Exhibit 17

GEOTECHNICAL REPORT (REV5)
LMC MARYMOOR
17611 Northeast 70th Street
Redmond, Washington

PROJECT NO. 17-406
January 2019

Prepared for:

Lennar Multifamily Communities, LLC

PanGEO INCORPORATED

Geotechnical & Earthquake
Engineering Consultants

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INCORPORATED
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Engineering Consultants

January 25, 2019
PanGEO Project No. 17-406

Mr. Dan Shieder
Lennar Multifamily Communities, LLC
1325 Fourth Avenue, Suite 1300
Seattle, Washington 98104

Subject: **Geotechnical Report**
Proposed LMC Marymoor Residential Development
17611 Northeast 70th Street, Redmond, Washington

Dear Mr. Shieder:

As requested, PanGEO, Inc. is pleased to present this geotechnical report to assist the project team with the planning and design of the proposed LMC Marymoor Residential Development, 17611 Northeast 70th Street in Redmond, Washington. In preparing this report, we drilled six test borings at the site, conducted a field infiltration test, monitored groundwater levels at the site, reviewed historical groundwater groundwater data for the site vicinity, and conducted our engineering analyses. The recommendations and conclusions outlined in this report superseded our previous report dated December 20, 2018.

In summary, the site may be developed generally as planned. Building support can be provided using a spread footing foundation system. It is not planned to dewater the site during construction. Instead construction of certain elements may occur into standing water or watertight shoring systems such as secant piles or sinking caisson may be used.

Should you have any questions, please do not hesitate to call.

Sincerely,

Siew L. Tan, P.E.
Principal Geotechnical Engineer

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GEOTECHNICAL REPORT
PROPOSED LMC MARYMOOR RESIDENTIAL DEVELOPMENT
17611 NORTHEAST 70^{TH} STREET
REDMOND, WASHINGTON

1.0 GENERAL

As requested, PanGEO, Inc. is pleased to present this geotechnical report for the proposed Redmond LMC Development at 17611 Northeast 70th Street, in Redmond, Washington. This study was performed in general accordance with our mutually agreed scope of services outlined in our agreement dated November 28, 2017. Our scope of services included reviewing readily available geologic and geotechnical data, drilling six borings, conducting a site reconnaissance, and evaluating the feasibility of developing the site as planned.

2.0 SITE AND PROJECT DESCRIPTION

The subject site is located at 17611 Northeast 70th Street in Redmond, Washington at the approximate location shown on Figure 1, *Vicinity Map*.

The subject site comprises three separate tax parcels with a combined area of 4.9 acres. The irregular-shaped site is bordered to the west by 176^{th} Avenue Northeast, Northeast 70^{th} Street to the north, a portion of the East Lake Sammamish Trail to the east, and a one-story light industrial/warehouse building to the south. An aerial view of the site is provided as Plate 1. The attached Figure 2, *Site and Exploration Plan* also shows the layout of the site.

The site is occupied by several one- and two-story warehouse buildings, maintenance shops, and automobile storage lots. Portions of the site are surfaced with gravel and asphalt paved parking and drive areas. Site vegetation consists of landscaping trees and shrubs around the perimeter of the site.

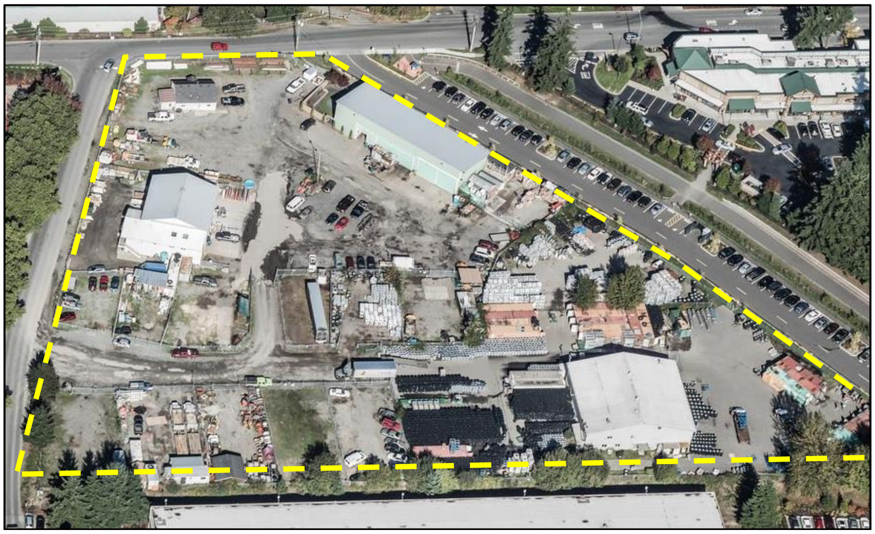


Plate 1: *Bird's Eye view of site outlined in yellow dashed line.*

View is from the south looking to the north.

The site and surrounding area is relatively level, with about two feet of elevation change across the length of the site. Based on review of the topographic survey prepared for the project (Terrane, 2018) site grades range from elevation 49 to 51 feet (NAVD88).

We understand it is planned to develop the site with a three building, 420-unit mixed-use development. The existing structures will be demolished to make way for the proposed construction. The proposed buildings will consist of four levels of residential living space over one level of commercial space, above a common parking garage that extends to one level below grade.

The ground level of the building will be constructed at elevation 48½ feet. The lower parking level will have a floor elevation ranging from 37.67 to 38.83 feet. Construction subgrade for the lower parking level will range from elevation 35.14 feet to 36.33 feet. The elevator pits will have finished floor elevation of 32.17 feet and a construction subgrade elevations of 28.17 feet. Plate 2 on the next page includes a portion of the building elevation from the architectural plans.

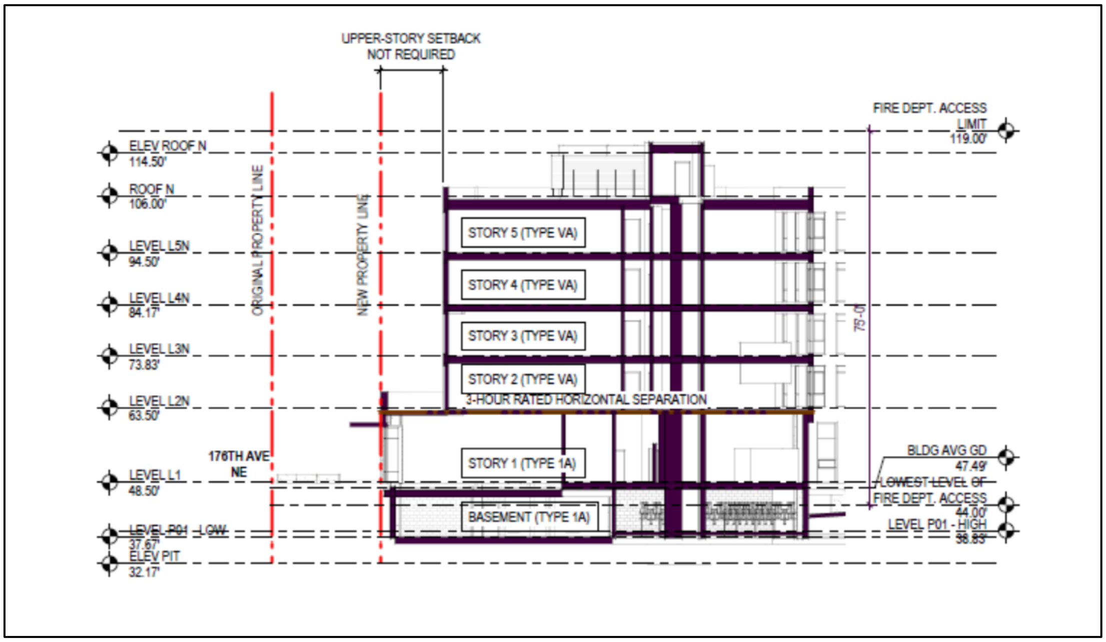


Plate 2: *North building section from the architectural plans showing floor and elevator pit elevations.*

We anticipate the excavation will be accomplished using a combination of conventional open cuts with temporary slopes and vertical excavations supported using temporary shoring.

Portions of the excavation will likely extend below the groundwater table; however, it is not planned to dewater the excavation. Instead watertight shoring will be used, or the construction processes will be modified to allow for construction into standing water. These methods may include staging excavators outside of the excavation and reaching into the excavation and assembling rebar mats and formwork outside of the excavation and placing them into the excavation using a crane.

The site is located in an area identified by the City of Redmond as the Marymoor 100-percent infiltration area due to limited stormwater conveyance capacity.

It is planned to dispose of stormwater from the development using an infiltration system. The system will consist of Stormtech infiltration chambers in the southeast portion of the site to dispose of runoff from the roof and impervious surfaces. Seven drywells are planned around the perimeter of the site to dispose of runoff from right of way areas. The conclusions and recommendations in this report are based on our understanding and assumption of the proposed development, which is in turn based on the project information provided. If the above project description is incorrect, or the project information changes, we should be consulted to review the recommendations contained in this study and make modifications, if needed. In any case PanGEO should be retained to provide a review of the final design to confirm that our geotechnical recommendations have been correctly interpreted and adequately implemented in the construction documents.

3.0 SUBSURFACE EXPLORATION AND SOIL CONDITIONS

3.1 SITE GEOLOGY

Based on review of the Geologic Map of the Redmond Quadrangle, King County, Washington (Minard 1988), the project site is underlain by Younger Alluvium – Geologic Map Unit Qyal. Younger Alluvium consists of stratified sand, silt and clay derived from glacial outwash deposited in the upper Bear Creek drainage.

3.2 SUBSURFACE EXPLORATION

Six borings, PG-1 through PG-6 were drilled at the site on January 22 and 23, 2018. The borings were drilled using a Brainard-Killman BK-81 truck mounted drill rig operated by Holocene Drilling under subcontract to PanGEO and were logged by an engineer with our firm. The borings were drilled to a maximum depth of 31 feet below existing grade. The approximate boring locations were identified in the field by measuring from property corners and site features and are shown on Figure 2, Site and Exploration Location Plan.

Standard Penetration Tests (SPT) were performed at 2½- to 5-foot depth intervals using a standard, 2-inch diameter split-spoon sampler. The sampler was advanced with a 140-pound drop hammer falling a distance of 30 inches for each strike, in general accordance with ASTM D-1586, *Standard Test Method for Penetration Test and Split Barrel Sampling of Soils*.

The soils were logged in general accordance with ASTM D-2487 S*tandard Practice for Classification of Soils for Engineering Purposes* and the system summarized on Figure A-1, Terms and Symbols for Boring and Test Pit Logs.

3.3 SOIL CONDITIONS

For a detailed description of the subsurface conditions encountered at each exploration location, please refer to our boring logs provided in Appendix A. The stratigraphic contacts indicated on the boring logs represent the approximate depth to boundaries between soil units. Actual transitions between soil units may be more gradual or occur at different elevations. The descriptions of groundwater conditions and depths are likewise approximate.

The following is a generalized description of the soils encountered in the borings.

Gravel Surface: All of our borings were located in gravel surfaced parking and drive areas. The gravel layer ranges from three to six inches thick.

Fill: At the location of Boring PG-6 (i.e., southeast corner of the site), we encountered undocumented fill. The fill consisted of gray to black silty fine sand and extended to a depth of 12½ feet below grade. The fill was loose to medium dense and was characterized by the presence of wood debris. No significant amount of fill was encountered at other test boring locations.

Quaternary Younger Alluvium (Qyal): Below the gravel surface and the fill in Boring PG-6, we encountered alluvium consisting of poorly graded sand with a trace of silt and varying amounts of gravel. The soil was typically loose to medium dense to a depth of 7½ feet below grade and medium dense to dense to 20 feet to 30 feet below grade. At 20 to 30 feet below grade the alluvium graded to dense to very dense. All of our borings were terminated in dense to very dense poorly graded sand with gravel at 26 to 31 feet below grade.

Our subsurface descriptions are based on the conditions encountered at the time of our exploration. Soil conditions between our exploration locations may vary from those encountered. The nature and extent of variations between our exploratory locations may not become evident until construction. If variations do appear, PanGEO should be requested to reevaluate the recommendations in this report and to modify or verify them in writing prior to proceeding with earthwork and construction.

3.4 Groundwater

We encountered groundwater during the drilling of borings PG-1 through PG-6 at 15 to 20 feet below grade. A standpipe piezometer was installed in Boring PG-3 to allow for monitoring of groundwater levels after completion of drilling.

In March 2018 Farallon Consulting installed four monitoring wells at the site (Farallon, 2018b). Groundwater was encountered in their monitoring wells at 15 to 17.2 feet below grade.

3.4.1 Review of Historical Groundwater Monitoring

Groundwater levels in the alluvial soils below Redmond fluctuate seasonally due to changes in precipitation, land use and groundwater withdrawals. As part of their wellhead protection program, the City of Redmond monitors groundwater levels using a network of more than 100 monitoring wells. The locations of the City of Redmond monitoring wells closest to the subject site are shown on Figure 3, *City of Redmond Groundwater Monitoring Well Locations*. The closest well to the site is MW334, which is located immediately southwest of the site. Other wells near the site include MW333 located about 1,200 feet to the west and MW-47 and MW-48 located about 1,000 feet to the south. Groundwater levels in MW334 and MW333 have been monitored by the City using pressure transducers and by hand gauging from 2010 through the present and provide a good historical record of groundwater fluctuations. Groundwater levels in MW47 and MW48 have been manually gauged twice a year, once during the wet season and once during the wet season, from 2007 through 2017. The results of the groundwater level monitoring using the City of Redmond records are summarized in Figure 4.

Based on a review of the City's groundwater records from MW333 and MW334, groundwater levels in this area fluctuate by almost eight feet between the seasonal high and low of elevation 37.6 feet and elevation 29.7 feet, respectively, based on the NAVD88 datum.

3.4.2 Design Groundwater Elevation

In order to develop a design groundwater elevation for this project, we conducted groundwater monitoring between monitoring well FMW-5 and City of Redmond well MW333, located about 1,200 feet west of the site. We selected FMW-5 for monitoring because it is centrally located, and the top of casing elevation had been surveyed. Well MW333 was selected based on a historical high groundwater elevation for this area of 37.6 feet recorded in December 2012.

Electronic pressure transducers (data loggers) were installed in the standpipe piezometers in FMW-5 and MW333 to allow for synoptic groundwater elevations to be obtained four times a day. Based on monitoring between December 21, 2018 and January 4, 2019, the average difference in groundwater elevation between FMW-5 and MW333 is -0.4 inches (where a negative value indicates the water level at MW333 is higher than the level recorded at FMW-005) with a maximum difference of -3.0 inches. A summary of the synoptic groundwater monitoring is provided as the attached Figure 5, which includes a plot of the groundwater elevation at FMW-005 and MW333 and a plot of the difference in groundwater elevation between the wells. In summary, the current data shows the groundwater level at the project site is practically the same as MW333. The groundwater elevation is based on NAVD88.

Based on our monitoring, in our opinion a design high groundwater elevation of 37.6 feet should be used.

3.5 Infiltration Testing

On October 31, 2018, we conducted an infiltration test identified as Test Pit PIT-1 on the west side of the site. The approximate location of infiltration test PIT-1 is shown on Figure 2 and a log of Test Pit PIT-1 is provided as Figure B-1. The infiltration test was conducted in general accordance with the procedure for a Small Pilot Infiltration Test (PIT) as outlined in the City of Redmond Stormwater Technical Notebook (STN) (Redmond, 2017) and the Washington Department of Ecology Stormwater Management Manual for Western Washington (WDOE, 2014). Plate 3 on the next page shows the test underway. In general, the test consisted of the following procedure:

- A test pit was excavated to the approximate design bottom of the proposed infiltration facilities with a minimum bottom area of 12 square feet.
- The test pit was pre-soaked for six hours by maintaining a water level of at least 12 inches above the bottom of the pit. A flow meter was used to monitor the amount of water used during the pre-soak.
- At the end of pre-soak period, a flow meter was used to monitor the amount of water needed to maintain a constant head of 12 inches for at least one hour and until at least a point at which a constant volume of water per time unit was achieved.

- At the end of the constant head test, we measured the falling head infiltration rate by shutting off the water flow and recording the decrease in water level over regular time intervals until all of the water was infiltrated.

Plate 3: *View of infiltration testing at PIT-1 underway.*

The field infiltration rates were calculated based on the measured flow per time unit and the surface area of the hole. The results of our test are summarized in Table 1 below. A graphical representation of our infiltration test showing the variation in the flow, water level, and infiltration rate during the presoak, constant head test, and falling head test is included as Figure 6, Infiltration Test Summary.

TABLE 1 -- INFILTRATION TEST SUMMARY

Test Location/Depth	Pre-Soak Duration (hours)	Test Stage	Test Duration	Test Result (inches/hour)	Soils
PIT-1 at 10 feet	6	Constant Head	1 hour	210	Poorly graded SAND with gravel
		Falling Head	3 minutes	128	

The field infiltration test estimates the saturated hydraulic conductivity (K_{sat}) of the soil. The estimated K_{sat} value is factored by applying a series of correction factors (CF) outlined in Table 3.3.1 of the WDOE Manual. The correction factors account for the test method, influent control and site variability.

The correction factor for the test method (CF_t) is used to account for differences between the laboratory test method and in-situ infiltration testing. We used a CF_t value of 0.5 based on the use of the small PIT method.

The influent control correction factor (CF_m) is intended to account for a reduction in infiltration capacity due to clogging from siltation and the build-up of biological material. An influent control factor of 0.9 was used, assuming that when the infiltration system loses 10 percent of its infiltration capacity due to clogging, the system will be maintained or cleaned.

The correction factor for site variability (CF_v) is intended to correct for the number of locations sampled and the consistency of the underlying soil conditions. The value for CF_v ranges from 0.33 to 1.0. Based on the relatively uniform soil conditions encountered at our exploration locations and our experience and engineering judgment, we assigned a correction factor of 0.9 for site variability. The total correction factor (CF_v x CF_t x CF_m) was then applied to the infiltration rate to obtain a corrected infiltration rate appropriate for long term design purposes. Table 2, below, provides a summary of the correction factors for Test Pit PIT-1.

TABLE 2: INFILTRATION RATE CORRECTIONS

Location	Infiltration Test Depth	Soil Type	Infiltrate Rate K_{sat} (in/hr)	CF_v	CF_t	CF_m	Corrected Infiltration Rate (in/hr)
PIT-1	9	Poorly graded SAND with gravel	210	0.9	0.5	0.9	85

Based on the results of our field exploration and grain size distribution testing, in our opinion, infiltration of stormwater should be feasible in the poorly graded sand with gravel underlying the site.

3.6 Laboratory Testing

Laboratory tests were conducted on representative soil samples to verify or modify the field soil classification and to evaluate the general physical properties and engineering characteristics of the soil encountered. Visual field classifications were supplemented by grain size analyses on representative soil samples. The results of laboratory tests performed on specific samples are provided either at the appropriate sample depth on the individual boring logs or on a separate data sheet contained in Appendix C. It is important to note that these test results may not accurately represent the overall in-situ soil conditions. Our geotechnical recommendations are based on our interpretation of these test results and their use in guiding our engineering judgment.

4.0 CRITICAL AQUIFER RECHARGE AREA CONSIDERATIONS

4.1 Critical Aquifer Recharge Areas

The subject site is located within a Critical Aquifer Recharge Area (CARA) Environmentally Critical Area (ECA) as defined in City of Redmond Zoning Code (RZC) 20D.140.50. Sensitive areas maps prepared by the City of Redmond indicate the site is located within a Wellhead Protection Zone 3, which represents the land area overlying portions of the aquifer with a five- to ten-year time-of-travel to any public water source well.

The CARA designation is assigned based on the presence of the Redmond Alluvial Aquifer which is an unconfined aquifer that is the primary water source for the City of Redmond. An unconfined aquifer is defined as an aquifer in which the upper boundary is the water table and it is therefore not separated from the ground surface by a restrictive or confining soil layer. Unconfined aquifers have a risk of contamination and water quality degradation from contaminants released to the ground surface and infiltrating surface water.

The closest City of Redmond water supply well to the subject site is Well #5 located at 17800 76th Avenue Northeast, about 3,000 feet north of the site.

4.2 Seasonal Groundwater Elevation Data

The City of Redmond monitors more than 100 wells in the Redmond Alluvial Aquifer as part of their wellhead protection program. Water levels in the wells are manually gauged at least twice a year, once during wet season and again during the dry season, and several of the wells have been periodically instrumented with pressure transducers to provide near continuous groundwater monitoring. We reviewed the City of Redmond groundwater elevation data for four monitoring wells located within a 1,300-foot radius of the site. The approximate locations of the City of Redmond monitoring wells in the vicinity of the site are shown on Figure 3, *City of Redmond Groundwater Monitoring Well Locations*.

The monitoring well water level data provided by the City was plotted along with historical precipitation records and is presented as Figure 4, *Groundwater Elevations and Precipitation, City of Redmond Monitoring Wells*. The graphs show the seasonal response of the wells to seasonal fluctuations in precipitation. Based on review of the data, groundwater levels in the wells near the site typically rise in October, with a wet season high groundwater elevation of 37.6 feet recorded at MW333 on December 15, 2010. The groundwater levels decrease in the late spring and throughout the summer with a dry season low groundwater elevation near the site of 29.7 feet recorded at MW048 on August 12, 2015. The City of Redmond uses the NAVD88 datum.

We reviewed groundwater level monitoring data from August 2017 obtained for the City of Redmond as part of their wellhead protection program (Golder, 2017) to infer the groundwater flow direction. Based on our review, groundwater flow in the vicinity of the site is generally from the northeast to the southwest with an estimated groundwater gradient of about 0.16 percent. The groundwater flow direction is shown on Figure 3.

The closest surface water bodies in vicinity of the site are Bear Creek, located about 1,600 feet north of the site and Lake Sammamish about 4,600 feet south of the site.

4.3 POTENTIAL CONSTRUCTION GROUNDWATER QUALITY IMPACTS

Because the site is located within a Wellhead Protection Zone 3, the City requires an assessment of potential impacts to groundwater quality due to construction activities. At the time this report is prepared, details regarding the proposed construction sequencing or methods were not available. When this information is available a more detailed discussion of potential construction related groundwater impacts can be provided.

For planning purposes, we are including general best construction practices for CARA areas in Appendix D of this report.

The construction should also conform to Redmond Zoning Code (RZC) 21.64.050.D.3.f, *Protection Standards During Construction*.

4.4 Potential Long-Term Groundwater Impacts

The proposed development will primarily consist of residential space with ground level commercial space and below grade parking. The commercial space tenants are unknown at this time. We anticipate potential contaminants from the proposed development could consist of leaks or discharges from vehicles in the parking garage and household chemicals.

All drainage within the building, such as surface water from below grade parking, the trash room and wash water, should pass through an oil/water separator and be discharged to the sanitary sewer.

Locations where significant spills and leaks could potentially occur at the facility and that could contribute pollutants to stormwater, surface water and groundwater include:

- Vehicle Storage Areas
- Liquid Storage Areas

For planning purposes, we are including general best management practices (BMP's) for CARA areas in Appendix E of this report.

4.5 Environmental Review

The project environmental consultant, Farallon Consulting prepared a Phase I environmental site assessment (ESA) for the subject site (Farallon, 2018a) and a Summary of Subsurface Investigation (Farallon, 2018b).

Based on our review, the Farallon report concludes "Groundwater is not a medium of concern at the Site because there are no COPCs (constituents of potential concern) exceeding groundwater cleanup levels." (Page 7, Farallon, 2018b).

The Farallon report identifies an area of environmentally impacted soils in the central portion of the site. These soils cannot be re-used on-site as structural fill. We understand it is planned to remove these soils as part of the mass excavation in order to obtain a No Further Action determination from the Washington Department of Ecology.

4.5.1 Stormwater Infiltration Impacts

Surface water from the building roofs will be infiltrated using a system of Stormtech infiltration chambers in the southeast portion of the site. Stormwater from right of way areas will be treated and then infiltrated using a series of seven dry wells along the north, west and south sides of the site. Low pH runoff such as precipitation from roofs can mobilize contaminants in soil. The building excavation will extend to between elevation 35.17 feet and 36.33 feet and in localized areas such as the elevator pits, to elevation 28.17 feet If contaminated or impacted soils are encountered during excavation they would be removed and disposed of in accordance with environmental regulations.

4.6 Critical Aquifer Recharge Area Conclusions

The site is underlain by the Redmond Alluvial Aquifer. Based on the current development plan with an excavation extending to elevation 35.6 feet across most of the site and elevation 27 feet in localized area, we anticipate the building excavation will intercept the groundwater table. Where excavations are needed to extend below groundwater, the excavation will either be performed into standing water or watertight shoring, such as secant pile walls or a sinking caisson, will be used.

The proposed development will include residential living and retail space. These tenants are not expected to generate hazardous materials.

Drainage collected within the building should pass through an oil/water separator and then be pumped to the sanitary sewer.

5.0 DEWATERING

As previously discussed, it is planned to eliminate the need for temporary construction dewatering. This will be accomplished using either watertight shoring such as secant pile walls or sinking caisson construction methods. Alternatively, the deepest elements of construction may be performed in in standing water.

This type of shoring would extend below the groundwater table to a sufficient depth provide a cutoff for groundwater. The soils inside the shoring would be excavated and a plug of lean-mix concrete would be placed to seal the bottom of the excavation and resist hydrostatic uplift. The water inside the excavation could then be removed without needing to dewater the site.

Excavation into standing water would be performed by excavators staged outside of the excavation that reach into the excavation to remove the soils.

6.0 INFILTRATION RECOMMENDATIONS

Based on the results of our field testing, infiltration of stormwater should be feasible. Our infiltration test yielded a corrected infiltration rate of 85 inches per hour. The City of Redmond specifies a maximum infiltration rate for sizing infiltration systems of 20 inches per hour, Redmond STN Chapter 2.9.3.9. As such, an infiltration rate of 20 inches per hour should be used for design.

In accordance with the Redmond STN, Chapter 8.3.3, the infiltration facilities should be located at least five feet above the seasonal high groundwater table. The separation may be reduced to three feet based on the results of a groundwater mounding analysis.

No impermeable soil layers were encountered at the infiltration test location to the maximum exploration depth of 13 feet below existing grade. Our closest boring to the infiltration test, Boring PG-1 did not encounter impermeable soil layers within 31½ feet of existing grade.

We encountered fill in the southeast portion of the site, at the location of our Boring PG-6. If fill is encountered at the design infiltration subgrade elevation, the fill should be overexcavated and be replaced with drain rock.

Where infiltration systems will be located within 15 feet of the building, the building envelop consultant should review the potential for infiltrating stormwater to enter the building and evaluate the need for waterproofing recommendations.

The infiltration capability of the natural deposits underlying the site will vary with depth and laterally. Due to this potential variability, a representative from PanGEO should observe the infiltration system soils after excavation to verify the soils encountered are as anticipated.

6.1 CONSTRUCTION CONSIDERATIONS

Infiltration facilities are post-construction facilities which are designed to improve the quality and manage the volume of stormwater runoff by encouraging natural infiltration on-site. In order to protect the infiltration receptor soils from becoming clogged with sediment and/or compacted during construction, we recommend the following measures be implemented:

- The infiltration facilities should be constructed as late in the schedule as feasible and should not be constructed until after the upstream areas are stabilized.

- Heavy equipment traffic on prepared subgrades should be limited, especially during wet weather.
- If fine grained sediment is deposited or tracked onto the infiltration system subgrade, it should be removed using an excavator with a grade plate, small dozer or vacuum truck.
- The subgrade should be scarified prior to placing fill to prevent sealing of the receptor soils.
- Structural fill and aggregate base materials should be end-dumped at the edge of the fill area and the material pushed out over the subgrade.
- Grading of the infiltration galleries should be accomplished using low-impact earth-moving equipment to prevent compaction of the underlying soils. Wide tracked vehicles such as back hoes, small dozers and bobcats are suggested.

Furthermore, infiltration facilities should be located as far away as possible from any footings and basements in order to avoid water migration into adjacent structures and long terms settlement of foundation soils.

PanGEO should be retained during construction to observe excavations of infiltration facilities to confirm the infiltration facilities are constructed in the intended soil unit.

7.0 GEOTECHNICAL RECOMMENDATIONS

7.1 SEISMIC DESIGN PARAMETERS

The 2015 International Building Code (IBC) seismic design section provides a basis for seismic design of structures. Table 3 below provides seismic design parameters for the site that are in conformance with the 2015 IBC, which specifies a design earthquake having a 2% probability of occurrence in 50 years (return interval of 2,475 years), and the 2008 USGS seismic hazard maps.

TABLE 3 – SEISMIC DESIGN PARAMETERS

Site Class	Spectral Acceleration at 0.2 sec. [g] S_S	Spectral Acceleration at 1.0 sec. [g] S_1	Site Coefficients		Design Spectral Response Parameters		Control Periods [sec.]	
			F_a	F_v	S_{DS}	S_{D1}	T_O	T_S
D	1.252	0.479	1.000	1.521	0.835	0.486	0.116	0.582

The spectral response accelerations were obtained from the USGS Earthquake Hazards Program Interpolated Probabilistic Ground Motion website (2008 data) for the project latitude and longitude.

***Liquefaction Potential* -** Liquefaction is a process that can occur when soils lose shear strength for short periods of time during a seismic event. Ground shaking of sufficient strength and duration results in the loss of grain-to-grain contact and an increase in pore water pressure, causing the soil to behave as a fluid. Soils with a potential for liquefaction are typically cohesionless, predominately silt and sand sized, must be loose, and be below the groundwater table. The site is predominantly underlain by medium dense to dense poorly graded sand and gravel. Based on these conditions, in our opinion the liquefaction potential at the site is negligible and design considerations related to soil liquefaction are not necessary for this project.

7.2 Building Foundations

Based on the subsurface conditions and our understanding of the planned development, it is our opinion the proposed building may be supported on a spread footing foundation.

Footings should bear on the medium dense to dense, undisturbed native soil underlying the site, or on properly compacted structural fill placed on undisturbed native soil. We encountered 12½ feet of fill at the location of Boring PG-6. The fill was characterized by its gray to black color and the presence of wood debris. If fill is encountered in the building excavation, the fill should be overexcavated and replaced with structural fill.

For frost protection considerations, exterior foundation elements should be placed at a minimum depth of 18 inches below final exterior grade. Interior spread foundations should be placed at a minimum depth of 12 inches below the top of concrete slabs.

We recommend a maximum allowable soil bearing pressure of 5,000 pounds per square foot (psf) be used for sizing foundation elements. The recommended allowable bearing pressure is for dead plus live loads. For allowable stress design, the recommended bearing pressure may be increased by one-third for transient loading, such as wind or seismic forces. Continuous and individual spread footings should have minimum widths of 18 and 24 inches, respectively.

Footings designed and constructed in accordance with the above recommendations should experience total settlement of less than one inch and differential settlement of less than ½ inch. Most of the anticipated settlement should occur during construction as dead loads are applied.

7.2.1 Lateral Resistance

Lateral loads on the structure may be resisted by passive earth pressure developed against the embedded portion of the foundation system and by frictional resistance between the bottom of the foundation and the supporting subgrade soils. A frictional coefficient of 0.35 may be used to evaluate sliding resistance developed between the foundation and the compacted subgrade soil. Passive soil resistance may be calculated using an equivalent fluid weight of 175 below elevation 37.6 feet and 350 pcf above elevation 37.6 feet, assuming foundations are backfilled with structural fill. The above values include a factor of safety of 1.5. The above values include a factor of safety of 1.5. Unless covered by pavements or slabs, the passive resistance in the upper 12 inches of soil should be neglected.

7.2.2 Foundation Subgrade Preparation

The foundation subgrade should be properly prepared and in a dense condition prior to setting forms and rebar. Loose or softened soil exposed in the excavation subgrade should be overexcavated and replaced with structural fill.

7.2.3 Perimeter Footing Drains

Due to the presence of highly permeable soils below the site, it is our opinion a footing drain with a discharge is not necessary. Instead, we recommend installing a four-inch diameter perforated pipe around the building perimeter at the footing invert elevation to collect and disperse potential groundwater seepage.

Exterior grades should be sloped to drain at a minimum 2 percent slope for a horizontal distance of at least 10 feet away from the building.

7.3 Floors Slabs

Assuming conventional footings will be used to support the proposed buildings, the floor slab for the proposed buildings may be constructed using conventional concrete slab-on-grade floor construction. The floor slabs should be supported on competent native soil or on structural fill. Any over-excavations, if needed, should be backfilled with structural fill.

7.4 Groundwater and Hydrostatic Uplift

In our opinion, there are two options to address the high groundwater at the site. The first would be to allow for periodic flooding of the parking garage. This may be acceptable given the relatively short periods of time groundwater will rise to peak levels. The second option would be to provide waterproofing around the lower level and design the structure to resist hydrostatic uplift.

The elevator pits for the building will extend about five feet below the parking garage level. If the components inside the elevator pits are not compatible with periodic flooding, then the elevator pits should be constructed as a watertight structure and be designed to resist hydrostatic uplift.

For design against hydrostatic uplift, a design groundwater elevation of 37.6 feet should be used.

Waterproofed structures should be designed to resist hydrostatic uplift and to prevent possible heave and cracking of foundations and slabs. The weight of the structure and the uplift capacity of the shoring system around the basement perimeter may be used to resist uplift forces. Pressure relief valves may need to be cast in the lower level slab on grade floor to relieve hydrostatic pressures.

7.5 Below-Grade Walls

7.5.1 Design Parameters

Below-grade walls should be designed to resist the lateral earth pressure of the retained soils and hydrostatic pressures. We recommend the basement walls be designed for an equivalent fluid weight of 85 pcf below elevation 37.6 feet, and 45 pcf above elevation 37.6 feet. The recommended equivalent fluid weights include the combination of lateral soil pressure and hydrostatic pressure. For the seismic condition, we recommend including an incremental uniform lateral earth pressure of 7H psf (where H is the height of the below grade portion of the wall) as an ultimate seismic load.

Surcharge Loads: If the below-grade walls will be subjected to the influence of traffic surcharge loading within a horizontal distance equal to or less than the height of the walls, a uniform horizontal pressure of 80 psf may be used to represent the traffic surcharge. The above recommended earth pressures assume level backslope conditions.

Lateral Resistance: Lateral forces would be resisted by passive earth pressure against the buried portions of structures and by friction at the bottom of mat slab. Allowable passive resistance in backfill should be computed using an equivalent fluid pressure of 175 pcf below elevation 37.6 feet), and 350 pcf when at least two feet above elevation 37.6 feet. An allowable coefficient of friction of 0.35 may be used between cast-in-place concrete and native soil subgrade. A factor of safety of at least 1.5 is included in the recommended values.

7.5.2 Wall Backfill

Where needed, the predominately poorly graded sand with gravel soil underlying the site is suitable for use as wall backfill. If imported wall backfill will be needed, the impacted wall backfill should consist of imported, free draining granular material meeting the requirements of Gravel Borrow as defined in WSDOT Section 9-03.14(1) (WSDOT, 2018). In areas where the space is limited between the wall and the face of excavation, pea gravel may be used as backfill without compaction.

Wall backfill should be moisture conditioned to within about 3 percent of optimum moisture content, placed in loose, horizontal lifts less than 8 inches in thickness, and systematically compacted to a dense and relatively unyielding condition and to at least 95 percent of the maximum dry density, as determined using test method ASTM D-1557. Within 5 feet of the wall, the backfill should be compacted with hand-operated equipment to at least 90 percent of the maximum dry density.

7.6 Permanent Cut and Fill Slopes

Based on the anticipated soil that will be exposed in the planned excavation, we recommend permanent cut and fill slopes be constructed no steeper than 2H:1V (Horizontal:Vertical).

8.0 TEMPORARY EXCAVATIONS AND SHORING

8.1 Temporary Excavations

In order to achieve construction subgrade elevations for the below grade parking, an excavation extending to a depth of about 10 feet below grade is planned. Temporary excavations should be constructed in accordance with Part N of WAC (Washington Administrative Code) 296-155. The contractor is responsible for maintaining safe excavation slopes and/or shoring.

Based on the soil conditions encountered in the test borings, it is our opinion temporary excavations may be cut at a maximum 1½H:1V inclination.

Temporary excavations may be made into standing water for the elevator pits and tower cranes. Temporary excavations into standing water should be inclined no steeper than 2H:1V. If sufficient space is not available, temporary excavation shoring will be needed.

Temporary excavations should be evaluated in the field during construction based on actual observed soil conditions. If seepage is encountered, excavation slope inclinations may need to be reduced. During wet weather, the cut slopes may need to be flattened to reduce potential erosion or should be covered with plastic sheeting.

8.2 Temporary Shoring

We anticipate a combination of conventional open cuts and temporary shoring may be used to accomplish the planned excavation. Given the subsurface conditions at the site, in our opinion temporary shoring consisting of a soldier pile wall is likely the most cost-effective shoring option.

The shoring system should be designed to provide adequate protection for the workers, adjacent structures, utilities, and other facilities. Excavations should be performed in accordance with the current requirements of WISHA. Construction should proceed as rapidly as feasible, to limit the time temporary excavations are open.

8.2.1 Temporary Soldier Pile Shoring Design Parameters

A soldier pile wall consists of vertical steel beams, typically spaced from 6 to 8 feet apart along the proposed excavation wall, spanned by timber lagging. Prior to the start of excavation, the steel beams are installed into holes drilled to a design depth and then backfilled with lean mix or structural concrete. As the excavation proceeds downward and the steel piles are subsequently exposed, timber lagging is installed between the piles to further stabilize the walls of the excavation.

8.2.2 Soldier Pile Wall Design Parameters

We recommend the earth pressures depicted on Figure 7, *Design Lateral Pressures, Soldier Pile Wall, Cantilevered or with One Tieback* can be used for design of soldier pile walls for this project. Our shoring design parameters assume the excavation is fully dewatered and do not include hydrostatic pressures from groundwater.

The vertical capacity of the soldier piles should be determined using an allowable skin friction value of 0.5 ksf for the portion of the pile below the bottom of the excavation, and an allowable end soil bearing capacity value of 15 ksf.

8.2.3 Lagging

Lagging design recommendations for general conditions are presented on Figure 7. Lagging located within 10 feet of the top of the shoring which may be subjected to surcharge loads from construction equipment or material storage should be designed for an additional uniform lateral surcharge pressure of 200 psf. This pressure approximately corresponds to a vertical uniform surcharge load of 500 psf at the top of the wall for general construction surcharge. Point loads located close to the top of the wall, such as outriggers of heavy cranes, may apply additional loads to the lagging. These loads may need to be individually analyzed. However, lagging designed for a uniform load of 600 psf in the top 10 feet of the wall should be able to accommodate most crane outrigger loads.

We recommend voids behind the lagging be backfilled with CDF.

Because the site is located over the Redmond Alluvial Aquifer, untreated timber should be used for the lagging.

8.2.4 Baseline Survey and Monitoring

Ground movements will occur as a result of excavation activities. As such, ground surface elevations of the adjacent properties and city streets should be documented prior to commencing earthwork to provide baseline data. As a minimum, optical survey points should be established at the following locations:

- The top of every other soldier pile. These monitoring points should be monitored twice a week. The monitoring frequency may be reduced based on the monitoring results.

- Adjacent structures located within 25 feet of the shoring walls.

- The curbs and the centerlines of adjacent streets should be monitored by establishing a set of baseline point spaced no more than 20 feet apart. These monitoring points should not need to be regularly surveyed after the baseline is established unless the soldier pile wall monitoring indicates deflections exceeding one inch.

The monitoring program should include monitoring for changes in both the horizontal (x and y directions) and vertical deformations. The monitoring should be performed by the contractor or the project surveyor, and the results should be promptly submitted to PanGEO for review. The results of the monitoring will allow the design team to confirm design parameters, and for the contractor to make adjustments if necessary.

We also recommend the existing conditions along the public right of way and the adjacent private properties be photo-documented prior to commencing earthwork at the site.

9.0 EARTHWORK CONSIDERATIONS

9.1 DEMOLITION AND CLEARING

Building, pavement and areas to receive structural fill should be stripped and cleared of existing structures, surface vegetation, organic matter, and other deleterious material. Existing utility pipes to be abandoned should be plugged or removed so they do not provide a conduit for water and cause soil saturation and stability problems.

In no case should the demolition materials be used as structural fill or mixed with material to be used as structural fill.

Following the stripping operation and excavations necessary to achieve construction subgrade elevations, the ground surface where structural fill, foundations, slabs, or pavements are to be placed should be observed by a representative of PanGEO. Soil in loose or soft areas, if re-compacted and still yielding, should be overexcavated and replaced with structural fill to a depth that will provide a stable base beneath the general structural fill. The optional use of a geotextile fabric placed directly on the overexcavated surface may also help to bridge unstable areas.

9.2 Structural Fill and Compaction

Structural fill, if needed, should be free of or organic and inorganic debris, be near its optimum moisture content, and be capable of being compacted to the requirements of structural fill. The native soils underlying the site are relatively granular and can be used as structural fill during dry weather. If an imported granular fill is to be used, it should consist of clean fill from a commercial source that complies with Redmond Municipal Code (RMC) Chapter 15.24.080 and 15.24.095. The fill should comprise a well graded material containing less than five percent fines (silt and clay sized particles) passing the US No. 200 Sieve.

Structural fill should be moisture conditioned to within about 3 percent of optimum moisture content, placed in loose, horizontal lifts less than 8 inches in thickness, and compacted to at least 95 percent maximum density, determined using ASTM D 1557 (Modified Proctor). The procedure to achieve proper density of a compacted fill depends on the size and type of compacting equipment, the number of passes, thickness of the lifts being compacted, and certain soil properties. If the excavation to be backfilled is constricted and limits the use of heavy equipment, smaller equipment can be used, but the lift thickness will need to be reduced to achieve the required relative compaction.

Generally, loosely compacted soils are a result of poor construction technique or improper moisture content. Soils with high fines contents are particularly susceptible to becoming too wet and coarse-grained materials easily become too dry, for proper compaction. Silty or clayey soils with a moisture content too high for adequate compaction should be dried as necessary, or moisture conditioned by mixing with drier materials, or other methods.

9.3 Material Reuse

The native soils underlying the site can be re-used as structural fill. The native soil to be re-used as structural fill should be stockpiled and protected with plastic sheeting to prevent it from becoming saturated by precipitation or runoff.

A subsurface investigation prepared by the project environmental consultant (Farallon, 2018b) identified an area of environmentally impacted soils in the central portion of the site. These soils will not be suitable for reuse on-site as structural fill. It is planned to export these soils.

9.4 Wet Weather Construction

General recommendations relative to earthwork performed in wet weather or in wet conditions are presented below. The following procedures are best management practices recommended for use in wet weather construction:

- Earthwork should be performed in small areas to minimize subgrade exposure to wet weather. Excavation or the removal of unsuitable soil should be followed promptly by the placement and compaction of clean structural fill. The size and type of construction equipment used may have to be limited to prevent soil disturbance.
- During wet weather, the allowable fines content of the structural fill should be reduced to no more than 5 percent by weight based on the portion passing the 0.75-inch sieve. The fines should be non-plastic.
- The ground surface within the construction area should be graded to promote run-off of surface water and to prevent the ponding of water.
- Geotextile silt fences should be installed at strategic locations around the site to control erosion and the movement of soil.
- Excavation slopes and soils stockpiled on site should be covered with plastic sheeting.

9.5 Erosion Considerations

Surface runoff can be controlled during construction by careful grading practices. Typically, this includes the construction of shallow, upgrade perimeter ditches or low earthen berms in conjunction with silt fences to collect runoff and prevent water from entering excavations or to prevent runoff from the construction area leaving the immediate work site. Temporary erosion control may require the use of hay bales on the downhill side of the project to prevent water from leaving the site and potential storm water detention to trap sand and silt before the water is discharged to a suitable outlet. All collected water should be directed under control to a positive and permanent discharge system.

Permanent control of surface water should be incorporated in the final grading design. Adequate surface gradients and drainage systems should be incorporated into the design such that surface runoff is collected and directed away from the structure to a suitable outlet. Potential issues associated with erosion may also be reduced by establishing vegetation within disturbed areas immediately following grading operations.

10.0 ADDITIONAL SERVICES

To confirm that our recommendations are properly incorporated into the design and construction of the proposed addition, PanGEO should be retained to conduct a review of the final project plans and specifications, and to monitor the construction of geotechnical elements. The City of Redmond, as part of the permitting process, will also require geotechnical construction inspection services. PanGEO can provide you a cost estimate for construction monitoring services at a later date.

11.0 CLOSURE

We have prepared this report for Lennar Multifamily Communities, LLC and the project design team. Recommendations contained in this report are based on a site reconnaissance, a subsurface exploration program, review of pertinent subsurface information, and our understanding of the project. The study was performed using a mutually agreed-upon scope of work.

Variations in soil conditions may exist between the locations of the explorations and the actual conditions underlying the site. The nature and extent of soil variations may not be evident until construction occurs. If any soil conditions are encountered at the site that are different from those described in this report, we should be notified immediately to review the applicability of our recommendations. Additionally, we should also be notified to review the applicability of our recommendations if there are any changes in the project scope.

Our scope of services does not include services related to construction safety precautions. Our recommendations are not intended to direct the contractors' methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design. Additionally, the scope of our services specifically excludes the assessment of environmental characteristics, particularly those involving hazardous substances. We are not mold consultants nor are our recommendations to be interpreted as being preventative of mold development. A mold specialist should be consulted for all mold-related issues.

This report has been prepared for planning and design purposes for specific application to the proposed project in accordance with the generally accepted standards of local practice at the time this report was written. No warranty, express or implied, is made.

This report may be used only by the client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both off and on-site), or other factors including advances in our understanding of applied science, may change over time and could materially affect our findings. Therefore, this report should not be relied upon after 24 months from its issuance. PanGEO should be notified if the project is delayed by more than 24 months from the date of this report so that we may review the applicability of our conclusions considering the time lapse.

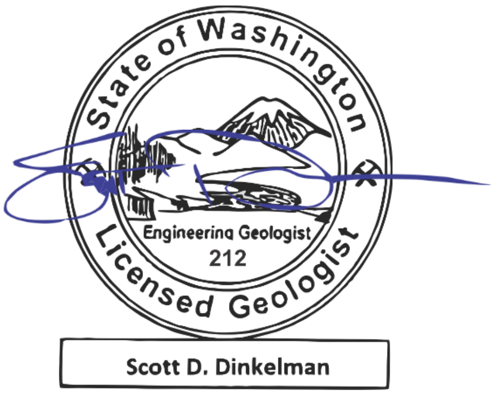
It is the client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's

Exhibit 17

option and risk. Any party other than the client who wishes to use this report shall notify PanGEO of such intended use and for permission to copy this report. Based on the intended use of the report, PanGEO may require that additional work be performed and that an updated report be reissued. Noncompliance with any of these requirements will release PanGEO from any liability resulting from the use this report.

Sincerely,

PanGEO, Inc.



Scott D. Dinkelman, LEG, LHG
Senior Engineering Geologist

Siew L Tan, P.E.
Principal Geotechnical Engineer

12.0 REFERENCES

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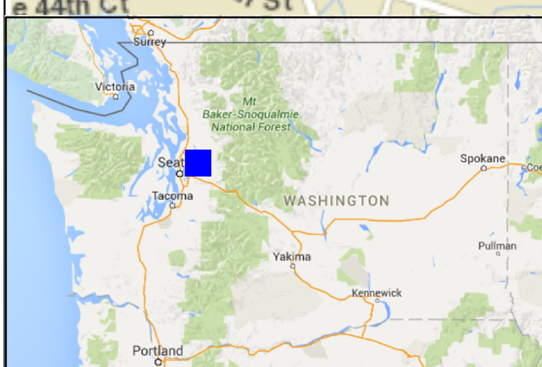

Base Map: WSDOT GeoPortal

NORTH

Not-To-Scale

PanGEO INCORPORATED

LMC Marymoor
17611 Northeast 70th Street
Redmond, Washington

VICINITY MAP

Project No.	**17-406**	Figure No.	**1**

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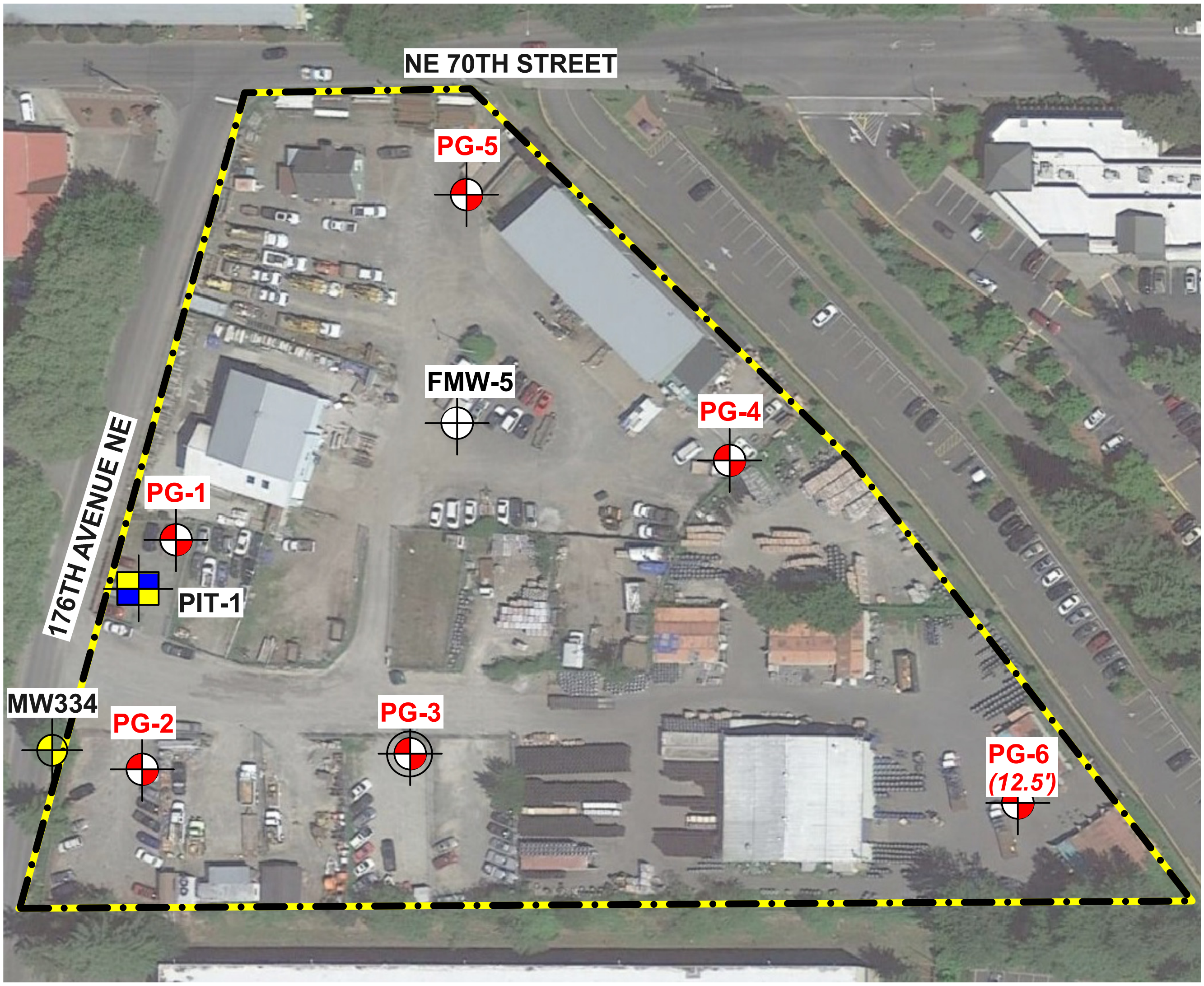
Exhibit 17



LEGEND:

Subject Site

Approximate Boring Location, PanGEO, Inc., January 2018
(Fill Thickness in Feet)
(Circle around symbol identifies standpipe piezometer location)

Approximate City of Redmond Monitoring Well Location

Approximate Infiltration Test Location, PanGEO, Inc., October 2018

Approximate Infiltration Test Location, PanGEO, Inc., October 2018

Approximate Scale (feet)

0' 50' 100'

NORTH

PanGEO INCORPORATED

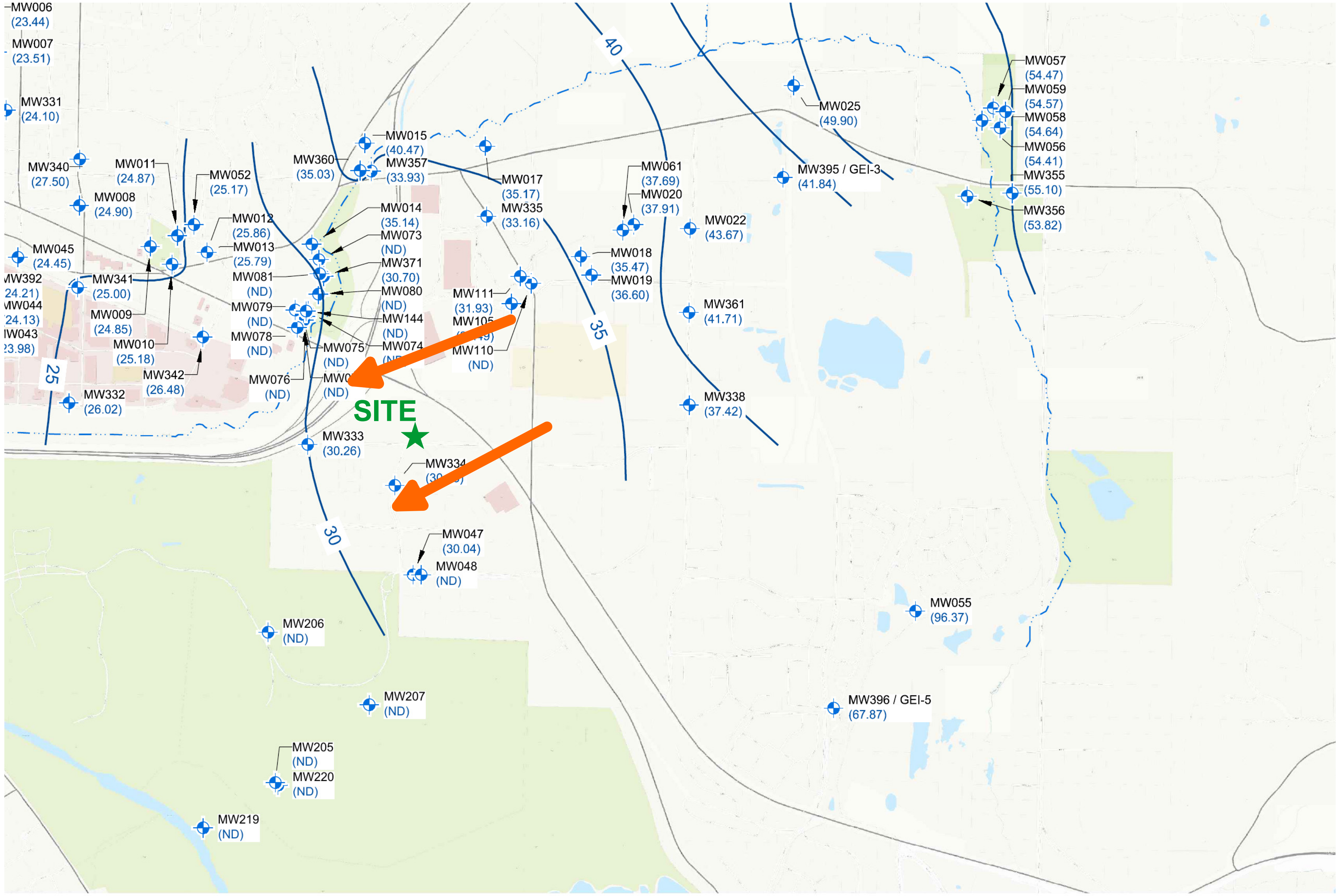
LMC Marymoor
17611 Northeast 70th Street
Redmond, WA

SITE AND EXPLORATION PLAN

Project No.	17-406	Figure No.	2

Site and Exploration Plan.grf 1/25/19 (16:28) RR

Exhibit 17



LEGEND:

★ Subject Site

Estimated Groundwater Flow Direction

CITY OF REDMOND MONITORING WELL
(GROUNDWATER ELEVATION, JULY 2017)

GROUNDWATER LEVEL CONTOUR BASED ON MEASUREMENT OBTAINED JULY 27, 2017

Approx. Scale (feet)

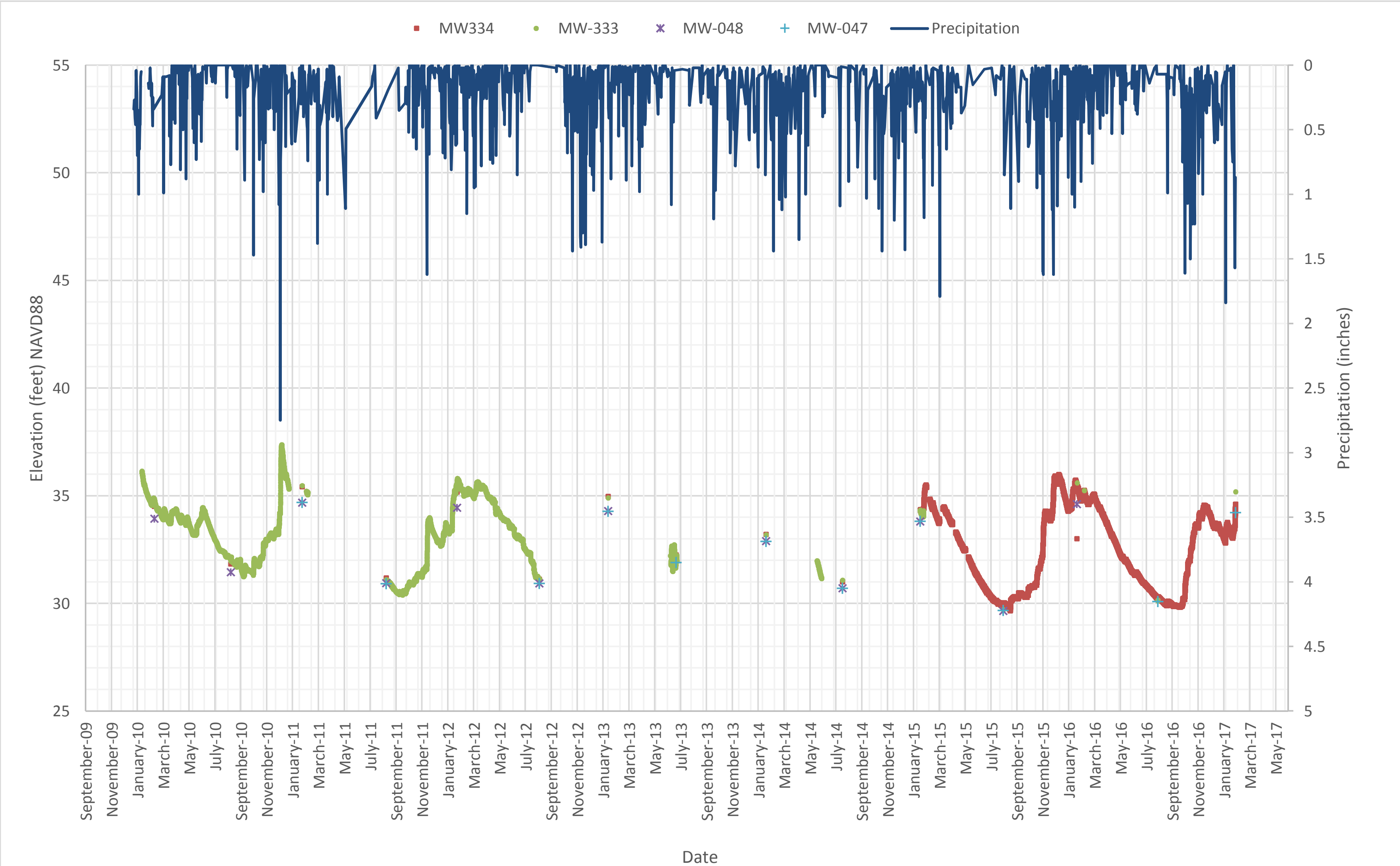
0 750 1500

NORTH

13-011_Fig 2 Site & Exploration Plan.grf 8/2/18 JCR

PanGEO INCORPORATED	LMC Marymoor Redmond, WA	CITY OF REDMOND GROUNDWATER MONITORING WELL LOCATIONS AND GROUNDWATER FLOW DIRECTION Project No. 17-406 / Figure No. 3

Exhibit 17

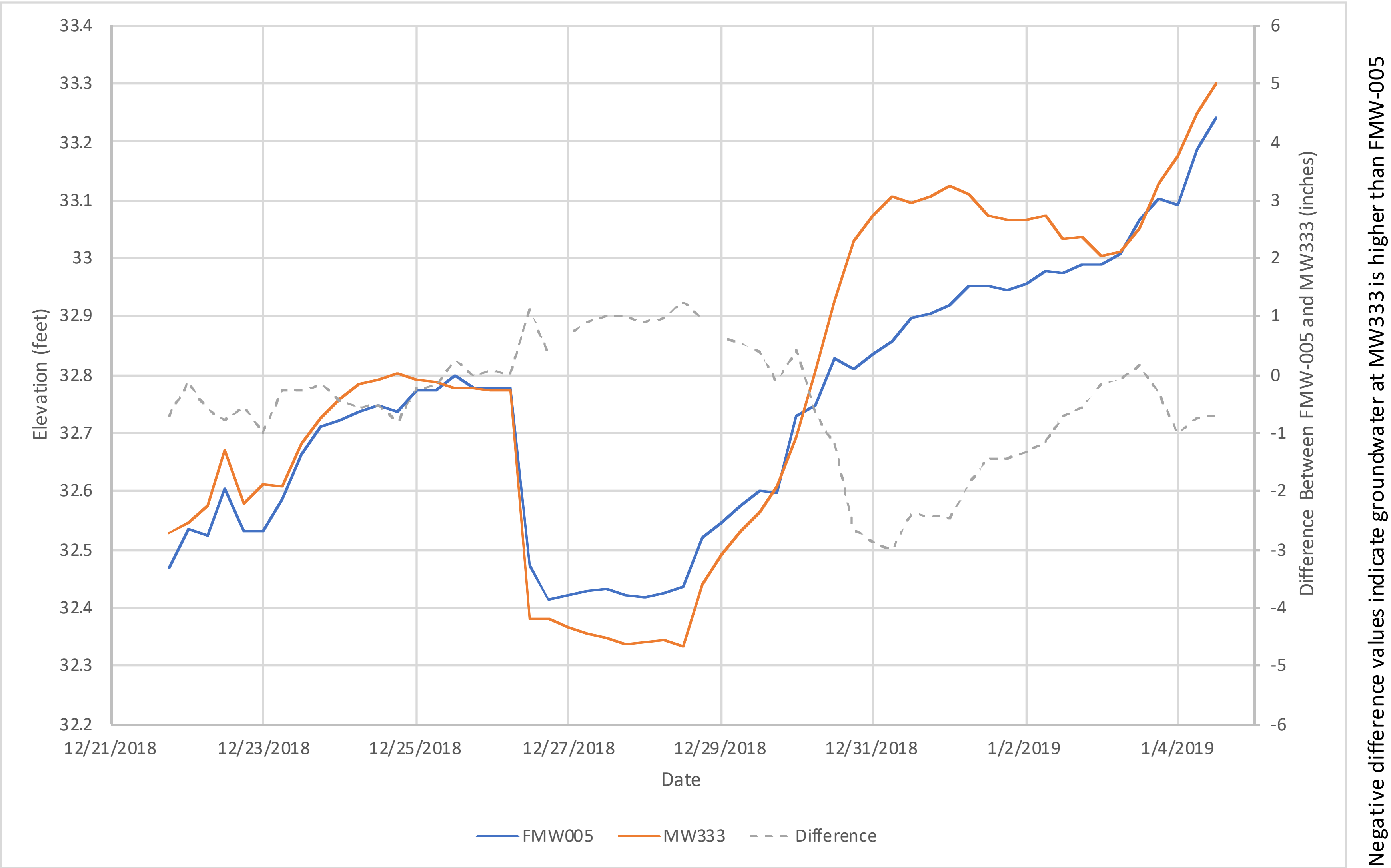


PanGEO INCORPORATED

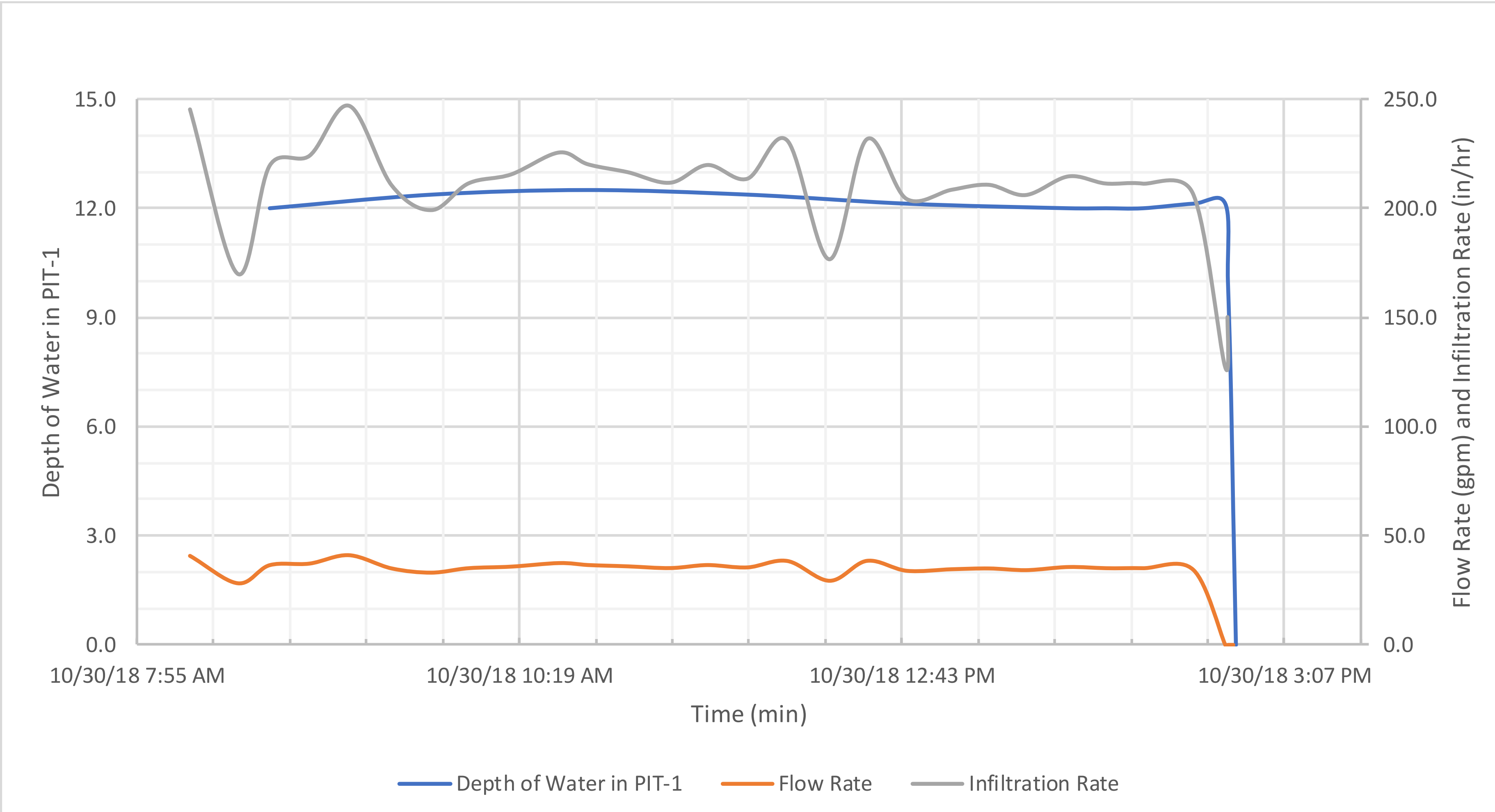
Marymoor LMC
17611 NE 70th St
Redmond, WA

Groundwater Elevations and Precipitation
City of Redmond Monitoring Wells

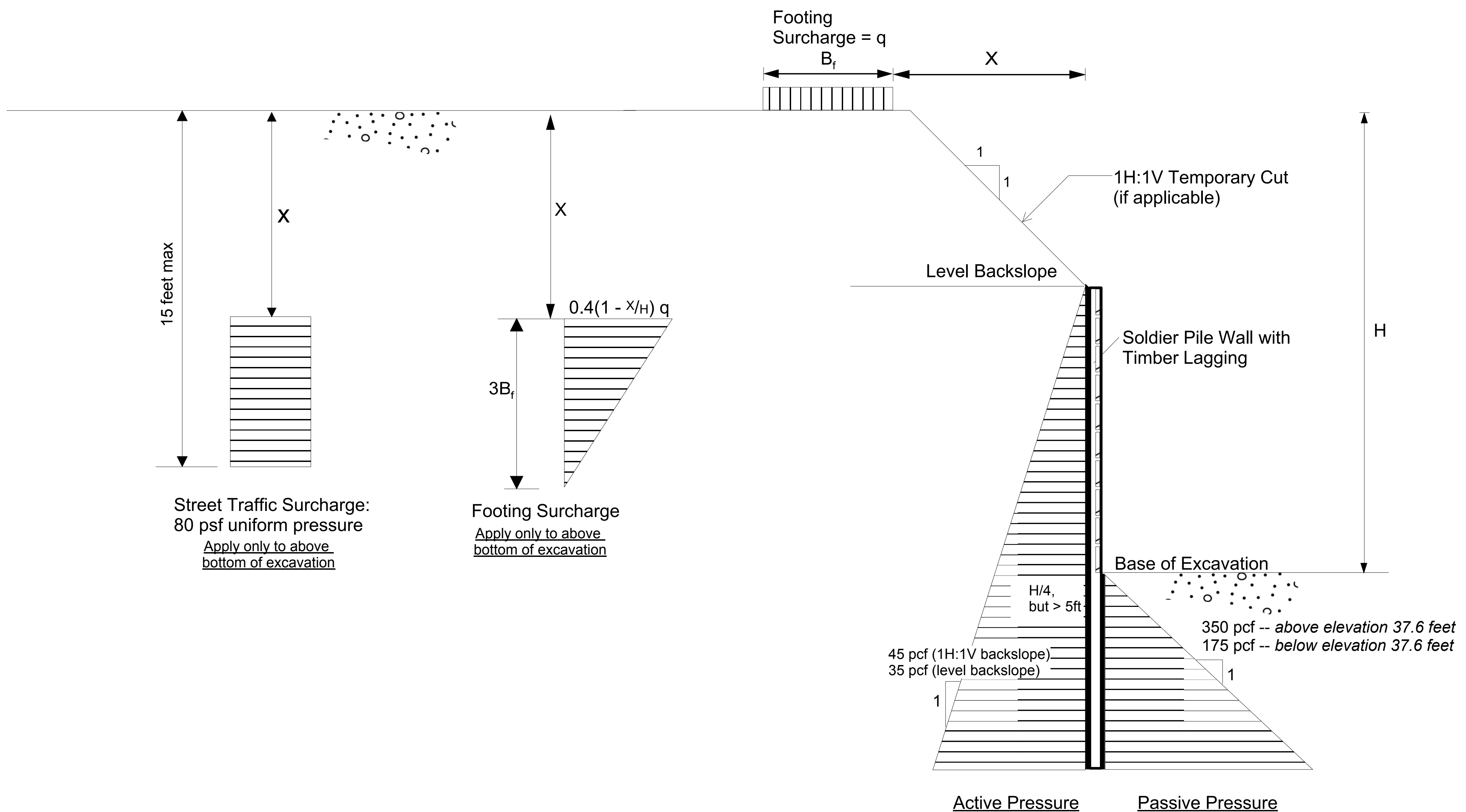
Project No.	17-406	Figure No.	4



PanGEO INCORPORATED	LMC Marymoor 17611 NE 70th St Redmond, WA	SUMMARY OF SYNOPTIC GROUNDWATER LEVEL MONITORING	
		Proj 17-406.410	Figure No. 5



PanGEO INCORPORATED	**LMC Marymoor** **17611 NE 70th St** **Redmond, WA**	**INFILTRATION TEST SUMMARY** **TEST PIT PIT-1** Project No. 17-406.200 Figure No. 6



Notes:
1. Active earth pressures assume shoring is fully drained and hydrostatic pressures are not allowed to develop behind the shoring.
2. Minumum embedment should be at least 10 feet below bottom of excavation.
3. A factor of safety of 1.5 has been applied to the recommended passive pressure values. No factor of safety has been applied to the recommended active earth pressure values.
4. Active pressures should be applied over the full width of the pile spacing above the base of the excavation, and over one pile diameter below the base of the excavation.
5. Surcharge pressures should be applied over the entire length of the loaded area.
6. Passive pressure should be applied to two times the diameter of the soldier piles.
7. Use 50% of the active and surcharge pressures for lagging design with soldier piles spaced at 8' or less.
8. Refer to report text for additional discussions.

PanGEO INCORPORATED

Marymoor LMC
17611 Northeast 70th Street
Redmond, Washington

DESIGN LATERAL PRESSURES
SOLDIER PILE WALL
CANTILEVERED

Project No. **17-406**
Figure No. **7**

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APPENDIX A

BORING LOGS

Exhibit 17

RELATIVE DENSITY / CONSISTENCY

SAND / GRAVEL			SILT / CLAY		
Density	SPT N-values	Approx. Relative Density (%)	Consistency	SPT N-values	Approx. Undrained Shear Strength (psf)
Very Loose	<4	<15	Very Soft	<2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Med. Dense	10 to 30	35 - 65	Med. Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	>50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	>30	>4000

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		GROUP DESCRIPTIONS	
Gravel 50% or more of the coarse fraction retained on the #4 sieve. Use dual symbols (eg. GP-GM) for 5% to 12% fines.	GRAVEL (<5% fines)	GW	Well-graded GRAVEL
		GP	Poorly-graded GRAVEL
	GRAVEL (>12% fines)	GM	Silty GRAVEL
		GC	Clayey GRAVEL
Sand 50% or more of the coarse fraction passing the #4 sieve. Use dual symbols (eg. SP-SM) for 5% to 12% fines.	SAND (<5% fines)	SW	Well-graded SAND
		SP	Poorly-graded SAND
	SAND (>12% fines)	SM	Silty SAND
		SC	Clayey SAND
Silt and Clay 50%or more passing #200 sieve	Liquid Limit < 50	ML	SILT
		CL	Lean CLAY
		OL	Organic SILT or CLAY
	Liquid Limit > 50	MH	Elastic SILT
		CH	Fat CLAY
		OH	Organic SILT or CLAY
Highly Organic Soils		PT	PEAT

Notes:
1. Soil exploration logs contain material descriptions based on visual observation and field tests using a system modified from the Uniform Soil Classification System (USCS). Where necessary laboratory tests have been conducted (as noted in the "Other Tests" column), unit descriptions may include a classification. Please refer to the discussions in the report text for a more complete description of the subsurface conditions.

2. The graphic symbols given above are not inclusive of all symbols that may appear on the borehole logs. Other symbols may be used where field observations indicated mixed soil constituents or dual constituent materials.

DESCRIPTIONS OF SOIL STRUCTURES

Layered:	Units of material distinguished by color and/or composition from material units above and below	**Fissured:**	Breaks along defined planes
Laminated:	Layers of soil typically 0.05 to 1mm thick, max. 1 cm	**Slickensided:**	Fracture planes that are polished or glossy
Lens:	Layer of soil that pinches out laterally	**Blocky:**	Angular soil lumps that resist breakdown
Interlayered:	Alternating layers of differing soil material	**Disrupted:**	Soil that is broken and mixed
Pocket:	Erratic, discontinuous deposit of limited extent	**Scattered:**	Less than one per foot
Homogeneous:	Soil with uniform color and composition throughout	**Numerous:**	More than one per foot
		BCN:	Angle between bedding plane and a plane normal to core axis

COMPONENT DEFINITIONS

COMPONENT	SIZE / SIEVE RANGE	COMPONENT	SIZE / SIEVE RANGE
Boulder:	> 12 inches	Sand	
Cobbles:	3 to 12 inches	Coarse Sand:	#4 to #10 sieve (4.5 to 2.0 mm)
Gravel		Medium Sand:	#10 to #40 sieve (2.0 to 0.42 mm)
Coarse Gravel:	3 to 3/4 inches	Fine Sand:	#40 to #200 sieve (0.42 to 0.074 mm)
Fine Gravel:	3/4 inches to #4 sieve	Silt	0.074 to 0.002 mm
		Clay	<0.002 mm

TEST SYMBOLS

for In Situ and Laboratory Tests listed in "Other Tests" column.

ATT	Atterberg Limit Test
Comp	Compaction Tests
Con	Consolidation
DD	Dry Density
DS	Direct Shear
%F	Fines Content
GS	Grain Size
Perm	Permeability
PP	Pocket Penetrometer
R	R-value
SG	Specific Gravity
TV	Torvane
TXC	Triaxial Compression
UCC	Unconfined Compression

SYMBOLS

Sample/In Situ test types and intervals

- 2-inch OD Split Spoon, SPT (140-lb. hammer, 30" drop)
- 3.25-inch OD Spilt Spoon (300-lb hammer, 30" drop)
- Non-standard penetration test (see boring log for details)
- Thin wall (Shelby) tube
- Grab
- Rock core
- Vane Shear

MONITORING WELL

- Groundwater Level at time of drilling (ATD)
- Static Groundwater Level
- Cement / Concrete Seal
- Bentonite grout / seal
- Silica sand backfill
- Slotted tip
- Slough
- Bottom of Boring

MOISTURE CONTENT

Dry	Dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water

LOG KEY 09-118 LOG.GPJ PANGEO.GDT 11/12/13

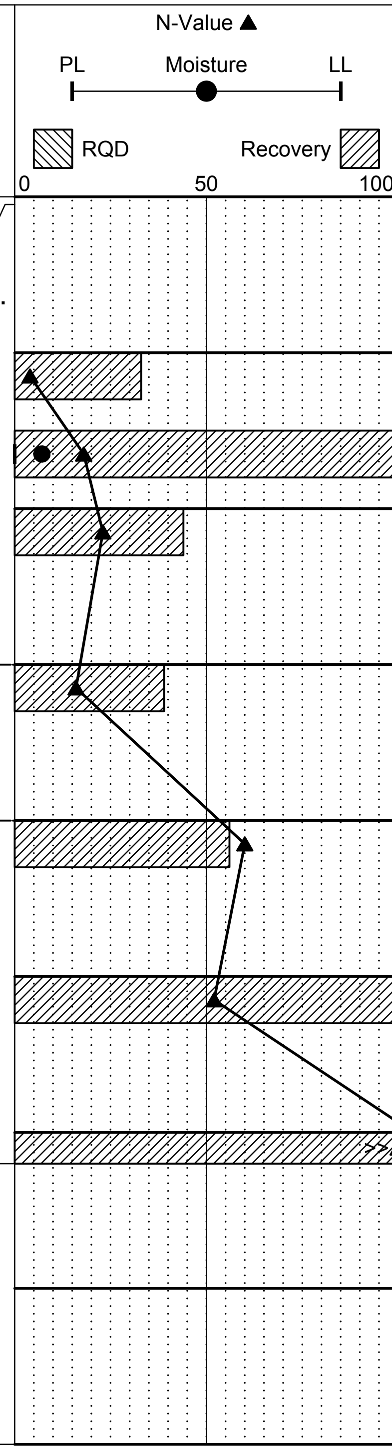
PanGEO INCORPORATED
Phone: 206.262.0370

Terms and Symbols for Boring and Test Pit Logs

Figure A-1

Project:	Marymoor LMC	Surface Elevation:	~50ft (per King County IMap)
Job Number:	17-406	Top of Casing Elev.:	Not Applicable
Location:	Redmond, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						~3 inches of gravel and sand **(Fill).**
						Loose, brown, poorly graded fine to medium SAND with trace silt and trace gravel; moist. **(Younger Alluvium - Qyal).**
5	S-1	X	1 1 3			
	S-2	X	6 8 10	MC/ GS		--becomes medium dense; Sample S-2: 7.1% moisture, 6% fines.
10	S-3	X	7 10 13			--increase in gravel content.
15	S-4	X	7 7 9			Medium dense, brown, poorly graded fine SAND with gravel and trace silt; moist to wet.
20	S-5	X	10 25 35			Very dense, brown, poorly graded fine to medium SAND with trace silt interbedded with sandy gravel; moist to wet.
25	S-6	X	17 18 34			
30	S-7	X	11 42 50/3			
						Boring was terminated at an approximate depth of 31 feet below ground surface (bgs). Groundwater was encountered at an approximate depth of 15 feet bgs at the time of drilling. Boring was excavated to an approximate depth of 7 feet bgs with vacuum truck for utililty clearance.
35						
40						



Completion Depth:	31.0ft
Date Borehole Started:	1/22/18
Date Borehole Completed:	1/22/18
Logged By:	R. Ragudos
Drilling Company:	Holocene Drilling

Remarks: Boring drilling using a Brainard-Killman BK-91 truck-mounted drill rig with automatic hammer. Standard Penetration Test (SPT) sampler driven with a 140 lb. automatic trip hammer. This surface elevation is provided for relative information only and is not a substitution for field survey.

PanGEO INCORPORATED

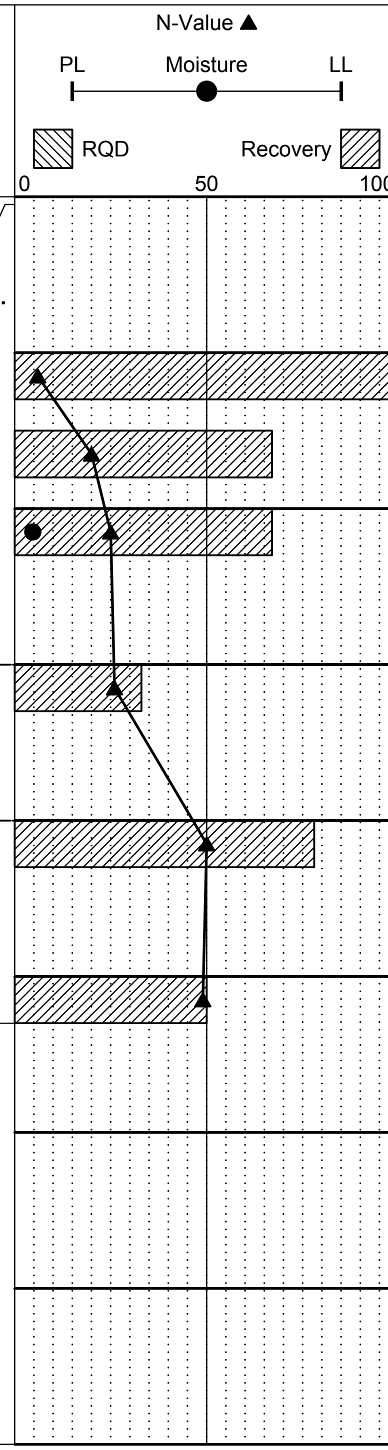
LOG OF TEST BORING PG-1

Figure A-2

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Marymoor LMC	Surface Elevation:	~50ft (per King County IMap)
Job Number:	17-406	Top of Casing Elev.:	Not Applicable
Location:	Redmond, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	MATERIAL DESCRIPTION
0					~3 inches of gravel and sand **(Fill).**
					Loose, brown, poorly graded fine to medium SAND with trace silt and trace gravel; moist. **(Younger Alluvium - Qyal).**
5	S-1	SPT	3 3 3		
	S-2	SPT	6 10 10		--becomes medium dense.
10	S-3	SPT	5 10 15	MC	--increase in gravel content; Sample S-3: 4.7% moisture.
15	S-4	SPT	18 12 14		Medium dense, brown, poorly graded fine to coarse SAND with gravel and trace silt; moist to wet.
20	S-5	SPT	20 20 30		Very dense, brown, poorly graded fine to medium SAND with trace silt interbedded with sandy gravel; moist to wet.
25	S-6	SPT	22 18 31		--becomes dense.
					Boring was terminated at an approximate depth of 26.5 feet below ground surface (bgs). Groundwater was encountered at an approximate depth of 15 feet bgs at the time of drilling. Boring was excavated to an approximate depth of 6 feet bgs with vacuum truck for utility clearance.
30					
35					
40					



Completion Depth:	26.5ft
Date Borehole Started:	1/22/18
Date Borehole Completed:	1/22/18
Logged By:	R. Ragudos
Drilling Company:	Holocene Drilling

Remarks: Boring drilling using a Brainard-Killman BK-91 truck-mounted drill rig with automatic hammer. Standard Penetration Test (SPT) sampler driven with a 140 lb. automatic trip hammer. This surface elevation is provided for relative information only and is not a substitution for field survey.

PanGEO INCORPORATED

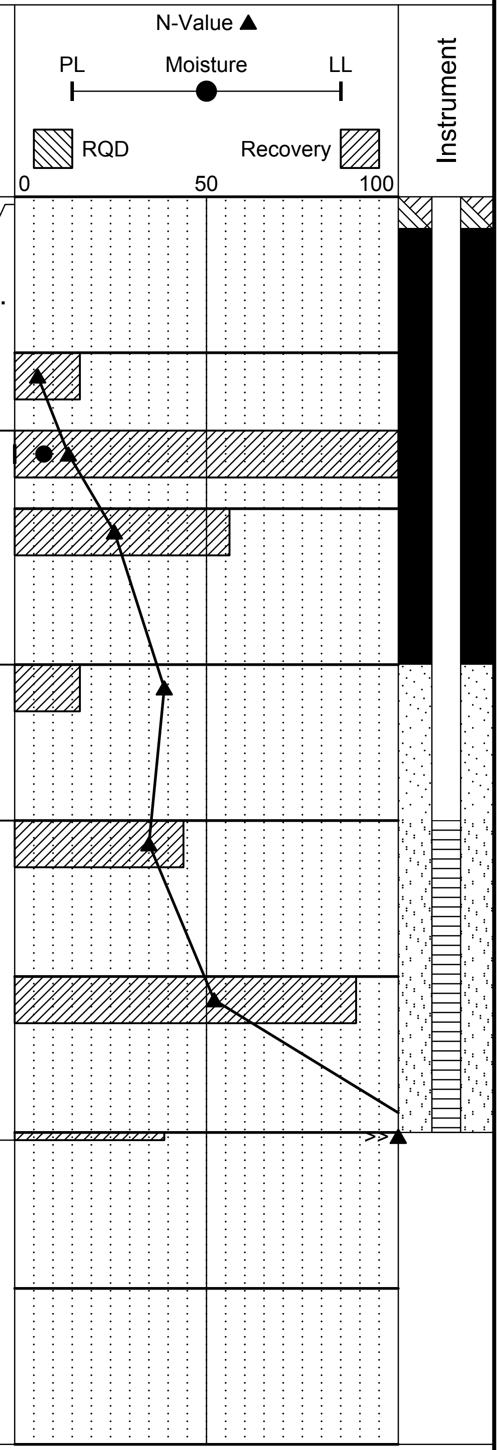
LOG OF TEST BORING PG-2

Figure A-3

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Marymoor LMC	Surface Elevation:	~50ft (per King County IMap)
Job Number:	17-406	Top of Casing Elev.:	~49.5ft
Location:	Redmond, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	MATERIAL DESCRIPTION
0					~3 inches of gravel and sand **(Fill).**
					Loose, brown, poorly graded fine to medium SAND with trace silt and trace gravel; moist. **(Younger Alluvium - Qyal).**
5	S-1		2 2 4		
	S-2		5 8 6	MC/ GS	Medium dense, brown, poorly graded fine to medium SAND with trace silt; moist; Sample S-2: 7.6% moisture, 4.8% fines.
10	S-3		5 13 13		--observed minor iron oxide staining near top of sample S-3.
15	S-4		12 19 20		Dense, brown, poorly graded fine to coarse SAND with gravel and trace silt; moist. -- February 8, 2018.
20	S-5		12 8 27		Dense, brown, poorly graded fine to medium SAND with trace silt interbedded with sandy gravel; moist to wet.
25	S-6		18 14 38		--becomes very dense.
30	S-7		50/3		Boring was terminated at an approximate depth of 30 feet below ground surface (bgs). Groundwater was encountered at an approximate depth of 20 feet bgs at the time of drilling. Boring was excavated to an approximate depth of 5.5 feet bgs with vacuum truck for utility clearance.
35					
40					



Completion Depth:	30.0ft
Date Borehole Started:	1/22/18
Date Borehole Completed:	1/22/18
Logged By:	R. Ragudos
Drilling Company:	Holocene Drilling

Remarks: Boring drilling using a Brainard-Killman BK-91 truck-mounted drill rig with automatic hammer. Standard Penetration Test (SPT) sampler driven with a 140 lb. automatic trip hammer. This surface elevation is provided for relative information only and is not a substitution for field survey. Well ID: BKC 107

PanGEO INCORPORATED

LOG OF TEST BORING PG-3

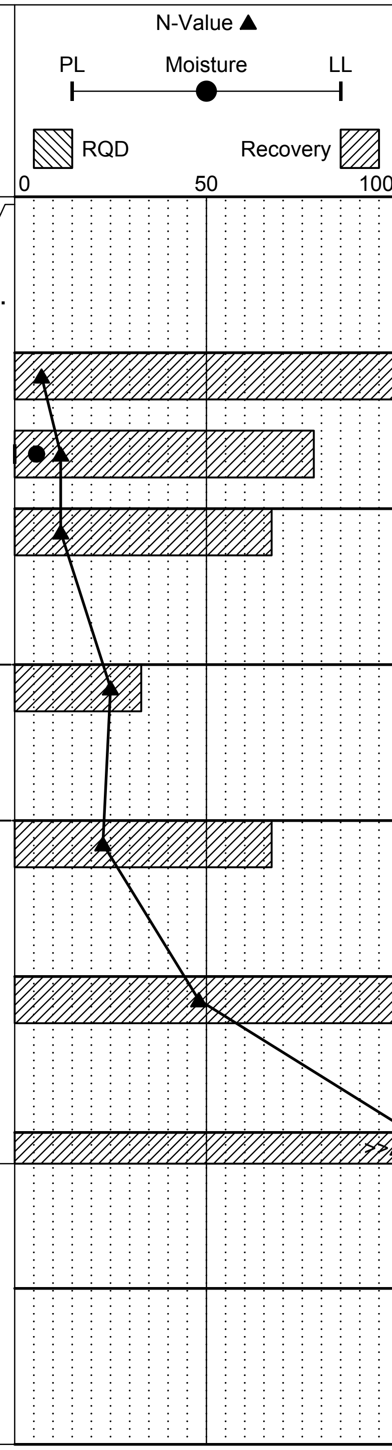
Figure A-4

The stratification lines represent approximate boundaries. The transition may be gradual.

Exhibit 17

Project:	Marymoor LMC	Surface Elevation:	~50ft (per King County IMap)
Job Number:	17-406	Top of Casing Elev.:	Not Applicable
Location:	Redmond, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						~3 inches of gravel and sand **(Fill).**
						Loose, brown, poorly graded fine to medium SAND with trace silt and trace gravel; moist. **(Younger Alluvium - Qyal).**
5	S-1	X	1 3 4			
	S-2	X	4 5 7	MC/ GS		--becomes medium dense; Sample S-2: 5.7% moisture, 4.1% fines.
10	S-3	X	4 6 6			--increase in gravel content.
15	S-4	X	9 10 15			Medium dense, brown, poorly graded fine to medium SAND with trace gravel and trace silt; moist to wet, encountered large gravel in tip of sampler preventing additional sample recovery.
20	S-5	X	8 13 10			Medium dense, brown, poorly graded fine to medium SAND with trace silt interbedded with sandy gravel; moist to wet.
25	S-6	X	12 19 29			--becomes dense.
30	S-7	X	15 50/5			--becomes very dense.
						Boring was terminated at an approximate depth of 31 feet below ground surface (bgs). Groundwater was encountered at an approximate depth of 15 feet bgs at the time of drilling. Boring was excavated to an approximate depth of 6 feet bgs with vacuum truck for utility clearance.
35						
40						



Completion Depth:	31.0ft
Date Borehole Started:	1/23/18
Date Borehole Completed:	1/23/18
Logged By:	R. Ragudos
Drilling Company:	Holocene Drilling

Remarks: Boring drilling using a Brainard-Killman BK-91 truck-mounted drill rig with automatic hammer. Standard Penetration Test (SPT) sampler driven with a 140 lb. automatic trip hammer. This surface elevation is provided for relative information only and is not a substitution for field survey.

PanGEO INCORPORATED

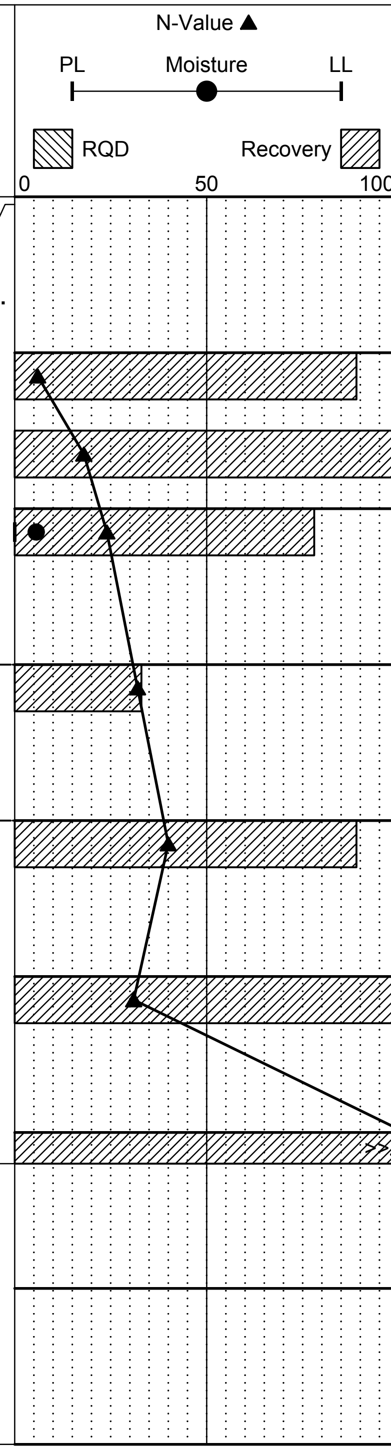
LOG OF TEST BORING PG-4

Figure A-5

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Marymoor LMC	Surface Elevation:	~50ft (per King County IMap)
Job Number:	17-406	Top of Casing Elev.:	Not Applicable
Location:	Redmond, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	MATERIAL DESCRIPTION
0					~3 inches of gravel and sand **(Fill).** Loose, brown, poorly graded fine to medium SAND with trace silt and trace gravel; moist. **(Younger Alluvium - Qyal).**
5	S-1	X	3 3 3		
	S-2	X	6 7 11		--becomes medium dense. --increase in gravel content near tip of sample S-2.
10	S-3	X	6 11 13	MC/ GS	Sample S-3: 5.6% moisture, 4% fines.
15	S-4	X	24 16 16		Dense, brown, poorly graded fine to medium SAND with gravel and trace silt; moist to wet.
20	S-5	X	16 19 21		Dense, brown, poorly graded fine to medium SAND with trace silt interbedded with sandy gravel; moist to wet.
25	S-6	X	16 19 12		
30	S-7	X	24 50/5		--becomes very dense. Boring was terminated at an approximate depth of 31 feet below ground surface (bgs). Groundwater was encountered at an approximate depth of 15 feet bgs at the time of drilling. Boring was excavated to an approximate depth of 6.5 feet bgs with vacuum truck for utility clearance.
35					
40					



Completion Depth:	31.0ft
Date Borehole Started:	1/23/18
Date Borehole Completed:	1/23/18
Logged By:	R. Ragudos
Drilling Company:	Holocene Drilling

Remarks: Boring drilling using a Brainard-Killman BK-91 truck-mounted drill rig with automatic hammer. Standard Penetration Test (SPT) sampler driven with a 140 lb. automatic trip hammer. This surface elevation is provided for relative information only and is not a substitution for field survey.

PanGEO INCORPORATED

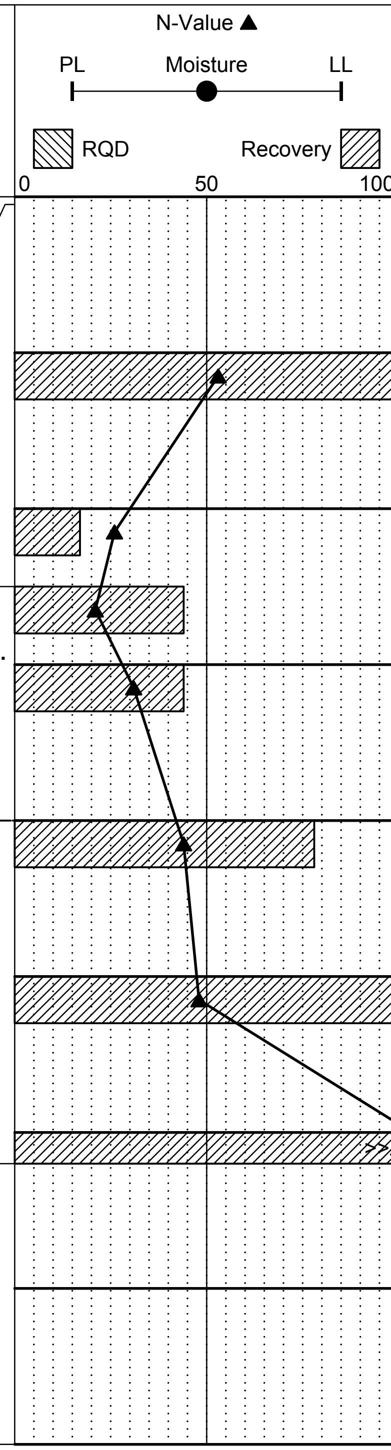
LOG OF TEST BORING PG-5

Figure A-6

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Marymoor LMC	Surface Elevation:	~50ft (per King County IMap)
Job Number:	17-406	Top of Casing Elev.:	Not Applicable
Location:	Redmond, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						~3 inches of gravel and sand **(Fill).**
						Loose to medium dense, gray to black, silty fine SAND with organics and trace gravel; moist, organics consists of relic rootlets. **(Fill).**
5	S-1	X	5 26 27			--observed approximately 8 inches of wood debris, blowcount overstated.
						-- unable to obtain sample at 7.5 feet due to wood debris.
10	S-2	X	18 13 13			--minimal sample return due to wood debris.
	S-3	X	8 9 12			Dense, gray, poorly gravded fine to medium SAND with trace silt and some gravel; moist. **(Younger Alluvium - Qyal).**
15	S-4	X	12 18 13		▽	--becomes moist to wet.
20	S-5	X	8 14 30			Dense, brown, poorly graded fine to medium SAND with trace silt interbedded with sandy gravel; moist to wet.
25	S-6	X	7 11 37			
30	S-7	X	16 50/6			--becomes very dense.
						Boring was terminated at an approximate depth of 31 feet below ground surface (bgs). Groundwater was encountered at an approximate depth of 15 feet bgs at the time of drilling. Boring was excavated to an approximate depth of 4.5 feet bgs with vacuum truck for utility clearance.
35						
40						



Completion Depth:	31.0ft
Date Borehole Started:	1/23/18
Date Borehole Completed:	1/23/18
Logged By:	R. Ragudos
Drilling Company:	Holocene Drilling

Remarks: Boring drilling using a Brainard-Killman BK-91 truck-mounted drill rig with automatic hammer. Standard Penetration Test (SPT) sampler driven with a 140 lb. automatic trip hammer. This surface elevation is provided for relative information only and is not a substitution for field survey.

PanGEO INCORPORATED

LOG OF TEST BORING PG-6

Figure A-7

The stratification lines represent approximate boundaries. The transition may be gradual.

APPENDIX B

TEST PIT LOG

Test Pit No. PIT-1

Approximate ground surface elevation: 49 feet

Coordinates (WGS84): 47.66703, -122.105639

Depth (ft)	Material Description
0 - 1	Gravel and asphalt over loose, brown to grey, silty coarse SAND with gravel; moist; well graded, trace rootlets and debris [Topsoil/Fill]
1 - 8	Loose to medium dense, red-brown to grey, coarse, poorly-graded SAND; moist, trace roots, trace gravels, iron oxide staining; increasing gravel at ~2 to 4-feet. [Qyal – Younger Alluvium]
8 - 8 ½	Medium dense, orange to light-brown, fine silty SAND; moist; trace gravels, root bearing. [Qyal – Younger Alluvium]
8 ½ - 10	Medium dense, grey-brown, coarse, poorly-graded SAND with gravel; moist, trace cobbles. [Qyal – Younger Alluvium]
10 - 13	Medium dense, grey-brown, coarse, poorly-graded SAND; moist, trace gravel. [Qyal – Younger Alluvium]

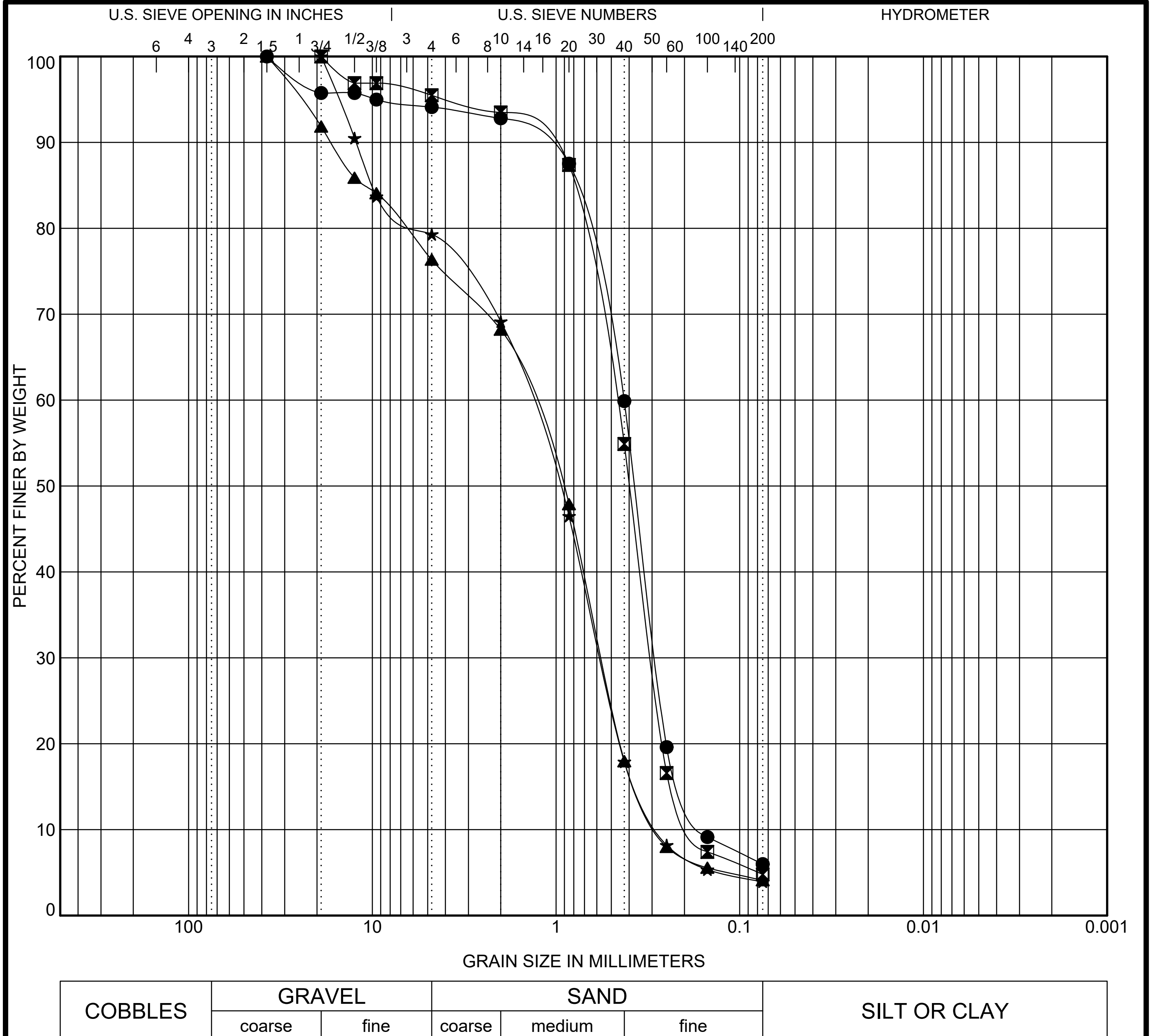
Photo PIT-1: Shows PIT-1 at approximately 10-feet in depth (looking southeast)

PIT-1 was terminated approximately 13-feet below ground surface. No groundwater seepage was observed at the location of PIT-1 within the excavation depth.

APPENDIX C

LABORATORY TEST RESULTS

Exhibit 17



	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	PG-1	@ 7.5 ft.	POORLY GRADED SAND with SILT(SP-SM)	NP	NP	NP	1.23	2.72
⧗	PG-3	@ 7.5 ft.	POORLY GRADED SAND(SP)	NP	NP	NP	1.10	2.74
▲	PG-4	@ 7.5 ft.	POORLY GRADED SAND with GRAVEL(SP)	NP	NP	NP	0.80	5.09
★	PG-5	@ 10.0 ft.	POORLY GRADED SAND with GRAVEL(SP)	NP	NP	NP	0.83	5.13

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	PG-1	7.5	37.5	0.426	0.287	0.156	5.9	88.1	6.0	
⧗	PG-3	7.5	19	0.474	0.301	0.173	4.5	90.7	4.8	
▲	PG-4	7.5	37.5	1.416	0.562	0.278	23.6	72.2	4.1	
★	PG-5	10.0	19	1.415	0.57	0.276	20.7	75.4	4.0	

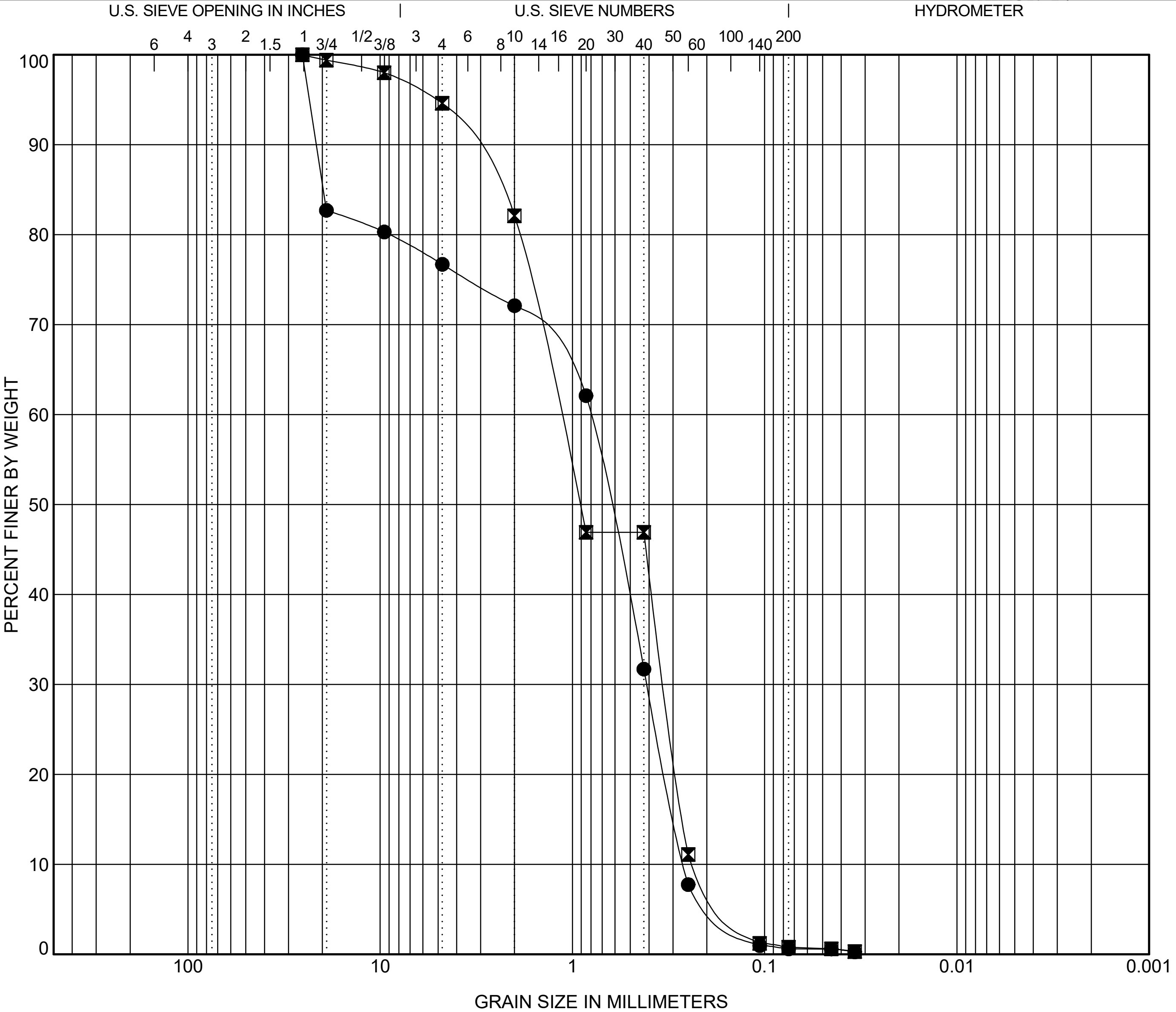
GRAIN SIZE DISTRIBUTION

PanGEO INCORPORATED
Phone: 206.262.0370

Project: Marymoor LMC
Job Number: 17-406
Location: Redmond, WA

Figure C-1

GRAIN SIZE 17-406 BORING LOGS.GPJ PANGEO.GDT 2/2/18



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	PIT-1	@ 10.0 ft.	POORLY GRADED SAND with GRAVEL(SP)				0.79	3.08
⊠	PIT-1	@ 13.0 ft.	POORLY GRADED SAND(SP)				0.41	5.14

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	PIT-1	10.0	25.4	0.81	0.409	0.263	23.3	76.1	0.6	
⊠	PIT-1	13.0	25.4	1.169	0.331	0.227	5.4	93.8	0.8	

GRAIN SIZE DISTRIBUTION

PanGEO INCORPORATED
Phone: 206.262.0370

Project: Marymoor LMC
Job Number: 17-406.200
Location: 17611 Northeast 70th Street, Redmond, WA

Figure C-2

APPENDIX D

GENERAL CONSTRUCTION PRACTICES FOR CRITICAL AQUIFER RECHARGE AREAS

GENERAL

In general, based on our understanding of the planned development, we anticipate potential construction related contaminants may consist of, but not limited to the following:

- Fuel, lubricants, hydraulic fluid and coolants, etc., from equipment;
- Construction materials, including imported fill, pressure treated wood, concrete washwater and water generated by concrete treatment processes; and
- Solvents, paints, and degreasers used during construction.

The contractor should maintain best management practices (BMP) in the storage, transfer and use of these materials. The contractor should also be prepared to contain and control a release of these materials if they are spilled on-site.

The General Contractor should prepare a Spill Prevention Control and Countermeasure (SPCC) plan to address the potential for a spill. The General Contractor should also designate a person on-site that has appropriate knowledge to be responsible for supervising activities dealing with hazardous materials and who has adequate training to take mitigating actions necessary in the event of a fire or spill. construction should also conform to Redmond Zoning Code (RZC) 21.64.050.D.3.f, *Protection Standards During Construction*.

The following sections of this portion of our study discuss the control of potential construction related contaminants. This information is general in nature and primarily provided for informational purposes. The contractor should be responsible for developing their own spill prevention and response plan based on the planned construction and the actual equipment and materials to be used on-site.

Equipment Fuel, Hydraulic Fluids, Lubricants, and Coolants

Hazardous materials shall not be accessible to the public while unsupervised (locked storage sheds, locked fencing, locked fuel tanks etc.);

Prior to moving equipment onto the site, the contractor should visually inspect their equipment for cracks, excessive corrosion, or other damage that may compromise the integrity of the fuel, hydraulic fluid, or cooling systems. Construction vehicles and stationary equipment leaking hazardous materials should be repaired or removed immediately after a leak is detected.

Construction vehicles and stationary equipment leaking hazardous materials need to be removed and repaired immediately.

Fuel nozzles should be equipped with automatic shut off valves. Prior to the arrival on-site of any fuel tank truck, all outlets on the vehicle should be examined by the driver for leakage and be tightened, adjusted, or replaced to prevent discharges on-site.

Routine maintenance of construction equipment, such as oil changes should be accomplished off-site. If maintenance is conducted on-site, it should be conducted in a manner to gather all discharges such that they can be removed from the site to a suitable disposal location.

Refueling of dewatering pumps, generators, and other small portable equipment should be performed using approved containers. If a pickup truck-mounted tank is used to fill equipment fuel tanks, the pump hose should have an automatic shut off valve and the person conducting the refueling should be present during the filling operations.

The provisions in the Washington Department of Ecology (WDOE) Stormwater Management Manual for Western Washington BMP S419 Mobile Fueling of Vehicles and Heavy Equipment (WDOE 2012) should also be followed for refueling construction equipment.

Construction Materials

***Concrete Washwater* –** Concrete washwater is high in suspended solids and has a high pH. Washwater from concrete trucks should not be discharged to the ground. Concrete washwater from the cleanout of trucks, chutes, pumps and hoses should ideally be returned with the concrete trucks for disposal at the batch plant. Alternatively, concrete washwater can be collected on-site using washout tubs or a concrete washout structure constructed on-site. Concrete washwater should be managed in accordance with WDOE BMP C154 Concrete Washout Area of the WDOE Manual (WDOE 2012).

Concrete saw cutting and surface preparation processes can generate leachate that contains fine particles and high pH. Runoff or leachate from wet or curing concrete as well as concrete grinding, saw cutting, or exposed aggregate surfacing processes should be collected and disposed of in accordance with WDOE BMP C152 Sawcutting and Surfacing Pollution Prevention (WDOE 2012).

***Imported Fill* –** Where imported fill materials are to be used on-site, such as structural fill, gravel backfill around dewatering wells, pipe bedding, or other natural aggregate materials, the fill should consist of clean fill from a commercial source.

Storage of Materials

The contractor should store fuel, petroleum products and other hazardous materials in a safe location and within a secondary containment structure or bund. Secondary containment systems should consist of a manufactured containment system or site constructed bermed area lined with an impervious material to provide a minimum containment volume of 110 percent of the largest storage container within the storage area.

Flammable and combustible liquid transferred from tanks to construction vehicles and stationary equipment should be performed in compliance with the Redmond Fire Code (Chapter 15.06 RMC).

If a spill occurs in the containment structure, the accumulated wastewater should be drawn off and pumped to a storage container for proper disposal.

The contractor should visually inspect hazardous material storage containers on a daily basis and whenever the storage tanks are refilled. Visible leaks in tanks or barrels should be repaired as soon as possible.

If concrete or cement will be stored on-site in bulk, it should be stored on pallets and within a secondary containment structure.

Storage and containment of material should be performed in accordance with the WDOE Manual BMP C153 Delivery, Storage and Containment (WDOE 2012).

Construction Spill Kit

In the event of a spill, the release should be contained and cleaned up as soon as possible. The contractor should have a spill kit on-site with a sufficient quantity of absorbent and barrier materials to adequately contain and recover spills of fuel and lubricants for the piece of equipment with the largest volume of fuel along with any associated lubricants and coolants. These materials may include but are not limited to the following:

- Drip pans;
- Buckets;
- Straw bales;
- Oil absorbent socks and pads;
- Absorbent clay;
- Sawdust;
- Drying agents;
- Plastic sheeting; and
- Other materials as needed.

The contractor also should have available on-site an assortment of hand tools to aid in the placement of absorbent materials and the containment and collection of a spill.

APPENDIX E

GENERAL BEST MANAGEMENT PRACTICES FOR CRITICAL AQUIFER RECHARGE AREAS

GENERAL

The site will be developed with a mixed-use development consisting of retail and residential uses. These tenants are not expected to generate hazardous materials. We anticipate potential building use contaminants may consist of, but not limited to the following:

- Fuel, lubricants, hydraulic fluid, batteries and coolants from vehicles.
- Household cleaning products.

Locations where significant spills and leaks could potentially occur at the facility and that could contribute pollutants to stormwater, surface water and groundwater include:

- Vehicle storage areas
- Liquid storage area

The building users should maintain best management practices (BMP) in the storage, transfer and use of these materials. The BMP's should be implemented in recognition that preventing pollutants from coming into contact with stormwater and groundwater is generally more effective, and less costly than trying to remove pollutants from stormwater and that using control measures in combination is more effective than using control measures in isolation for minimizing pollutants.

BMP's for Good Housekeeping

Description of Pollutant Sources

Pollutant sources include cleaning supplies, vehicle fluids, lubricants stored in containers, and hydraulic fluids for vehicle lifts.

Source Control BMP's

- Unloading of materials, cleaning supplies, and products should be confined to designated areas.
- Materials, cleaning supplies and products should be moved inside or to a covered storage area on the same day as they are received at the facility.
- Unless essential for use, materials should not be transferred to containers other than those supplied by the manufacturer.
- Approved mixing or transfer of material should be performed inside a building or under a covered area.
- Containers should store indoors or an appropriate cabinet.
- Used oil, antifreeze, and hazardous waste (if any) should be collected and placed in appropriately labeled bulk storage containers. These containers should be emptied and their contents shipped off site for disposal or recycling on a regular basis.

- The condition of drums and tanks containing waste and virgin products should be inspected regularly and the results documented.
- All storage and shop areas should be inspected and cleaned on a weekly basis and the maintenance supervisor notified if issues are found and that need to be taken care of immediately.
- Structural BMPs (curbs, gutters, retention basin, etc.) should inspected on an annual basis and after each major storm event.
- Provide signage clearly designating storage areas and listing the maximum container volume to be stored in the area.
- Dumpster(s) should be placed in a designated area with curbs.
- Dumpster lids should remain closed when not in use.
- Spills should be promptly cleaned up using dry cleanup methods.
- Drip pans should be placed under vehicles or equipment needing service.

Materials and equipment necessary for spill cleanup should be kept on-site. The spill kit should include at least the following:

- Broom
- Dust pan
- Mop bucket
- Gloves
- Goggles
- Dust masks
- Absorbent clay
- Labeled bags
- Absorbent socks
- Plastic and metal containers

Spill kits should be inspected and restocked on a quarterly basis.

The procedures for preventing and responding to spills and leaks are evaluated annually and updated as necessary and appropriate.

BMP's for Vehicles and Equipment

Description of Pollutant Sources
Pollutant sources include parts/vehicle cleaning, spills/leaks of fuel and other liquids, replacement of liquids, outdoor storage of vehicle parts, batteries and liquids, and vehicle parking.

Source Control BMPs

- Inspect all incoming vehicles, parts, and equipment for leaks.
- Use drip pans or containers under parts or vehicles or hydraulic lifts that drip or that are likely to drip liquids.
- Drip pans should be inspected regularly and emptied as needed.
- Remove batteries and liquids from vehicles and equipment in designated areas designed to contain spills and leaks.
- Store used or damaged batteries in a designated area with covered secondary containment designed to prevent run-on and runoff.
- Empty oil and fuel filters before disposal. Provide for proper disposal of waste oil and fuel.
- Do not pour/convey washwater, liquid waste, or other pollutants into storm drains or to surface water. Check with the local sanitary sewer authority for approval to discharge to a sanitary sewer.
- Building floor drains should not be connected to storm drains, surface water sources, or areas where surface water can infiltrate.
- Vehicle fluids, cleaning supplies, and chemicals should be properly stored in accordance with the appropriate material safety data sheets (MSDS).
- Inspect all BMPs regularly, particularly after a significant storm event. Identify and
- correct deficiencies to confirm that the BMPs are functioning as intended.

BMPs for Washing Vehicles

Description of Pollutant Sources

Vehicles that may be cleaned using low or high pressure water or steam. Washwater from cleaning activities can contain oil and grease, suspended solids, heavy metals, soluble organics, soaps, and detergents that can contaminate stormwater and surface water.

Source Control BMPs:

- Washing of vehicles, parts, and equipment should be performed in a designated area.

BMPs for Parking Lots

Description of Pollutant Sources

Parking lots can be sources of toxic hydrocarbons and other organic compounds, oils and greases, metals, and suspended solids caused by the parked vehicles.

Source control BMPs:

- If washing of a parking lot is conducted, discharge the washwater to a sanitary sewer, if allowed by the local sewer authority, or other approved wastewater treatment system, or collect the washwater for off-site disposal.
- Do not hose down parking lots to a storm drain, surface water sources, or areas where surface water can infiltrate.
- Outdoor parking lots, storage areas, and driveways, should be dry swept or vacuum swept regularly to collect dirt, waste, and debris.

BMP’s for Excavation and Construction into Standing Water

In general it is planned to mitigate impacts of excavation and construction in standing water by timing the deeper portions of the excavation during periods of the year when water levels are below the planned excavation depth.

Description of Pollutant Sources

Excavations into standing water would be performed by equipment staged outside of the excavation that reach into the excavation and standing water.

Pollutant sources include spills/leaks of fuel, hydraulic fluid, and lubricants associated with the boom, stick and bucket of the excavator.

Source Control BMPs

- Inspect all incoming vehicles, parts, and equipment for leaks.
- Steam clean the boom, stick and bucket of excavation equipment.
- Excavators to be used in standing water should utilize biodegradable hydraulic fluid and lubricants.
- Inspect hydraulic hoses, lines and fittings before the start of every work day.