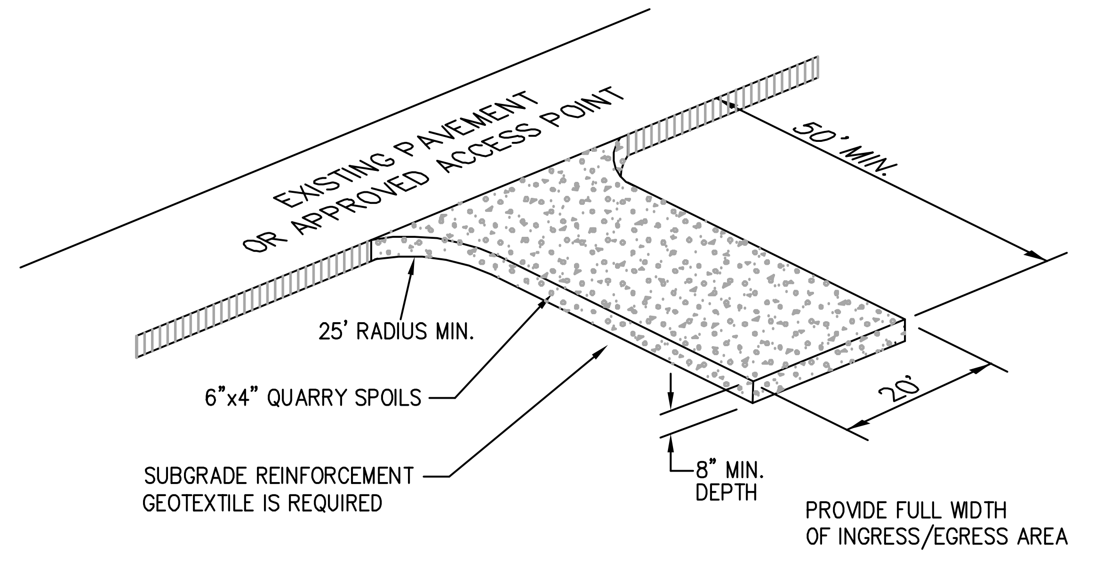
email: thetaeng@comcast.net

Icon Construction and Developement
1380 Willamette Falls Drive, No. 200
West Linn, Oregon 97068

Partition Site Plan
6123 Skyline Drive
West Linn, Oregon

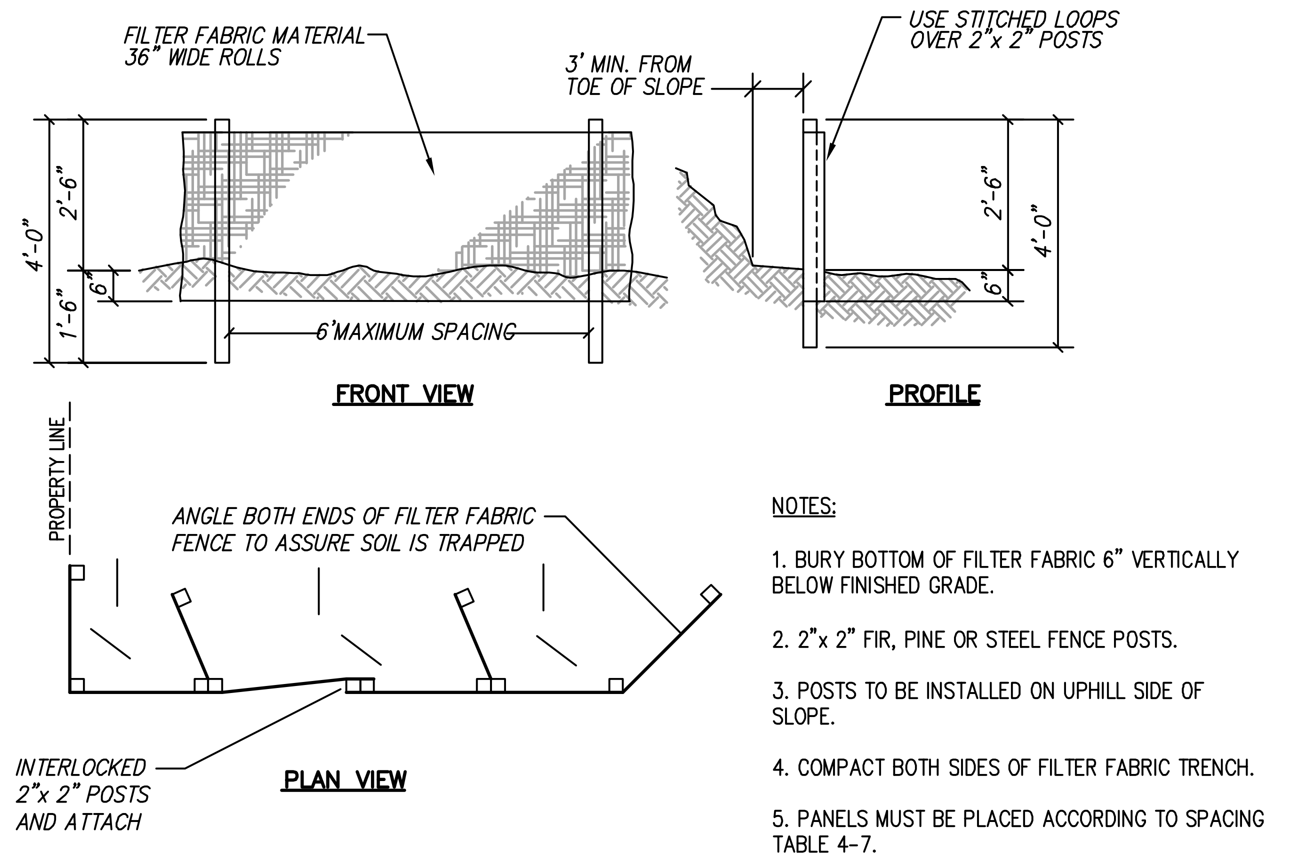
SHEET:
2/4





GRAVEL CONSTRUCTION ENTRANCE

SCALE: NTS



NOTES:

1. BURY BOTTOM OF FILTER FABRIC 6" VERTICALLY BELOW FINISHED GRADE.
2. 2"x 2" FIR, PINE OR STEEL FENCE POSTS.
3. POSTS TO BE INSTALLED ON UPHILL SIDE OF SLOPE.
4. COMPACT BOTH SIDES OF FILTER FABRIC TRENCH.
5. PANELS MUST BE PLACED ACCORDING TO SPACING TABLE 4-7.

SEDIMENT FENCE

SCALE: NTS

NOTES:

PURSUANT TO CDC 85-200 E AND GEOTECHNICAL INVESTIGATION

1. CONCEPTUAL GRADING PLAN ONLY TO DEMONSTRATE FEASIBILITY.
2. ALL CUT AND FILL SLOPES ARE GREATER THAN 2:1.
3. GRADING IS MINIMUM OF 5-FEET FROM PROJECT BOUNDARY.
4. GRI GEOTECHNICAL INVESTIGATION (9-10-15)

"THE SURROUNDING NEIGHBORHOOD WAS ALSO EXAMINED FROM THE PUBLIC RIGHT OF WAY FOR INDICATIONS OF SLOPE MOVEMENT (CRACKED AND SEPARATED SIDEWALKS OR CURBS). THE RECONNAISSANCE DID NOT DISCLOSE OBVIOUS INDICATIONS OF RELATIVELY RECENT MOVEMENT, SUCH AS CRACKED STREETS, SIDEWALKS, OR CURBS. LIMITED INTERVIEWS WITH CITY MAINTENANCE PERSONNEL DID NOT DISCLOSE REPORTS OF BROKEN OR SHEARED UNDERGROUND UTILITIES."

"THE RESERVOIR SITE IS LOCATED ON A VERY LARGE, ANCIENT LANDSLIDE. HOWEVER, RECONNAISSANCE BY GRI AS PART OF THIS STUDY AND DURING OUR 2012 STUDY DID NOT DISCLOSE INDICATIONS OF RECENT LANDSLIDE MOVEMENT. A RECONNAISSANCE RECENTLY COMPLETED BY CORNFORTH CONSULTANTS (DECEMBER 2014) ALSO DID NOT IDENTIFY SIGNS OF ACTIVE MOVEMENT. IT IS OUR OPINION THE RISK OF SIGNIFICANT FUTURE MOVEMENT OF THE LARGE, ANCIENT LANDSLIDE IS LOW."

STORM DRAINAGE NOTES:

1. ABOVE GROUND FACILITIES - RAINGARDENS
2. SIZING OF FACILITIES FOR TOTAL INFILTRATION WITH NO OUTFLOW.
3. PRIVATE DRIVE IMPERVIOUS AREA TO BE INCLUDED IN A ROOF RAINGARDEN.
4. FINAL SIZING TO BE BASED ON ACTUAL IMPERVIOUS AREA.

PRELIMINARY GRADING AND EROSION CONTROL PLAN

2014-129U

DESIGNED:	BDG			
DRAWN:	BJS			
SCALE:	As Noted			
DATE:	September, 2018	03/12/2019	1	CONCEPTUAL HOUSE GRADING
FILE:	Skyline Partition Prelim1	DATE	NO.	REVISION

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