Attachment 14

PRELIMINARY GEOTECHNICAL REPORT

Mansoori Parcel
172nd Avenue NE and NE 122nd Street
Redmond, Washington

Project No. T-7037

Terra Associates, Inc.

Prepared for:

Quadrant Homes
Bellevue, Washington

April 21, 2014
Updated January 15, 2015

Attachment 14

TERRA ASSOCIATES, Inc.

Consultants in Geotechnical Engineering, Geology
and
Environmental Earth Sciences

April 21, 2014
Updated January 15, 2015
Project No. T-7037

Mr. Mike Behn
Quadrant Homes
14725 SE 36th Street, Suite 200
Bellevue, Washington 98006

Subject: Preliminary Geotechnical Report
Mansoori Parcel
172nd Avenue NE and NE 122nd Street
Redmond, Washington

Dear Mr. Behn:

As requested, we have conducted a preliminary geotechnical engineering study for the subject project. The attached report presents our findings and recommendations for the geotechnical aspects of project design and construction.

Our field exploration indicates the site is generally underlain by 6 to 18 inches of organic topsoil overlying 1 to 4 feet of loose to medium dense silty sand with gravel (weathered till) overlying medium dense to very dense silty sand with gravel (unweathered glacial till). There were two exceptions to this general condition. One was observed at Test Pit TP-1 where we observed a one-foot medium stiff silt layer between the weathered and unweathered glacial till soils. The other was observed at test pit TP-10 where we observed approximately eight feet of loose, wet, organic fill material overlying the very dense native soils. We observed minor to heavy groundwater seepage in 9 of the 12 test pits between approximately 1 and 8 feet below current site grades.

In our opinion, soil conditions observed at the site will be suitable for support of the proposed development provided the recommendations present in this report are incorporated into project design and construction.

We trust the information presented in this report is sufficient for your current needs. If you have any questions or require additional information, please call.

Sincerely yours,
TERRA ASSOCIATES, INC.

CAROLYN S. DECKER
STATE OF WASHINGTON
47016
REGISTERED
PROFESSIONAL ENGINEER

1/15/15

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Preliminary Geotechnical Report
Mansoori Parcel
172nd Avenue NE and NE 122nd Street
Redmond, Washington

1.0 PROJECT DESCRIPTION

The project consists of developing the approximately 11-acre site with residential building lots and associated access, utilities, and stormwater facilities. Grading and development plans were not available at the time of this report. However, based on our knowledge of the site, we would expect cuts and fills up to ten feet will be required to achieve level building lots with site retaining walls used to support vertical grade transitions.

We expect that the residential structures constructed on the lots will be two- to three-story wood-framed buildings constructed over a crawl space with garages attached and constructed at grade. Structural loading should be relatively light; with bearing walls carrying loads of one to three kips per foot and isolated columns carrying maximum loads of 30 to 60 kips.

The recommendations in the following sections of this report are based on our understanding of the preceding design features. We should review design drawings as they become available to verify that our recommendations have been properly interpreted and to supplement them, if required.

2.0 SCOPE OF WORK

On April 11, 2014, we observed soil conditions at 12 test pits excavated between 6.5 and 9 feet below existing site grades. Using the information obtained from the subsurface exploration and laboratory testing, we performed analyses to develop preliminary geotechnical recommendations for project design and construction. Specifically, this report addresses the following:

- Soil and groundwater conditions
- Seismic design parameters per 2012 International Building Code (IBC)
- Geologic hazards per the Redmond Zoning Code (RZC)
- Site preparation and grading
- Embankments and slopes
- Excavation
- Foundations
- Floor slabs at grade
- Site retaining walls
- Drainage
- Utilities
- Pavement

It should be noted that recommendations outlined in this report regarding drainage are associated with soil strength, design earth pressures, erosion, and stability. Design and performance issues with respect to moisture as it relates to the structure environment (i.e., humidity, mildew, mold) is beyond Terra Associates' purview. A building envelope specialist or contractor should be consulted to address these issues, as needed.

3.0 SITE CONDITIONS

3.1 Surface

The project site is located at and east of the intersection of 172nd Avenue NE and NE 122nd Street in Redmond, Washington. The approximate site location is shown on Figure 1.

The site is currently covered with thick vegetation in the form of mature trees, understory, blackberries, and brush. There is a wooden fence in the south-central portion of the site that is associated with the former residence. Site topography in the western half of the site is relatively flat with a slight slope that descends to the east with an overall relief of approximately ten feet. Site topography in the eastern half of the site consists of a moderate slope that descends to the east with an overall relief of approximately 60 feet.

3.2 Subsurface

Soil conditions observed indicate the site is generally underlain by 6 to 18 inches of organic topsoil overlying 1 to 4 feet of loose to medium dense silty sand with gravel (weathered till) overlying medium dense to very dense silty sand with gravel (unweathered glacial till). There were two exceptions to this general condition. One was observed at Test Pit TP-1 where we observed a one-foot medium stiff silt layer between the weathered and unweathered glacial till soils. The other was observed at Test Pit TP-10 where we observed approximately eight feet of loose, wet, organic fill material overlying the very dense native soils.

The *Geologic Map of Redmond Quadrangle, King County, Washington,* by J.P. Minard and D.B. Booth (1988) maps the site as till (Qvt). This mapped description is consistent with the native soil we observed in the test pits.

The preceding discussion is intended to be a general review of the soil conditions encountered. For more detailed descriptions, please refer to the Test Pit Logs in Appendix A.

3.3 Groundwater

Light to heavy groundwater seepage was observed in 9 of the 12 test pits including TP-1, TP-3, TP-4, TP-6, TP-8, TP-9, TP-10, TP-11, and TP-12 between 1 and 8 feet below current site grades. Typically, we noted seepage at the contact between the upper weathered and unweathered till horizons. This condition is very common within till geology and we expect that this seepage will diminish when we move into the drier summer and fall months. Deeper zones of seepage observed in the test pits appear to be flowing from sandier layers contained within the till stratum such as at a depth of 8 feet at Test Pit TP-9. This groundwater seepage would not be significantly affected by seasonal weather variations and will be present during the drier summer and fall months. However, once exposed by excavation, we would anticipate the rate and volume of flow will diminish as storage from the isolated sandier zones is depleted.

4.0 GEOLOGICAL HAZARDS

4.1 Seismic Considerations

Section 21.64.060A.1.c of the Redmond Zoning Code (RZC) defines seismic hazard areas as "…lands subject to severe risk of damage as a result of earthquake-induced ground shaking, slope failure, settlement, soil liquefaction, or surface faulting."

Based on the soil and groundwater conditions we observed at the site, it is our opinion that the risk for damage resulting from earthquake induced slope failure, ground settlement, surface faulting, or soil liquefaction is negligible. Therefore, in our opinion, unusual seismic hazard areas do not exist at the site, and design in accordance with local building codes for determining seismic forces would adequately mitigate impacts associated with ground shaking.

Based on soil conditions observed in the test pits and our knowledge of the area geology, per Chapter 16 of the 2012 International Building Code (IBC), site class "C" should be used in structural design. Based on this site class, in accordance with the 2012 IBC, the following parameters should be used in computing seismic forces:

Seismic Design Parameters (IBC 2012)

Spectral response acceleration (Short Period), S_{Ms}	1.257
Spectral response acceleration (1 – Second Period), S_{M1}	0.636
Five percent damped .2 second period, S_{Ds}	0.838
Five percent damped 1.0 second period, S_{D1}	0.424

Values determined using the United States Geological Survey (USGS) Ground Motion Parameter Calculator accessed on April 8, 2014 at the web site http://earthquake.usgs.gov/designmaps/us/application.php.

4.2 Erosion Hazard Areas

Section 21.64.060A.1.a of the RZC defines erosion hazard areas as "...lands or areas underlain by soils identified by the U.S. Department of Agriculture Soil Conservation Service (SCS) as having "severe" or "very severe" rill and inter-rill erosion hazards. This includes, but is not limited to, the following group of soils when they occur on slopes of 15 percent or greater: Alderwood-Kitsap (AkF), Alderwood gravelly sandy loam (AgD), Kitsap silt loam (KpD), Everett (EvD), and Indianola (InD)."

The soils observed on-site are classified as Alderwood gravelly sandy loam 6 to 15 percent slopes by the United States Department of Agriculture Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service. Over most of the site with the existing slope gradients, these soils will have a slight to moderate potential for erosion when exposed. Therefore, the site is not considered an erosion hazard area by the City of Redmond. Regardless, erosion protection measures as required by the City of Redmond will need to be in place prior to starting grading activities on the site. This would include perimeter silt fencing to contain erosion on-site and cover measures to prevent or reduce soil erosion during and following construction.

4.3 Landslide Hazard Areas

Section 21.64.060A.1.b of the RZC defines landslide hazard areas as "…areas potentially subject to significant or severe risk of landslides based on a combination of geologic, topographic, and hydrogeologic factors.

They include areas susceptible because of any combination of bedrock, soil, slope, slope aspect, structure, hydrology, or other factors. They are areas of the landscape that are at a high risk of failure or that presently exhibit downslope movement of soil and/or rocks and that are separated from the underlying stationary part of the slope by a definite plane of separation. The plane of separation may be thick or thin and may be composed of multiple failure zones depending on local conditions, including soil type, slope gradient, and groundwater regime." Landslide hazard areas include the following:

i. Areas of historic failures, such as:

   a. Areas designated as quaternary slumps or landslides on maps published by the United States Geologic Survey (USGS).

   b. Those areas designated by the United States Department of Agriculture (USDA) Soil Conservation Service (SCS) as having a "severe" limitation for building site development.

ii. Areas containing a combination of slopes steeper than 15 percent, springs or groundwater seepage, and hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock.

iii. Areas that have shown movement during the Holocene epoch (from 10,000 years ago to the present) or which are underlain or covered by mass wastage debris of that epoch.

iv. Slopes that are parallel or subparallel to planes of weakness in subsurface materials.

v. Slopes having gradients steeper than 80 percent subject to rockfall during seismic shaking.

vi. Areas potentially unstable as a result of rapid stream incision, stream bank erosion, and undercutting by wave action.

vii. Any area with a slope 40 percent or steeper with a vertical relief of 10 feet or more.

None of the above conditions exist at the site, therefore, in our opinion; the site does not contain any landslide hazard areas as defined by the RZC.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 General

Based on our study, there are no geotechnical considerations that would preclude continued development of the site as currently planned. Residential buildings can be supported on conventional spread footings bearing on inorganic competent native soils or on structural fill placed and compacted above competent mineral native soils. Pavement and floor slabs can be similarly supported. The exception to this is in the vicinity of Test Pit TP-10 where we observed loose, wet, organic fill material that would not be suitable for support of building foundations, floor slabs, or pavements. We recommend removing the existing fill from below new building elements and replacing the material with new structural fill.

The native soils that will be encountered at the site contain a significant amount of soil fines and will be difficult to compact as structural fill when too wet. The ability to use native soil from site excavations as structural fill will depend on its moisture content and the prevailing weather conditions at the time of construction. If grading activities will take place during winter, the owner should be prepared to import clean granular material for use as structural fill and backfill. The existing fill material would not be suitable for reuse as structural fill.

The following sections provide detailed recommendations regarding the preceding issues and other geotechnical design considerations. These recommendations should be incorporated into the final design drawings and construction specifications.

5.2 Site Preparation and Grading

To prepare the site for construction, all vegetation, organic surface soils, and other deleterious material should be stripped and removed from the site. Surface stripping depths of about 6 to 18 inches should be expected to remove the organic surface soils except in the area of Test Pit TP-10 where the wet organic fill was observed. In this area, excavation depths of eight feet should be expected. Organic topsoil will not be suitable for use as structural fill, but may be used for limited depths in nonstructural areas.

Once clearing and stripping operations are complete, cut and fill operations can be initiated to establish desired grades. Prior to placing fill, all exposed bearing surfaces should be observed by a representative of Terra Associates to verify soil conditions are as expected and suitable for support of new fill. Our representative may request a proofroll using heavy rubber-tired equipment to determine if any isolated soft and yielding areas are present. If excessively yielding areas are observed, and they cannot be stabilized in place by compaction, the affected soils should be excavated and removed to firm bearing and grade restored with new structural fill. Beneath embankment fills or roadway subgrade if the depth of excavation to remove unstable soils is excessive, the use of geotextile fabrics, such as Mirafi 500X, or an equivalent fabric, can be used in conjunction with clean granular structural fill. Our experience has shown that, in general, a minimum of 18 inches of a clean, granular structural fill placed and compacted over the geotextile fabric should establish a stable bearing surface.

The native soils encountered at the site contain a sufficient amount of soil fines that will make them difficult to compact as structural fill when too wet or too dry. The ability to use native soils from site excavations as structural fill will depend on its moisture content and the prevailing weather conditions at the time of construction. If wet soils are encountered, the contractor will need to dry the soils by aeration during dry weather conditions. Alternatively, the use of an additive such as Portland cement, cement kiln dust (CKD), or lime to stabilize the soil moisture can be considered. If the soil is amended, additional Best Management Practices (BMPs) addressing the potential for elevated pH levels will need to be included in the Storm Water Pollution Prevention Program (SWPPP) prepared with the Temporary Erosion and Sedimentation Control (TESC) plan.

If grading activities are planned during the wet winter months, or if they are initiated during the summer and extend into fall and winter, the owner should be prepared to import wet weather structural fill. For this purpose, we recommend importing a granular soil that meets the following grading requirements:

U.S. Sieve Size	Percent Passing
6 inches	100
No. 4	75 maximum
No. 200	5 maximum*

* Based on the 3/4-inch fraction.

Prior to use, Terra Associates, Inc. should examine and test all materials imported to the site for use as structural fill.

Structural fill should be placed in uniform loose layers not exceeding 12 inches and compacted to a minimum of 95 percent of the soil's maximum dry density, as determined by American Society for Testing and Materials (ASTM) Test Designation D-698 (Standard Proctor). The moisture content of the soil at the time of compaction should be within two percent of its optimum, as determined by this ASTM standard. In nonstructural areas, the degree of compaction can be reduced to 90 percent.

5.3 Slopes and Embankments

All permanent cut and fill slopes should be graded with a finished inclination of no greater than 2:1. Upon completion of grading, the slope face should be appropriately vegetated or provided with other physical means to guard against erosion. Final grades at the top of the slope must promote surface drainage away from the slope crest. Water must not be allowed to flow uncontrolled over the slope face. If surface runoff must be directed towards the slope, the runoff should be controlled at the top of the slope, piped in a closed conduit installed on the slope face, and taken to an appropriate point of discharge beyond the toe.

All fill placed for embankment construction should meet the structural fill requirements in Section 5.2 of this report. In addition, if the new fills will be placed over existing slopes of 20 percent or greater, the structural fill should be keyed and benched into competent native slope soils. Figure 3 presents a typical slope key and bench configuration. At minimum, a toe drain should be installed in the key cut as shown on Figure 3. Depending on seepage conditions, drains may also be required along individual benches excavated on the slope face especially along the pond slopes. The need for drains along the upper benches will be best determined in the field at the time of construction.

5.4 Excavations

All excavations at the site associated with confined spaces, such as utility trenches, must be completed in accordance with local, state, and federal requirements. Based on regulations outlined in the Washington Industrial Safety and Health Act (WISHA), the upper one to four feet of weathered till and the upper eight feet of fill material would be classified as Type C soil. The native dense till soils would be classified as Type A soil.

Temporary slopes for excavations in Type C soils should be laid back at an inclination of 1.5:1 (Horizontal:Vertical) or flatter, from the toe to the crest of the slope. Excavation slopes in Type A soils can be laid back at a slope inclination of 0.75:1 or flatter. For temporary excavation slopes less than eight feet in height in Type A soils, the lower 3.5 feet can be cut to a vertical condition with a 0.75:1 slope graded above. For temporary excavation slopes of greater than eight feet, the slope above the 3.5-foot vertical portion should be laid back at a minimum slope inclination of 1:1. All temporary excavation slopes that will remain open for an extended time period should be covered with a durable reinforced plastic membrane during construction to prevent slope raveling and rutting during periods of precipitation.

In general, groundwater seepage should be anticipated within excavations that extend to depths of greater than three feet below site grades particularly during and shortly following the normally wet winter season. We anticipate that the volume of water and rate of flow into the excavation will be relatively minor and are not expected to impact the stability of the excavations when completed, as described. Conventional sump pumping procedures, along with a system of collection trenches, if necessary should be capable of maintaining a relatively dry excavation for construction purposes.

The above information is provided solely for the benefit of the owner and other design consultants, and should not be construed to imply that Terra Associates, Inc. assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project contractor.

5.5 Foundation Support

Residential buildings can be supported on conventional spread footing foundations bearing on undisturbed surfaces consisting of inorganic competent native soils or on structural fills placed above competent soils. Foundation subgrade should be prepared as recommended in Section 5.2 of this report. As noted above, the foundations in the vicinity of Test Pit TP-10 will need to be founded on new structural fill that replaces the existing loose, wet, organic material or the foundations can be lowered to bear on the native soils. Perimeter foundations exposed to the weather should bear a minimum depth of 1.5 feet below final exterior grades for frost protection. Interior foundations can be constructed at any convenient depth below the floor slab.

Foundations can be dimensioned for a net allowable bearing capacity of 2,500 pounds per square foot (psf). For short-term loads, such as wind and seismic, a one-third increase in this allowable capacity can be used. With structural loading as anticipated and this bearing stress applied, estimated total settlements are less than one-half inch.

For designing foundations to resist lateral loads, a base friction coefficient of 0.35 can be used. Passive earth pressures acting on the side of the footing and buried portion of the foundation stem wall can also be considered. We recommend calculating this lateral resistance using an equivalent fluid weight of 300 pcf. We recommend not including the upper 12 inches of soil in this computation because they can be affected by weather or disturbed by future grading activity. This value assumes the foundation will be constructed neat against competent native soil or backfilled with structural fill as described in Section 5.2 of this report. The values recommended include a safety factor of 1.5.

5.6 Floor Slab-on-Grade

Slab-on-grade floors may be supported on subgrade prepared as recommended in Section 5.2 of this report. Immediately below the floor slab, we recommend placing a four-inch thick capillary break layer composed of clean, coarse sand or fine gravel that has less than three percent passing the No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slab. As noted above, the existing fill material in the vicinity of Test Pit TP-10 will need to be removed from below slab-on-grade floors and replaced with new structural fill.

The capillary break layer will not prevent moisture intrusion through the slab caused by water vapor transmission. Where moisture by vapor transmission is undesirable, such as covered floor areas, a common practice is to place a durable plastic membrane on the capillary break layer and then cover the membrane with a layer of clean sand or fine gravel to protect it from damage during construction, and to aid in uniform curing of the concrete slab. It should be noted that if the sand or gravel layer overlying the membrane is saturated prior to pouring the slab, it will not be effective in assisting uniform curing of the slab and can actually serve as a water supply for moisture bleeding through the slab, potentially affecting floor coverings. Therefore, in our opinion, covering the membrane with a layer of sand or gravel should be avoided if floor slab construction occurs during the wet winter months and the layer cannot be effectively drained. We recommend floor designers and contractors refer to the 2003 American Concrete Institute (ACI) Manual of Concrete Practice, Part 2, 302.1R-96, for further information regarding vapor barrier installation below slab-on-grade floors.

5.7 Site Retaining Walls

Based on the existing topography of the site, site retaining walls will likely be required to achieve flat building lots. For design of conventional cast-in-place concrete walls or gravity block walls, the magnitude of earth pressure development will partly depend on the quality of the wall backfill. We recommend placing and compacting wall backfill as structural fill as described in Section 5.2 of this report. To guard against hydrostatic pressure development, wall drainage must also be installed. A typical recommended wall drainage detail is shown on Figure 4.

With wall backfill placed and compacted as recommended, and drainage properly installed, we recommend designing unrestrained walls for an active earth pressure equivalent to a fluid weighing 35 pounds per cubic foot (pcf). For restrained walls, an additional uniform load of 100 psf should be included in the wall design. To account for typical traffic surcharge loading, the walls can be designed for an additional imaginary height of two feet (two-foot soil surcharge). For evaluation of wall performance under seismic loading, a uniform pressure equivalent to 8H psf, where H is the height of the below-grade portion of the wall should be applied in addition to the static lateral earth pressure. These values assume a horizontal backfill condition and that no other surcharge loading, sloping embankments, or adjacent buildings will act on the wall. If such conditions exist, then the imposed loading must be included in the wall design. Friction at the base of foundations and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in Section 5.5 of this report.

For design of mechanically stabilized earth (MSE) walls faced with precast segmental block units, we recommend using a soil unit weight of 125 pcf and an internal friction angle of 34 degrees for both the reinforced and retained soil zones.

5.8 Drainage

Surface

Final exterior grades should promote free and positive drainage away from the building sites at all times. Water must not be allowed to pond or collect adjacent to foundations or within the immediate building areas. We recommend providing a positive drainage gradient away from the building perimeters. If this gradient cannot be provided, surface water should be collected adjacent to the structures and disposed to appropriate storm facilities.

Surface water must not be allowed to flow uncontrolled over the crest of the site slopes and embankments. Surface water should be directed away from the slope crests to a point of collection and controlled discharge. If site grades do not allow for directing surface water away from slopes, then water should be collected and tightlined down the slope face in a controlled manner.

Subsurface

We recommend installing perimeter foundation drains adjacent to shallow foundations. The drains can be laid to grade at an invert elevation equivalent to the bottom of footing grade. The drains can consist of four-inch diameter perforated PVC pipe that is enveloped in washed pea gravel-sized drainage aggregate. The aggregate should extend six inches above and to the sides of the pipe. Roof and foundation drains should be tightlined separately to the storm drains. All drains should be provided with cleanouts at easily accessible locations.

Infiltration

The native glacial till soils composed of silty sand characteristically exhibit low permeability's and would not be a suitable receptor soil for discharge of development stormwater using infiltration/retention facilities. Conventional stormwater detention with controlled release to the drainage basin should be used to manage development stormwater.

5.9 Utilities

Utility pipes should be bedded and backfilled in accordance with American Public Works Association (APWA) or the City of Redmond specifications. As a minimum, trench backfill should be placed and compacted as structural fill, as described in Section 5.2 of this report. As noted, depending on the soil moisture when excavated most inorganic native soils on the site should be suitable for use as backfill material during dry weather conditions. The contractor should be prepared to aerate soils to reduce moisture and facilitate proper compaction. However, if utility construction takes place during the wet winter months, it will likely be necessary to import suitable wet weather fill for utility trench backfilling.

5.10 Pavement

Pavement subgrades should be prepared as described in the Section 5.2 of this report. Regardless of the degree of relative compaction achieved, the subgrade must be firm and relatively unyielding before paving. The subgrade should be proofrolled with heavy rubber-tire construction equipment such as a loaded 10-yard dump truck to verify this condition.

The pavement design section is dependent upon the supporting capability of the subgrade soils and the traffic conditions to which it will be subjected. For residential access, with traffic consisting mainly of light passenger vehicles with only occasional heavy traffic, and with a stable subgrade prepared as recommended, we recommend the following pavement sections:

- Two inches of hot mix asphalt (HMA) over six inches of crushed rock base (CRB)
- Four inches of full depth HMA

The paving materials used should conform to the Washington State Department of Transportation (WSDOT) specifications for ½-inch class HMA and CRB.

Long-term pavement performance will depend on surface drainage. A poorly-drained pavement section will be subject to premature failure as a result of surface water infiltrating into the subgrade soils and reducing their supporting capability. For optimum pavement performance, we recommend surface drainage gradients of at least two percent. Some degree of longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks when they occur.

6.0 ADDITIONAL SERVICES

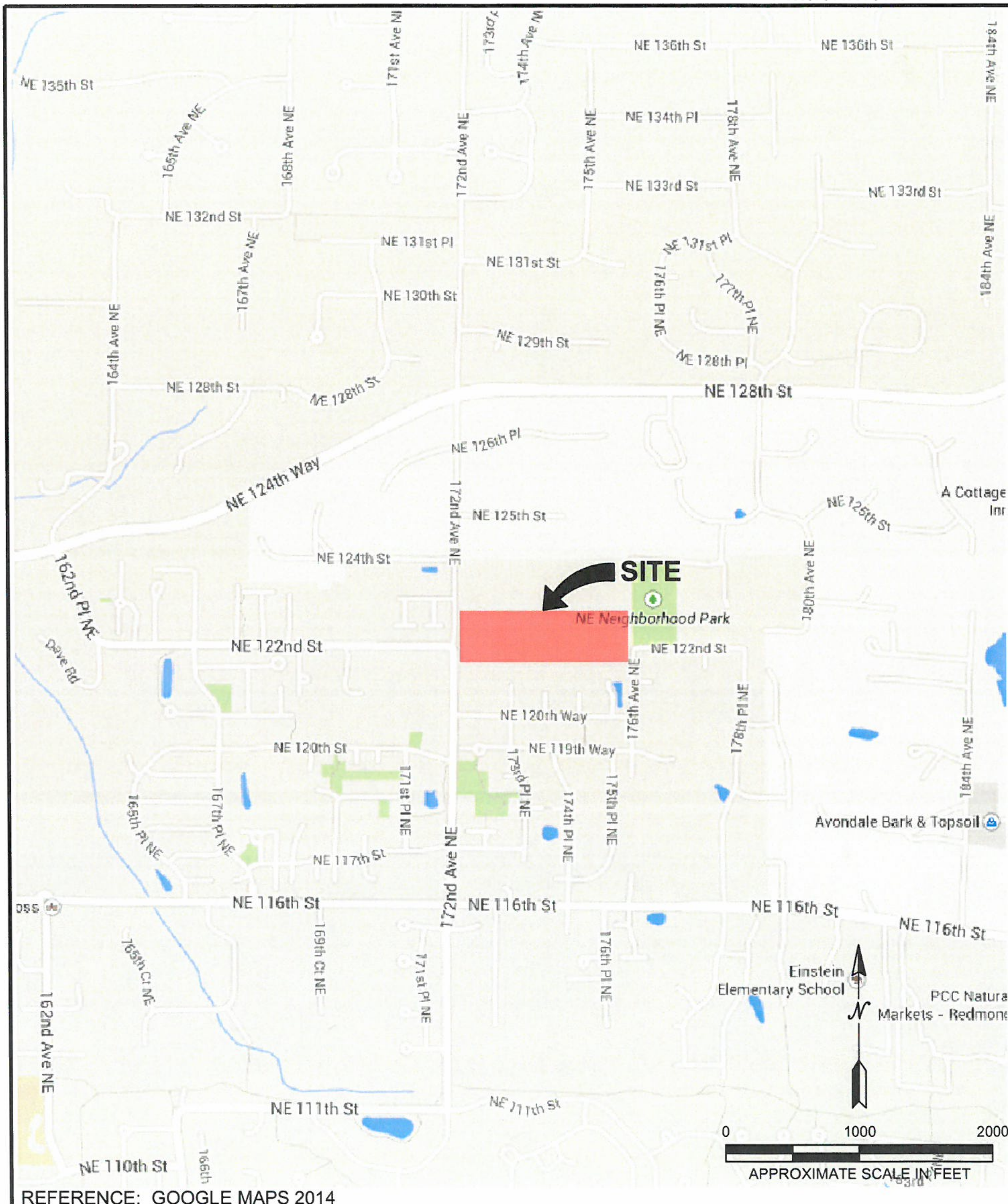
Terra Associates, Inc. should review the final design drawings and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and implemented in project design. We should also provide geotechnical service during construction to observe compliance with our design concepts, specifications, and recommendations. This will allow for design changes if subsurface conditions differ from those anticipated prior to the start of construction.

7.0 LIMITATIONS

We prepared this report in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made. This report is the copyrighted property of Terra Associates, Inc. and is intended for specific application to the Mansoori Parcel project. This report is for the exclusive use of Quadrant Homes and its authorized representatives.

The analyses and recommendations present in this report are based on data obtained from the test pits and borings done on site. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear evident, Terra Associates, Inc. should be requested to reevaluate the recommendations in this report prior to proceeding with construction.

Attachment 14



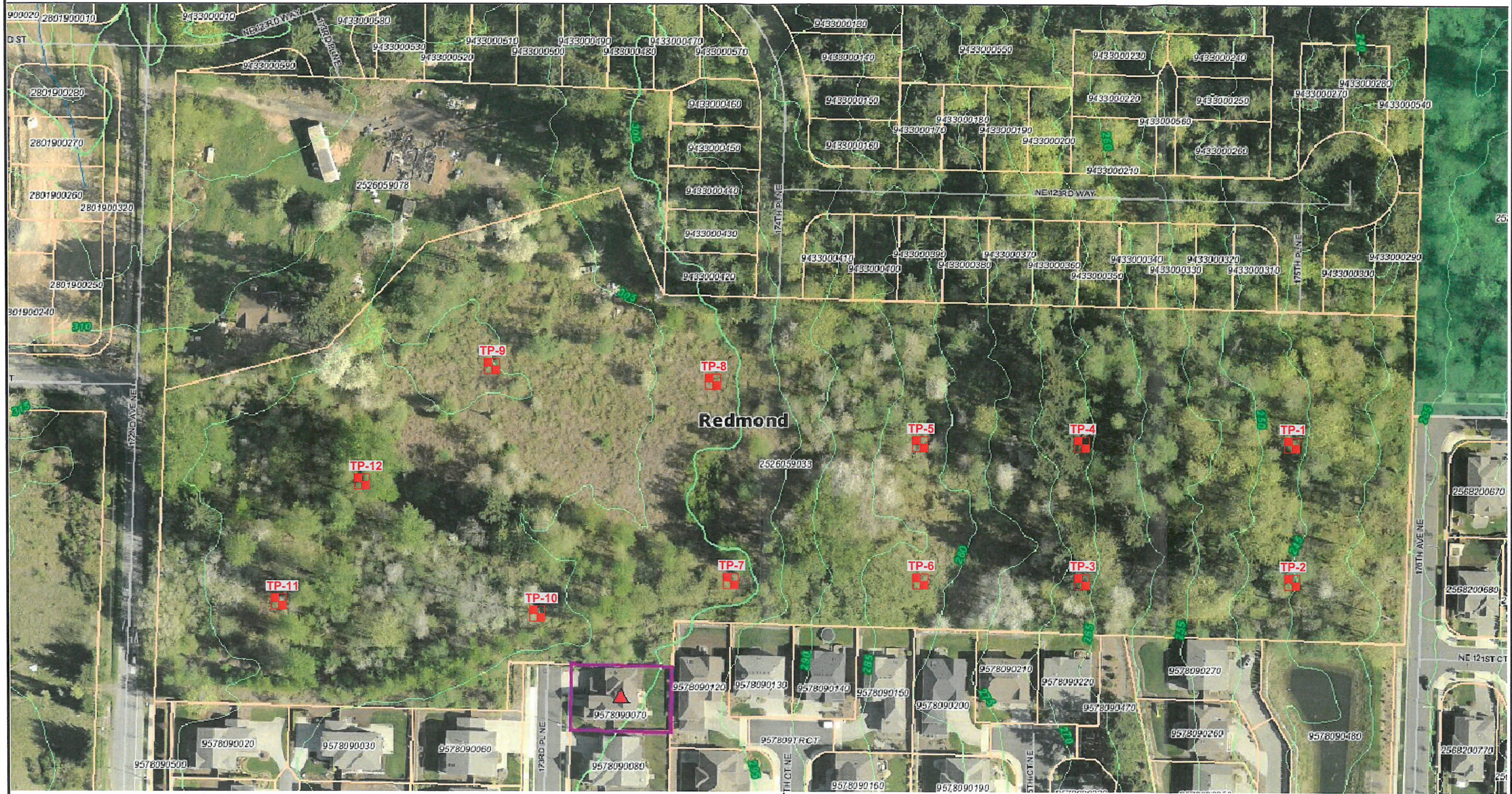
REFERENCE: GOOGLE MAPS 2014

Terra Associates, Inc.
Consultants in Geotechnical Engineering
Geology and
Environmental Earth Sciences

VICINITY MAP
MANSOORI PARCEL
REDMOND, WASHINGTON

Proj. No.T-7037	Date APRIL 2014	Figure 1

Attachment 14



NOTE:

THIS SITE PLAN IS SCHEMATIC. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE. IT IS INTENDED FOR REFERENCE ONLY AND SHOULD NOT BE USED FOR DESIGN OR CONSTRUCTION PURPOSES.

REFERENCE: SITE PLAN PROVIDED BY KING COUNTY IMAP.

LEGEND:

APPROXIMATE TEST PIT LOCATION

0 100 200

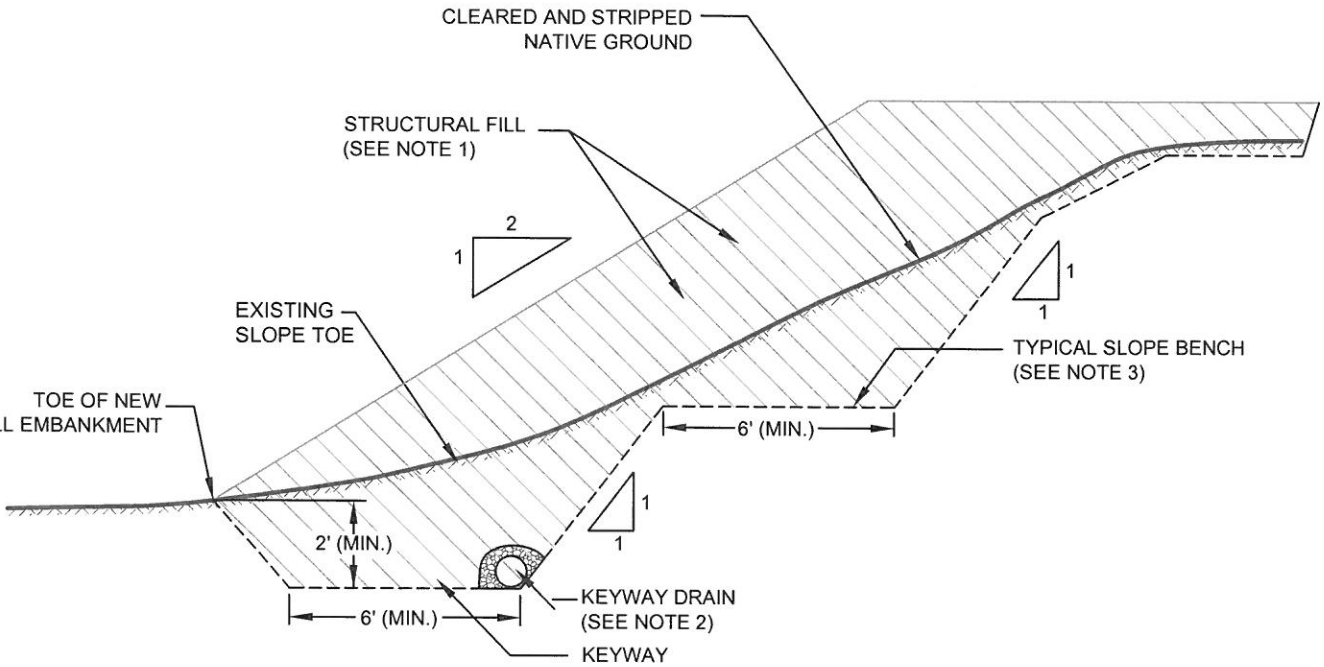
APPROXIMATE SCALE IN FEET

N

Terra Associates, Inc.
Consultants in Geotechnical Engineering
Geology and
Environmental Earth Sciences

EXPLORATION LOCATION PLAN
MANSOORI PARCEL
REDMOND, WASHINGTON

Proj. No.T-7037	Date APRIL 2014	Figure 2



NOT TO SCALE

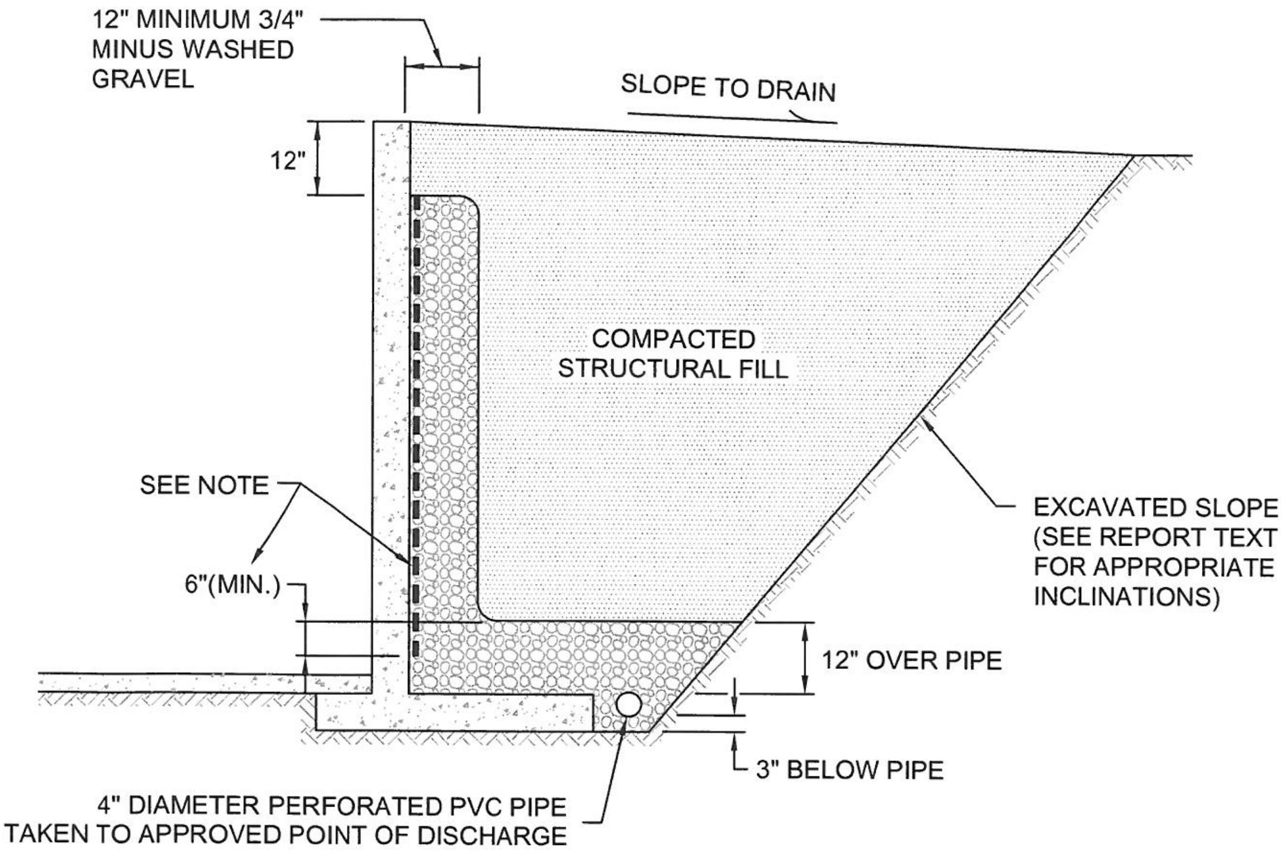
NOTES:

1) STRUCTURAL FILL SHALL BE COMPACTED TO A MINIMUM OF 95% OF ASTM D 698 MAXIMUM DRY DENSITY VALUE.

2) DRAINS SHALL CONSIST OF 6" DIA. PERFORATED PVC PIPE ENVELOPED IN 1 cu ft OF 3/4" WASHED GRAVEL. DRAIN PIPE SHALL BE DIRECTED TO THE STORM DRAIN SYSTEM OR APPROVED POINT OF DISCHARGE.

3) ADDITIONAL BENCHES AND BENCH DRAINS MAY BE REQUIRED BASED ON FIELD EVALUATION BY THE GEOTECHNICAL ENGINEER.

Terra Associates, Inc. Consultants in Geotechnical Engineering Geology and Environmental Earth Sciences	TYPICAL SLOPE KEY AND BENCH DETAIL MANSOORI PARCEL REDMOND, WASHINGTON		
	Proj. No.T-7037	Date APRIL 2014	Figure 3



NOT TO SCALE

NOTE:

MIRADRAIN G100N PREFABRICATED DRAINAGE PANELS OR SIMILAR PRODUCT CAN BE SUBSTITUTED FOR THE 12-INCH WIDE GRAVEL DRAIN BEHIND WALL. DRAINAGE PANELS SHOULD EXTEND A MINIMUM OF SIX INCHES INTO 12-INCH THICK DRAINAGE GRAVEL LAYER OVER PERFORATED DRAIN PIPE.

Terra Associates, Inc. Consultants in Geotechnical Engineering Geology and Environmental Earth Sciences	TYPICAL WALL DRAINAGE DETAIL MANSOORI PARCEL REDMOND, WASHINGTON
Proj. No. T-7037	Date APRIL 2014 — Figure 4

APPENDIX A
FIELD EXPLORATION AND LABORATORY TESTING

Mansoori Parcel
Redmond, Washington

On April 11, 2014, we completed our site exploration by observing soil conditions at 12 test pits. The test pits were excavated using a trackhoe to a maximum depth of nine feet below existing site grades. Test pit locations were determined in the field by measurements from existing site features. The approximate location of the test pits is shown on the attached Exploration Location Plan, Figure 2. Test Pit Logs are attached as Figures A-2 through A-13.

A geotechnical engineer from our office conducted the field exploration. Our representative classified the soil conditions encountered, maintained a log of each test pit, obtained representative soil samples, and recorded water levels observed during excavation. All soil samples were visually classified in accordance with the Unified Soil Classification System (USCS) described on Figure A-1.

Representative soil samples obtained from the test pits were placed in closed containers and taken to our laboratory for further examination and testing. The moisture content of each sample was measured and is reported on the individual Test Pit Logs.

MAJOR DIVISIONS				LETTER SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	More than 50% material larger than No. 200 sieve size	**GRAVELS** More than 50% of coarse fraction is larger than No. 4 sieve	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.
			Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
				GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
		SANDS More than 50% of coarse fraction is smaller than No. 4 sieve	Clean Sands (less than 5% fines)	SW	Well-graded sands, sands with gravel, little or no fines.
				SP	Poorly-graded sands, sands with gravel, little or no fines.
			Sands with fines	SM	Silty sands, sand-silt mixtures, non-plastic fines.
				SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS	More than 50% material smaller than No. 200 sieve size	**SILTS AND CLAYS** Liquid Limit is less than 50%		ML	Inorganic silts, rock flour, clayey silts with slight plasticity.
				CL	Inorganic clays of low to medium plasticity. (Lean clay)
				OL	Organic silts and organic clays of low plasticity.
		SILTS AND CLAYS Liquid Limit is greater than 50%		MH	Inorganic silts, elastic.
				CH	Inorganic clays of high plasticity. (Fat clay)
				OH	Organic clays of high plasticity.
HIGHLY ORGANIC SOILS				PT	Peat.

DEFINITION OF TERMS AND SYMBOLS

COHESIONLESS

Density	Standard Penetration Resistance in Blows/Foot
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	>50

COHESIVE

Consistancy	Standard Penetration Resistance in Blows/Foot
Very Soft	0-2
Soft	2-4
Medium Stiff	4-8
Stiff	8-16
Very Stiff	16-32
Hard	>32

Symbol	Definition
I	2" OUTSIDE DIAMETER SPILT SPOON SAMPLER
II	2.4" INSIDE DIAMETER RING SAMPLER OR SHELBY TUBE SAMPLER
▼	WATER LEVEL (Date)
Tr	TORVANE READINGS, tsf
Pp	PENETROMETER READING, tsf
DD	DRY DENSITY, pounds per cubic foot
LL	LIQUID LIMIT, percent
PI	PLASTIC INDEX
N	STANDARD PENETRATION, blows per foot

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UNIFIED SOIL CLASSIFICATION SYSTEM
MANSOORI PARCEL
REDMOND, WASHINGTON

Proj. No.T-7037	Date APRIL 2014	Figure A-1

LOG OF TEST PIT NO. TP-1

FIGURE A-2

PROJECT NAME: Mansoori Parcel **PROJ. NO:** T-7037 **LOGGED BY:** CSD

LOCATION: Redmond, Washington **SURFACE CONDS:** Underbrush **APPROX. ELEV:** N/A

DATE LOGGED: April 11, 2014 **DEPTH TO GROUNDWATER:** 5 Feet **DEPTH TO CAVING:** N/A

DEPTH (FT.)	SAMPLE NO.	DESCRIPTION	CONSISTENCY/ RELATIVE DENSITY	W (%)	POCKET PEN. (TSF)	REMARKS
0–1		Dark brown silty SAND with gravel, fine to medium grained, moist, heavy organics. (SM) (TOPSOIL)	Loose			
1–3	1	Red-brown to brown silty SAND with gravel, fine to medium grained, moist to wet, roots. (SM) (Weathered Till)	Medium Dense	26.3		
3–4	2	Gray SILT, fine grained, saturated, mottled. (ML)	Medium Stiff	29.8		
4–8 (groundwater at 5)	3	Gray silty SAND with gravel, fine to medium grained, wet to moist. (SM) (Unweathered Till)	Medium Dense Dense	14.3		
8–10		Test pit terminated at approximately 8 feet. Minor groundwater seepage observed at 5 feet.				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-2

FIGURE A-3

PROJECT NAME: Mansoori Parcel **PROJ. NO:** T-7037 **LOGGED BY:** CSD

LOCATION: Redmond, Washington **SURFACE CONDS:** Underbrush **APPROX. ELEV:** N/A

DATE LOGGED: April 11, 2014 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

DEPTH (FT.)	SAMPLE NO.	DESCRIPTION	CONSISTENCY/ RELATIVE DENSITY	W (%)	POCKET PEN. (TSF)	REMARKS
0–1		Dark brown silty SAND with gravel, fine to medium grained, moist, heavy organics. (SM) (TOPSOIL)	Loose			
1–3	1	Red-brown to brown silty SAND with gravel, fine to medium grained, moist to wet, roots. (SM) (Weathered Till)	Medium Dense	32.8		
3–7	2	Gray silty SAND with gravel, fine to medium grained, moist, some cementation, mottled to 4 feet. (SM) (Unweathered Till)	Medium Dense Dense Very Dense	13.2		
7–10		Test Pit terminated at approximately 7 feet. No groundwater seepage observed.				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-3

FIGURE A-4

PROJECT NAME: Mansoori Parcel **PROJ. NO:** T-7037 **LOGGED BY:** CSD

LOCATION: Redmond, Washington **SURFACE CONDS:** Underbrush **APPROX. ELEV:** N/A

DATE LOGGED: April 11, 2014 **DEPTH TO GROUNDWATER:** 4 Feet **DEPTH TO CAVING:** N/A

DEPTH (FT.)	SAMPLE NO.	DESCRIPTION	CONSISTENCY/ RELATIVE DENSITY	W (%)	POCKET PEN. (TSF)	REMARKS
1		Dark brown silty SAND with gravel, fine to medium grained, moist, heavy organics. (SM) (TOPSOIL)	Loose			
	1			27.0		
2		Brown silty SAND with gravel, fine to medium grained, moist to wet, roots. (SM) (Weathered Till)	Medium Dense			
3						
			Medium Dense			
▼ 4			Dense			
	2			14.8		
5		Gray silty SAND with gravel, fine to medium grained, moist, some cementation, mottled to 4 feet. (SM) (Unweathered Till)				
6			Very Dense			
7						
8		Test pit terminated at approximately 8 feet. Moderate groundwater seepage observed at 4 feet.				
9						
10						

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-4

FIGURE A-5

PROJECT NAME: Mansoori Parcel **PROJ. NO:** T-7037 **LOGGED BY:** CSD

LOCATION: Redmond, Washington **SURFACE CONDS:** Underbrush **APPROX. ELEV:** N/A

DATE LOGGED: April 11, 2014 **DEPTH TO GROUNDWATER:** 4 Feet **DEPTH TO CAVING:** N/A

DEPTH (FT.)	SAMPLE NO.	DESCRIPTION	CONSISTENCY/ RELATIVE DENSITY	W (%)	POCKET PEN. (TSF)	REMARKS
0–1		Dark brown silty SAND with gravel, fine to medium grained, moist, heavy organics. (SM) (TOPSOIL)	Loose			
1–4	1	Brown silty SAND with gravel, fine to medium grained, moist to wet, roots. (SM) (Weathered Till)	Medium Dense	24.7		
4 (groundwater) – 6.5	2	Gray silty SAND with gravel, fine to medium grained, moist, some cementation. (SM) (Unweathered Till)	Dense Very Dense	16.3		
6.5–10		Test pit terminated at approximately 6.5 feet. Minor groundwater seepage observed at 4 feet.				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-5

FIGURE A-6

PROJECT NAME: Mansoori Parcel **PROJ. NO:** T-7037 **LOGGED BY:** CSD

LOCATION: Redmond, Washington **SURFACE CONDS:** Underbrush **APPROX. ELEV:** N/A

DATE LOGGED: April 11, 2014 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

DEPTH (FT.)	SAMPLE NO.	DESCRIPTION	CONSISTENCY/ RELATIVE DENSITY	W (%)	POCKET PEN. (TSF)	REMARKS
0–1		Dark brown silty SAND with gravel, fine to medium grained, moist, heavy organics. (SM) (TOPSOIL)	Loose			
1–4	1	Brown silty SAND with gravel, fine to medium grained, moist to wet, roots. (SM) (Weathered Till)	Medium Dense	21.3		
4–8	2	Gray silty SAND with gravel, fine to medium grained, moist, some cementation. (SM) (Unweathered Till)	Dense	13.5		
8–10		Test pit terminated at approximately 8 feet. No groundwater seepage observed.				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-6

FIGURE A-7

PROJECT NAME: Mansoori Parcel **PROJ. NO:** T-7037 **LOGGED BY:** CSD

LOCATION: Redmond, Washington **SURFACE CONDS:** Tall Blackberries **APPROX. ELEV:** N/A

DATE LOGGED: April 11, 2014 **DEPTH TO GROUNDWATER:** 3 Feet **DEPTH TO CAVING:** N/A

DEPTH (FT.)	SAMPLE NO.	DESCRIPTION	CONSISTENCY/ RELATIVE DENSITY	W (%)	POCKET PEN. (TSF)	REMARKS
0–1		Dark brown silty SAND with gravel, fine to medium grained, moist, heavy organics. (SM) (TOPSOIL)	Loose			
1–2	1	Red-brown to brown silty SAND with gravel, fine to medium grained, moist to wet, roots. (SM) (Weathered Till)	Medium Dense	23.0		
2–8 (groundwater at 3)	2	Gray silty SAND with gravel, fine to medium grained, moist, some cementation, mottled to 3 feet. (SM) (Unweathered Till)	Dense Very Dense	13.7		
8–10		Test pit terminated at approximately 8 feet. Minor groundwater seepage observed at 3 feet.				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-7

FIGURE A-8

PROJECT NAME: Mansoori Parcel **PROJ. NO:** T-7037 **LOGGED BY:** CSD

LOCATION: Redmond, Washington **SURFACE CONDS:** Tall Blackberries **APPROX. ELEV:** N/A

DATE LOGGED: April 11, 2014 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

DEPTH (FT.)	SAMPLE NO.	DESCRIPTION	CONSISTENCY/ RELATIVE DENSITY	W (%)	POCKET PEN. (TSF)	REMARKS
0–1		Dark brown silty SAND with gravel, fine to medium grained, moist, heavy organics. (SM) (TOPSOIL)	Loose			
1	1			14.7		
1–3		Brownish gray silty SAND with gravel, fine to medium grained, moist. (SM) (Weathered Till)	Medium Dense			
4	2			13.8		
3–8		Gray silty SAND with gravel, fine to medium grained, moist, some cementation, mottled to 4 feet. (SM) (Unweathered Till)	Dense			
8		Test pit terminated at approximately 8 feet. No groundwater seepage observed.				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-8

FIGURE A-9

PROJECT NAME: Mansoori Parcel **PROJ. NO:** T-7037 **LOGGED BY:** CSD

LOCATION: Redmond, Washington **SURFACE CONDS:** Tall Blackberries **APPROX. ELEV:** N/A

DATE LOGGED: April 11, 2014 **DEPTH TO GROUNDWATER:** 4 Feet **DEPTH TO CAVING:** N/A

DEPTH (FT.)	SAMPLE NO.	DESCRIPTION	CONSISTENCY/ RELATIVE DENSITY	W (%)	POCKET PEN. (TSF)	REMARKS
1		Dark brown silty SAND with gravel, fine to medium grained, moist to wet, heavy organics. (SM) (TOPSOIL)	Loose			
2	1	Red-brown silty SAND with gravel, fine to medium grained, moist, roots. (SM) (Weathered Till)	Medium Dense	28.1		
3, 4 (groundwater), 5, 6, 7	2	Gray silty SAND with gravel, fine to medium grained, moist, mottled to 4 feet, some cementation. (SM) (Unweathered Till)	Dense	16.2		
8, 9, 10		Test pit terminated at approximately 8 feet. Minor groundwater seepage observed at 4 feet.				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-9

FIGURE A-10

PROJECT NAME: Mansoori Parcel **PROJ. NO:** T-7037 **LOGGED BY:** CSD

LOCATION: Redmond, Washington **SURFACE CONDS:** Tall Blackberries **APPROX. ELEV:** N/A

DATE LOGGED: April 11, 2014 **DEPTH TO GROUNDWATER:** 8 Feet **DEPTH TO CAVING:** N/A

DEPTH (FT.)	SAMPLE NO.	DESCRIPTION	CONSISTENCY/ RELATIVE DENSITY	W (%)	POCKET PEN. (TSF)	REMARKS
0 – 1.5		Dark brown silty SAND with gravel, fine to medium grained, moist to wet, heavy organics. (SM) (TOPSOIL)	Loose			
1.5 – 3	1	Red-brown silty SAND with gravel, fine to medium grained, moist to wet, roots. (SM) (Weathered Till)	Medium Dense	22.5		
3 – 8	2	Gray silty SAND with gravel, fine to medium grained, wet to moist, mottled to 4 feet. (SM) (Unweathered Till)	Dense	14.6		
8		Test pit terminated at approximately 8 feet. Moderate groundwater seepage observed at 8 feet.				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-10

FIGURE A-11

PROJECT NAME: Mansoori Parcel **PROJ. NO:** T-7037 **LOGGED BY:** CSD

LOCATION: Redmond, Washington **SURFACE CONDS:** Tall Blackberries/Brush **APPROX. ELEV:** N/A

DATE LOGGED: April 11, 2014 **DEPTH TO GROUNDWATER:** 0 to 8 Feet **DEPTH TO CAVING:** 0 to 8 Feet

DEPTH (FT.)	SAMPLE NO.	DESCRIPTION	CONSISTENCY/ RELATIVE DENSITY	W (%)	POCKET PEN. (TSF)	REMARKS
		(6 inches ORGANICS)				
1 (groundwater symbol) – 8		FILL: gray and brown silty sand with gravel, fine to medium grained, saturated, highly organic, bricks, pvc, plastic.	Loose			
8 – 9	1	Gray silty SAND with gravel, fine to medium grained, moist, pieces of weathered bedrock. (SM) (Unweathered Till)	Very Dense	11.2		
9 – 10		Test pit terminated at approximately 9 feet. Heavy groundwater seepage observed from 0 to 8 feet. Moderate caving observed from 0 to 8 feet.				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-11

FIGURE A-12

PROJECT NAME: Mansoori Parcel PROJ. NO: T-7037 LOGGED BY: CSD

LOCATION: Redmond, Washington SURFACE CONDS: Brush, Weeds, Grass APPROX. ELEV: N/A

DATE LOGGED: April 11, 2014 DEPTH TO GROUNDWATER: 3 Feet DEPTH TO CAVING: N/A

DEPTH (FT.)	SAMPLE NO.	DESCRIPTION	CONSISTENCY/ RELATIVE DENSITY	W (%)	POCKET PEN. (TSF)	REMARKS
0–1		Dark brown silty SAND with gravel, fine to medium grained, moist, heavy organics. (SM) (TOPSOIL)	Loose			
1–3	1	Red-brown to brown silty SAND with gravel, fine to medium grained, wet, roots. (SM) (Weathered Till)	Medium Dense	33.5		
3 (groundwater) – 7	2	Gray silty SAND with gravel, fine to medium grained, moist, some cementation, mottled to 4.5 feet, occasional cobble. (SM) (Unweathered Till)	Dense	17.2		
	3			11.6		
7–10		Test pit terminated at approximately 7 feet. Minor groundwater seepage observed at 3 feet.				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-12

FIGURE A-13

PROJECT NAME: Mansoori Parcel **PROJ. NO:** T-7037 **LOGGED BY:** CSD

LOCATION: Redmond, Washington **SURFACE CONDS:** Tall Blackberries/Brush **APPROX. ELEV:** N/A

DATE LOGGED: April 11, 2014 **DEPTH TO GROUNDWATER:** 3 Feet **DEPTH TO CAVING:** N/A

DEPTH (FT.)	SAMPLE NO.	DESCRIPTION	CONSISTENCY/ RELATIVE DENSITY	W (%)	POCKET PEN. (TSF)	REMARKS
0–1.5		Dark brown silty SAND with gravel, fine to medium grained, moist to wet, heavy organics. (SM) (TOPSOIL)	Loose			
1.5	1			34.7		
1.5–3		Red-brown silty SAND with gravel, fine to medium grained, wet to saturated, roots. (SM) (Weathered Till)	Loose			
3 (groundwater)						
3.5	2			19.9		
3–8		Gray silty SAND with gravel, fine to medium grained, wet to moist, mottled to 5 feet. (SM) (Unweathered Till)	Dense			
6	3			15.9		
8		Test pit terminated at approximately 8 feet. Moderate groundwater seepage observed at 3 feet.				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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