

February 28, 2014

JN 14055

Ohana Development, LLC
918 South Horton Street #1000
Seattle, Washington 98134

Attention: Travis Ameche

via email: travis.ameche@urbanstorage.com

Subject: **Transmittal Letter – Preliminary Geotechnical Engineering Study**
Proposed Self Storage Facility
927 Northeast Lincoln Road
Poulsbo, Washington

Dear Mr. Ameche:

We are pleased to present this geotechnical engineering report for the self storage facility to be constructed in Poulsbo, Washington. The scope of our services consisted of exploring site surface and subsurface conditions, and then developing this report to provide recommendations for general earthwork and design criteria for foundations, retaining walls, and temporary excavations. This work was authorized by your acceptance of our proposal, P-8860, dated February 12, 2014.

The attached report contains a discussion of the study and our recommendations. Please contact us if there are any questions regarding this report, or for further assistance during the design and construction phases of this project.

Respectfully submitted,

GEOTECH CONSULTANTS, INC.



Thor Christensen, P.E.
Senior Engineer

TRC/DRW: at

PRELIMINARY GEOTECHNICAL ENGINEERING STUDY
Proposed Self Storage Facility
927 Northeast Lincoln Road
Poulsbo, Washington

This report presents the findings and recommendations of our geotechnical engineering study for the site of the proposed self storage facility to be located in Poulsbo.

We have been provided with an undated topographic survey of the site by Pazooki & Associates Map. We have also been provided with preliminary site plans of the proposed development. Based on these plans, we understand that the development will consist of a three-story self storage building with a paved parking area on the south side of the building. The irregularly shaped building will have dimensions of up to about 180 feet in the north-south direction and 190 feet in the east-west direction. The building limits are constrained on the southeast because of a 125-foot building setback from an existing stream located at the southwestern corner of the site. The lowest level of the building will be close to the existing ground surface along the western edge of the building, but a cut of up to about 20 feet will be required at the eastern side of the building. We understand that a stormwater infiltration system is being considered for the project and may be located at the southeastern and northeastern sides of the site.

If the scope of the project changes from what we have described above, we should be provided with revised plans in order to determine if modifications to the recommendations and conclusions of this report are warranted.

SITE CONDITIONS

SURFACE

The Vicinity Map, Plate 1, illustrates the general location of the trapezoidal-shaped site. The site is bordered to the north by Northeast Lincoln Road, to the east by 10th Avenue Northeast, to the south by undeveloped wooded land, and to the west by a commercial property. The site has maximum dimensions of about 270 feet in east-west direction and about 450 feet in north-south direction.

The ground surface within the northern portion of the site where development is planned slopes gently to moderately down toward the west. The southern portion of the site has a steeper inclination, being more moderate. Across the northern portion of the site there is a change in elevation of about 25 feet across a distance of 280 feet. A stream crosses the southwest corner of the site and flows toward the west/northwest. Because the slope on the southern portion of the site continues down to the stream, its elevation change is in the range of 40 vertical feet across a distance of 200 feet.

An apparent basement excavation that is a few feet deep remains at the location of a former house near the northwest corner of the site. A collapsed shed is located about 50 feet south of the basement excavation. An apparent fill embankment up to about 5 feet high has been constructed adjacent to the eastern portion of the site and supports Lincoln Road.

The northern portion of the site is vegetated with brush, blackberry vines, and scattered mature evergreen and deciduous trees. The southern portion of the site is wooded with mature evergreen trees.

A commercial building is located as close as about 15 feet west of the western property line. Between this building and the western edge of the site, the ground surface slopes down to the adjacent building about 6 feet vertically. This slope appears to be the result of a cut made when the adjacent property was developed in our opinion.

SUBSURFACE

The subsurface conditions were explored by excavating six test pits at the approximate locations shown on the Site Exploration Plan, Plate 2. Our exploration program was based on the proposed construction, anticipated subsurface conditions and those encountered during exploration, and the scope of work outlined in our proposal.

Test pits were excavated on February 17, 2014 with an excavator with rubber-tracks. A geotechnical engineer from our staff observed the excavation process, logged the test pits, and obtained representative samples of the soil encountered. "Grab" samples of selected subsurface soil were collected from the backhoe bucket. The Test Pit Logs are attached to this report as Plates 3 through 5.

Soil Conditions

Test Pits 1, 2, 4, and 6, located in the northern portion of the proposed building, encountered about one foot of topsoil and fill over loose silty sand that extended to depths of about 2 to 3.5 feet. The silty sand was underlain by relatively coarse sand with varying amounts of gravel; it was initially medium-dense, but became dense with depth. This sand and gravel generally extended to the base of the test pits at depths of 8 to 8.5 feet. In Test Pit 6, excavated in the lower, northwestern portion of the site, some lenses of finer sand and silt were revealed in the coarse sand.

Test Pits 3 and 5 were located in the southern portion of the proposed building. Below the topsoil, these explorations found loose to medium-dense silty sand that extended to a depth of approximately 2.5 feet. The silty sand was underlain by mostly medium-dense sand (some with silt) to a depth of approximately 6 to 7 feet. Dense silty sand was revealed below these depths to the maximum explored depth of 9 feet.

Groundwater Conditions

No groundwater seepage was observed in the test pits, which were left open for only a short time period. Therefore, the lack of seepage levels on the logs may not accurately represent the absence of a static groundwater level. It should be noted that groundwater levels vary seasonally with rainfall and other factors. We anticipate that groundwater could be found between the near-surface sandy soil and the underlying low-permeability soil.

The stratification lines on the logs represent the approximate boundaries between soil types at the exploration locations. The actual transition between soil types may be gradual, and subsurface conditions can vary between exploration locations. The logs provide specific subsurface information only at the locations tested. The relative densities and moisture descriptions indicated on the test pit logs are interpretive descriptions based on the conditions observed during excavation.

Compaction of test pit backfill was not in the scope of our services. Loose soil will therefore be found in the area of the test pits. If this presents a problem, the backfill will need to be removed and replaced with structural fill during construction.

CONCLUSIONS AND RECOMMENDATIONS

GENERAL

THIS SECTION CONTAINS A SUMMARY OF OUR STUDY AND FINDINGS FOR THE PURPOSES OF A GENERAL OVERVIEW ONLY. MORE SPECIFIC RECOMMENDATIONS AND CONCLUSIONS ARE CONTAINED IN THE REMAINDER OF THIS REPORT. ANY PARTY RELYING ON THIS REPORT SHOULD READ THE ENTIRE DOCUMENT.

The test pits conducted for this study encountered medium-dense native soils at relatively shallow depths, with more dense sand/silty sand soils at depths of approximately 5 to 7 feet. These medium-dense soils are adequate to support the proposed structure that is founded on conventional footings. It appears that a significant portion of the structure will be excavated into the dense soils.

The significant consideration for the development from a geotechnical engineering perspective is the proposed excavations at the eastern side of the building. Because our study was preliminary and information of site soils was needed quickly, we used exploration equipment that could only dig to depths of about 9 feet. Excavations of up to 20 feet are proposed on the eastern side of the building. Our three explorations in that part of the site generally found sandy soils that should be temporarily excavated to an inclination no steeper than 1:1 (Horizontal:Vertical). However, more dense and compact silty sand was revealed in the most southeastern test pit at about 7 feet. The silty sand soil could possibly be excavated more steeply. We recommend that additional, deeper explorations be conducted on the eastern side of the building to evaluate subsurface conditions to the approximate elevation of the planned excavation. The deeper explorations would be able to determine if the more dense, silty sand soil is present more consistently and if groundwater is present above the base of the proposed excavation. If temporary excavations cannot be safely kept within the property, then shoring may be necessary.

We understand that infiltration is being proposed for the project, with the likely locations at the southeastern corner or the northwestern corner of the site. Most other areas are covered with the building or within the stream buffer. Some relatively clean sand soils were revealed at relatively shallow depths in these areas that have high permeability and are suitable for infiltration of stormwater. However, we believe that infiltration is not suitable from a geotechnical engineering standpoint at the southeastern area because the infiltrated water could flow to the building (the basement level of the building is quite deep in that area), and also not at the northwestern area because there is a declining slope and building just off the western edge of the property.

Based on our explorations, we expect that most of the volume of soil from the proposed building excavation area will consist of sand and gravel. An appropriate amount of this material should be stockpiled onsite for use as retaining wall backfill. Because substantial fills are not proposed for the project, most of the excavated soil will need to be exported. The sand and gravel soil is only slightly moisture sensitive and is therefore desirable. It may be possible to export the soil at low cost, or even to sell the soil, especially the sand/gravel soil with little silt.

The erosion control measures needed during the site development will depend heavily on the weather conditions that are encountered. We anticipate that a silt fence will be needed around the downslope sides of any cleared areas. Existing pavements, ground cover, and landscaping should be left in place wherever possible to minimize the amount of exposed soil. Rocked staging areas and construction access roads should be provided to reduce the amount of soil or mud carried off the property by trucks and equipment. Wherever possible, the access roads should follow the alignment of planned pavements. Trucks should not be allowed to drive off of the rock-covered areas. Cut slopes and soil stockpiles should be covered with plastic during wet weather. Following clearing or rough grading, it may be necessary to mulch or hydroseed bare areas that will not be immediately covered with landscaping or an impervious surface. On most construction projects it is necessary to periodically maintain or modify temporary erosion control measures to address specific site and weather conditions.

The drainage and/or waterproofing recommendations presented in this report are intended only to prevent active seepage from flowing through concrete walls or slabs. Even in the absence of active seepage into and beneath structures, water vapor can migrate through walls, slabs, and floors from the surrounding soil, and can even be transmitted from slabs and foundation walls due to the concrete curing process. Water vapor also results from occupant uses, such as cooking and bathing. Excessive water vapor trapped within structures can result in a variety of undesirable conditions, including, but not limited to, moisture problems with flooring systems, excessively moist air within occupied areas, and the growth of molds, fungi, and other biological organisms that may be harmful to the health of the occupants. The designer or architect must consider the potential vapor sources and likely occupant uses, and provide sufficient ventilation, either passive or mechanical, to prevent a build up of excessive water vapor within the planned structure.

Geotech Consultants, Inc. should be allowed to review the final development plans to verify that the recommendations presented in this report are adequately addressed in the design. Such a plan review would be additional work beyond the current scope of work for this study, and it may include revisions to our recommendations to accommodate site, development, and geotechnical constraints that become more evident during the review process.

We recommend including this report, in its entirety, in the project contract documents. This report should also be provided to any future property owners so they will be aware of our findings and recommendations.

SEISMIC CONSIDERATIONS

In accordance with the International Building Code (IBC), the site soil profile within 100 feet of the ground surface is best represented by Site Class Type D (Stiff Site Class). As noted in the USGS website, the mapped spectral acceleration value for a 0.2 second (S_s) and 1.0 second period (S_1) equals 1.24g and 0.44g, respectively.

The site soils are have a very low potential for seismic liquefaction because of their dense nature and/or the absence of near-surface groundwater.

CONVENTIONAL FOUNDATIONS

The proposed structure can be supported on conventional continuous and spread footings bearing on undisturbed, medium-dense or denser, native sand soils. Some compaction of the sand at the subgrade level with vibratory equipment, especially on the western side of the building, may be needed. We recommend that continuous and individual spread footings have minimum widths of 16 and 24 inches, respectively. Exterior footings should also be bottomed at least 18 inches below the lowest adjacent finish ground surface for protection against frost and erosion. Local building codes should be reviewed to determine if different footing widths or embedment depths are required. Footing subgrades must be cleaned of loose or disturbed soil prior to pouring concrete. Depending upon site and equipment constraints, this may require removing the disturbed soil by hand.

An allowable bearing pressure of 3,000 pounds per square foot (psf) is appropriate for footings supported on competent, medium-dense or denser native soil. A one-third increase in this design bearing pressure may be used when considering short-term wind or seismic loads. For the above design criteria, it is anticipated that the total post-construction settlement of footings founded on competent native soil will be up to about one-inch, with differential settlements on the order of 3/4-inch in a distance of 50 feet along a continuous footing with a uniform load.

Lateral loads due to wind or seismic forces may be resisted by friction between the foundation and the bearing soil, or by passive earth pressure acting on the vertical, embedded portions of the foundation. For the latter condition, the foundation must be either poured directly against relatively level, undisturbed soil or be surrounded by level, well-compacted fill. We recommend using the following ultimate values for the foundation's resistance to lateral loading:

PARAMETER	ULTIMATE VALUE
Coefficient of Friction	0.45
Passive Earth Pressure	300 pcf

Where: (i) pcf is pounds per cubic foot, and (ii) passive earth pressure is computed using the equivalent fluid density.

If the ground in front of a foundation is loose or sloping, the passive earth pressure given above will not be appropriate. We recommend maintaining a safety factor of at least 1.5 for the foundation's resistance to lateral loading, when using the above ultimate values.

FOUNDATION AND RETAINING WALLS

Retaining walls backfilled on only one side should be designed to resist the lateral earth pressures imposed by the soil they retain. The following recommended parameters are for walls that restrain level backfill:

PARAMETER	VALUE
Active Earth Pressure *	35 pcf
Passive Earth Pressure	300 pcf
Coefficient of Friction	0.45
Soil Unit Weight	130 pcf

Where: (i) pcf is pounds per cubic foot, and (ii) active and passive earth pressures are computed using the equivalent fluid pressures.

* For a restrained wall that cannot deflect at least 0.002 times its height, a uniform lateral pressure equal to 10 psf times the height of the wall should be added to the above active equivalent fluid pressure.

The design values given above do not include the effects of any hydrostatic pressures behind the walls and assume that no surcharges, such as those caused by slopes, vehicles, or adjacent foundations will be exerted on the walls. If these conditions exist, those pressures should be added to the above lateral soil pressures. Where sloping backfill is desired behind the walls, we will need to be given the wall dimensions and the slope of the backfill in order to provide the appropriate design earth pressures. The surcharge due to traffic loads behind a wall can typically be accounted for by adding a uniform pressure equal to 2 feet multiplied by the above active fluid density. Heavy construction equipment should not be operated behind retaining and foundation walls within a distance equal to the height of a wall, unless the walls are designed for the additional lateral pressures resulting from the equipment.

The values given above are to be used to design only permanent foundation and retaining walls that are to be backfilled, such as conventional walls constructed of reinforced concrete or masonry. It is not appropriate to use the above earth pressures and soil unit weight to back-calculate soil strength parameters for design of other types of retaining walls, such as soldier pile, reinforced earth, modular or soil nail walls. We can assist with design of these types of walls, if desired. The passive pressure given is appropriate only for a shear key poured directly against undisturbed native soil, or for the depth of level, well-compacted fill placed in front of a retaining or foundation wall. The values for friction and passive resistance are ultimate values and do not include a safety factor. We recommend a safety factor of at least 1.5 for overturning and sliding, when using the above values to design the walls. Restrained wall soil parameters should be utilized for a distance of 1.5 times the wall height from corners or bends in the walls. This is intended to reduce the amount of cracking that can occur where a wall is restrained by a corner.

Wall Pressures Due to Seismic Forces

The surcharge wall loads that could be imposed by the design earthquake can be modeled by adding a uniform lateral pressure to the above-recommended active pressure. The recommended surcharge pressure is $8H$ pounds per square foot (psf), where H is the

design retention height of the wall. Using this increased pressure, the safety factor against sliding and overturning can be reduced to 1.2 for the seismic analysis.

Retaining Wall Backfill and Waterproofing

Backfill placed behind retaining or foundation walls should be coarse, free-draining structural fill containing no organics. This backfill should contain no more than 5 percent silt or clay particles and have no gravel greater than 4 inches in diameter. The percentage of particles passing the No. 4 sieve should be between 25 and 70 percent. If the native sand is used as backfill, a drainage composite similar to Miradrain 6000 should be placed against the backfilled retaining walls. The later section entitled **Drainage Considerations** should also be reviewed for recommendations related to subsurface drainage behind foundation and retaining walls.

The purpose of these backfill requirements is to ensure that the design criteria for a retaining wall are not exceeded because of a build-up of hydrostatic pressure behind the wall. Also, subsurface drainage systems are not intended to handle large volumes of water from surface runoff. The top 12 to 18 inches of the backfill should consist of a compacted, relatively impermeable soil or topsoil, or the surface should be paved. The ground surface must also slope away from backfilled walls to reduce the potential for surface water to percolate into the backfill. Water percolating through pervious surfaces (pavers, gravel, permeable pavement, ect.) must also be prevented from flowing toward walls or into the backfill zone. The compacted subgrade below pervious surfaces and any associated drainage layer should therefore be sloped away. Alternatively, a membrane and subsurface collection system could be provided below a pervious surface.

It is critical that the wall backfill be placed in lifts and be properly compacted, in order for the above-recommended design earth pressures to be appropriate. The wall design criteria assume that the backfill will be well-compacted in lifts no thicker than 12 inches. The compaction of backfill near the walls should be accomplished with hand-operated equipment to prevent the walls from being overloaded by the higher soil forces that occur during compaction. The section entitled **General Earthwork and Structural Fill** contains additional recommendations regarding the placement and compaction of structural fill behind retaining and foundation walls.

The above recommendations are not intended to waterproof below-grade walls, or to prevent the formation of mold, mildew or fungi in interior spaces. Over time, the performance of subsurface drainage systems can degrade, subsurface groundwater flow patterns can change, and utilities can break or develop leaks. Therefore, waterproofing should be provided where future seepage through the walls is not acceptable. This typically includes limiting cold-joints and wall penetrations, and using bentonite panels or membranes on the outside of the walls. There are a variety of different waterproofing materials and systems, which should be installed by an experienced contractor familiar with the anticipated construction and subsurface conditions. Applying a thin coat of asphalt emulsion to the outside face of a wall is not considered waterproofing, and will only help to reduce moisture generated from water vapor or capillary action from seeping through the concrete. As with any project, adequate ventilation of basement and crawl space areas is important to prevent a build up of water vapor that is commonly transmitted through concrete walls from the surrounding soil, even when seepage is not present. This is appropriate even when waterproofing is applied to the outside of foundation and retaining walls. We recommend that you contact an experienced envelope consultant if detailed

recommendations or specifications related to waterproofing design, or minimizing the potential for infestations of mold and mildew are desired.

The **General**, **Slabs-On-Grade**, and **Drainage Considerations** sections should be reviewed for additional recommendations related to the control of groundwater and excess water vapor for the anticipated construction.

SLABS-ON-GRADE

The building floors can be constructed as slabs-on-grade atop competent native soil, or on structural fill. The subgrade soil must be in a firm, non-yielding condition at the time of slab construction or underslab fill placement. Any soft areas encountered should be excavated and replaced with select, imported structural fill.

Even where the exposed soils appear dry, water vapor will tend to naturally migrate upward through the soil to the new constructed space above it. This can affect moisture-sensitive flooring, cause imperfections or damage to the slab, or simply allow excessive water vapor into the space above the slab. All interior slabs-on-grade should be underlain by a capillary break drainage layer consisting of a minimum 4-inch thickness of clean gravel or crushed rock that has a fines content (percent passing the No. 200 sieve) of less than 3 percent and a sand content (percent passing the No. 4 sieve) of no more than 10 percent. Pea gravel or crushed rock are typically used for this layer.

As noted by the American Concrete Institute (ACI) in the *Guides for Concrete Floor and Slab Structures*, proper moisture protection is desirable immediately below any on-grade slab that will be covered by tile, wood, carpet, impermeable floor coverings, or any moisture-sensitive equipment or products. ACI also notes that vapor *retarders* such as 6-mil plastic sheeting have been used in the past, but are now recommending a minimum 10-mil thickness for better durability and long term performance. A vapor retarder is defined as a material with a permeance of less than 0.3 perms, as determined by ASTM E 96. It is possible that concrete admixtures may meet this specification, although the manufacturers of the admixtures should be consulted. Where vapor retarders are used under slabs, their edges should overlap by at least 6 inches and be sealed with adhesive tape. The sheeting should extend to the foundation walls for maximum vapor protection. If no potential for vapor passage through the slab is desired, a vapor *barrier* should be used. A vapor barrier, as defined by ACI, is a product with a water transmission rate of 0.01 perms when tested in accordance with ASTM E 96. Reinforced membranes having sealed overlaps can meet this requirement.

In the recent past, ACI (Section 4.1.5) recommended that a minimum of 4 inches of well-graded compactable granular material, such as a 5/8-inch-minus crushed rock pavement base, be placed over the vapor retarder or barrier for their protection, and as a "blotter" to aid in the curing of the concrete slab. Sand was not recommended by ACI for this purpose. However, the use of material over the vapor retarder is controversial as noted in current ACI literature because of the potential that the protection/blotter material can become wet between the time of its placement and the installation of the slab. If the material is wet prior to slab placement, which is always possible in the Puget Sound area, it could cause vapor transmission to occur up through the slab in the future, essentially destroying the purpose of the vapor barrier/retarder. Therefore, if there is a potential that the protection/blotter material will become wet before the slab is installed, ACI now recommends that no protection/blotter material be used. However, ACI then recommends that, because there is a potential for slab curl due to the loss of the blotter material, joint spacing in the

slab be reduced, a low shrinkage concrete mixture be used, and "other measures" (steel reinforcing, etc.) be used. ASTM E-1643-98 "Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs" generally agrees with the recent ACI literature.

We recommend that the contractor, project materials engineer, and owner discuss these issues and review recent ACI literature and ASTM E-1643 for installation guidelines and guidance on use of the protection/blotter material.

The **General, Permanent Foundation and Retaining Walls**, and **Drainage Considerations** sections should be reviewed for additional recommendations related to control of groundwater and excess water vapor for the anticipated construction.

EXCAVATIONS AND SLOPES

Excavation slopes should not exceed the limits specified in local, state, and national government safety regulations. Temporary cuts to a depth of about 4 feet may be attempted vertically in unsaturated soil, if there are no indications of slope instability. However, vertical cuts should not be made near property boundaries, or existing utilities and structures. Based upon Washington Administrative Code (WAC) 296, Part N, the loose to dense sand soil at the subject site would generally be classified as Type B. Therefore, temporary cut slopes greater than 4 feet in height should not be excavated at an inclination steeper than 1:1 (Horizontal:Vertical), extending continuously between the top and bottom of a cut. Dense silty sand soil may be excavated steeper depending on results of future explorations on the eastern side of the site.

The above-recommended temporary slope inclination is based on the conditions exposed in our explorations, and on what has been successful at other sites with similar soil conditions. It is possible that variations in soil and groundwater conditions will require modifications to the inclination at which temporary slopes can stand. Temporary cuts are those that will remain unsupported for a relatively short duration to allow for the construction of foundations, retaining walls, or utilities. Temporary cut slopes should be protected with plastic sheeting during wet weather. It is also important that surface runoff be directed away from the top of temporary slope cuts. Cut slopes should also be backfilled or retained as soon as possible to reduce the potential for instability. Please note that sand or loose soil can cave suddenly and without warning. Excavation, foundation, and utility contractors should be made especially aware of this potential danger. These recommendations may need to be modified if the area near the potential cuts has been disturbed in the past by utility installation, or if settlement-sensitive utilities are located nearby.

All permanent cuts into native soil should be inclined no steeper than 2:1 (H:V). Compacted fill slopes should not be constructed with an inclination steeper than 2:1 (H:V). To reduce the potential for shallow sloughing, fill must be compacted to the face of these slopes. This can be accomplished by overbuilding the compacted fill and then trimming it back to its final inclination. Adequate compaction of the slope face is important for long-term stability and is necessary to prevent excessive settlement of patios, slabs, foundations, or other improvements that may be placed near the edge of the slope.

Water should not be allowed to flow uncontrolled over the top of any temporary or permanent slope. All permanently exposed slopes should be seeded with an appropriate species of vegetation to reduce erosion and improve the stability of the surficial layer of soil.

DRAINAGE CONSIDERATIONS

Footing drains should be used where (1) crawl spaces or basements will be below a structure, (2) a slab is below the outside grade, or (3) the outside grade does not slope downward from a building. Drains should also be placed at the base of all earth-retaining walls. These drains should be surrounded by at least 6 inches of 1-inch-minus, washed rock that is encircled with non-woven, geotextile filter fabric (Mirafi 140N, Supac 4NP, or similar material). At its highest point, a perforated pipe invert should be at least 6 inches below the bottom of a slab floor or the level of a crawl space. The discharge pipe for subsurface drains should be sloped for flow to the outlet point. Roof and surface water drains must not discharge into the foundation drain system. A typical drain detail is attached to this report as Plate 6. For the best long-term performance, perforated PVC pipe is recommended for all subsurface drains.

If the structure includes an elevator, it may be necessary to provide special drainage or waterproofing measures for the elevator pit. If no seepage into the elevator pit is acceptable, it will be necessary to provide a footing drain and free-draining wall backfill, and the walls should be waterproofed. If the footing drain will be too low to connect to the storm drainage system, then it will likely be necessary to install a pumped sump to discharge the collected water. Alternatively, the elevator pit could be designed to be entirely waterproof; this would include designing the pit structure to resist hydrostatic uplift pressures.

As a minimum, a vapor retarder, as defined in the **Slabs-On-Grade** section, should be provided in any crawl space area to limit the transmission of water vapor from the underlying soils. Crawl space grades are sometimes left near the elevation of the bottom of the footings. As a result, an outlet drain is recommended for all crawl spaces to prevent an accumulation of any water that may bypass the footing drains. Providing even a few inches of free draining gravel underneath the vapor retarder limits the potential for seepage to build up on top of the vapor retarder.

No groundwater was observed during our field work. If seepage is encountered in an excavation, it should be drained from the site by directing it through drainage ditches, perforated pipe, or French drains, or by pumping it from sumps interconnected by shallow connector trenches at the bottom of the excavation.

The excavation and site should be graded so that surface water is directed off the site and away from the tops of slopes. Water should not be allowed to stand in any area where foundations, slabs, or pavements are to be constructed. Final site grading in areas adjacent to a building should slope away at least 2 percent, except where the area is paved. Surface drains should be provided where necessary to prevent ponding of water behind foundation or retaining walls. A discussion of grading and drainage related to pervious surfaces near walls and structures is contained in the **Foundation and Retaining Walls** section. Additionally, a drainage swale should be provided upslope of the building to intercept surface run-off and direct it into the storm drains. Water from roof, storm water, and foundation drains should not be discharged onto slopes; it should be tightlined to a suitable outfall located away from any slopes.

GENERAL EARTHWORK AND STRUCTURAL FILL

All building and pavement areas should be stripped of surface vegetation, topsoil, organic soil, and other deleterious material. It is important that existing foundations be removed before site development. The stripped or removed materials should not be mixed with any materials to be used as structural fill, but they could be used in non-structural areas, such as landscape beds.

Structural fill is defined as any fill, including utility backfill, placed under, or close to, a building, behind permanent retaining or foundation walls, or in other areas where the underlying soil needs to support loads. All structural fill should be placed in horizontal lifts with a moisture content at, or near, the optimum moisture content. The optimum moisture content is that moisture content that results in the greatest compacted dry density. The moisture content of fill is very important and must be closely controlled during the filling and compaction process.

Fills placed on sloping ground should be keyed into the firm native soils. This is typically accomplished by placing and compacting the structural fill on level benches that are cut into the competent soils. The allowable thickness of the fill lift will depend on the material type selected, the compaction equipment used, and the number of passes made to compact the lift. The loose lift thickness should not exceed 12 inches. We recommend testing the fill as it is placed. If the fill is not sufficiently compacted, it can be recompacted before another lift is placed. This eliminates the need to remove the fill to achieve the required compaction. The following table presents recommended relative compactions for structural fill:

LOCATION OF FILL PLACEMENT	MINIMUM RELATIVE COMPACTION
Beneath footings, slabs or walkways	95%
Filled slopes and behind retaining walls	90%
Beneath pavements	95% for upper 12 inches of subgrade; 90% below that level

Where: Minimum Relative Compaction is the ratio, expressed in percentages, of the compacted dry density to the maximum dry density, as determined in accordance with ASTM Test Designation D 1557-91 (Modified Proctor).

Use of On-Site Soil

The on-site sand soil that contains little silt could likely be used as structural fill throughout much of the year provided it is not excessively wet or dry and vibratory equipment is used for compaction. The more silty soil on the site is moisture sensitive. If grading activities take place during wet weather, or when the on-site soil of the site is wet, site preparation costs may be higher because of delays due to rain and the potential need for less moisture-sensitive soil, which could be sourced from the upper portion of the site. Grading operations in the lower portion of the site will be difficult during wet weather, or when the moisture content of this soil exceeds the optimum moisture content.

Moisture-sensitive soil may also be susceptible to excessive softening and "pumping" from construction equipment, or even foot traffic, when the moisture content is greater than the optimum moisture content. It may be beneficial to protect subgrades with a layer of sand or crushed rock to limit disturbance from traffic.

LIMITATIONS

The conclusions and recommendations contained in this report are based on site conditions as they existed at the time of our exploration and assume that the soil and groundwater conditions encountered in the test pits are representative of subsurface conditions on the site. If the subsurface conditions encountered during construction are significantly different from those observed in our explorations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. Unanticipated conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking samples in test pits. Subsurface conditions can also vary between exploration locations. Such unexpected conditions frequently require making additional expenditures to attain a properly constructed project. It is recommended that the owner consider providing a contingency fund to accommodate such potential extra costs and risks. This is a standard recommendation for all projects.

This report has been prepared for the exclusive use of Ohana Development, LLC and its representatives for specific application to this project and site. Our conclusions and recommendations are professional opinions derived in accordance with our understanding of current local standards of practice, and within the scope of our services. No warranty is expressed or implied. The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design. Our services also do not include assessing or minimizing the potential for biological hazards, such as mold, bacteria, mildew and fungi in either the existing or proposed site development.

ADDITIONAL SERVICES

In addition to reviewing the final plans, Geotech Consultants, Inc. should be retained to provide geotechnical consultation, testing, and observation services during construction. This is to confirm that subsurface conditions are consistent with those indicated by our exploration, to evaluate whether earthwork and foundation construction activities comply with the general intent of the recommendations presented in this report, and to provide suggestions for design changes in the event subsurface conditions differ from those anticipated prior to the start of construction. However, our work would not include the supervision or direction of the actual work of the contractor and its employees or agents. Also, job and site safety, and dimensional measurements, will be the responsibility of the contractor.

During the construction phase, we will provide geotechnical observation and testing services when requested by you or your representatives. Please be aware that we can only document site work we actually observe. It is still the responsibility of your contractor or on-site construction team to verify that our recommendations are being followed, whether we are present at the site or not.

The following plates are attached to complete this report:

Plate 1	Vicinity Map
Plate 2	Site Exploration Plan
Plates 3 - 5	Test Pit Logs
Plate 6	Typical Footing Drain Detail

We appreciate the opportunity to be of service on this project. Please contact us if you have any questions, or if we can be of further assistance.

Respectfully submitted,

GEOTECH CONSULTANTS, INC.



Thor Christensen, P.E.
Senior Engineer



2/28/14

D. Robert Ward, P.E.
Principal

TRC/DRW:at

NORTH



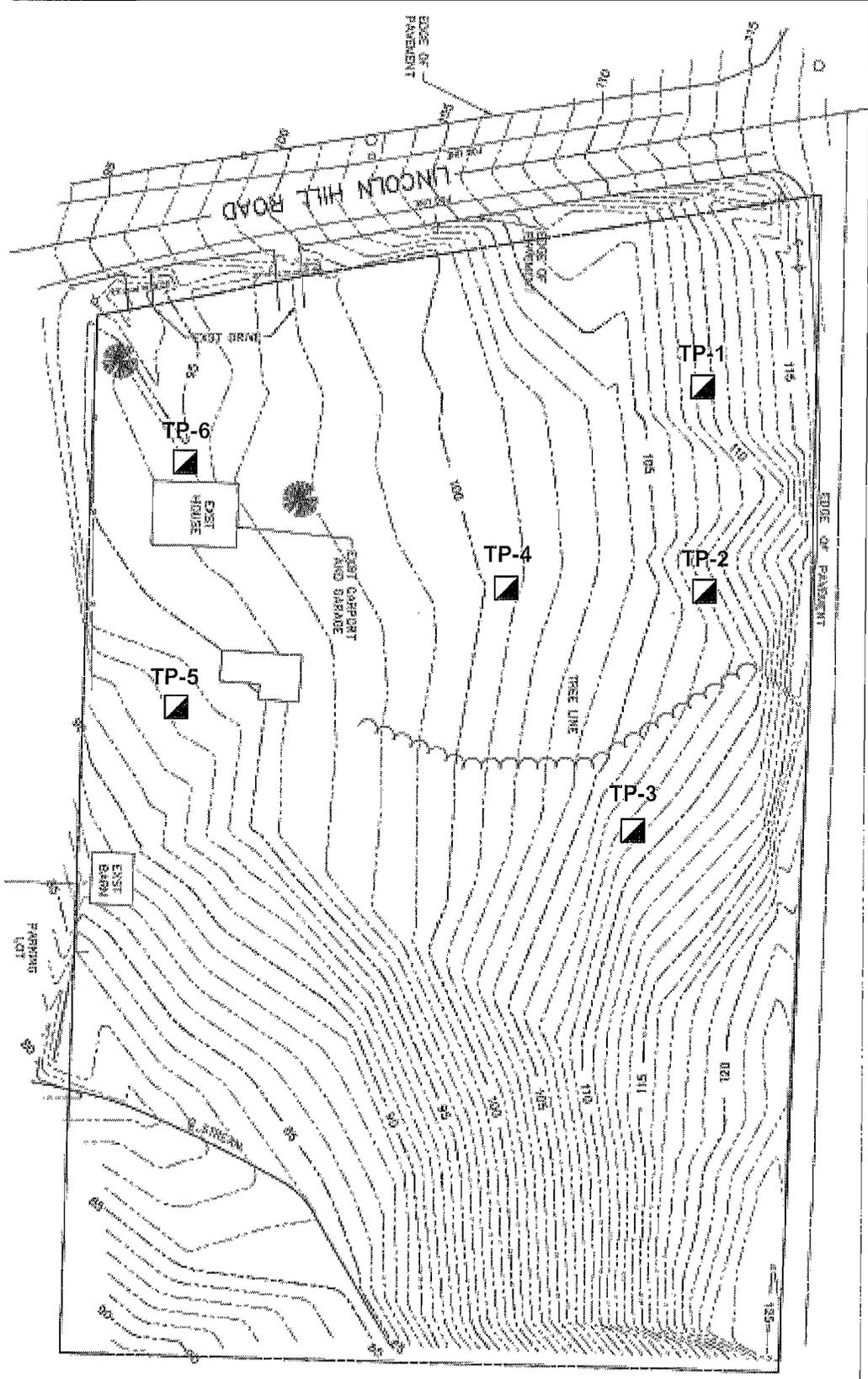
(Source: Microsoft Streets and Trips, 2004)



VICINITY MAP
 927 Northeast Lincoln Road
 Poulsbo, Washington

Job No: 14055	Date: Feb. 2014	Plate: 1
------------------	--------------------	-------------

NORTH



Legend:

▣ Test pit location



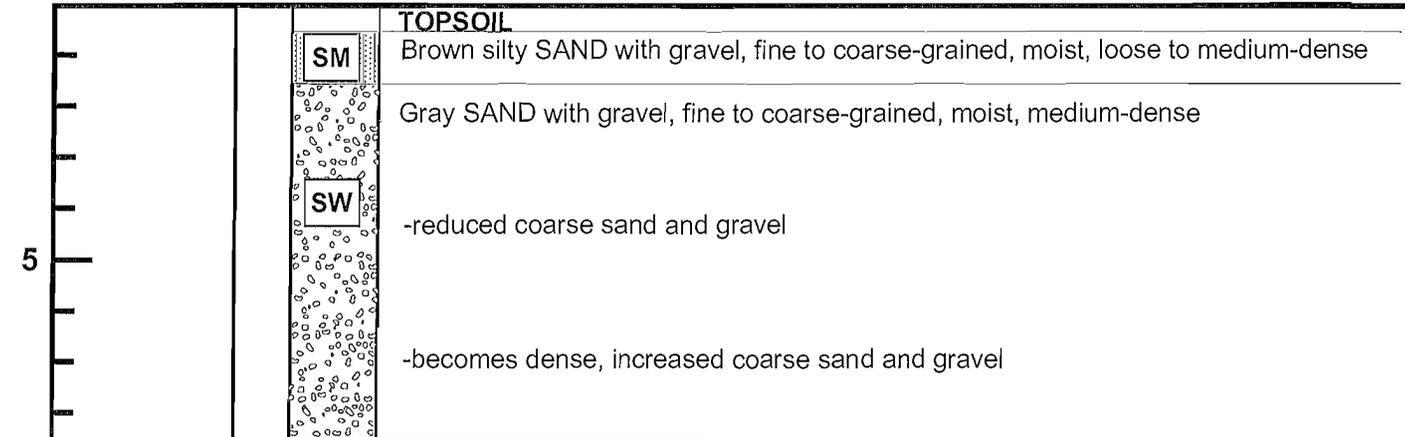
SITE EXPLORATION PLAN
927 Northeast Lincoln Road
Poulsbo, Washington

Job No: 14055	Date: Feb. 2014	No Scale	Plate: 2
------------------	--------------------	----------	-------------

TEST PIT 1

Depth (ft.)
Moisture
Content (%)
Water
Table
USCS

Description

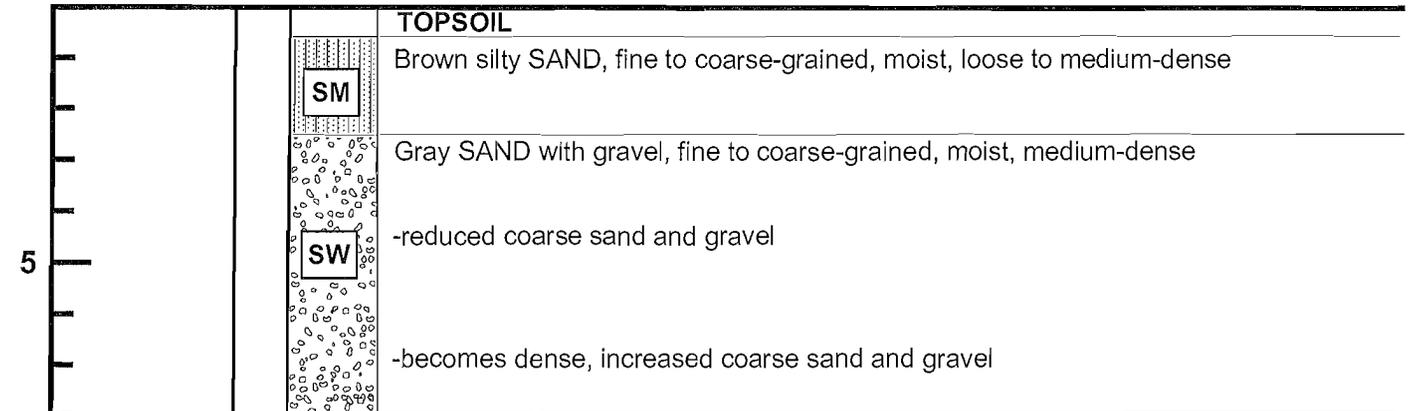


- * Test Pit terminated at 8.5 feet on February 17, 2014.
- * No groundwater seepage was observed during excavation.
- * No caving observed during excavation.

TEST PIT 2

Depth (ft.)
Moisture
Content (%)
Water
Table
USCS

Description



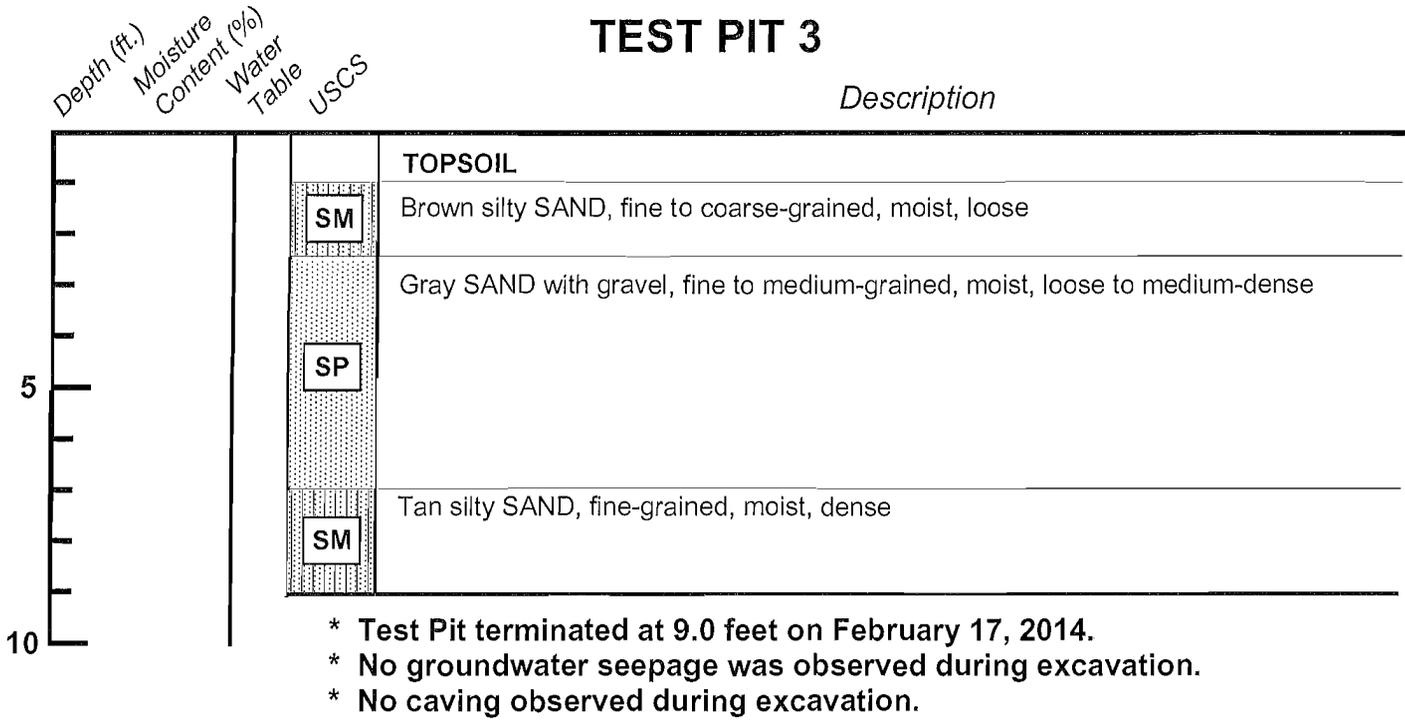
- * Test Pit terminated at 8.0 feet on February 17, 2014.
- * No groundwater seepage was observed during excavation.
- * No caving observed during excavation.



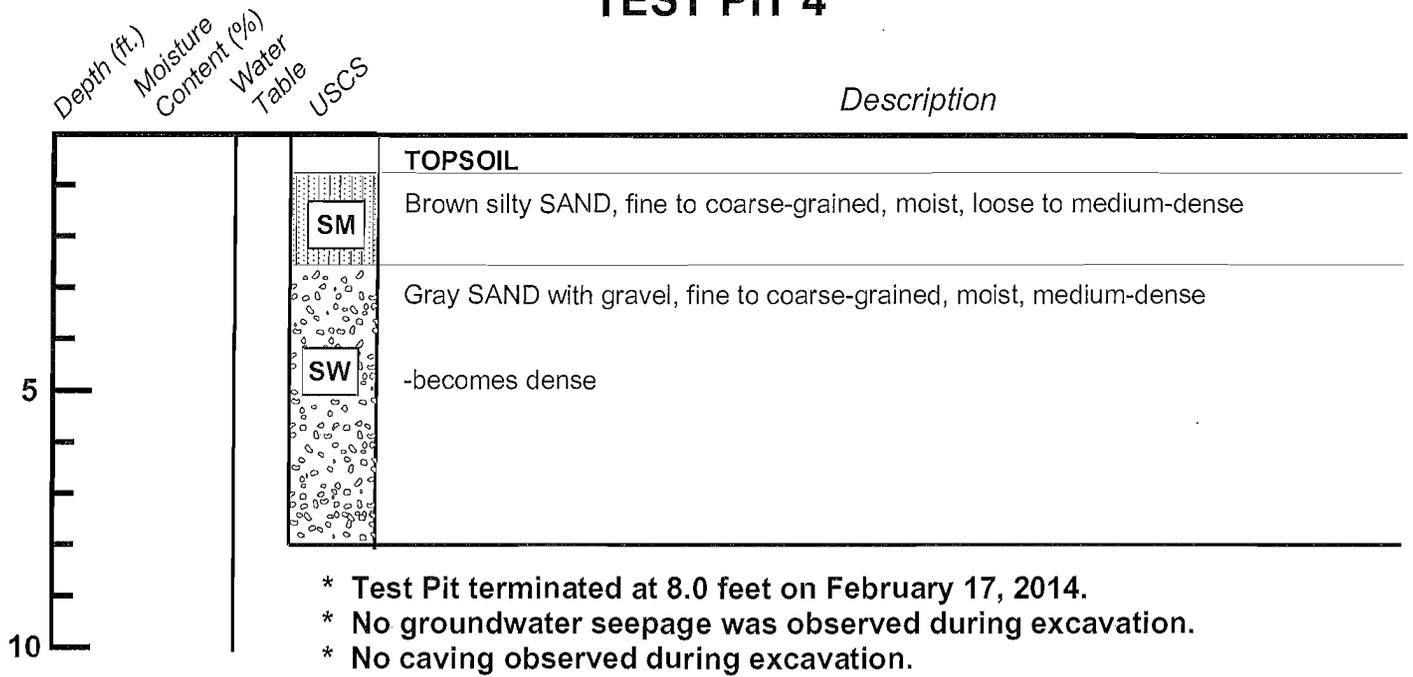
TEST PIT LOG
927 Northeast Lincoln Road
Poulsbo, Washington

Job 14055	Date: Feb. 2014	Logged by: TRC	Plate: 3
---------------------	---------------------------	--------------------------	--------------------

TEST PIT 3



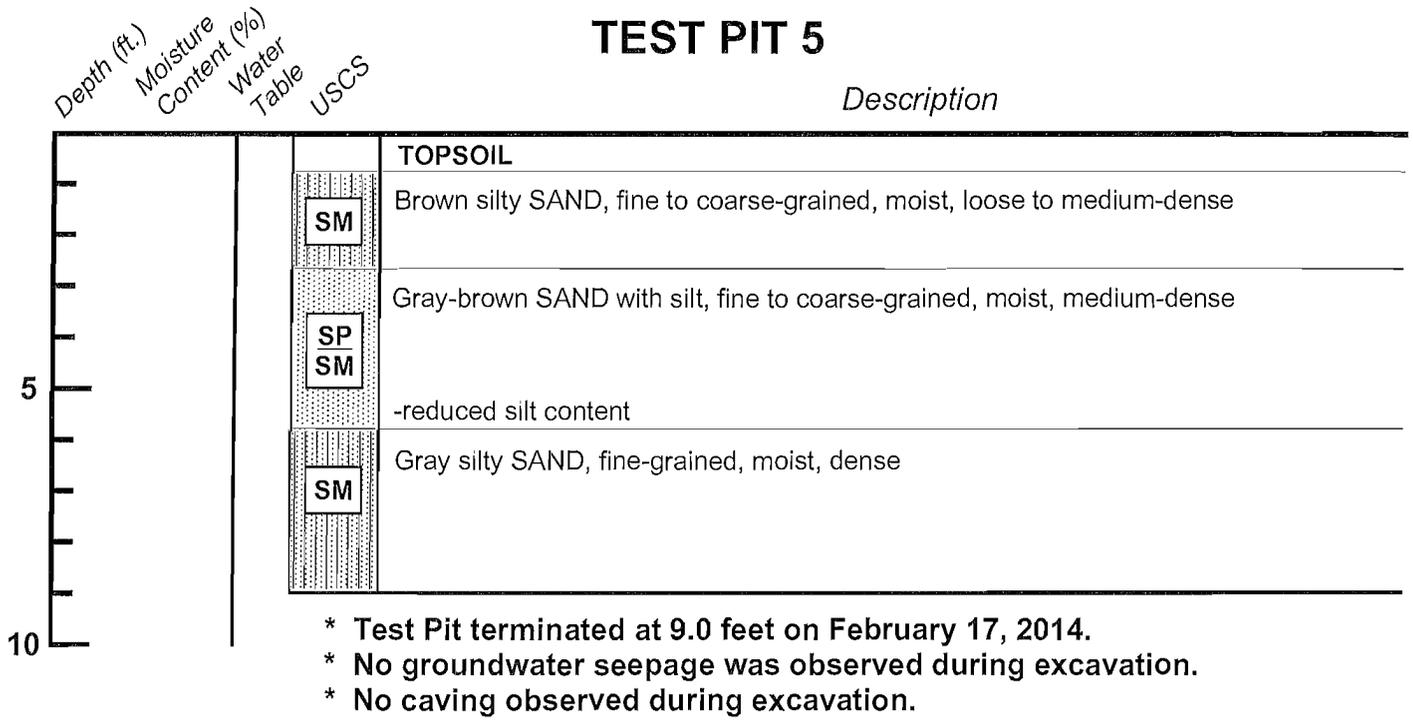
TEST PIT 4



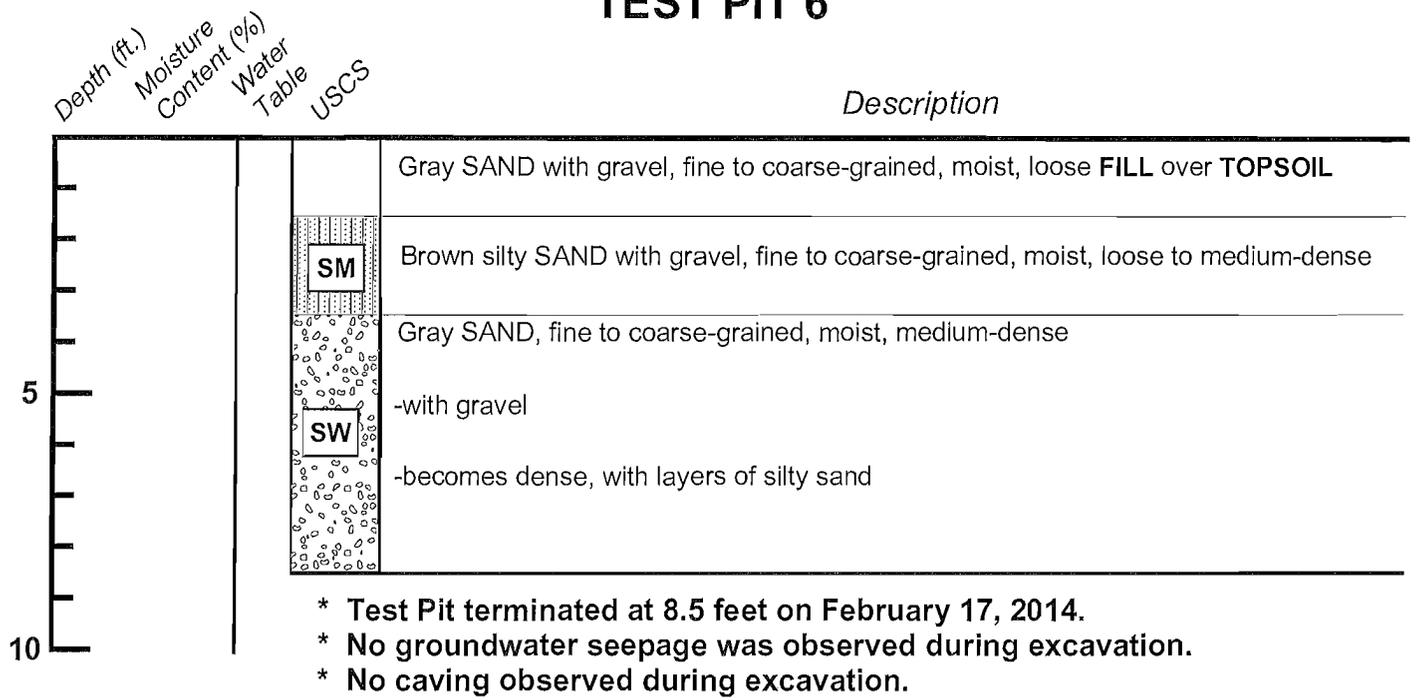
TEST PIT LOG
 927 Northeast Lincoln Road
 Poulsbo, Washington

Job	Date:	Logged by:	Plate:
14055	Feb. 2014	TRC	4

TEST PIT 5



TEST PIT 6

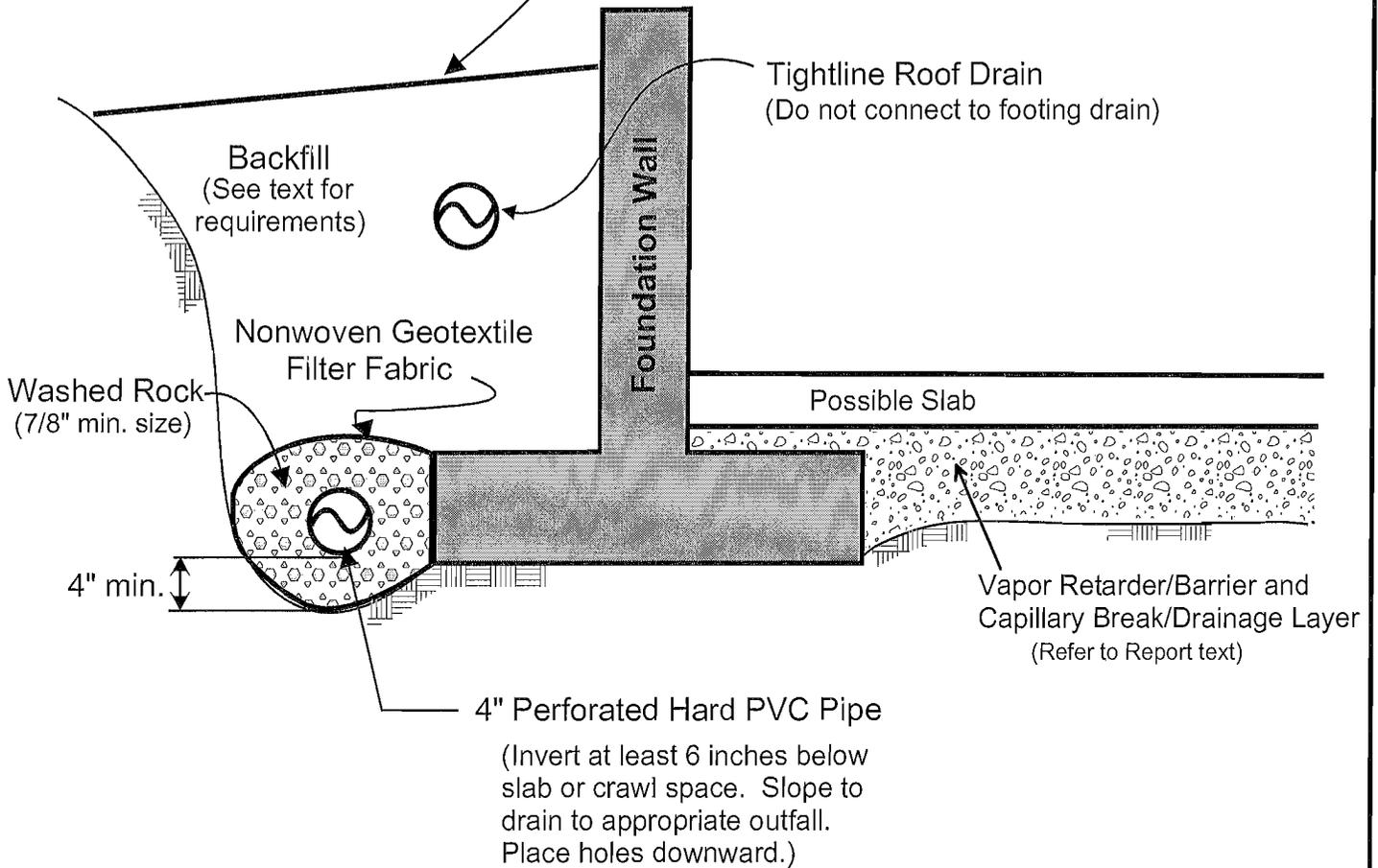


TEST PIT LOG

927 Northeast Lincoln Road
Poulsbo, Washington

Job	Date:	Logged by:	Plate:
14055	Feb. 2014	TRC	5

Slope backfill away from foundation. Provide surface drains where necessary.



NOTES:

- (1) In crawl spaces, provide an outlet drain to prevent buildup of water that bypasses the perimeter footing drains.
- (2) Refer to report text for additional drainage, waterproofing, and slab considerations.



FOOTING DRAIN DETAIL
927 Northeast Lincoln Road
Poulsbo, Washington

Job No: 14055	Date: Feb. 2014	Plate: 6
------------------	--------------------	-------------