Geotechnical Engineering Report

Memory Care Facility
12215 NE 128th Street
Kirkland, Washington

September 15, 2015
Terracon Project No. 81155037

Prepared for:
RJ Development Services
Olympia, Washington

Prepared by:
Terracon Consultants, Inc.
Mountlake Terrace, Washington

Offices Nationwide Established in 1965
Employee-Owned terracon.com
Terracon
Geotechnical ■ Environmental ■ Construction Materials ■ Facilities

September 15, 2015

Terracon

RJ Development Services
401 Central Street SE
Olympia, WA 98501

Attn: Mr. Jeff Yates
P: (360) 528-3343
E: jeff@rjdevelopmentservices.com

Re: Geotechnical Engineering Report
Memory Care Facility
12215 NE 128th Street
Kirkland, King County, Washington 98034
Terracon Project No. 81155037

Dear Mr. Yates:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. These services were performed in accordance with Terracon's Proposal No. P81150214, dated July 10, 2015. This geotechnical engineering report presents the results of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, floor slabs, retaining walls, and pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us at (425) 771-3304.

Sincerely,
Terracon Consultants, Inc.

FOR
Tori Hesedahl, E.I.T.
Staff Engineer

Ryan M. Scheffler, P.E.
Project Engineer

Dennis R. Stettler, P.E.
Senior Consultant

TABLE OF CONTENTS

		Page
EXECUTIVE SUMMARY		**i**
1.0	**INTRODUCTION**	**1**
2.0	**PROJECT INFORMATION**	**1**
2.1	Site Location and Description	1
2.2	Project Description	2
3.0	**SUBSURFACE CONDITIONS**	**2**
3.1	Published Geologic Conditions	2
3.2	Soil Conditions	2
3.3	Groundwater	3
4.0	**RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION**	**3**
4.1	Geotechnical Considerations	3
4.2	Earthwork	4
4.2.1	Site Preparation	5
4.2.2	Structural Fill	5
4.2.3	Compaction Requirements	6
4.2.4	Grading and Drainage	6
4.2.5	Construction Considerations	7
4.3	Foundations	8
4.3.1	Design Recommendations	8
4.3.2	Foundation Drains	9
4.3.3	Construction Considerations	9
4.4	Slabs-on-Grade	10
4.4.1	Slab-on-Grade Design Recommendations	10
4.4.2	Slab-on-Grade Construction Considerations	11
4.5	Seismic Considerations	12
4.6	Lateral Earth Pressures	12
4.7	Pavements	14
4.7.1	Pavement Subgrade Preparation	14
4.7.2	Pavement Design Considerations	15
4.7.3	Estimates of Minimum Pavement Thickness	16
4.7.4	Pavement Drainage	17
4.7.5	Pavement Maintenance	17
4.8	Environmentally Sensitive Areas	17
4.9	Retaining Walls	18
4.9.1	Gravity Walls	18
4.9.2	Mechanically Stabilized Earth Walls	19
5.0	**GENERAL COMMENTS**	**20**

TABLE OF CONTENTS– continued

APPENDIX A – FIELD EXPLORATION

Exhibit A-1	Site Location Plan
Exhibit A-2	Site and Exploration Plan
Exhibit A-3	Field Exploration Description
Exhibits A-4 to A-9	Borings B-1 to B-6

APPENDIX B – LABORATORY TESTING

Exhibit B-1	Laboratory Testing Description
Exhibit B-2	Grain Size Distribution

APPENDIX C – SUPPORTING DOCUMENTS

Exhibit C-1	General Notes
Exhibit C-2	Unified Soil Classification
Exhibit C-3	USGS Seismic Design Maps Summary Report

EXECUTIVE SUMMARY

A geotechnical exploration program has been performed for the proposed Memory Care Facility located at 12215 NE 128th Street in Kirkland, Washington. Terracon's scope of services included the advancement of six exploratory borings to approximate depths of 11 to 36 feet below existing site grades. The site appears suitable for the proposed construction based upon geotechnical conditions encountered in the borings and our current understanding of the proposed development. The following geotechnical considerations were identified:

- We observed organic-rich soils at the surface of our explorations to depths ranging from approximately 4 inches to 3½ feet. Additionally, we encountered existing fill soils in one of our borings to a depth of about 4½ feet. We recommend complete removal of these organic-rich and existing fill soils underneath structures and pavements.

- The recommended allowable bearing pressures for shallow footings bearing on at least medium dense native soils or structural fill above native soils is 3,000 pounds per square foot (psf) for strip footings and 3,500 psf for individual spread footings.

- The on-site granular soils typically appear suitable for reuse as structural fill if placed at a moisture content near their optimum value. However, these soils contain a significant fraction of fines and will quickly become unstable, soft and unsuitable for reuse as structural fill when exposed to moisture. During periods of wet weather it may be necessary to import clean granular fill for use as structural fill.

- Groundwater was observed at approximately 29 and 27 feet below the existing ground surface in borings B-3 and B-1, respectively, but was not observed in any of the other borings at the time of drilling.

- Slopes in the western and southern portions of the site are mapped by the City of Kirkland as High Landslide Hazard Areas. Certain considerations should be given to the location and depth of building foundations and retaining walls within and near these steep slopes.

- The 2012 International Building Code seismic site classification for this site is C, based on our borings.

Close monitoring of the construction operations discussed herein will be critical in achieving the design subgrade support. We therefore recommend that Terracon be retained to monitor this portion of the work. This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
MEMORY CARE FACILITY
12215 NE 128TH STREET
KIRKLAND, WASHINGTON

Terracon Project No. 81155037
September 15, 2015

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services performed for the proposed Memory Care Facility to be located at 12215 NE 128th Street in Kirkland, Washington. Our geotechnical engineering scope of services for this project included the advancement of six exploratory soil borings to depths ranging from approximately 11 to 36 feet below existing site grades. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- earthwork
- floor slab design and construction
- lateral earth pressure
- discussion of suitable retaining wall types
- groundwater conditions
- foundation design and construction
- seismic considerations
- pavement design and construction
- environmentally sensitive areas

2.0 PROJECT INFORMATION

2.1 Site Location and Description

ITEM	DESCRIPTION
Location	12215 NE 128th Street in Kirkland, Washington
Existing Improvements	Roughly 6.1 acre parcel, mostly undeveloped except for a high voltage power line monopole near the southeastern corner of the site.
Current ground cover	The approximate west half of the site is lightly forested. A gravel covered area is located below the northern portion of the high voltage power easement. The remainder of the site is heavily vegetated with blackberries and other low-lying shrubs.
Existing topography	Relatively level in the northeastern area with steep downward slopes on the west and south sides of the site.

2.2 Project Description

ITEM	DESCRIPTION
Site layout	Refer to the Exploration Plan (Exhibit A-2 in Appendix A).
Structures	Proposed 25,000 square foot, 3- to 4-story building to be located in the approximate center of the site, west of the power line easement. Asphalt paved parking is planned on the north and east sides of the structure. Landscaped areas planned for the west and south sides of the site will require several retaining walls up to 12 feet tall. Existing power lines and monopoles to be left in place.
Site grading	Significant grading with fills of up to about 15 feet assumed over portions of the sloped areas on west side of site. Minor to moderate grading of up to about 5 feet assumed elsewhere.

3.0 SUBSURFACE CONDITIONS

A description of our field exploration is presented in Appendix A. Laboratory tests were conducted on selected soil samples obtained during our exploration. A description of the laboratory testing is presented in Appendix B. Supporting information including general notes related to the exploration program and the Unified Soil Classification System is presented in Appendix C.

3.1 Published Geologic Conditions

The 1983 USGS *Geologic Map of the Kirkland Quadrangle, Washington* indicates the project site is mapped as Advance Outwash (Q_{va}). These soils typically consist of a thick section of clean to silty, gray, pebbly sand with increasing amounts of gravel higher in the section. Increasing silt content may be observed with depth. Soils encountered in our borings were generally consistent with the mapped conditions.

3.2 Soil Conditions

We observed approximate topsoil and organic rich soil depths at our boring locations ranging from about 4 inches up to about 3½ feet. Additionally, we encountered existing fill soils to a depth of approximately 4½ feet at the location of boring B-2. Below the topsoil and existing fill, soil conditions encountered in the borings were relatively uniform across the site and can be generalized as follows:

Description	Approximate Depth to Bottom of Stratum	Material Encountered	Consistency/Density
Stratum 1	0-3½ feet	Topsoil	Loose to Medium Dense
Stratum 2	3½ - 7½	Poorly graded silty SAND, trace gravel (Weathered Advance Outwash)	Medium Dense
Stratum 3	To full termination depth of all explorations	Poorly graded Sand with increasing silt content at depth, variable gravel (Advance Outwash)	Dense to Very Dense

Laboratory tests were conducted on selected soil samples. Moisture content and fines content results are reported on the boring logs in Appendix A. Results of other tests are presented in Appendix B. Laboratory test results indicate that the fines content (that portion passing the #200 sieve) of the dense to very dense native advance outwash soils ranged from about 24 to 31 percent while the medium dense soil at a depth of 5 to 6½ feet in boring B-4 had a fines content of approximately 8 percent.

Specific conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Details for each of the borings can be found on the boring logs included in Appendix A of this report.

3.3 Groundwater

The boreholes were observed while drilling for the presence and level of groundwater. Groundwater was observed at a depth of 29 feet and 27 feet below ground surface within the advance outwash silty sand soils in borings B-1 and B-3, respectively. Groundwater was not encountered in the remainder of our borings to the full exploration depths of 11 to 21½ feet.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the borings were performed. In addition, perched groundwater can develop over low-permeability soil. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

The site appears suitable for the proposed construction supported by conventional shallow spread footings. Geotechnical engineering recommendations for foundation systems and other earth

connected phases of the project are outlined below. The recommendations contained in this report are based upon the results of data presented herein, on engineering analyses, and on our current understanding of the proposed project.

We encountered existing fill soils to a depth of approximately 4½ feet below the existing ground surface in one of our six borings on the site. Fill, especially undocumented fill, by nature can be highly variable and could vary between exploration locations. If existing fill soils are left in place below buildings or pavements, there is an inherent risk for the owner that compressible fill or unsuitable material within or buried by the fill will not be discovered, increasing the risk of unpredictable total and differential settlements. This risk cannot be eliminated without completely removing the existing fill, but can be reduced by performing additional testing and evaluation. Assuming the existing fill soils are relatively limited in volume on the site, we recommend complete removal and replacement of the fill soils below the building pad. Test pits or additional borings could be advanced on the site in the area of the encountered fill soils to refine the anticipated extents of the fill, or observations could be made during clearing and grading operations to verify complete removal of the existing fill soils. If the extent of the existing fill soils is found to be greater than the limited area observed in our borings, Terracon may revise the recommendation to a more economical solution, depending on conditions encountered.

Slopes in the western and southern portions of the site are mapped by the City of Kirkland as High Landslide Hazard Areas. Special considerations for foundations, retaining walls, and site drainage should be implemented in the final planning and design of the site layout and building design to maintain stability of the slopes. Further discussion of the High Landslide Hazard Areas is provided in section 4.9 of this report.

ASTM and Washington State Department of Transportation (WSDOT) specifications cited herein refer to the current standards published by the American Society of Testing & Materials and the 2014 edition of the WSDOT *Standard Specifications for Road, Bridge, and Municipal Construction* (Publication M41-10), respectively.

4.2 Earthwork

The following text presents recommendations for site preparation, excavation, subgrade improvements, and placement of structural fills for the project. The recommendations presented for design and construction of earth supported elements including foundations, slabs and pavements are contingent upon following the recommendations outlined in this section.

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of structural fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project.

4.2.1 Site Preparation

We anticipate construction will be initiated by clearing and grubbing. Existing vegetation and organic-rich topsoil in areas under proposed structures and pavement should be removed completely from the site. Alternatively, topsoil may be reused in non-structural landscape areas. Based on our observations, we anticipate a stripping depth on the order of 4 to about 40 inches, with deeper areas possible where trees are present.

The silty sand soils encountered in the borings will be sensitive to disturbance from construction activity and increased moisture. If precipitation occurs prior to or during construction, the near-surface soils could increase in moisture content and become more susceptible to disturbance. Construction activity should be monitored, and should be curtailed if the construction activity is causing subgrade disturbance. A Terracon representative can help with monitoring and developing recommendations to aid in limiting subgrade disturbance.

After clearing and grubbing, and excavation to subgrade elevation, proof-rolling should be performed with heavy rubber-tire construction equipment such as a fully loaded tandem-axle dump truck. A Terracon representative should observe proof-rolling to aid in locating unsuitable subgrade materials. Proof-rolling should be performed after a suitable period of dry weather to avoid degrading an otherwise acceptable subgrade and to reduce the amount of remedial work required. Unsuitable materials located during proof-rolling should be stabilized as recommended by the Terracon representative. Removal and replacement, and densification in place are typical remediation methods.

4.2.2 Structural Fill

For the purposes of this report, structural fill is defined as any fill placed above or immediately below utilities, below foundations or slabs-on-grade, and abutting any retaining walls or foundations.

The suitability of soils used for structural fill depends primarily on their grain-size distribution and moisture content when they are placed. As the fines content (that soil fraction passing the U.S. No. 200 Sieve) increases, soils become more sensitive to small changes in moisture content. Soils containing more than about 5 percent fines (by weight) cannot be consistently compacted to a firm, unyielding condition when the moisture content is more than 2 percentage points above or below optimum. Optimum moisture content is the moisture content at which the maximum dry density for the material is achieved in the laboratory following ASTM procedures.

The soils encountered in our borings below the topsoil generally appeared to be near or slightly below their optimum moisture content. Laboratory tests on the soils indicate a fines content on the order of about 24 to 31 percent. These soils appear to be acceptable for reuse from a compositional perspective, though they may require the addition of moisture during grading to reach their optimum moisture content. Due to the relatively high fines content, these soils will also be susceptible to disturbance during periods of wet weather. We recommend that

stockpiles of excavated soil intended for reuse be covered with plastic sheeting if precipitation is anticipated.

If construction is anticipated to take place during the wet weather season (typically November through April), the project specifications should include provisions for using imported, clean, granular fill. As a general structural fill material, we recommend using a well-graded sand and gravel such as "Ballast" or "Gravel Borrow" per WSDOT specification sections 9-03.9(1) and 9-03.14, respectively. For combined structural fill and drainage purposes, a relatively clean and uniform angular material such as "Crushed Surfacing Base Course" per WSDOT: 9-03.9(3) is preferable. Structural fill should consist of approved materials, free of organic material, debris and particles larger than about 4 inches in maximum dimension.

4.2.3 Compaction Requirements

Structural fill materials should be placed in horizontal lifts not exceeding about 8 inches in loose thickness. We recommend that each lift then be thoroughly compacted with a mechanical compactor to a uniform density of at least 95 percent of the maximum dry density as determined by the modified Proctor test (ASTM D 1557). Where light compaction equipment is used, as is typical within a few feet of retaining walls and in utility trenches, the lift thickness may need to be reduced to achieve the desired degree of compaction. Excavated soils that will be reused as structural fill should be protected from rain and other factors to aid in maintaining optimum moisture content. Moisture contents at the time of compaction should be within 2 percent of the optimum moisture content as determined by the modified Proctor test (ASTM D 1557).

4.2.4 Grading and Drainage

Adequate positive drainage of exposed subgrades should be provided during construction and maintained throughout the life of the development to prevent an increase in moisture content of the foundation and pavement subgrades and excavation backfill materials. Surface water drainage should be controlled to prevent undermining of fill slopes and structures during and after construction.

Surface water should be directed away from the steep slopes in the south and west portions of the site. If discharge points are required at the base of the slopes, the flow should be directed downhill in tight-line pipes to an appropriate area at least 20 feet away from the base of the slope. Pipe anchors and/or energy dissipaters should be considered for pipe runs greater than about 40 feet at slopes of greater than about 20 percent. The size, location, and anticipated volume within the pipes will dictate the size and frequency of the anchors and/or energy dissipaters.

Gutters and downspouts should be routed into tight-line pipes that discharge into a municipal storm drain or other suitable location. Splash-blocks should also be considered below hose bibs and water spigots.

It is recommended that all exposed earth slopes be seeded to provide protection against erosion as soon as possible after completion. Seeded slopes should be protected until the vegetation is established. Sprinkler systems should not be installed behind or in front of retaining walls without the approval of the civil engineer and wall designer.

4.2.5 Construction Considerations

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment.

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of floor slabs and pavements. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and re-compacted prior to floor slab and pavement construction and observed by Terracon.

Surface water should not be allowed to pond on the site and soak into the soil during construction. Construction staging should provide drainage of surface water and precipitation away from the building and pavement areas. Any water that collects over or adjacent to construction areas should be promptly removed, along with any softened or disturbed soils. Surface water control in the form of sloping surfaces, drainage ditches and trenches, and sump pits and pumps will be important to avoid ponding and associated delays due to precipitation and seepage.

Groundwater was encountered in borings B-1 and B-3 at depths below ground surface existing at the time of exploration of 27 and 29 feet, respectively. Based on our understanding of the proposed development, we do not expect groundwater to affect construction. If groundwater is encountered during construction, such as during installation of deeply buried utilities, some form of temporary dewatering may be required. Conventional dewatering methods, such as pumping from sumps and dewatering wells, should likely be adequate for temporary removal of any groundwater encountered during excavation at the site.

Temporary excavations will probably be required during grading operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current Occupational Health and Safety Administration (OSHA) Excavation and Trench Safety Standards. All excavations should be sloped or braced as required by OSHA regulations to provide stability and safe working conditions.

Construction site safety is the sole responsibility of the contractor who controls the means, methods and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean that Terracon is assuming any responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

4.3 Foundations

The site explorations encountered up to 3½ feet of organic-rich topsoil below the proposed building footprint. Additionally, existing fill soils were encountered within boring B-2 to a depth of about 4½ feet. We recommend complete removal of topsoil and existing, undocumented fill soils below the building pad. In our opinion, the proposed building can be supported by a shallow, spread footing foundation system bearing on at least medium dense native soils or compacted structural fill extending to native soils after removal of topsoil and existing fill soils. Design recommendations for shallow foundations for the proposed structure are presented in the following paragraphs.

4.3.1 Design Recommendations

DESCRIPTION	Column	Wall
Net allowable bearing pressure [1]	3,500 psf	3,000 psf
Minimum dimensions	18 inches	16 inches
Minimum embedment below finished exterior grade for perimeter footings [2, 3]	18 inches	18 inches
Minimum embedment below finished floor grade for interior footings	12 inches	18 inches
Approximate total settlement [4]	<1 inch	<1 inch
Estimated differential settlement [4]	<½ inch between columns	<½ inch over 50 feet
Ultimate coefficient of sliding friction	0.4	

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes any unsuitable fill or soft soils, if encountered, will be removed and replaced with structural fill.
2. For frost protection and to reduce the effects of seasonal moisture variations in the subgrade soils.
3. The embedment depth of footings on or atop sloping ground should be increased to reduce surcharge loading of the slopes and achieve the recommended bearing capacities.
4. The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of compacted fill, and the quality of the earthwork operations.

The allowable foundation bearing pressures apply to dead loads plus design live load conditions. The design bearing pressure may be increased by one-third when considering total

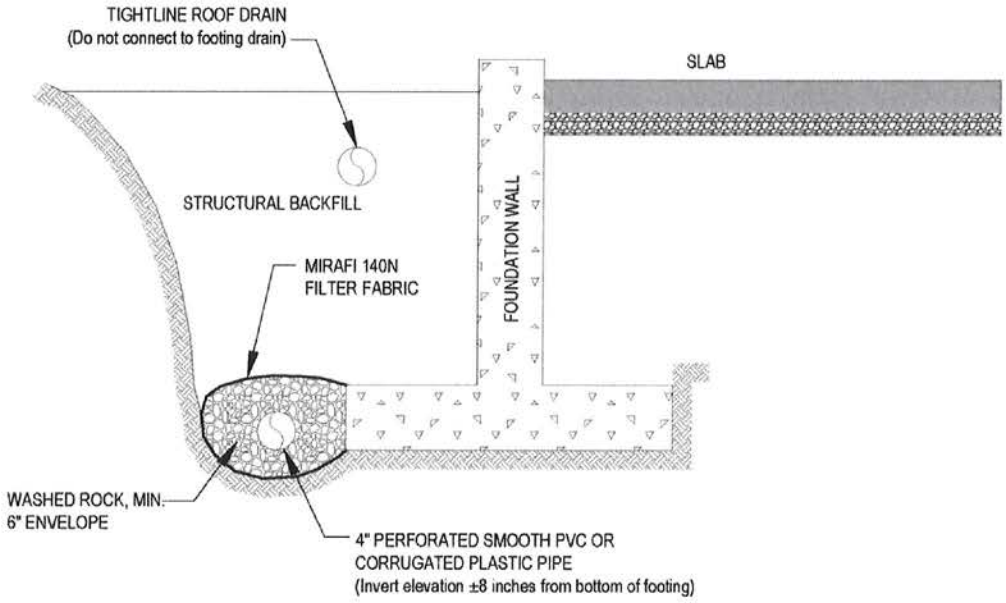
loads that include wind or seismic conditions. The weight of the foundation concrete below grade may be neglected in dead load computations.

Footings, foundations, and masonry walls should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement. The use of joints at openings or other discontinuities in masonry walls is recommended.

Foundation excavations should be observed by a Terracon representative. If the soil conditions encountered differ from those presented in this report, supplemental recommendations will be required.

4.3.2 Foundation Drains

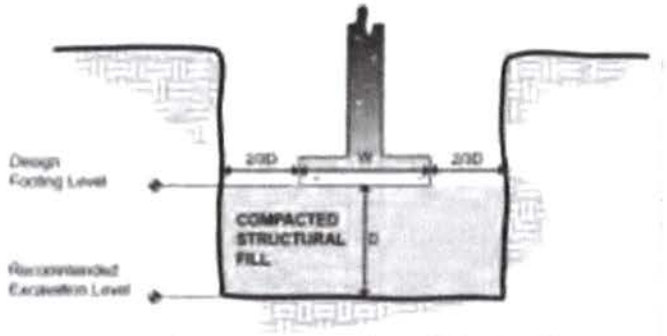
We recommend that the building be encircled with a perimeter foundation drain to collect exterior seepage water. This drain should consist of a 4-inch-diameter perforated pipe within an envelope of pea gravel or washed rock, extending at least 6 inches on all sides of the pipe. The gravel envelope should be wrapped with filter fabric (such as Mirafi 140N) to reduce the migration of fines from the surrounding soils. Ideally, the drain invert would be installed no more than 8 inches above or below the base of the perimeter footings. These recommendations are summarized in the figure below.



4.3.3 Construction Considerations

Localized zones of unsuitable soil might be encountered in footing excavations. In this case, the excavations should be extended deeper to suitable soils. Over-excavation below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of over-excavation depth below footing base elevation. The over-excavation should then be backfilled

up to the footing base elevation with well graded granular material placed in lifts of 8 inches or less in loose thickness and compacted to at least 95 percent of the material's maximum modified Proctor dry density (ASTM D-1557). The over-excavation and backfill procedure is described in the figure below.



Overexcavation / Backfill

NOTE: Excavation shown vertical for convenience; excavations should be sloped as necessary for safety.

4.4 Slabs-on-Grade

We recommend over-excavation and complete removal of organic-rich soils and existing fill soils encountered below the proposed building footprint, as described above for the foundation subgrades. If required to bring the subgrade up to final design elevation, removed soils should be replaced with structural fill placed and compacted in accordance with the Earthwork section of this report. A subgrade prepared and tested as recommended in this report should provide adequate support for lightly loaded floor slabs. Based on conditions exposed at time of construction it may be necessary to over-excavate additional material to reduce the risk of settlement.

4.4.1 Slab-on-Grade Design Recommendations

Floor slabs should be structurally independent of any building footings or walls to reduce floor slab cracking caused by differential movements between the slab and foundation. Narrower, turned-down slab-on-grade foundations may be utilized at the approval of the structural engineer. The slabs should be appropriately reinforced to support the proposed loads.

DESCRIPTION	VALUE
Interior floor system	Slab-on-grade concrete.
Floor slab support	At least medium dense native soils or structural fill placed and compacted in accordance with the Earthwork section of this report.
Base Course [1]	4-inch compacted layer of free draining, granular material

1. The base course serves as a capillary break layer, a drainage layer, a leveling layer, and a bearing layer and should meet the gradation requirements shown in the table below.

Gradation Requirements for Base Course

Sieve Size or Diameter	Percent Passing
1.5 inch	100
No. 4	0 to 70
No. 10	0 to 30
No. 100	0 to 5
No. 200	0 to 3

We recommend subgrades be maintained at the proper moisture condition until floor slabs are constructed. If the subgrade should become desiccated prior to construction of floor slabs, the affected material should be removed or the materials scarified, moistened, and re-compacted. Upon completion of grading operations in the building areas, care should be taken to maintain the recommended subgrade moisture content and density prior to construction of the building floor slabs.

Where appropriate, saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual.

The use of a vapor retarder or barrier should be considered beneath concrete slab-on-grade floors that will be covered with wood, tile, carpet or other moisture-sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer and slab contractor should refer to ACI 302 and ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder/barrier.

4.4.2 Slab-on-Grade Construction Considerations

On most project sites, the site grading is generally accomplished early in the construction phase. However as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. As a result, the floor slab subgrade may not be suitable for placement of the base course and concrete slab, and corrective action may be required.

All floor slab subgrade areas should be moisture conditioned and properly compacted per the recommendations in this report, then thoroughly proof rolled with a rubber-tired piece of heavy equipment such as a loaded tandem-axle dump truck prior to final grading and placement of the base course. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the affected material with properly compacted structural fill.

4.5 Seismic Considerations

The 2012 International Building Code (IBC) indicates that the seismic site classification is based on the average soil and bedrock properties in the top 100 feet of the soil profile. The current scope does not include a 100-foot soil profile determination. The 2012 IBC seismic site classification for this site is C, based on our interpretation of available subsurface information. This seismic site class definition considers that soils encountered at depth in our boring continue below the termination depth. Additional exploration to deeper depths or geophysical survey would be required to confirm the conditions below the current depth of exploration. Site response spectral values are provided on the USGS Design Maps Summary Report attached in Appendix C.

We reviewed the USGS Earthquake Hazards Program Quaternary Faults and Folds Database available online (http://earthquake.usgs.gov/hazards/qfaults/map). The nearest fault to the project site is the Seattle fault zone approximately 9 miles south of the project site. According to this source, the fault age is less than 15,000 years, has been mapped with northwest striking features, and is in the slip rate category of between 0.2 and 1.0 mm/year. Based on the information described above, we estimate that the risk associated with surface rupture at the site is low.

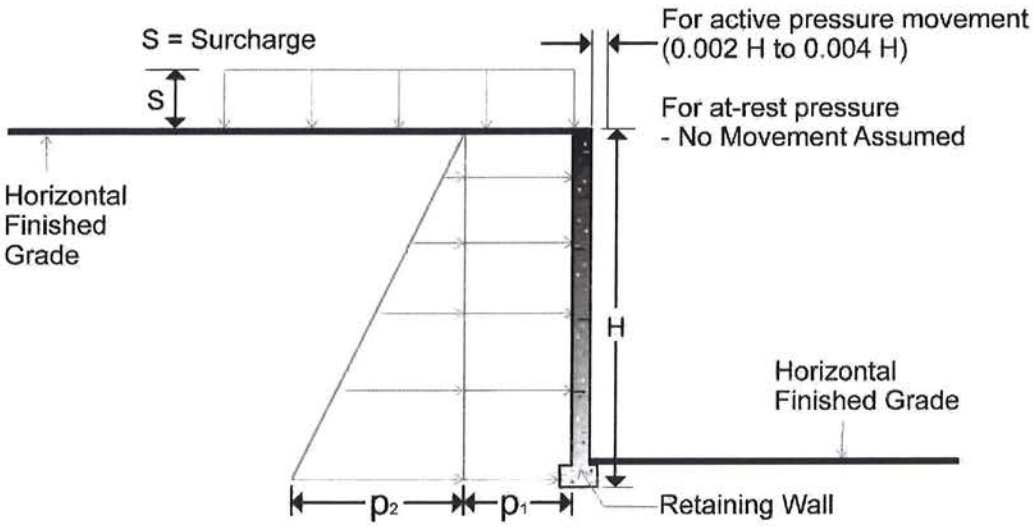
As part of our services, we evaluated the risk of liquefaction at this site. Based on our understanding of groundwater and geology at the site, it is our opinion that the risk of liquefaction at the site is low. The potential for seismic related settlement is also considered low. Based on our analyses, foundation bearing capacity failure is considered unlikely, and settlement of greater than 1 inch is considered unlikely during a design-level earthquake. It is our opinion that no additional engineering geology investigations or geologic hazard evaluations are necessary relative to seismic hazards for this project.

4.6 Lateral Earth Pressures

The lateral earth pressure recommendations herein are applicable to the design of rigid retaining walls subject to slight rotation, such as cantilever, or gravity type concrete walls, or to a foundation stem wall extending to native bearing soil that retains fill supporting slabs-on-grade. These recommendations are not applicable to the design of modular block, geogrid-reinforced backfill walls, or rockeries. Preliminary design recommendations for these types of walls are provided in Section 4.9 of this report. If these types of walls are planned for this project, we are available to provide complete retaining wall design services once the types and locations of the walls have been determined.

Reinforced concrete walls with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to those indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall

restraint conditions are shown. "Active" earth pressure is commonly used for design of free standing cantilever retaining walls and assumes wall movement. The "at rest" condition assumes no wall movement. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls.



EARTH PRESSURE COEFFICIENTS

EARTH PRESSURE CONDITIONS	COEFFICIENT FOR BACKFILL TYPE	EQUIVALENT FLUID DENSITY (pcf)	SURCHARGE PRESSURE, p_1 (psf)	EARTH PRESSURE, p_2 (psf)
Active (Ka)	0.31	35	(0.31)S	(35)H
At-Rest (Ko)	0.47	55	(0.47)S	(45)H
Passive (Kp)	3.25	400	---	---

Applicable conditions to the above include:

- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 **H** to 0.004 **H**, where **H** is wall height
- For passive earth pressure to develop, wall must move horizontally to mobilize resistance
- Uniform surcharge, where S is surcharge pressure
- Wall backfill weight a maximum of 120 pcf
- Horizontal finished grade compacted to 95 percent of modified Proctor maximum dry density
- Loading from heavy compaction equipment not included
- No hydrostatic pressures acting on wall
- No dynamic loading
- No safety factor included in soil parameters
- Ignore passive pressure in frost zone

The values provided in the table above are based on the assumption of horizontal finished grades both above and below the walls. For walls and foundations constructed on sloping ground, reduced passive and increased active and at-rest pressures will apply. Terracon should be consulted to determine applicable pressures for walls and footings in sloped conditions once location and loading conditions have been determined.

Backfill placed against walls should consist of granular structural fill. For these pressures to be valid, the structural fill must extend out from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively. To calculate the resistance to sliding, a value of 0.4 should be used as the ultimate coefficient of friction between the footing and the underlying soil.

To account for increased lateral pressures on foundation and retaining walls due to earthquake motions, we recommend uniformly distributed pressures of 7H and 12H in pounds per square foot (rectangular distribution) to be applied to yielding and non-yielding walls, respectively. These pressures are in addition to the static pressures presented below.

To aid in reducing the potential for hydrostatic pressure behind walls, we recommend placing a gravel curtain drain or geosynthetic drainage mat against the back of the wall with a collection pipe at the base leading to a reliable discharge. If adequate drainage is not possible, then combined hydrostatic and lateral earth pressures should be calculated for granular backfill using an equivalent fluid weighing 80 and 90 pcf for active and at-rest conditions, respectively. These pressures do not include the influence of surcharge, equipment, or floor loading, which should be added where appropriate. Heavy equipment should not operate within a distance closer than the exposed height of retaining walls to prevent lateral pressures more than those provided.

4.7 Pavements

Explorations in the areas of proposed paved parking lots and drive lanes encountered organic-rich soils to depths of up to 3½ feet below existing grades. We recommend complete removal of these soils and, if needed to achieve finished grade, replacement with structural fill.

4.7.1 Pavement Subgrade Preparation

On most project sites, the site grading is accomplished relatively early in the construction phase. Fills are placed and compacted in a uniform manner. However, as construction proceeds, excavations are made into these areas, rainfall and surface water saturates some areas, heavy traffic from concrete trucks and other construction vehicles disturbs the subgrade, and many surface irregularities are filled in with loose soils to temporarily improve traffic-ability. As a result, the pavement subgrades, initially prepared early in the project, should be carefully evaluated as the time for pavement construction approaches.

We recommend that the moisture content and density of the top 12 inches of the subgrade be evaluated and that the pavement subgrades be proof-rolled within two days prior to

commencement of actual paving operations. Areas not in compliance with the required ranges of moisture or density should be moisture conditioned and re-compacted. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the materials with properly compacted structural fills. If a significant precipitation event occurs after the evaluation or if the surface becomes disturbed, the subgrade should be reviewed by qualified personnel immediately prior to paving. The subgrade should be in its finished form at the time of the final review.

4.7.2 Pavement Design Considerations

We anticipate that traffic loads will be produced primarily by typical passenger cars and by occasional delivery and trash-removal trucks. Pavement thicknesses were determined based on an assumed 20-year design life.

The minimum pavement sections outlined below were determined based on the results of our explorations and on post-construction traffic loading conditions. These pavement sections do not account for heavy construction traffic during development. A partially constructed structural section may be subjected to heavy construction traffic that can result in pavement deterioration and premature failure. Our experience indicates that this pavement construction practice can result in pavements that will not perform as intended. Considering this information, several alternatives are available to mitigate the impact of heavy construction traffic on pavement construction. These include using thicker sections to account for the construction traffic; using some method of soil stabilization to improve the support characteristics of the pavement subgrade; routing heavy construction traffic around paved areas; or delaying paving operations until as near the end of construction as is feasible.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements, where possible:

- Final grade adjacent to parking lots and drives should slope down from pavement edges at a minimum 2%
- The subgrade and the pavement surface should have a minimum ¼ inch per foot slope to promote proper surface drainage
- Install pavement drainage surrounding areas anticipated for frequent wetting (e.g., landscaping areas)
- Install joint sealant and seal cracks immediately
- Seal all landscaped areas in, or adjacent to pavements to reduce moisture migration to subgrade soils
- Place compacted, low permeability backfill against the exterior side of curb and gutter.

4.7.3 Estimates of Minimum Pavement Thickness

The listed pavement component thicknesses should be used as a guide for pavement sections at the site for the traffic classifications stated herein. These recommendations assume a 20-year pavement design life. If pavement frequencies or loads will be different than that specified, Terracon should be contacted and allowed to review these pavement sections.

As a minimum, we recommend the following typical pavement section be considered for the proposed project:

Material	Thickness (inches)	WSDOT Std. Spec.
Subgrade	At least 12 inches of compacted in-place material or structural fill	95% of Modified Proctor MDD, -2 to +3% OMC
Crushed Aggregate Base	4	9-03.9(3) Base Course
Asphalt Surface Course	3	9-03.8(2) ½-inch HMA 9-03.8(6) ½-inch Aggregate
Total Pavement Section	7	

Asphalt concrete aggregates and base course materials should conform to WSDOT specifications noted in the table above. The abbreviations MDD, OMC, and HMA in the table above refer to Maximum Dry Density, Optimum Moisture Content, and Hot Mix Asphalt, respectively.

The graded crushed aggregate base should be compacted to a minimum of 95 percent of the material's modified Proctor (ASTM D-1557, Method C) maximum dry density. Where base course thickness exceeds 8 inches, the material should be placed and compacted in two or more lifts of equal thickness.

We recommend that a Portland cement concrete pavement (CCP) be utilized in entrance and exit sections, dumpster pads, or other areas where extensive wheel maneuvering or repeated loading are expected. The dumpster pad should be large enough to support the wheels of the truck which will bear the load of the dumpster. We recommend a minimum of 6 inches of CCP underlain by 4 inches of crushed aggregate base. Although not required for structural support, the base course layer is recommended to help reduce potential for slab curl, shrinkage cracking, and subgrade "pumping" through joints. Proper joint spacing will also be required to prevent excessive slab curling and shrinkage cracking. All joints should be sealed to prevent entry of foreign material and dowelled where necessary for load transfer.

Portland cement concrete should be designed with proper air-entrainment and have a minimum compressive strength of 4,000 psi after 28 days of laboratory curing. Adequate reinforcement and number of longitudinal and transverse control joints should be placed in the rigid pavement

in accordance with ACI requirements. The joints should be sealed as soon as possible (in accordance with sealant manufacturer's instructions) to minimize water infiltration into the soil.

4.7.4 Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the crushed aggregate base section.

We recommend drainage be included at the bottom of the crushed aggregate base layer at the storm structures to aid in removing water that may enter this layer. Drainage could consist of small diameter weep holes excavated around the perimeter of the storm structures. The weep holes should be excavated at the elevation of the crushed aggregate base and soil interface. The excavation should be covered with crushed aggregate wrapped in a geosynthetic filter fabric, such as Mirafi 140NL or approved equivalent, to aid in reducing fines from entering the storm system.

4.7.5 Pavement Maintenance

The pavement sections provided in this report represent minimum recommended thicknesses. Therefore preventive maintenance should be planned and provided for through an on-going pavement management program. Preventive maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment. Preventive maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the first priority when implementing a planned pavement maintenance program Additional engineering observation is recommended to determine the type and extent of preventive maintenance. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

4.8 Environmentally Sensitive Areas

According to the online mapping tool published by the City of Kirkland (http://www.kirklandwa.gov/depart/planning/Maps.htm), the slopes along the south and west sides of the site are mapped as a High Landslide Hazard Area. High Landslide Hazard Areas are defined in Chapter 85 of the City of Kirkland Zoning Code as areas sloping 40 percent or greater or subject to previous landslide activities. We did not observe evidence of previous landslide activity, sloughing, or soil creep on the slopes during our visits to the site during and before advancing our subsurface explorations. We also did not observe indications of springs, seeps, or surface expression of groundwater during our visits. Based on the topographic survey provided to us by the client, the slopes in the western portion of the site appear to be at grades of roughly 40 to 50 percent, while slopes in the southern portion of the site appear to be as steep as about 80 percent. As such, the classification of the slopes as High Landslide Hazard is likely based on the steepness of the slope. Based on our surface observations and the results

of our subsurface explorations, in our opinion the existing slopes currently appear to be in a stable condition.

We understand the new building location is currently planned to overlap a portion of the western slope, but development is not planned on or immediately above the southern slope. In addition, we understand a series of retaining walls is being considered to create tiered landscape areas on the slope west of the building. Sufficient information related to the development plans is not currently available to address the impact to slope stability and potential mitigating measures that may be required to address slope stability.

Building foundations and retaining walls may need to be set back or embedded to greater depths than typical minimums to reduce surcharge loading on the slopes. We recommend building foundations be set back at least 20 feet from the top of the steep slope or embedded to a sufficient depth that prevents the addition of a surcharge load to the slope. Reduced passive earth pressures will also apply to foundations and retaining walls constructed on sloping ground. Specific embedment depths and earth pressure conditions will vary depending on slope and building geometry and should be established once the size and locations of the foundations and retaining walls have been determined.

Development on the steep slopes will be subject to the requirements of Sections 85.15 and 85.25 of the Kirkland Zoning Code. We recommend slope stability analyses be performed once building loads and locations and retaining wall layouts and heights are finalized so that we may comment on potential impacts to stability of the slope and provide recommendations to mitigate slope hazards. Design of retaining walls planned for the slopes should include both local and global stability analyses.

4.9 Retaining Walls

We understand that one or more retaining walls are desired on the site to create walkable landscaped areas on the presently steeply-sloped western portion of the site. Selection of retaining wall type depends on several factors, including height of the soil mass to be retained, soil conditions, cost, and aesthetics. Based on existing contours and anticipated site grading, we understand site retaining walls will be primarily used to raise grade and will retain fill soils.

4.9.1 Gravity Walls

A gravity wall is a wall that relies solely on its own weight to resist the lateral earth pressures applied by the retained soil behind. These walls are generally the least expensive wall type due to the simplicity of their materials and construction and limited requirements for space and imported soils. Gravity walls are typically constructed with cast-in-place concrete, but can also consist of welded-wire baskets, precast concrete modular blocks, rockeries, and several other materials.

Gravity walls are typically limited to exposed heights of about 4 to 8 feet. Larger wall footings or precast blocks may allow construction of walls above this height, but MSE walls typically become more cost effective at heights greater than about 8 feet, unless boundary conditions limit the use of buried reinforcement behind the walls.

After cast-in-place concrete walls, gravity walls utilizing precast concrete modular blocks are the most common. These blocks can range in size from approximately 60 pounds to 4500 pounds each and are available in a wide range of sizes, colors, and facing textures. If desired, we can provide further detail of modular block types, manufacturers, and suppliers. When compared to cast-in-place walls, walls constructed with modular blocks have a greater degree of flexibility and are therefore less susceptible to damage from differential settlement or extreme loading events.

For preliminary design of gravity walls, we recommend use of the soil parameters shown in the following table for walls bearing on and retaining native soils. The coefficient of friction between the soil and the wall base will vary depending on the wall material and should be determined once a wall type has been chosen.

Material	Unit Weight (pcf)	Φ Friction Angle (degrees)	Cohesion (psf)
Native Silty Sand	120	32	0

4.9.2 Mechanically Stabilized Earth Walls

Mechanically Stabilized Earth (MSE) walls use artificial reinforcement elements, typically steel straps or geosynthetic fabrics, to create a reinforced soil mass designed to retain native or fill soils behind the wall. To prevent erosion of the wall face, reinforcement elements are attached to facing units. Modular precast concrete blocks, often similar or identical to those described above for gravity walls, used with geogrid reinforcement are the most common type of reinforced earth wall for commercial and residential construction, while precast concrete facing units with steel strip reinforcement are typical in road and highway construction. Geogrid reinforced walls with vegetated facing are also available for areas where the aesthetics of a "soft" wall system are preferred over "hard" concrete or rock facing.

As noted with modular block gravity retaining walls, differential settlement tolerance and the relative ease of construction is an advantage of MSE walls. MSE walls have been constructed to retained heights of over 70 feet, but are more typically on the range of 5 to 30 feet. The largest cost associated with the construction of MSE walls is typically the requirement of clean, well graded backfill material not commonly found on project sites.

We recommend the use of material meeting the requirements of Gravel Borrow for Structural Earth Wall in Section 9-03.14(4) of the 2014 WSDOT Standard Specifications for the reinforced fill zone of MSE retaining walls. This requirement limits the fines content of the fill to a

maximum of 7 percent. Laboratory testing of native site soils showed a fines content generally on the order of 24 to 31 percent, with one test showing a fines content of 8%. MSE walls may be designed using reinforced fill materials with up to about 30 percent fines, though additional consideration should be given to drainage both behind and in front of the reinforced soils to prevent the buildup of hydrostatic pressure within the reinforced zone.

For preliminary design of MSE walls, we recommend use of the soil parameters provided above for Gravity Walls for retained and foundation soils. If Gravel Borrow for Structural Earth Walls meeting the WSDOT specification section noted above is used in the reinforced zone of the MSE walls, we recommend using the parameters in the following table for design.

Material	Unit Weight (pcf)	Φ Friction Angle (degrees)	Cohesion (psf)
Gravel Borrow for Structural Earth Walls	135	36	0

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

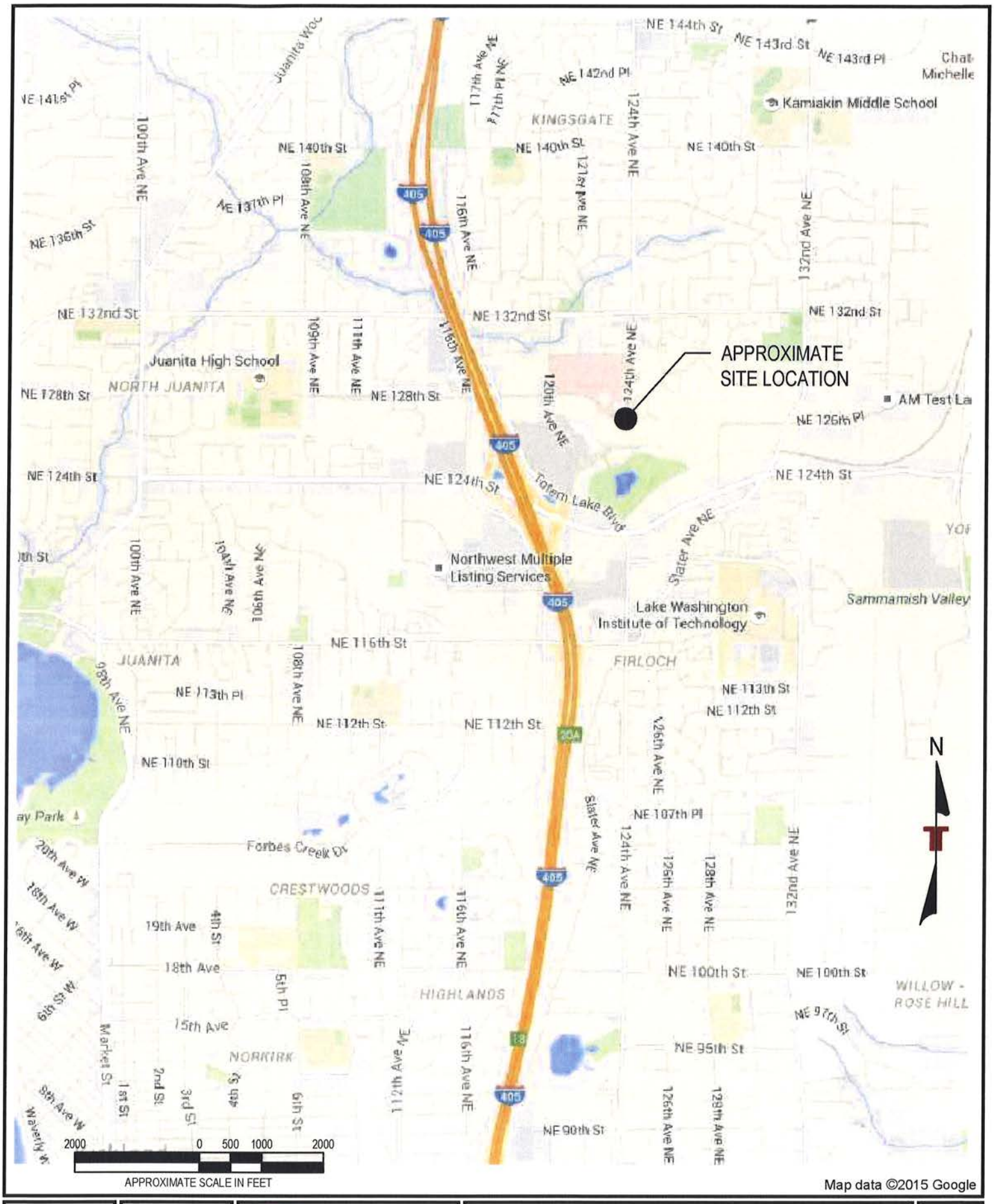
The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of RJ Development Services for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the

responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

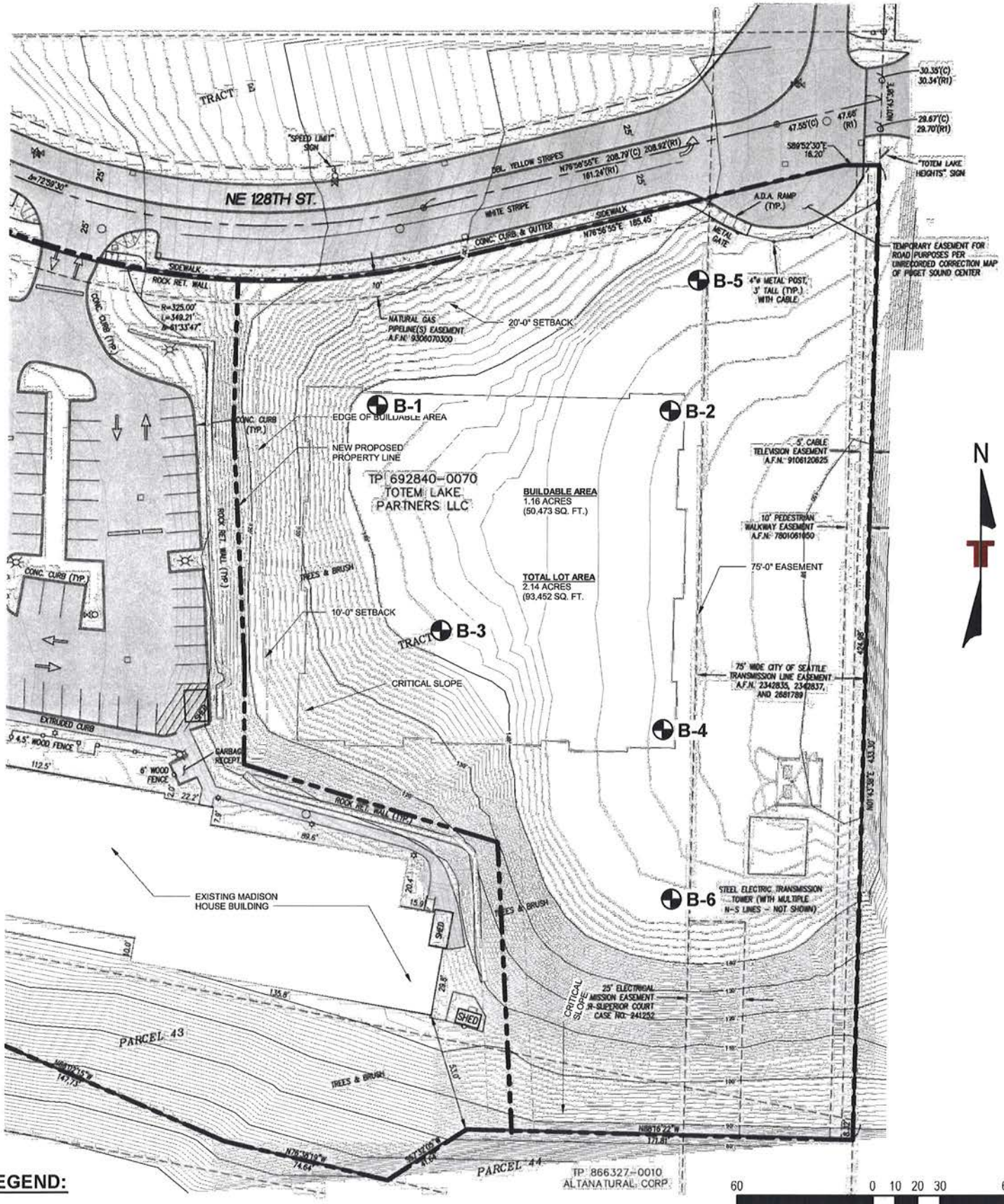
FIELD EXPLORATION



Project Mngr: RMS	Project No. 81155037	Terracon Consulting Engineers and Scientists	SITE LOCATION PLAN
Drawn By: RMS	Scale: AS SHOWN	21905 64th Avenue W., Ste 100 Mountlake Terrace, WA 98043	Memory Care Facility
Checked By: DRS	File No. TCI Exhibits.dwg	PH. (425) 771-3304 FAX. (425) 771-3549	12215 NE 128th Street
Approved By: DRS	Date: August 2015		Kirkland, Washington

EXHIBIT

A-1



LEGEND:

B-1 BORING NUMBER AND APPROXIMATE LOCATION

Basemap PDF file provided by Client and modified by Terracon.

Project Mngr: RMS	Project No. 81155037	Terracon Consulting Engineers and Scientists	SITE AND EXPLORATION PLAN
Drawn By: RMS	Scale: AS SHOWN	21905 64th Avenue W., Ste 100 Mountlake Terrace, WA 98043	Memory Care Facility
Checked By: TTA	File No. TCI Exhibits.dwg	PH. (425) 771-3304 FAX. (425) 771-3549	12215 NE 128th Street
Approved By: DAB	Date: August 2015		Kirkland, Washington

EXHIBIT A-2

Field Exploration Description

The subsurface exploration consisted of drilling and sampling 6 borings at the site to depths ranging from about 11 to 36 feet below existing grade. The boring locations were laid out by Terracon personnel. Distances from these locations to the reference features indicated on the attached diagram are approximate. Boring locations were estimated using a GPS-enabled phone and elevations were estimated from a topographic survey provided by the client. The locations and elevations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were drilled with a track-mounted rotary drill rig using hollow-stem augers to advance the boreholes. Representative soil samples were obtained by the split-barrel sampling procedure. In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split-barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a 140-pound hammer with a free fall of 30 inches, is the standard penetration resistance value (N). These values are indicted on the borings logs at the depths of occurrence. This value is used to estimate the in-situ relative density of cohesionless soils and the consistency of cohesive soils. The sampling depths and penetration distance, plus the standard penetration resistance values, are shown on the boring logs. The samples were sealed and taken to the laboratory for testing and classification.

An automatic SPT hammer was used to advance the split-barrel sampler in the borings performed on this site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT values and soil properties are based on the lower efficiency cathead and rope method. This higher efficiency affects the standard penetration resistance blow count (N) value by increasing the penetration per hammer blow over what would obtained using the cathead and rope method. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

Field logs of each boring were prepared by the engineer on site. These logs included visual description of the materials encountered during drilling as well as the engineer's interpretation of the subsurface conditions between samples. Final boring logs included with this report represent an interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

The samples were classified in the laboratory based on visual observation, texture and plasticity. The descriptions of the soils indicated on the boring logs are in general accordance with the enclosed General Notes and the Unified Soil Classification System. Estimated group symbols according to the Unified Soil Classification System are given on the boring logs. A brief description of this classification system is attached to this report.

BORING LOG NO. B-1

PROJECT: Memory Care Facility

CLIENT: RJ Development Services Olympia, Washington

SITE: 12215 NE 128th St Kirkland, Washington

LOCATION See Exhibit A-2

Latitude: 47.71373° Longitude: -122.1765°

Approximate Surface Elev: 140 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	PERCENT FINES
TOPSOIL, light brown to light gray, medium dense, damp, mild organic odor, rootlets									
3.5	136.5+/-								
SILTY SAND (SM), with gravel, light brown, dense, damp									
				X	14	7-6-9 N=15	S-1		
		5		X	18	17-19-20 N=39	S-2	4	24
				X	16	11-17-18 N=35	S-3		
		10		X	18	16-17-18 N=35	S-4		
		15		X	18	14-18-20 N=38	S-5		
grades to very dense		20		X	9	24-50/5" N=50/5"	S-6	11	
		25							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with bentonite chips upon completion

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *29' While Drilling*

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Boring Started: 7/31/2015 | Boring Completed: 7/31/2015

Drill Rig: D-50 track | Driller: Holocene

Project No.: 81155037 | Exhibit: A-4

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 81155037 BORING LOGS.GPJ TERRACON2015.GDT 9/2/15

BORING LOG NO. B-1

PROJECT: Memory Care Facility

CLIENT: RJ Development Services
Olympia, Washington

SITE: 12215 NE 128th St
Kirkland, Washington

LOCATION See Exhibit A-2

Latitude: 47.71373° Longitude: -122.1765°

Approximate Surface Elev: 140 (Ft.) +/-

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	PERCENT FINES
	SILTY SAND (SM), with gravel, light brown, dense, damp *(continued)*					5	50/5" N=50/5"	S-7		
	27.0	113+/-								
	SILTY SAND (SM), gray, very dense, moist			▽						
	30.4	109.5+/-	30			5	50/5" N=50/5"	S-8		
	Boring Terminated at 30.4 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with bentonite chips upon completion

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *29' While Drilling*

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Boring Started: 7/31/2015	Boring Completed: 7/31/2015
Drill Rig: D-50 track	Driller: Holocene
Project No.: 81155037	Exhibit: A-4

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 81155037 BORING LOGS.GPJ TERRACON2015.GDT 9/2/15

BORING LOG NO. B-2

PROJECT: Memory Care Facility

CLIENT: RJ Development Services
Olympia, Washington

SITE: 12215 NE 128th St
Kirkland, Washington

LOCATION See Exhibit A-2

Latitude: 47.71366° Longitude: -122.17588°

Approximate Surface Elev: 147 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
		6 inches **SANDY GRAVEL** surfacing over **FILL - SILTY SAND (SM)**, with gravel, brown, medium dense, damp
4.5	142.5+/-	**SILTY SAND (SM)**, trace silt and gravel, grayish-brown, medium dense, damp to moist
7.0	140+/-	**SILTY SAND (SM)**, with gravel, gray to tan, dense to very dense, damp to moist
13.0	134+/-	**SILTY SAND (SM)**, trace gravel, gray to tan, very dense, damp to moist
18.0	129+/-	**SAND (SP)**, trace silt, gray to tan, very dense, stratified, wet, 2-4 inch thick gray to tan sandy silt strata
21.3	125.5+/-	***Boring Terminated at 21.3 Feet***

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	PERCENT FINES
	X	5	10-12-17 N=29	S-1	6	
5	X	12	4-9-7 N=16	S-2		
	X	16	16-31-32 N=63	S-3		
10	X	18	12-20-20 N=40	S-4	7	27
15	X	10	36-50/4" N=50/4"	S-5		
20	X	16	24-32-50/4" N=82/10"	S-6		

WATER LEVEL OBSERVATIONS

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with bentonite chips upon completion

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not Encountered

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Boring Started: 7/31/2015 | Boring Completed: 7/31/2015
Drill Rig: D-50 track | Driller: Holocene
Project No.: 81155037 | Exhibit: A-5

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 81155037 BORING LOGS.GPJ TERRACON2015.GDT 9/2/15

BORING LOG NO. B-3

PROJECT: Memory Care Facility

CLIENT: RJ Development Services
Olympia, Washington

SITE: 12215 NE 128th St
Kirkland, Washington

LOCATION See Exhibit A-2

Latitude: 47.71352° Longitude: -122.17639°

Approximate Surface Elev: 141 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
0.5	140.5+/-	**TOPSOIL**, light brown to light gray, damp
		SAND (SP-SM), with silt, trace gravel, brown and tan, medium dense, damp
7.0	134+/-	**SILTY SAND (SM)**, light brown to light gray, dense, damp
13.0	128+/-	**SILTY SAND (SM)**, trace gravel, brown to gray, very dense, moist

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	PERCENT FINES
			10	4-6-7 N=13	S-1		
5			10	5-6-7 N=13	S-2	3	
			14	7-15-25 N=40	S-3		
10			12	15-25-22 N=47	S-4		
15			6	14-32-40 N=72	S-5	9	31
20			11	48-50/5" N=50/5"	S-6		
25							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with bentonite chips upon completion

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

27' While Drilling

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Boring Started: 7/31/2015 | Boring Completed: 7/31/2015
Drill Rig: D-50 track | Driller: Holocene
Project No.: 81155037 | Exhibit: A-6

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 81155037 BORING LOGS.GPJ TERRACON2015.GDT 9/2/15

BORING LOG NO. B-3

PROJECT: Memory Care Facility

CLIENT: RJ Development Services Olympia, Washington

SITE: 12215 NE 128th St Kirkland, Washington

LOCATION See Exhibit A-2

Latitude: 47.71352° Longitude: -122.17639°

Approximate Surface Elev: 141 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	PERCENT FINES
		SILTY SAND (SM), trace gravel, brown to gray, very dense, moist *(continued)*				9	43-50/3" N=50/3"	S-7		
		grades to wet		▽						
			30			10	41-50/4" N=50/4"	S-8	12	
33.0	108+/-	**SILTY SAND (SM)**, gray, very dense, wet								
			35			9	44-50/3" N=50/3"	S-9		
35.8	105+/-	***Boring Terminated at 35.8 Feet***								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with bentonite chips upon completion

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *27' While Drilling*

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Boring Started: 7/31/2015 | Boring Completed: 7/31/2015

Drill Rig: D-50 track | Driller: Holocene

Project No.: 81155037 | Exhibit: A-6

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 81155037 BORING LOGS.GPJ TERRACON2015.GDT 9/2/15

BORING LOG NO. B-4

PROJECT: Memory Care Facility

CLIENT: RJ Development Services Olympia, Washington

SITE: 12215 NE 128th St Kirkland, Washington

LOCATION See Exhibit A-2

Latitude: 47.71333° Longitude: -122.17598°

Approximate Surface Elev: 147 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
0.3	146.5+/-	**TOPSOIL**, light brown
		SAND (SP-SM), with silt, trace gravel, tan to brown, medium dense, moist
7.0	140+/-	
		SAND (SP-SM), with silt, trace gravel, light gray to light brown, very dense, moist
13.0	134+/-	
		SILTY SAND (SM), trace gravel, gray to brown, very dense, moist
20.4	126.5+/-	
		Boring Terminated at 20.4 Feet

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	PERCENT FINES
		12	5-7-8 N=15	S-1		
5		14	4-6-10 N=16	S-2	3	8
		18	18-40-45 N=85	S-3		
10		18	13-30-45 N=75	S-4		
15		10	24-50/4" N=50/4"	S-5		
20		5	50/5" N=50/5"	S-6		

WATER LEVEL OBSERVATIONS

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with bentonite chips upon completion

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not Encountered

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Boring Started: 7/31/2015 | Boring Completed: 7/31/2015

Drill Rig: D-50 track | Driller: Holocene

Project No.: 81155037 | Exhibit: A-7

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 81155037 BORING LOGS.GPJ TERRACON2015.GDT 9/2/15

BORING LOG NO. B-5

PROJECT: Memory Care Facility

CLIENT: RJ Development Services
Olympia, Washington

SITE: 12215 NE 128th St
Kirkland, Washington

LOCATION See Exhibit A-2

Latitude: 47.71385° Longitude: -122.17592°

Approximate Surface Elev: 145 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	PERCENT FINES
TOPSOIL, trace gravel, brown to dark brown, loose to medium dense, mild organic odor, rootlets, damp									
3.5	141.5+/-			X	10	8-4-7 N=11	S-1	5	
SILTY SAND (SM), trace gravel, light gray to light brown, dense to very dense, moist		5		X	14	9-22-29 N=51	S-2		
				X	18	17-23-26 N=49	S-3	7	30
10.9	134+/-	10		X	8	20-50/5" N=50/5"	S-4		
Boring Terminated at 10.9 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with bentonite chips upon completion

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not Encountered

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Boring Started: 7/31/2015 | Boring Completed: 7/31/2015
Drill Rig: D-50 track | Driller: Holocene
Project No.: 81155037 | Exhibit: A-8

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 81155037 BORING LOGS.GPJ TERRACON2015.GDT 9/2/15

BORING LOG NO. B-6

PROJECT: Memory Care Facility

CLIENT: RJ Development Services
Olympia, Washington

SITE: 12215 NE 128th St
Kirkland, Washington

LOCATION See Exhibit A-2

Latitude: 47.71314° Longitude: -122.176°

Approximate Surface Elev: 145 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	PERCENT FINES
		TOPSOIL, light brown to brown, damp to moist								
1.5	143.5+/-	**SAND (SP-SM)**, with silt, tan and gray, medium dense, damp								
					X	10	4-4-6 N=10	S-1	2	
4.5	140.5+/-	**SILTY SAND (SM)**, light gray to light brown, very dense, damp to moist								
			5		X	12	20-30-40 N=70	S-2	5	
7.0	138+/-	**SILTY SAND (SM)**, with gravel, gray to brown, very dense, moist								
					X	12	17-25-25 N=50	S-3		
			10		X	8	29-50/5" N=50/5"	S-4		
10.9	134+/-	***Boring Terminated at 10.9 Feet***								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with bentonite chips upon completion

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not Encountered

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Boring Started: 7/31/2015 | Boring Completed: 7/31/2015
Drill Rig: D-50 track | Driller: Holocene
Project No.: 81155037 | Exhibit: A-9

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 81155037 BORING LOGS.GPJ TERRACON2015.GDT 9/2/15

APPENDIX B

LABORATORY TESTING

Laboratory Testing

As part of the testing program, all samples were examined in the laboratory by experienced personnel and classified in accordance with the attached General Notes and the Unified Soil Classification System based on the texture and plasticity of the soils. The group symbol for the Unified Soil Classification System is shown in the appropriate column on the boring logs and a brief description of the classification system is included with this report in Appendix C.

At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

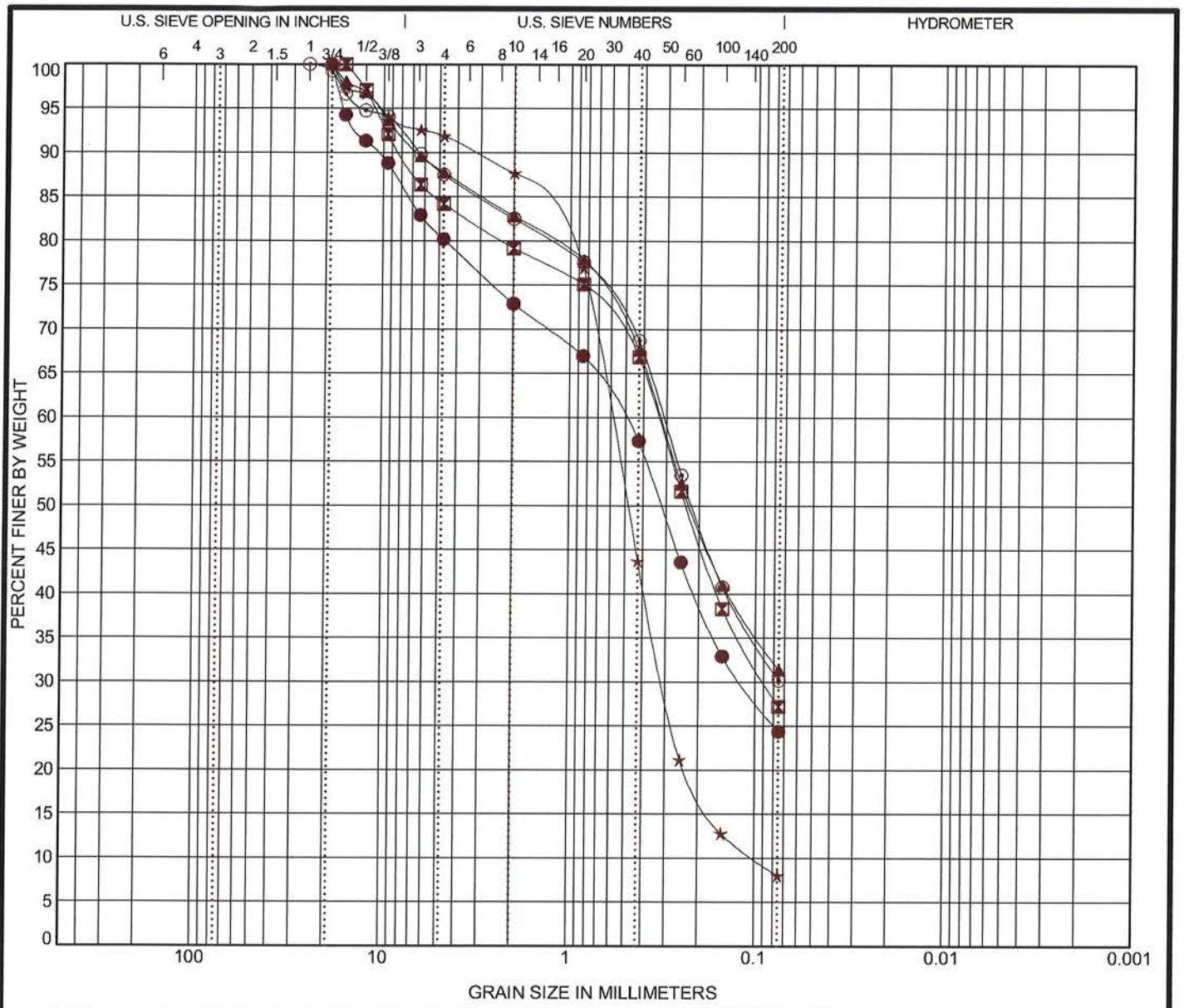
Laboratory tests were conducted on selected soil samples and the test results are presented in this appendix. The laboratory test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards.

Selected soil samples obtained from the site were tested for the following engineering properties:

- In-situ Water Content
- Grain Size Distribution

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth	USCS Classification	LL	PL	PI	Cc	Cu
●	B-1	5 - 6.5	SILTY SAND (SM), with gravel					
⊠	B-2	10 - 11.5	SILTY SAND (SM), with gravel					
▲	B-3	15 - 16.5	SILTY SAND (SM), trace gravel					
★	B-4	5 - 6.5	SAND (SP-SM), with silt, trace gravel				1.58	5.95
⊙	B-5	7.5 - 9	SILTY SAND (SM), trace gravel					

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Fines
●	B-1	5 - 6.5	19	0.515	0.118		19.8	55.8	24.4
⊠	B-2	10 - 11.5	16	0.335	0.089		15.8	57.0	27.2
▲	B-3	15 - 16.5	19	0.326			12.3	56.4	31.3
★	B-4	5 - 6.5	19	0.597	0.308	0.1	8.1	83.9	8.0
⊙	B-5	7.5 - 9	25	0.314			12.5	57.3	30.2

PROJECT: Proposed Memory Care Facility

SITE: 12215 NE 128th St
Kirkland, Washington

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

PROJECT NUMBER: 81155037

CLIENT: RJ Development Services
Olympia, Washington

EXHIBIT: B-2

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 81155037 BORING LOGS.GPJ TERRACON2012.GDT 8/21/15

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Split Spoon

WATER LEVEL

Water Initially Encountered

Water Level After a Specified Period of Time

Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

N	**Standard Penetration Test Resistance (Blows/Ft.)**
(HP)	**Hand Penetrometer**
(T)	**Torvane**
(DCP)	**Dynamic Cone Penetrometer**
(PID)	**Photo-Ionization Detector**
(OVA)	**Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (psf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 500	0 - 1
Loose	4 - 9	Soft	500 to 1,000	2 - 4
Medium Dense	10 - 29	Medium Stiff	1,000 to 2,000	4 - 8
Dense	30 - 50	Stiff	2,000 to 4,000	8 - 15
Very Dense	> 50	Very Stiff	4,000 to 8,000	15 - 30
		Hard	> 8,000	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

Terracon

Exhibit: C-1

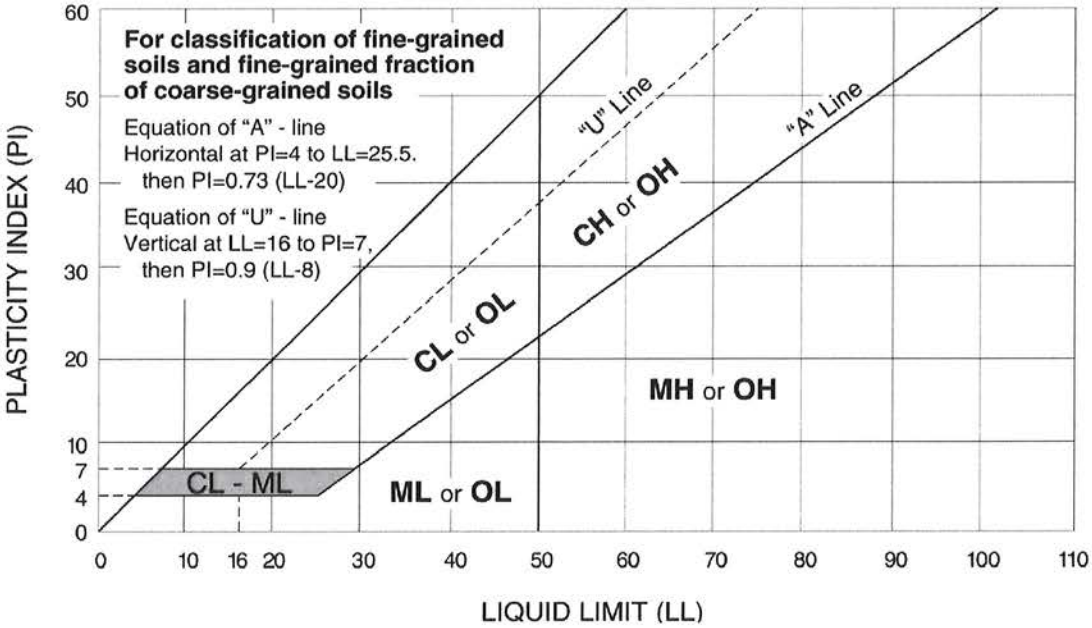
UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay [K,L,M,N]
						Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay [K,L,M,P]
						Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.



Terracon

Exhibit C-2

USGS Design Maps Summary Report

User-Specified Input

Report Title Kirkland Memory Care
Tue August 11, 2015 19:37:11 UTC

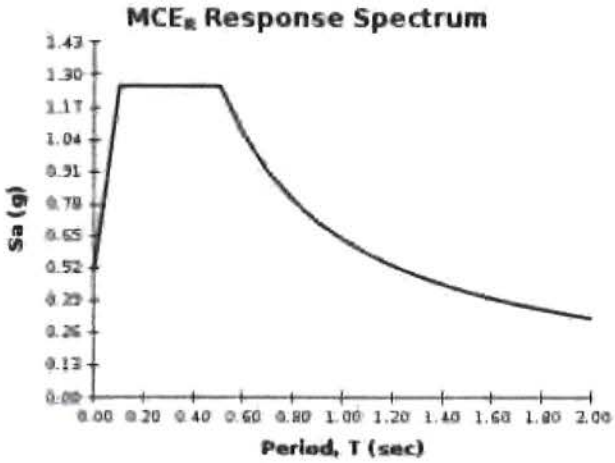
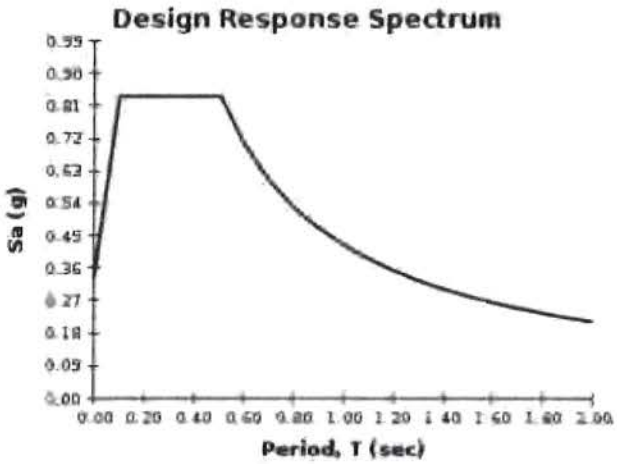
Building Code Reference Document 2012 International Building Code
(which utilizes USGS hazard data available in 2008)

Site Coordinates 47.71358°N, 122.17588°W

Site Soil Classification Site Class C – "Very Dense Soil and Soft Rock"

Risk Category I/II/III

USGS-Provided Output

S_S =	1.254 g	S_{MS} =	1.254 g	S_{DS} =	0.836 g
S_1 =	0.483 g	S_{M1} =	0.636 g	S_{D1} =	0.424 g

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