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March 18, 2020

JN 20046

Seascape Homes LLC
PO Box 40568
Bellevue, Washington 98015

Attention: Jon Tellefson
via email: jmt1231@gmail.com

Subject: **Transmittal Letter – Geotechnical Engineering Study**
Proposed Four Lot Short-Plat
5224 Forest Avenue Southeast
Mercer Island, Washington

Dear Mr. Tellefson:

Attached to this transmittal letter is our geotechnical engineering report for the proposed four lot short plat to be constructed in Mercer Island, 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 considerations for foundations, retaining walls, subsurface drainage, and temporary excavations. This work was authorized by your acceptance of our proposal dated February 4, 2020.

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.

James H. Strange, P.E.
Associate

MKM/JHS:kg

GEOTECHNICAL ENGINEERING STUDY
Proposed Four Lot Short-Plat
5224 Forest Avenue Southeast
Mercer Island, Washington

This report presents the findings and recommendations of our geotechnical engineering study for the site of the proposed four lot short plat to be located in Mercer Island.

We were provided with preliminary site and utility plans. ADH Engineering developed the civil plans, which are dated April 20, 2006 and Sturman Architects developed the preliminary lot layout plan, which is dated January 31, 2020. Based on these plans, we understand that the existing house and detached garage on the property will be demolished. The site will be split into four new lots, each containing a new, large single-family residence. No plans related to the residence layout and construction have been developed at this time, but we can anticipate that the residences will be at least two stories in height and will likely contain basements. Attached garages are shown on the preliminary lot layouts, and covered patios and decks will likely extend off the edges of the residences. Four separate new driveways will extend off Forest Avenue Southeast into each lot and Forest Avenue Southeast is shown to widen to the east to allow for enough width for two lanes of traffic. At this time, new rockeries are shown to facilitate some of the finish grading of the lots, but we do not anticipate that lot grading will be extensive at this time. Excavations for the basements will be relatively extensive but due to relatively large setbacks should be able to be maintained within the property boundaries. We anticipate that the new residences will be constructed to code minimums regarding lot line setbacks and will maximize square footage to allowable lot percentages.

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 site in Mercer Island. The irregular shaped site has approximate dimensions of 350 feet in the north-south direction, and 267 to 314 feet in the east-west direction. The site is bordered to the north by a large single-family parcel, to the east and south by other single-family parcels, and to the west by Forest Avenue Southeast. The adjacent parcels all contain single family residences of varying construction that are not located in close proximity to the shared property lines.

The site is currently developed with a one-story house located south of the center of the lot. A detached garage is located to the southeast of the house, and a gravel roundabout driveway provides access to the house and garage. In addition to the existing residential development located on the property, some preliminary earthwork and utility work related to the short plat appear to have been completed. New driveway entrance cuts have been made off Forest Avenue Southeast, and gravel has been placed in the driveway aprons. New side sewer and water service stubs have been brought into the lots, and currently are stubbed within the property line. A storm detention pipe has been installed beneath the northern tract road, and a new outfall has been installed extending downslope to the east to a gabion energy dissipater. It does not appear that any extensive individual lot grading has occurred prior to completion of this study.

The grade across the site bounds drops moderately from south to north and east, with a total elevation change of 64 feet across the site bounds. Much of this elevation change occurs both on a moderately sloped area to the north of the existing yard area, and past the northwestern edge of proposed Lot 4, where a slope leads down to the previously installed energy dissipator.

While the grade within the proposed development areas is generally sloped moderately, the site is located on a ridgeline between two distinct topographic features. To the east of the lots, the grade extends downward at a moderate rate before the slope terminates at the location of a small stream. This stream has been eroding the streambanks over time, and tall oversteepened soil faces were observed during our time onsite. This stream continues past the northeastern corner of Lot 4. The grade slopes back up past the east side of the creek and continues past the eastern property lines up into the neighboring lots.

To the west of the lots, the grade drops 8 to 10 feet down to the Forest Avenue Southeast right-of-way. This slope appears to have been man-made and resulted from the construction of the Forest Avenue Southeast right-of-way. The grade carries out relatively flat over the narrow street, before dropping steeply down into a tall ravine that has a height of 28 to 44 feet. Much of this ravine is sloped in excess of 40 percent. A stream is present in the base of this stream and continues downslope to the north.

The subject site is mapped within a potential landslide hazard area according to the City of Mercer Island Geologic Hazard Map. The map indicates that slopes of 15 percent or more are located on the site, and slopes greater than 40 percent are in the direct vicinity of the site. This landslide hazard mapping extends across the northern half of the site. The site is also mapped as an erosion hazard area. The Mercer Island Landslide Hazard Map lists these hazard areas as "Areas of moderate to severe stream incision/erosion that may result in unstable slopes." While onsite, we were able to observe these sloped areas, and noted that several of the mature trees were bowed in their trunks, indicating that some shallow soil creep has been occurring over time. No apparent signs of deep-seated slope instability were observed while onsite.

SUBSURFACE

The subsurface conditions were explored by drilling four test borings 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.

The borings were drilled on February 20, 2020 using a track-mounted, hollow-stem auger drill. Samples were taken at approximate 2.5 and 5-foot intervals with a standard penetration sampler. This split-spoon sampler, which has a 2-inch outside diameter, is driven into the soil with a 140-pound hammer falling 30 inches. The number of blows required to advance the sampler a given distance is an indication of the soil density or consistency. A geotechnical engineer from our staff observed the drilling process, logged the test borings, and obtained representative samples of the soil encountered. The Test Boring Logs are attached as Plates 3 through 6.

Soil Conditions

In general, the four test borings encountered native, loose silty sand and sand beneath the ground surface, becoming medium-dense beneath depths of 5 to 10 feet. A layer of fill was encountered in Test Boring 4 to a depth of 4 feet, where native, loose sand was encountered below. The medium-dense silty sand and sand extended to depths of 10.5 to 18 feet, where medium-dense/stiff silt was encountered. This silt became dense beneath depths of 20 feet in Test Boring 3 and became very stiff beneath depths of 15 to 20 feet in the remaining three borings. At the base of all four test borings, auger refusal was met on very dense fragmented pieces of rock at depths ranging from 16.5 to 26.5 feet. Recovered samples from this layer revealed pink to dark-gray pieces of fractured rock interpreted as weathered bedrock.

Previous borings were conducted by Liu and Associates in 2002 as part of the original short plat report. The four test borings conducted as part of this original study encountered similar soil conditions as was found in our test borings. These test borings are attached to the end of this report for reference.

Obstructions were revealed at the base of all four of our borings in the form of what was interpreted as weathered bedrock, and refusal was met on this soil layer in all four of our test borings. Debris, buried utilities, and old foundation and slab elements are commonly encountered on sites that have had previous development.

Although our explorations did not encounter cobbles or boulders, they are often found in soils that have been deposited by glaciers or fast-moving water.

Groundwater Conditions

Perched groundwater seepage was observed at a depth of 5 to 8 feet in Test Boring 4. The test borings were left open for only a short time period. Therefore, the seepage levels on the logs represent the location of transient water seepage and may not indicate the static groundwater level. Groundwater levels encountered during drilling can be deceptive, because seepage into the boring can be blocked or slowed by the auger itself.

It should be noted that groundwater levels vary seasonally with rainfall and other factors. We anticipate that groundwater could be found in more permeable soil layers and between the looser near-surface soil and the underlying denser 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. If a transition in soil type occurred between samples in the borings, the depth of the transition was interpreted. The relative densities and moisture descriptions indicated on the test boring logs are interpretive descriptions based on the conditions observed during drilling.

CRITICAL AREA STUDY (MICC 19.07)

Seismic Hazard and Potential Landslide Hazard Areas: The majority of the subject site is located within a mapped Potential Landslide Hazard area. This is noted on the attached Critical Areas Delineation Plan, Plate 8. Please note that this plan from the City of Mercer Island is not to scale and is interpreted from the available GIS mapping data. The site is not located within a Seismic Hazard Area.

MICC/19.07.160 (A) uses WAC 365-190-120 for landslide hazard designation as follows:

(6) Landslide hazard areas include areas subject to landslides based on a combination of geologic, topographic, and hydrologic factors. They include any areas susceptible to landslide because of any combination of bedrock, soil, slope (gradient), slope aspect, structure, hydrology, or other factors, and include, at a minimum, the following:

(a) Areas of historic failures, such as:

(i) Those areas delineated by the United States Department of Agriculture Natural Resources Conservation Service as having a significant limitation for building site development;

(ii) Those coastal areas mapped as class u (unstable), uos (unstable old slides), and urs (unstable recent slides) in the department of ecology Washington coastal atlas; or

(iii) Areas designated as quaternary slumps, earthflows, mudflows, lahars, or landslides on maps published by the United States Geological Survey or Washington department of natural resources.

(b) Areas with all three of the following characteristics:

(i) Slopes steeper than fifteen percent;

(ii) Hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock; and

(iii) Springs or groundwater seepage.

(c) Areas that have shown movement during the holocene epoch (from ten thousand years ago to the present) or which are underlain or covered by mass wastage debris of this epoch;

(d) Slopes that are parallel or subparallel to planes of weakness (such as bedding planes, joint systems, and fault planes) in subsurface materials;

(e) Slopes having gradients steeper than eighty percent subject to rockfall during seismic shaking;

(f) Areas potentially unstable as a result of rapid stream incision, stream bank erosion, and undercutting by wave action, including stream channel migration zones;

(g) Areas that show evidence of, or are at risk from snow avalanches;

(h) Areas located in a canyon or on an active alluvial fan, presently or potentially subject to inundation by debris flows or catastrophic flooding; and

(i) Any area with a slope of forty percent or steeper and with a vertical relief of ten or more feet except areas composed of bedrock. A slope is delineated by establishing its toe and top and measured by averaging the inclination over at least ten feet of vertical relief.

The potential landslide mapping from Mercer Island (Plate 8) can be refined by consulting the WAC designations above with responses as follows:

a) No historic failures (i-iii) were indicated or mapped on the eastern slopes at the site.
b) Many of the slopes at the site are over 15 percent (i), but we observed no indications of the eastern slopes intersecting geologic contacts (ii); and we did not observe any springs or groundwater seeps on the eastern slopes.
c) Not indicated at the site.
d) Not indicated at the site.
e) Not indicated at the site.
f) The small steep incised slopes at the edge of the stream would be considered in this criteria, but based on their height, we would recommend a 25 foot setback from these slopes.
g) Not indicated at the site.
h) Not indicated at the site.

i) Some of the steep slopes incised at the edge of the stream would meet this criteria (where the slope is at least 10 feet tall) and we would recommend a 25 foot setback from these steep slope areas.

As such, we would anticipate that the mapped potential geologic hazard area (landslide) that covers much of the site and general vicinity to the north and south as well would be reduced to just the steeper slopes along the edges of the stream; and the buffers would be set from those slopes. To elaborate, the core of the subject site consists of medium-dense sand and silty sand as well as medium-dense and stiff silt that is underlain by weathered bedrock; both of which have a low potential for deep-seated landslides. However, this competent soil is overlain by looser surficial soils that could experience slope movement, particularly during a large earthquake. The recommendations presented in our report (lowering foundations using basements and supporting ongrade structures near the slopes with pipe piles} are intended to not cause adverse effects to the hazard areas.

Numerical slope stability analyses were conducted for three separate cross sections across the site. The location of the cross sections can be found on Plate 2.

Western Steep Slope Hazard Areas: Based on the provided topographic map of the subject site, and our site observations, the slope located west and northwest of the property is over 10 feet in height, and exceeds an inclination of 40 percent. This slope would meet the definition of a steep slope under the MICC. The approximate top of this steep slope area could be delineated as the western edge of the Forest Avenue Southeast right-of-way, and the toe can be delineated by the location of the stream centerline. The height of this slope varies from about 22 feet to 44 feet near the site; and the recommended buffer in MI code would be the height of the slope (with a minimum of 25 feet and maximum of 75 feet). The preliminary residence locations are currently set back more than 50 feet from this western slope. It is our opinion that a 50-foot buffer from these western slopes is appropriate for the proposed development. The recommendations presented in the report are intended to prevent adverse impacts to the stability of the steep slope, and to protect the planned development from foreseeable future soil movement on the steep slope.

Erosion Hazard Area: The site also meets the City of Mercer Island's criteria for an Erosion Hazard Area. This approximate area has also been indicated on the attached Critical Areas Delineation Map. We recommend that these areas be shown on a formal copy of the site survey as well.

Excavation and construction of the planned residence can be accomplished without adverse to the site and surrounding properties by exercising care and being proactive with the maintenance and potential upgrading of the erosion control system through the entire construction process. Proper erosion control implementation will be important to prevent adverse impacts to the site and neighboring properties. The temporary erosion control measures needed during the site development will depend heavily on the weather conditions that are encountered during the site work. One of the most important considerations, particularly during wet weather, is to immediately cover any bare soil areas to prevent accumulated water or runoff from the work area from becoming silty in the first place. Silty water cannot be discharged off the site, so a temporary holding tank should be planned for wet weather earthwork. A wire-backed silt fence bedded in compost, not native soil or sand, should be erected as close as possible to the planned work area, and the existing vegetation between the silt fence and the lake left in place. Rocked construction access and staging areas should be established wherever trucks will have to drive off of pavement, in order reduce the amount of soil or mud carried off the property by trucks and equipment. Covering the base of the excavation with a layer of clean gravel or rock is also prudent to reduce the amount of mud and silty water generated. Cut slopes and soil stockpiles should be covered with plastic during wet weather. Soil stockpiles should be minimized. Following rough grading, it may be necessary to mulch or hydroseed bare areas that will not be immediately covered with landscaping or an impervious surface.

Eastern Slope Buffers and Mitigation: The attached Critical Areas Delineation Plan, Plate 8 denotes the extents of the critical areas that cover the site. Under MICC 19.07.160(C), a prescriptive buffer of 25 feet is indicated from all sides of a shallow landslide-hazard area. As noted above, most of the site lies within a mapped Potential Landslide Hazard Area, and the prescriptive buffer would extend far beyond the boundaries of the property and the planned development area. The prescriptive Steep Slope buffers from the top and toe of the western steep slope are indicated on the Plan. No buffer is required by the MICC for an Erosion Hazard Area.

As discussed above, we would recommend a 25-foot minimum buffer from the steep (40+ percent and at least 10 feet tall) sections of the slopes near the stream. The recommendations presented in this geotechnical report are intended to allow the project to be constructed in the proposed configuration without adverse impacts to critical areas on the site or the neighboring properties. The geotechnical recommendations associated with foundations, shoring, and erosion control will mitigate any potential hazards to critical areas on the site.

Statement of Risk: In order to satisfy the City of Mercer Island's requirements, a statement of risk is needed. As such, we make the following statement:

> *Provided the recommendations in this report and our subsequent recommendations are followed, it is our professional opinion that the recommendations presented in this report for the planned alteration will render the development as safe as if it were not located in a geologically hazardous area, and will not adversely impact critical areas on adjacent properties.*

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 borings conducted for this study encountered native, medium-dense sand and silty sand beneath a layer of loose weathered and fill soil ranging in thickness from 5 to 10 feet. Medium-dense and stiff silt was encountered beneath the sand and silty sand at depths of 10.5 to 18 feet. Conventional foundations bearing on this competent medium-dense soil will provide suitable foundation support for most of the proposed residences, assuming that basements will be incorporated into the layouts. We recommend that the footing subgrades be recompacted if granular soils are present prior to placing footing forms. However, if excavations are not planned to be as deep, or if the residences contain at-grade settlement sensitive elements whose foundations will not reach suitable soils, we recommend that they be supported on deep foundations consisting of small diameter pipe piles that are drive to refusal in the underlying core of the site. Pipe piles would also greatly lessen the total amount of required earthwork for each of the houses. It will be important that any prepared bearing surface be free of any loose and disturbed soils that may be generated during excavation. This can usually be accomplished by using a cleanout bucket, grade bar, or flat blade shovel. We can provide more precise foundation recommendations once preliminary house siting and design have been completed.

Excavations for the proposed residences will vary depending on finish floor elevations. No residence designs have been provided at this time, and excavations could vary significantly between the four lots. Based on the soils encountered in our test borings, a temporary excavation inclination of no steeper than a 1:1 (Horizontal:Vertical) is appropriate for this project. We do not recommend that vertical excavation be made on or near the property lines, or near any settlement sensitive structures. Due to the medium-dense nature of the upper soils, vertical cuts should not be made at the base of sloped cuts. At this time, it appears that the excavations for the proposed residences will be able to be adequately maintained within the property boundaries, and temporary shoring or excavation easements will not be needed.

As previously discussed, the subject site is located within a potential landslide hazard area that encompasses much of the northern portion of the site and most of the surrounding vicinity. The core of the site consists of very stiff and dense silt and what was interpreted as weathered bedrock, which have a low potential for deep-seated instability. However, any slope in the Puget Sound area has some potential for shallow soil movement in the upper soils, particularly after periods of extended concentrated precipitation. The potential for failures in the adjacent steep slopes will be reduced by founding the new residences on competent soil, or on a system of pipe piles that are driven to refusal into the underlying core of the site, reducing any surcharge loads from the tops of these slopes. As discussed above in the ***Critical Area Study*** section, the recommendations presented in this report are intended to prevent adverse impacts to the stability of the slope onsite, protect the planned development from damage in the event of future instability, and prevent the development from adversely affecting the stability of surrounding properties.

No soil generated from the project excavation or new structural fill should be placed on, or near the adjacent slopes, as the surcharge from the additional soils could reduce the stability of the slopes. No water should be directed towards the steep slope to the west of the property. Poorly managed stormwater runoff is a common cause of slope instability that is well documented in the Puget Sound area. Due to the silty, fine-grained nature of the upper fill and native soils onsite and the steep inclination of the slope to the west of the proposed residence, it is our professional opinion that onsite infiltration of stormwater is not feasible for this project. All collected stormwater should be discharged to an approved stormwater system.

Even though the site is located within an erosion hazard area, the potential for adverse erosion impacts to the site and surrounding area are low, provided that sufficient temporary erosion control measures are implemented. The required erosion control measures 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. 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, cleaning, 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 class within 100 feet of the ground surface is best represented by Site Class Type D (Stiff Soil). 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 1.45g and 0.55g, respectively.

The IBC and ASCE 7 require that the potential for liquefaction (soil strength loss) during an earthquake be evaluated for the peak ground acceleration of the Maximum Considered Earthquake (MCE), which has a probability of occurring once in 2,475 years (2 percent probability of occurring in a 50-year period). The MCE peak ground acceleration adjusted for site class effects (F_{PGA}) equals 0.6g. The soils beneath the site are not susceptible to seismic liquefaction under the ground motions of the MCE because of the absence of near-surface groundwater.

PIPE PILES

Depending on final foundation elevations, the residence foundations may be supported on pipe piles. As stated in the ***General*** section of this report, any settlement sensitive, at-grade elements should also be supported on pipe piles.

Three- or 4-inch-diameter pipe piles driven with a 850- or 1,100- or 2,000-pound hydraulic jackhammer to the following final penetration rates may be assigned the following compressive capacities.

INSIDE PILE DIAMETER	FINAL DRIVING RATE (850-pound hammer)	FINAL DRIVING RATE (1,100-pound hammer)	FINAL DRIVING RATE (2,000-pound hammer)	ALLOWABLE COMPRESSIVE CAPACITY
3 inches	10 sec/inch	6 sec/inch	2 sec/inch	6 tons
4 inches	16 sec/inch	10 sec/inch	4 sec/inch	10 tons

Note: The refusal criteria indicated in the above table are valid only for pipe piles that are installed using a hydraulic impact hammer carried on leads that allow the hammer to sit on the top of the pile during driving. If the piles are installed by alternative methods, such as a vibratory hammer or a hammer that is hard-mounted to the installation machine, numerous load tests to 200 percent of the design capacity would be necessary to substantiate the allowable pile load. The appropriate number of load tests would need to be determined at the time the contractor and installation method are chosen.

As a minimum, Schedule 40 pipe should be used. The site soils are not highly organic, and are not located near salt water. As a result, they do not have an elevated corrosion potential. Considering this, it is our opinion that standard “black” pipe can be used, and corrosion protection, such as galvanizing, is not necessary for the pipe piles.

Pile caps and grade beams should be used to transmit loads to the piles. Isolated pile caps should include a minimum of two piles to reduce the potential for eccentric loads being applied to the piles. Subsequent sections of pipe can be connected with slip or threaded couplers, or they can be welded together. If slip couplers are used, they should fit snugly into the pipe sections. This may require that shims be used or that beads of welding flux be applied to the outside of the coupler.

Lateral loads due to wind or seismic forces may be resisted by passive earth pressure acting on the vertical, embedded portions of the foundation. For this condition, the foundation must be either poured directly against relatively level, undisturbed soil or be surrounded by level compacted fill. We recommend using a passive earth pressure of 250 pounds per cubic foot (pcf) for this resistance. If the ground in front of a foundation is loose or sloping, the passive earth pressure given above will not be appropriate. We recommend a safety factor of at least 1.5 for the foundation's resistance to lateral loading, when using the above ultimate passive value.

CONVENTIONAL FOUNDATIONS

Depending on final residence design and layout, the new residences could be supported on conventional continuous and spread footings bearing on undisturbed, medium-dense, native soil. 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. The 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 2,000 pounds per square foot (psf) is appropriate for footings supported on competent 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 about one-inch, with differential settlements on the order of one-inch in a distance of 25 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: pcf is Pounds per Cubic Foot, and 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. The above ultimate values for passive earth pressure and coefficient of friction do not include a safety factor.

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 <u>level</u> backfill:

PARAMETER	VALUE
Active Earth Pressure *	35 pcf
Passive Earth Pressure	300 pcf
Coefficient of Friction	0.45
Soil Unit Weight	125 pcf

Where: pcf is Pounds per Cubic Foot, and 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. This applies only to walls with level backfill.**

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. Restrained wall soil parameters should be utilized the wall and reinforcing design for a distance of 1.5 times the wall height from corners or bends in the walls, or from other points of restraint. 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 8**H** 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. A minimum 12-inch width of free-draining gravel or drainage composite similar to Miradrain 6000 should be placed against the backfilled retaining walls. The gravel or drainage composites should be hydraulically connected to the foundation drain system. Free-draining backfill should be used for the entire width of the backfill where seepage is encountered. For increased protection, drainage composites should be placed along cut slope faces, and the walls should be backfilled entirely with free-draining soil. 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 at one to 2 percent to reduce the potential for surface water to percolate into the backfill.

Water percolating through pervious surfaces (pavers, gravel, permeable pavement, etc.) must also be prevented from flowing toward walls or into the backfill zone. Foundation drainage and waterproofing systems are not intended to handle large volumes of infiltrated water. 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 recommended 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 buildup 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.

SLABS-ON-GRADE

The building floors can be constructed as slabs-on-grade atop competent native soil, or on structural fill. Alternately, the building floors could be constructed as framed floors atop a crawlspace. 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 recommends a minimum 10-mil thickness vapor retarder for better durability and long term performance than is provided by 6-mil plastic sheeting that has historically been used. 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.

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

EXCAVATIONS AND SLOPES

Temporary excavation slopes should not exceed the limits specified in local, state, and national government safety regulations. Also, temporary cuts should be planned to provide a minimum 2 to 3 feet of space for construction of foundations, walls, and drainage. Temporary cuts to a maximum overall 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. As stated previously, it is important that vertical cuts not be made at the base of sloped cuts. Based upon Washington Administrative Code (WAC) 296, Part N, the 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 the bottom of a cut.

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 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). Fill slopes should not be constructed with an inclination greater than 3:1 (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 footing drain detail is attached to this report as Plate 7. For the best long-term performance, perforated PVC pipe is recommended for all subsurface drains. Clean-outs should be provided for potential future flushing or cleaning of footing drains.

Drainage inside the building's footprint should also be provided where (1) a crawl space or slab will slope or be lower than the surrounding ground surface, (2) an excavation encounters significant seepage, or (3) an excavation for a building will be close to the expected high groundwater elevations. We can provide recommendations for interior drains, should they become necessary, during excavation and foundation construction.

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 a few inches of free draining gravel underneath the vapor retarder is also prudent to limit the potential for seepage to build up on top of the vapor retarder.

Perched 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 the residences should slope away at least one to 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.

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, 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.

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, but should be thinner if small, hand-operated compactors are used. We recommend testing structural fill as it is placed. If the fill is not sufficiently compacted, it should 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 levels of relative compaction for compacted fill:

LOCATION OF FILL PLACEMENT	MINIMUM RELATIVE COMPACTION
Beneath 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).

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 borings 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 borings. 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 Seascape Homes 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 - 6	Test Boring Logs
Plate 7	Typical Footing Drain Detail
Plate 8	Critical Areas Delineation Map
Attachment	Previous Boring Logs
Attachment	Slope Stability Analyses

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.

3/18/20

James H. Strange, Jr., P.E.
Associate

MKM/JHS:kg

NORTH

(Source: Microsoft MapPoint, 2013)

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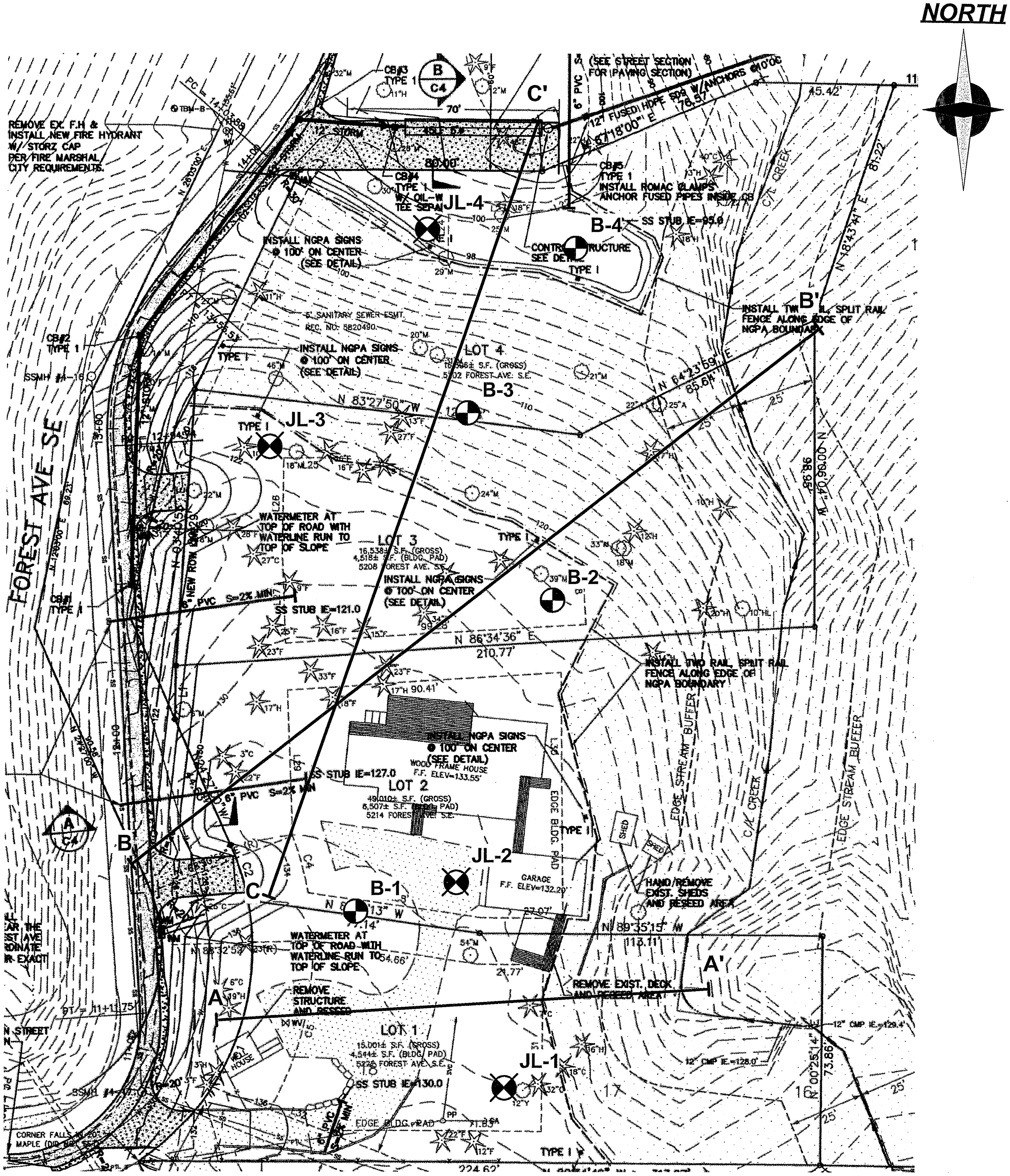
VICINITY MAP

5224 Forest Avenue Southeast
Mercer Island, Washington

Job No:	Date:		Plate:
20046	Mar. 2020		1



Legend:

- Test Boring Location
- Previous Test Boring Location - Liu and Associates, September, 2002

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SITE EXPLORATION PLAN

5224 Forest Avenue Southeast
Mercer Island, Washington

Job No:	Date:		Plate:
20046	Mar. 2020	No Scale	2

BORING 1

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
					SM	Topsoil
			7	1	SM	Gray silty SAND, fine-grained, moist, loose
5			16	2	SM	-becomes gravelly, fine to medium-grained -with a small root
			19	3	SM	-with a 6-inch clean sand seam -becomes rusted, very fine-grained, moist to very moist
10			21	4	ML	Gray with rust, sandy SILT, non-plastic, moist, medium-dense -with small pieces of gray silt
15			27	5	ML	-becomes gray and gray-brown -becoems gray, very moist
20						
25						
30						

*** Test boring was terminated at 16.5 feet on February 20, 2020 due to auger refusal on rocks.**

*** No groundwater was encountered during drilling.**

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TEST BORING LOG

5224 Forest Avenue Southeast
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
20046	Mar. 2020	MKM	3

BORING 2

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
					SP	Grass over;
			5	1		Brown SAND with silt, fine-grained, moist, loose
5			10	2		-becomes slightly gravelly
			7	3		-with thin layers of iron staining
10			14	4		-becomes gray with a lense of silt, becomes medium-dense
					ML	Gray-brown slightly gravelly SILT, low plasticity, moist, stiff
15			15	6	SP	Gray gravelly sand, fine to medium-grained, very moist, medium-dense
					SM	Gray silty SAND, fine-grained, very moist, medium-dense
20			24	7	ML	Gray-brown and gray with rusting, SILT, low plasticity, moist, very stiff
			50/0"	8	Rx	Gray and light pink weathered bedrock?, very dense
25						
30						

*** Test boring was terminated at 22 feet on February 20, 2020 due to refusal.**
*** No groundwater was encountered during drilling.**

GEOTECH
CONSULTANTS, INC.

TEST BORING LOG

5224 Forest Avenue Southeast
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
20046	Mar. 2020	MKM	4

BORING 3

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
					SP	Topsoil over;
			8	1		Brown SAND, fine-grained, moist, loose
5			12	2		-becomes gray-brown, slightly gravelly, medium-dense
			12	3		-becomes rusted with thin silt lenses, very moist
10			15	4		-becomes slightly silty
15						-becomes gray, no silt
			19	5	SM	Gray with rusting, slightly gravelly, very silty SAND, fine-grained, moist, medium-dense
20			40	6	ML	Gray with rusting, slightly gravelly SILT, non-plastic, moist, dense -becomes slightly sandy, horizontally beded -becomes blue-gray
25			75	7		-becomes gray with seams of silty sand, very dense -with pieces of fractured rock
30						

* **Test boring was terminated at 26.5 feet on February 20, 2020 due to auger refusal.**

* **No groundwater was encountered during drilling.**

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TEST BORING LOG

5224 Forest Avenue Southeast
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
20046	Mar. 2020	MKM	5

BORING 4

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
					FILL	Crushed rock over;
			2	1		Dark-brown silty sand with roots, fine-grained, moist, loose **(FILL)**
5			4	2	SP	Brown SAND, fine-grained, wet, loose
			15	3		
					SM	Gray-brown mottled orange, slightly gravelly, silty SAND, fine-grained, moist, medium-dense
10			19	4		-becomes very moist, medium-dense
15			50/3"	5	ML	Bluish-gray slightly gravelly silt, non-plastic, moist, very dense
20			26	6		-becomes blue-gray with seams of rusting, slightly plastic, moist, very stiff -becomes gray-brown with gravel
			100/3"	7	Rx	Pink and gray weathered bedrock?, very dense
25						
30						

* **Test boring was terminated at 24.25 feet on February 20, 2020 due to auger refusal.**

* **Perched groundwater was encountered from 5 to 8 feet during drilling.**

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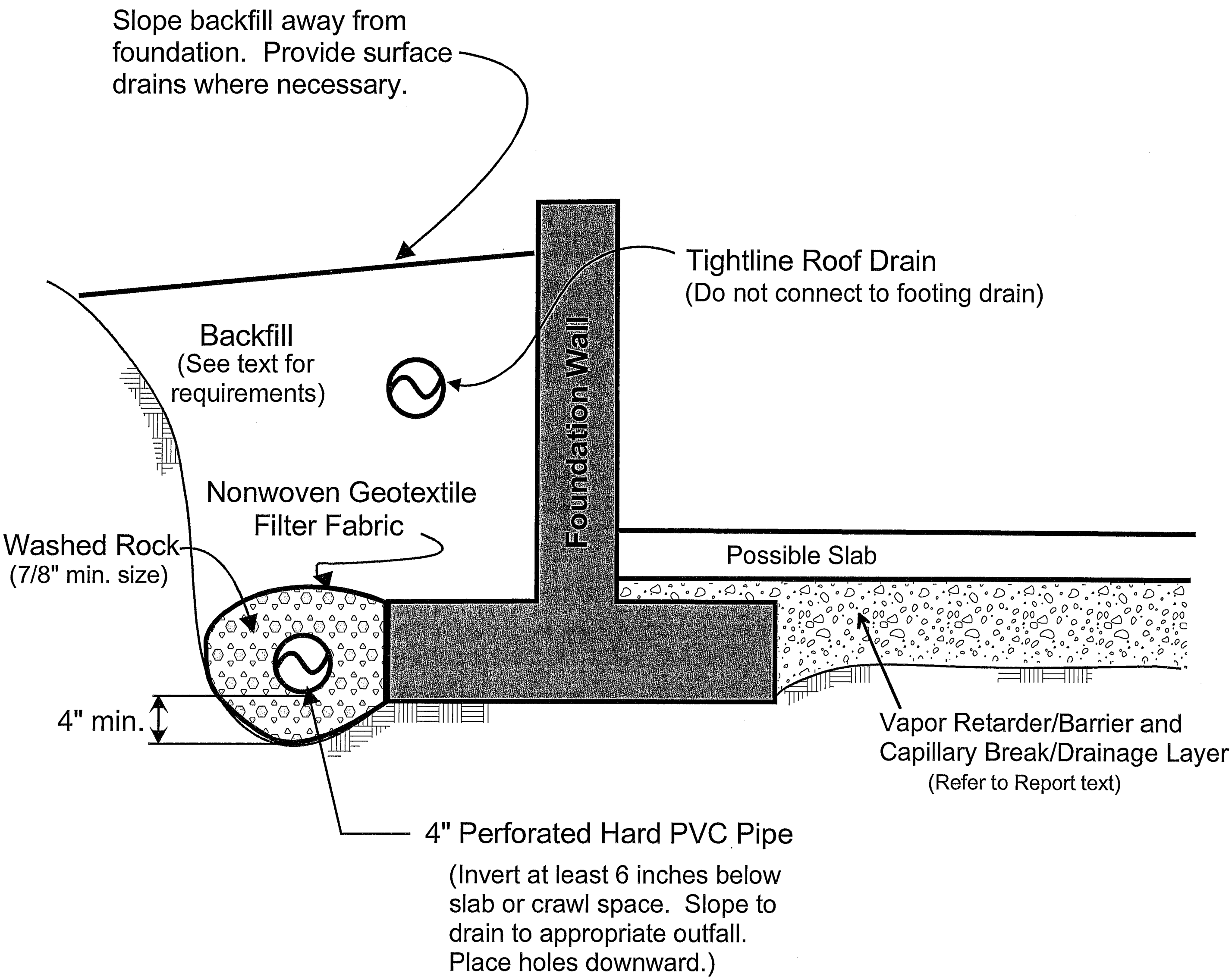
TEST BORING LOG

5224 Forest Avenue Southeast
Mercer Island, Washington

Job	*Date:*	*Logged by:*	*Plate:*
20046	Mar. 2020	MKM	6



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.

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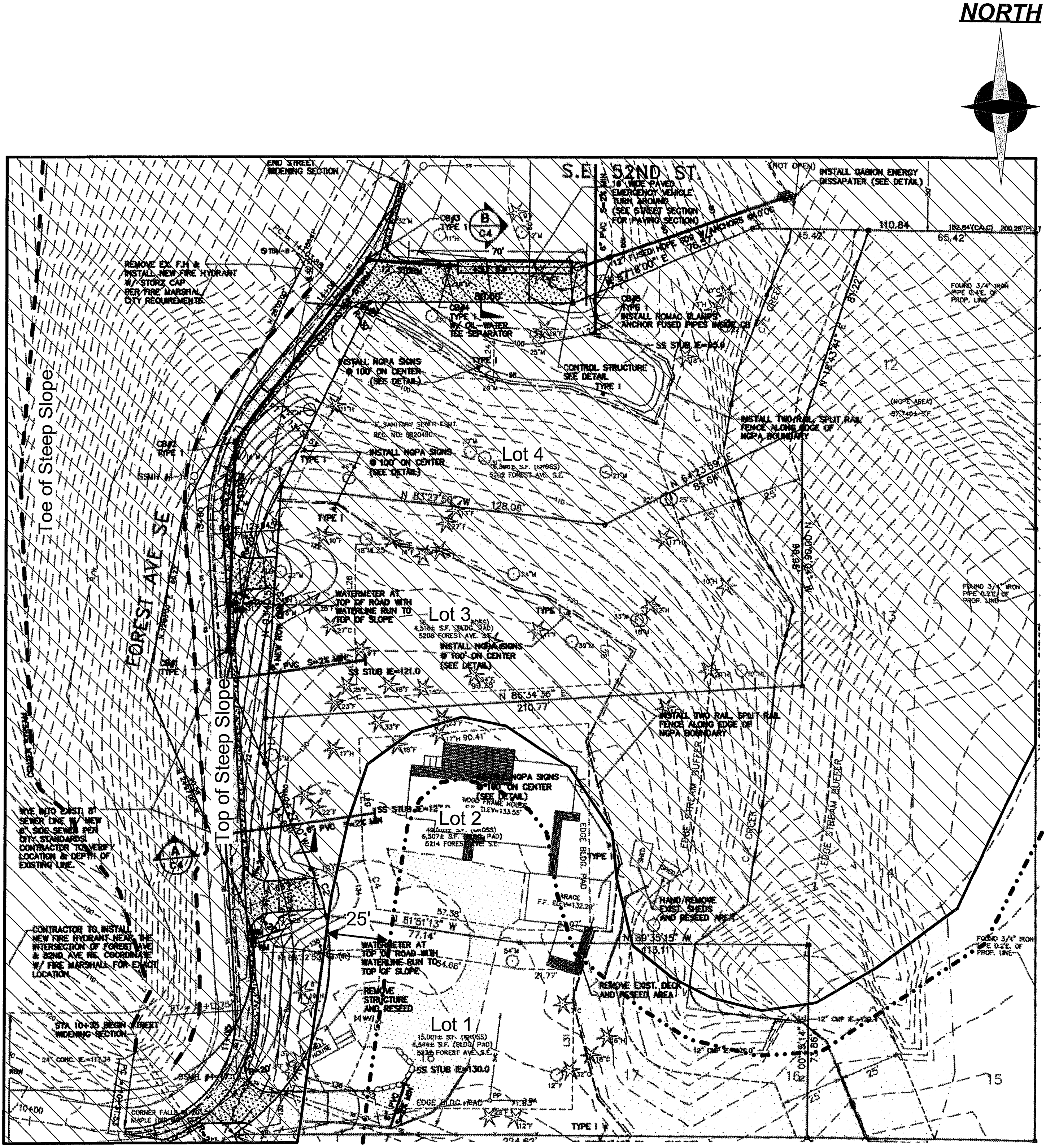
FOOTING DRAIN DETAIL

5224 Forest Avenue Southeast
Mercer Island, Washington

Job No:	Date:		Plate:
20046	Mar. 2020		7



Potential Landslide Hazard & Erosion Hazard Area (Based on Mercer Island Mapping)

Approximate 25-Foot Potential Landslide Hazard Area Buffer

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CRITICAL AREAS DELINEATION MAP

5224 Forest Avenue Southeast
Mercer Island, Washington

Job No:	Date:		Plate:
20046	Mar. 2020	Not To Scale	8

Previous Boring Logs

DRILLING METHOD: Trac mounted Auger Rig	SURFACE ELEVATION: 138 feet	LOGGED BY: R. J. Bielefeld
DEPTH TO GROUNDWATER None Encou	BORING DIAMETER: 8"	DATE DRILLED:8/15/02

DESCRIPTION AND CLASSIFICATION									
DESCRIPTION & REMARKS	CONSIST	SOIL TYPE	DEPTH (FEET)	SAMPLE	PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT (%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (TSF)	OTHER TESTS
0.0 - 14.0: Sand; fine grained, trace of coarse sand, organics, moderate reddish brown, dry	loose	Cl - Sc			3 / 2				
					1				
Sand, gradually becomes medium grained with gravel			5	B - 1 - 1	5 / 6				
					6				
Becomes moist at 6 feet									
	Dense	Sc							
			10	B - 1 - 2	4 / 12				Sieve Analys
					10				
moist, moderate reddish brown									
14.0 - 18.0: Clay; moist, dark yellow brown	Stiff	Cl - CH	15	B - 1 - 3	15/ 14				
					13				
Possible water level in this zone									
18.0 - Bottom: Silt; blue gray, moist to wet.	Stiff	Ml - MH							
Bottom of Hole: 19.5 feet Hole left open for three hours.			20	B - 1 - 4	7 / 11				
					14				

ENGINEERING GEOLOGICAL SERVICES 4538 Lake Washington Blvd. NE Kirkland, WA 98033 Tel.: (425) 828-3162	**EXPLORATORY BORING LOG** Knudsen Development		
	PROJECT Nº R2203	DATE 8/27/02	BORING Nº B-1

DRILLING METHOD: Trac mounted auger	SURFACE ELEVATION: 133 feet	LOGGED BY: R. J. Bielefeld
DEPTH TO GROUNDWATERNone Encou	BORING DIAMETER: 8"	DATE DRILLED: 8 - 27 - 02

DESCRIPTION & REMARKS	CONSIST	SOIL TYPE	DEPTH (FEET)	SAMPLE	PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT (%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (TSF)	OTHER TESTS
0.0 - 14.0: Sand; medium grained, moderate reddish brown, moist	Dense	Sc - Sp			6 / 6				
					5				
Sugar sand, dry			5	B - 2 - 1	4 / 5				
	Dense	Sp			6				
Gravel lense, becomes moist			10	B - 2 - 2	4 / 5				
					6				
14.0 - Bottom: Clay, sandy yellow brown, layered, moist to wet.	Stiff to Very	Cl	15	B - 2 - 3	4 / 5				
	Stiff				20				
Trace of blue gray silt									
Bottom of Hole at 19.5 feet.			20	B - 2 - 4	6 / 15				
Located in front of garage. Held open for Two hours.					15				

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EXPLORATORY BORING LOG

Knudsen Development

PROJECT Nº	DATE	BORING Nº
R2203	8 - 27 - 02	B - 2

AEC Form File: Boring.tem

DRILLING METHOD: Trac mounted auger Rig	SURFACE ELEVATION: 95.5 feet	LOGGED BY: R. J. Bielefeld
DEPTH TO GROUNDWATER None Encou	BORING DIAMETER: 8"	DATE DRILLED: 8 - 28 - 02

DESCRIPTION AND CLASSIFICATION			DEPTH (FEET)	SAMPLE	PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT (%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (TSF)	OTHER TESTS
DESCRIPTION & REMARKS	CONSIST	SOIL TYPE							
0.0 - 17.5: Sand; fine grained, 12" of duff, dry, light yellow brown	loose	Sp			1 for 18"				
Clean duff/sand contact	Dense								
			5	B - 3 - 1	10 / 8				
					9				
Thin layers of fine to medium sand.	Dense	Sp							
Becoming moist, Sand			10	B - 3 - 2	4 / 7				
					8				
	Medium	Sp	15	B - 3 - 3	7 / 8				Sieve Anal
	Dense				3				
17.5 - 24.0: Clay; light reddish brown, Moist									
	Very Stiff	Cl - CH	20	B - 3 - 4	5 / 10				
Sheared, gravel intermixed					13				

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EXPLORATORY BORING LOG

Knudsen Development

PROJECT Nº	DATE	BORING Nº
R2203	8 - 28 - 02	B - 3.

DRILLING METHOD: Trac mounted auger Rig	SURFACE ELEVATION: 95.5 feet	LOGGED BY: R. J. Bielefeld
DEPTH TO GROUNDWATER None Encou	BORING DIAMETER: 8"	DATE DRILLED: 8 - 28 - 02

DESCRIPTION AND CLASSIFICATION: DESCRIPTION & REMARKS	CONSIST	SOIL TYPE	DEPTH (FEET)	SAMPLE	PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT (%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (TSF)	OTHER TESTS
(Continued: 17.5 - 24) 24.0 - 33.75: Sand, coarse, brownish black, dry	Very Dense	Sp	25	B - 3 - 5	4 / 11				
					19				
Sand, black with white fragments, brecciated	Very Dense	Sp	30	B - 3 - 6	24 / 33				
					38				
Sharp, angular gravel in a clay matrix, pebble size									
33.75 - Bottom: Clay; yellow brown, moist	Very Stiff	CH - CI	35	B - 3 - 7	15 / 23				
38.0: Clay; blue gray, moist, smoother drilling					31				
									LL = 38
Bottom of Hole: 39.5 feet	Very Stiff	CH - CI	40	B - 3 - 8	12 / 20				PL = 24,
					23				PI = 12

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EXPLORATORY BORING LOG

Knudsen Development

PROJECT №	DATE	BORING №
R2203	8 - 28 - 02	B - 3

DRILLING METHOD: Trac mounted Auger Rig	SURFACE ELEVATION: 127 feet	LOGGED BY: R. J. Bielefeld
DEPTH TO GROUNDWATER Not encou	BORING DIAMETER: 8"	DATE DRILLED: 8 - 27 - 02

DESCRIPTION AND CLASSIFICATION			DEPTH (FEET)	SAMPLE	PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT (%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (TSF)	OTHER TESTS
DESCRIPTION & REMARKS	CONSIST	SOIL TYPE							
0.0 - 6.0: Sand; fine grained reddish brown, dry	Dense	Sp			1for 18"				
Sand: reddish brown, dry	Dense	Sp - Sc	5	B - 4 - 1	7 / 9				
					13				
6.0 - Bottom: Clay; yellow brown, moist	Stiff	Cl - CH							
	Stiff to Very Stiff	Cl - CH	10	B - 4 - 2	7 / 12				
					22				
Clay; blue gray, moist	Very Stiff	Cl - CH							
			15	B - 4 - 3	10 / 15				
					23				
Baked sand with gravel in the clay zone	Very Stiff								
Bottom of Hole 19.5 feet			20	B - 4 - 4	30 / 50				
Backfilled on completion									

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Kirkland, WA 98033
Tel.: (425) 828-3162

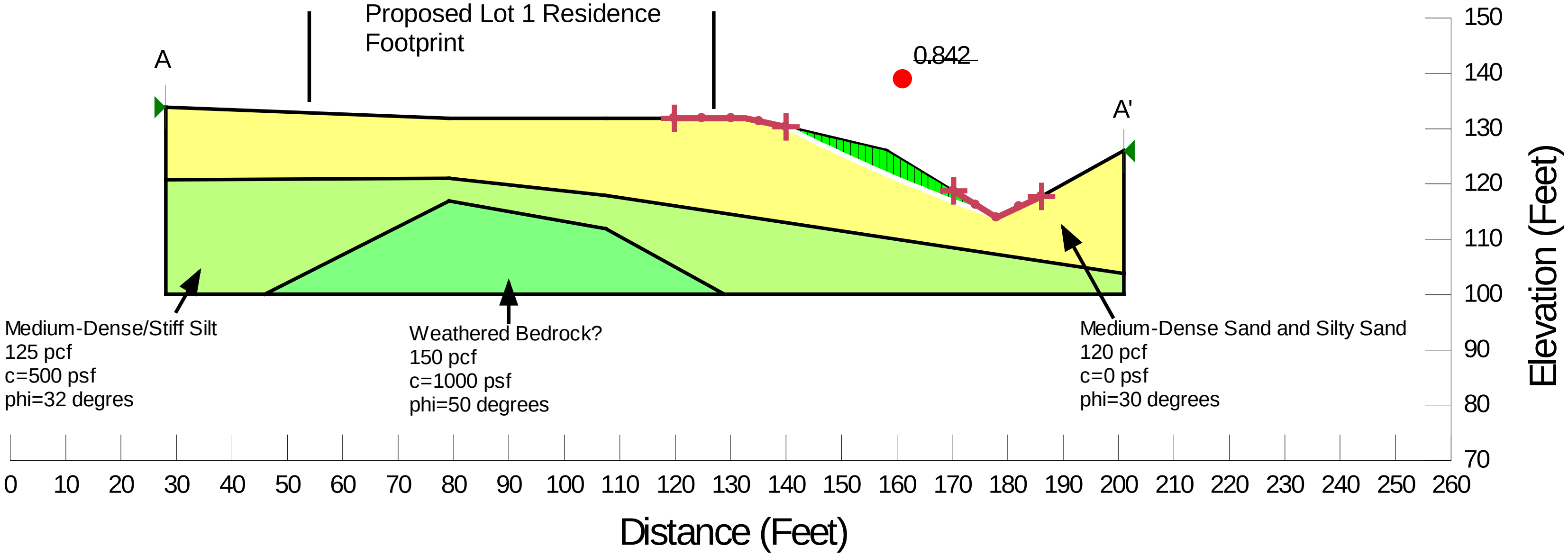
EXPLORATORY BORING LOG

Knudsen Development

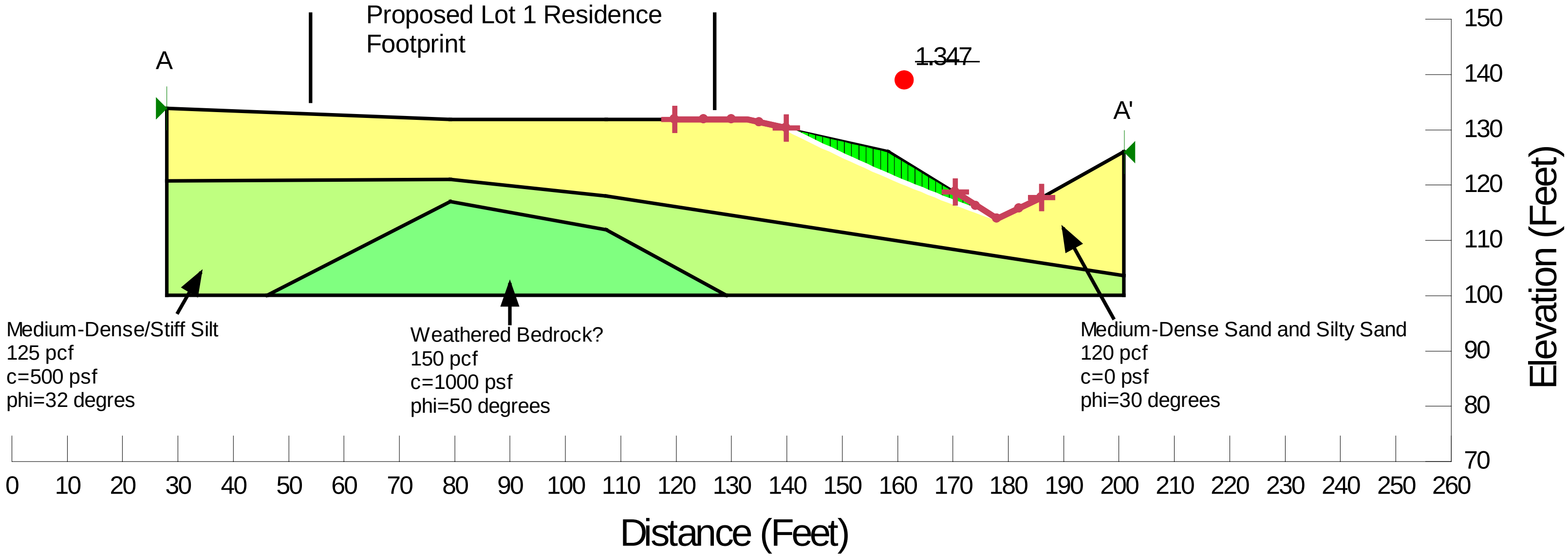
PROJECT Nº	DATE	BORING Nº
R2203	8-27-02	B-4

Slope Stability Sections

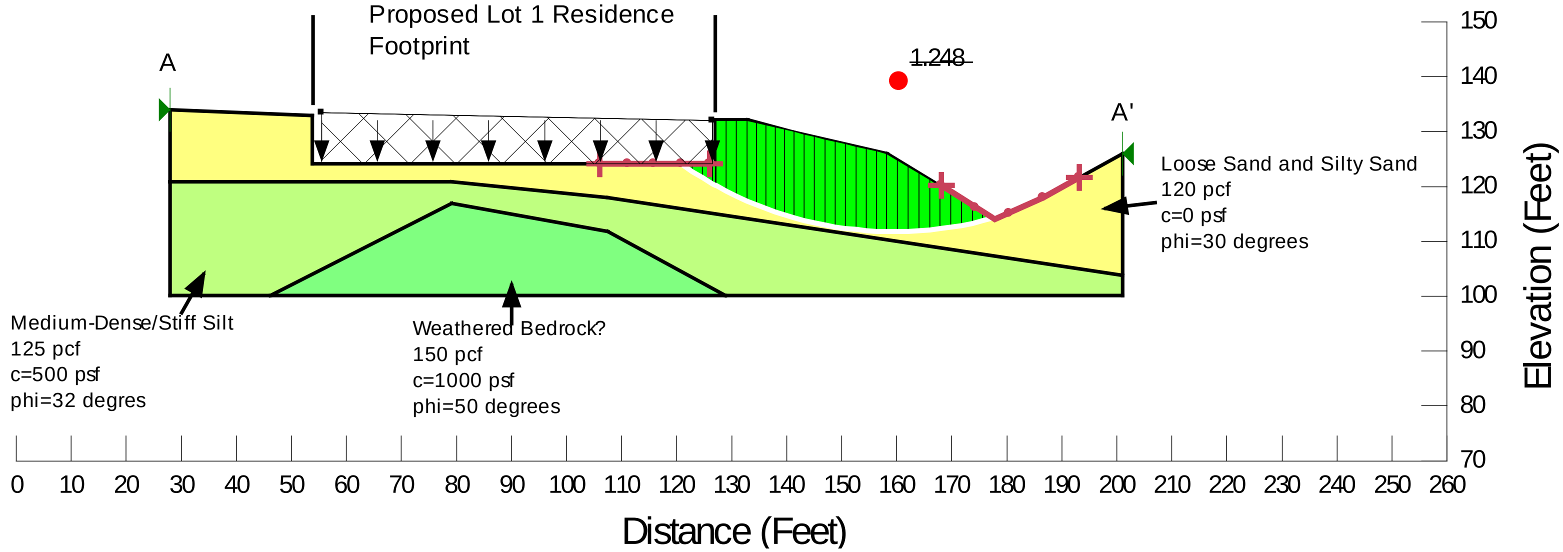
20046 - Seascape Homes
Seismic



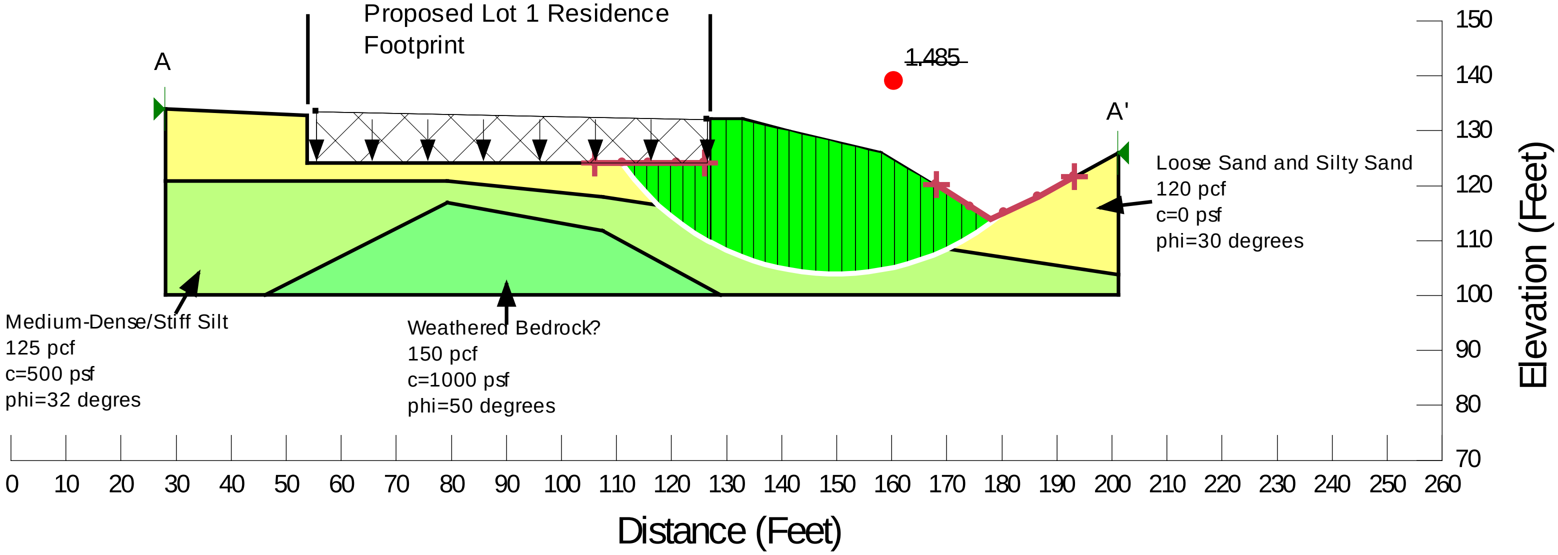
20046 - Seascape Homes
Static



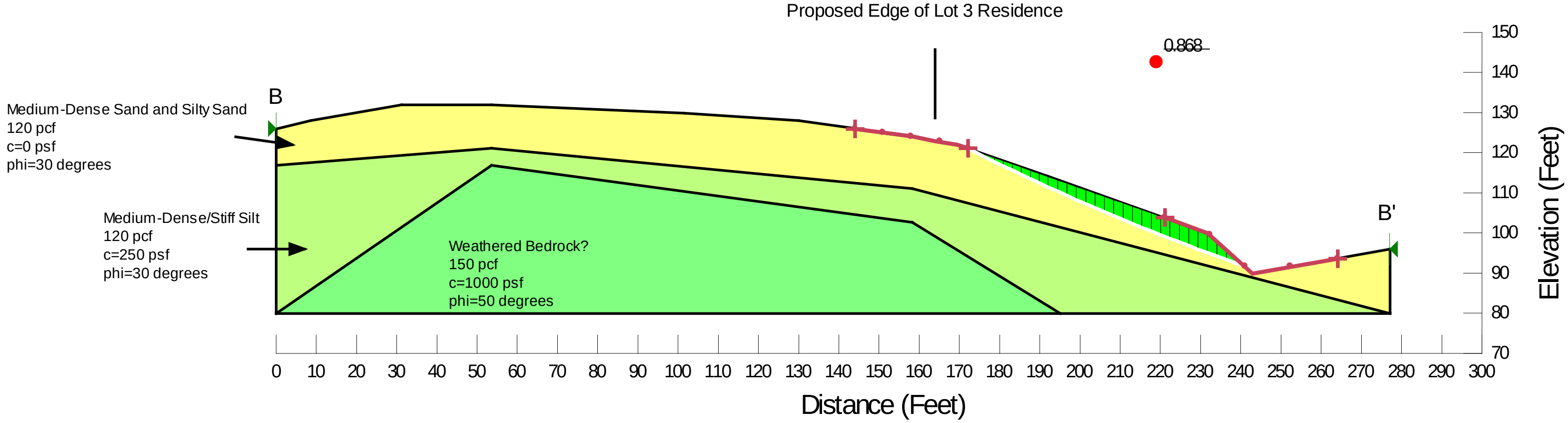
20046 - Seascape Homes
Seismic

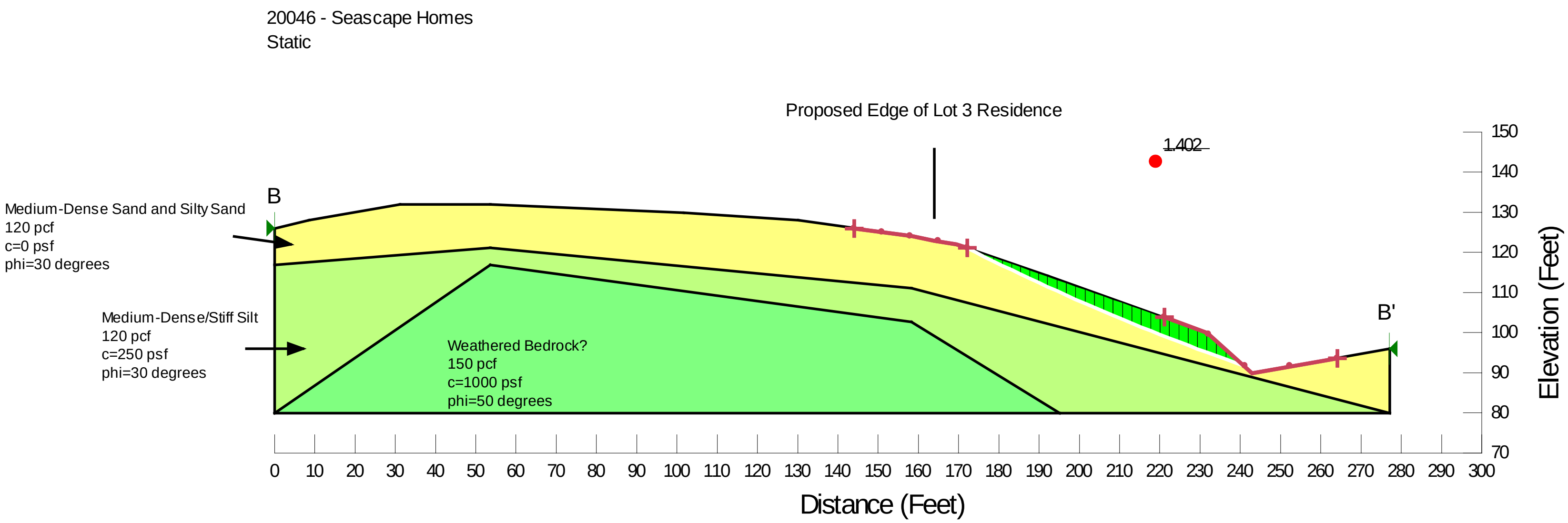


20046 - Seascape Homes
Static

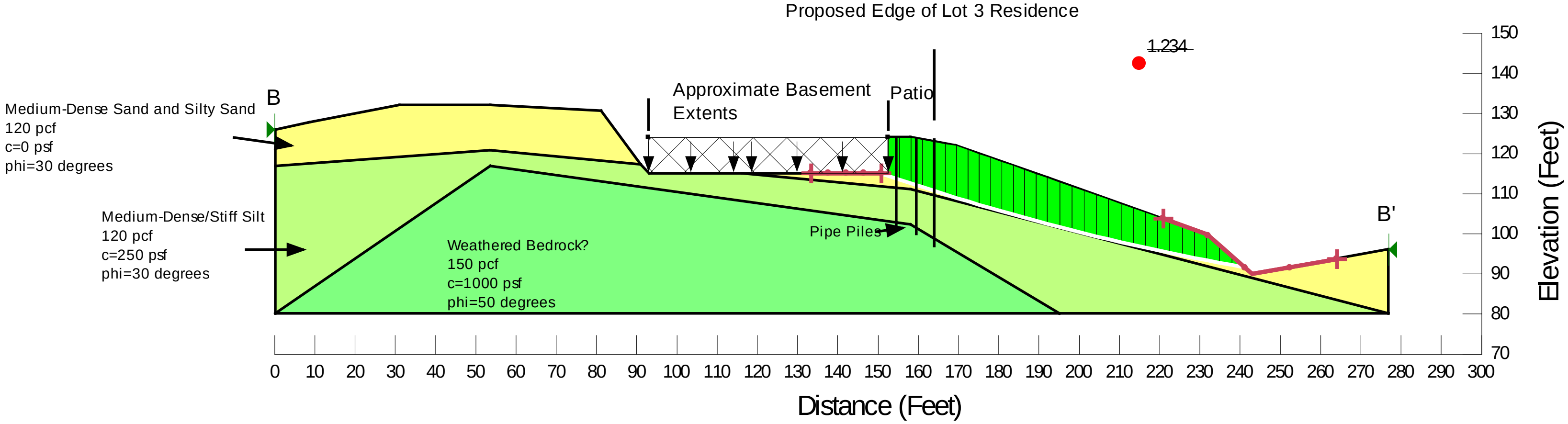


20046 - Seascape Homes
Seismic

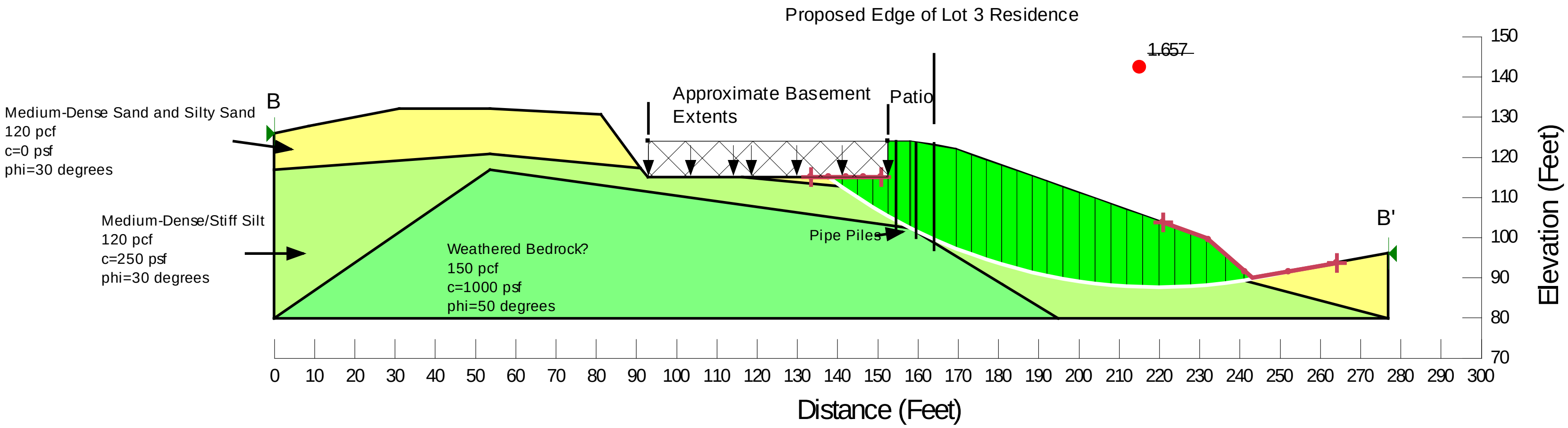



20046 - Seascape Homes
Static
Proposed Edge of Lot 3 Residence
1.402
B
B'
Medium-Dense Sand and Silty Sand
120 pcf
c=0 psf
phi=30 degrees
Medium-Dense/Stiff Silt
120 pcf
c=250 psf
phi=30 degrees
Weathered Bedrock?
150 pcf
c=1000 psf
phi=50 degrees
Distance (Feet)
Elevation (Feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
150
140
130
120
110
100
90
80
70

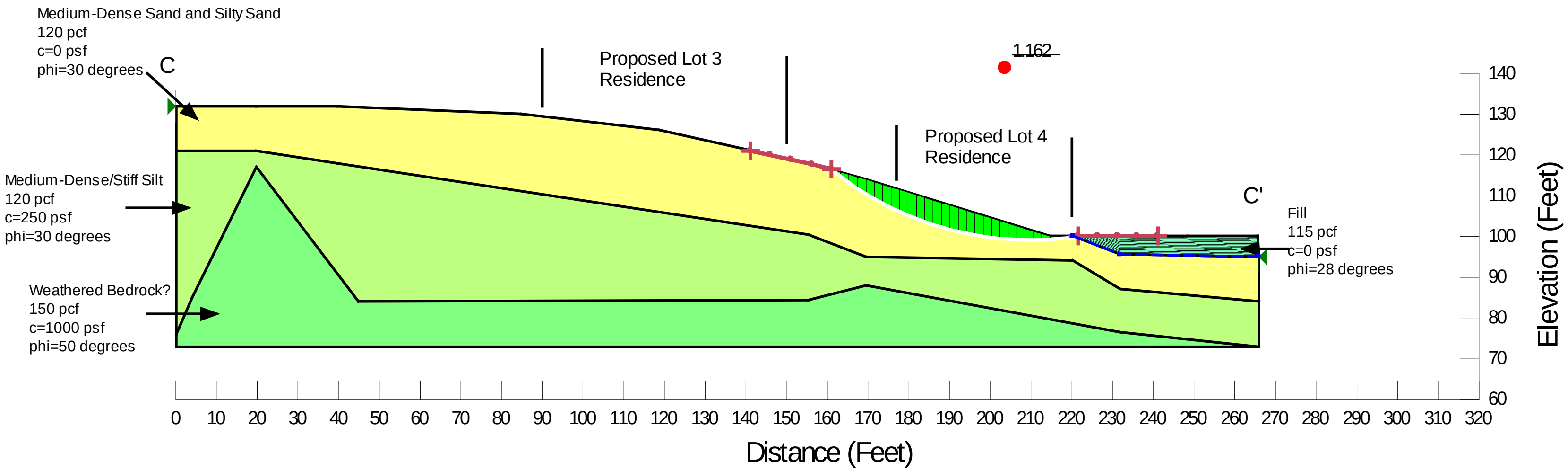
20046 - Seascape Homes
Seismic

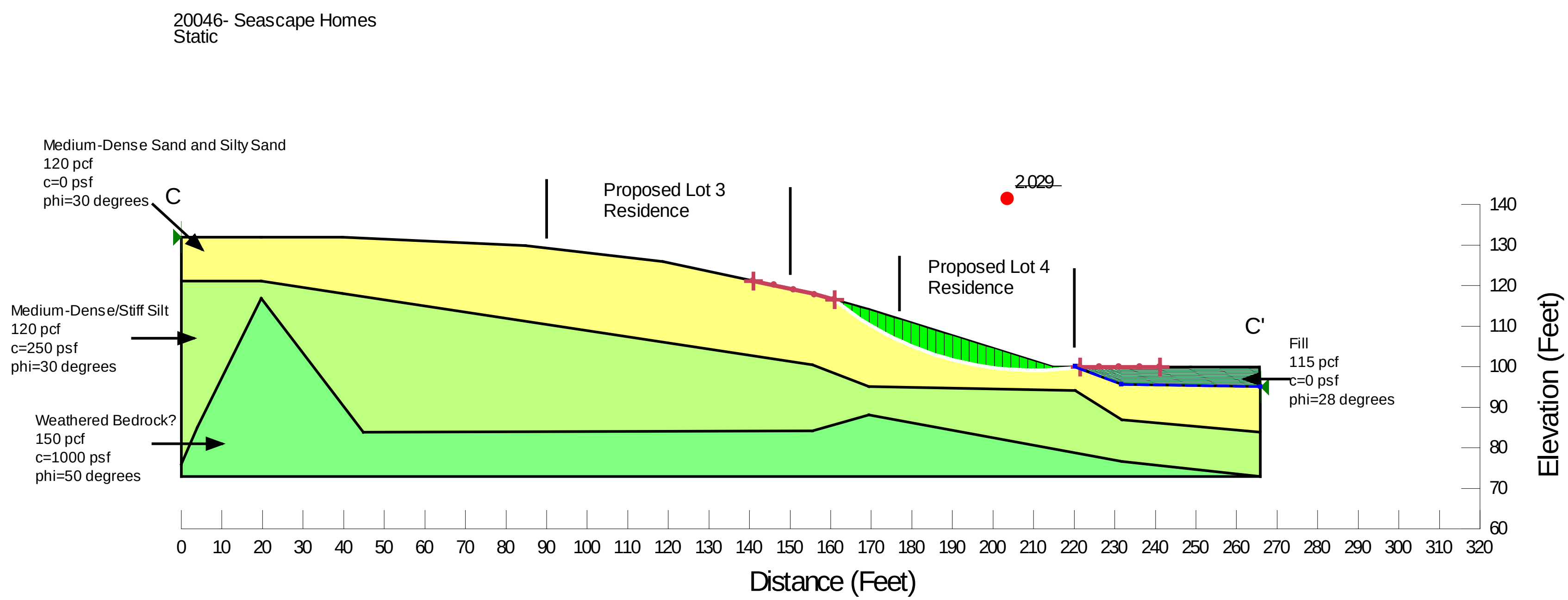


20046 - Seascape Homes
Static

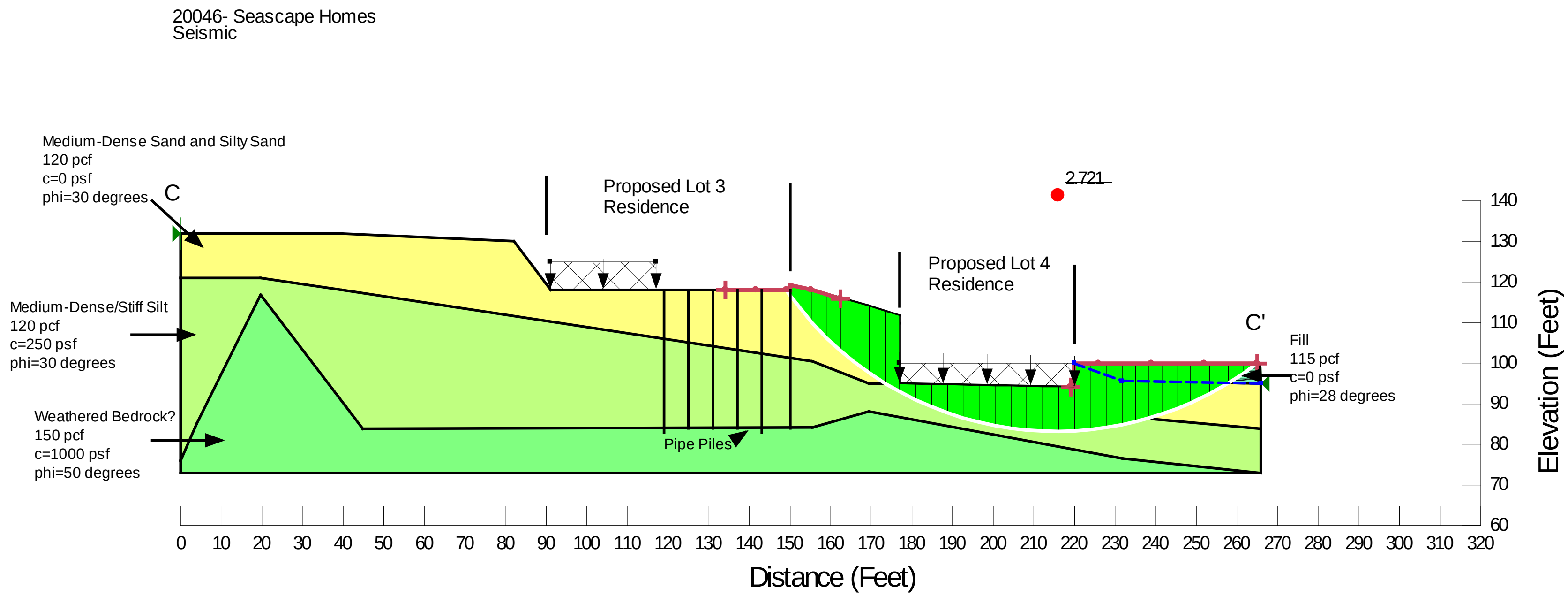


20046- Seascape Homes
Seismic

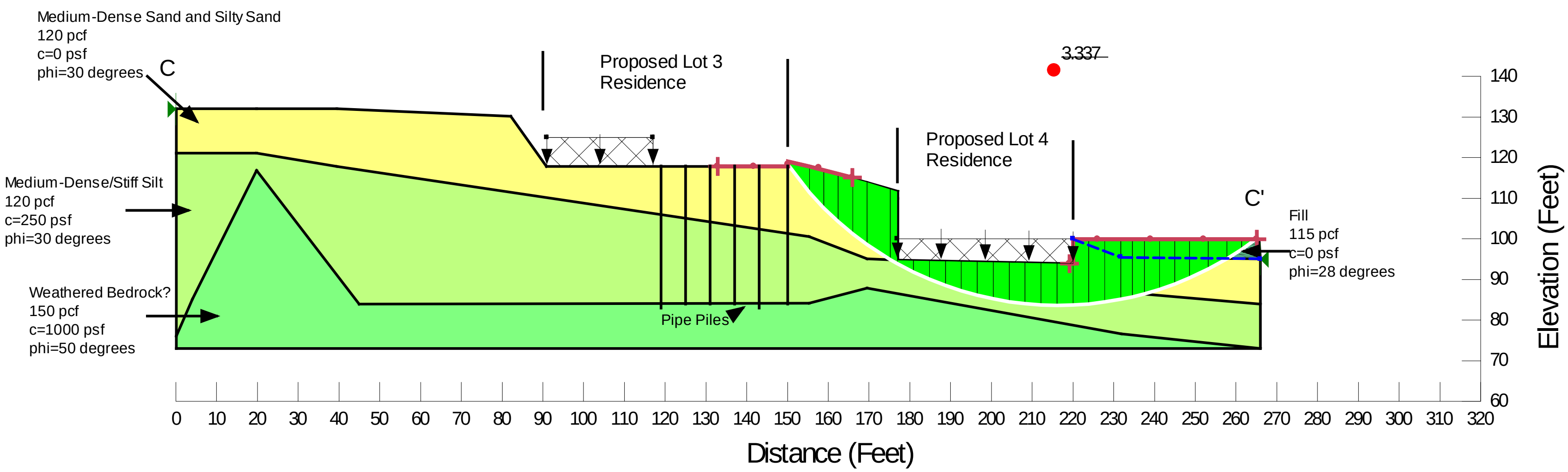




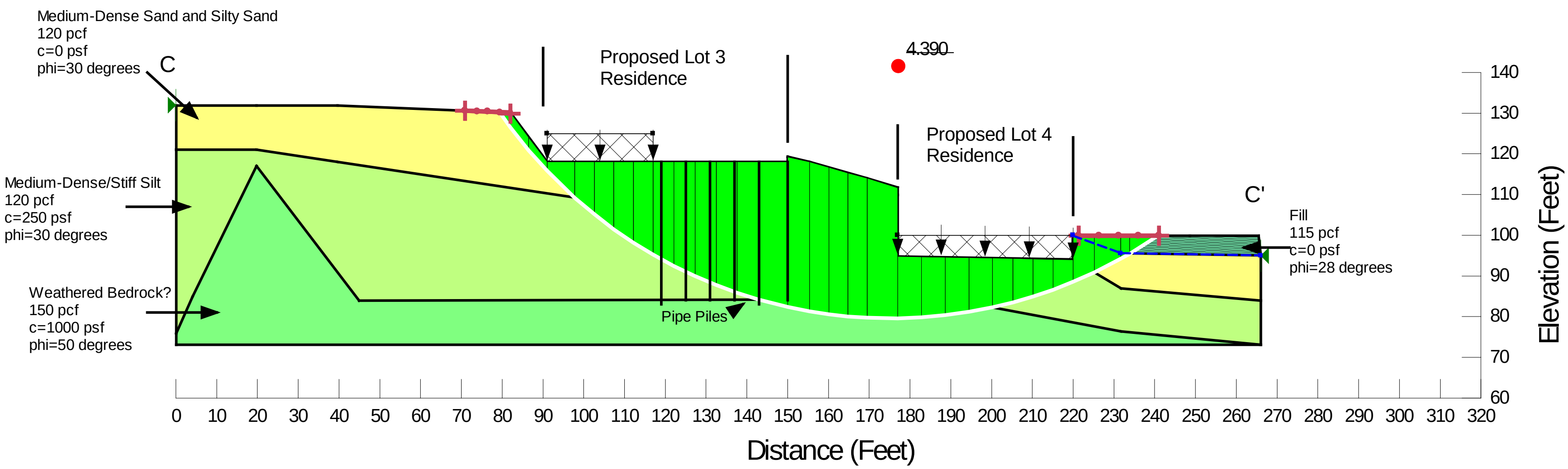
20046- Seascape Homes
Static
Medium-Dense Sand and Silty Sand
120 pcf
c=0 psf
phi=30 degrees
C
Proposed Lot 3
Residence
2.029
Proposed Lot 4
Residence
C'
Medium-Dense/Stiff Silt
120 pcf
c=250 psf
phi=30 degrees
Fill
115 pcf
c=0 psf
phi=28 degrees
Weathered Bedrock?
150 pcf
c=1000 psf
phi=50 degrees
140
130
120
110
100
90
80
70
60
Elevation (Feet)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320
Distance (Feet)

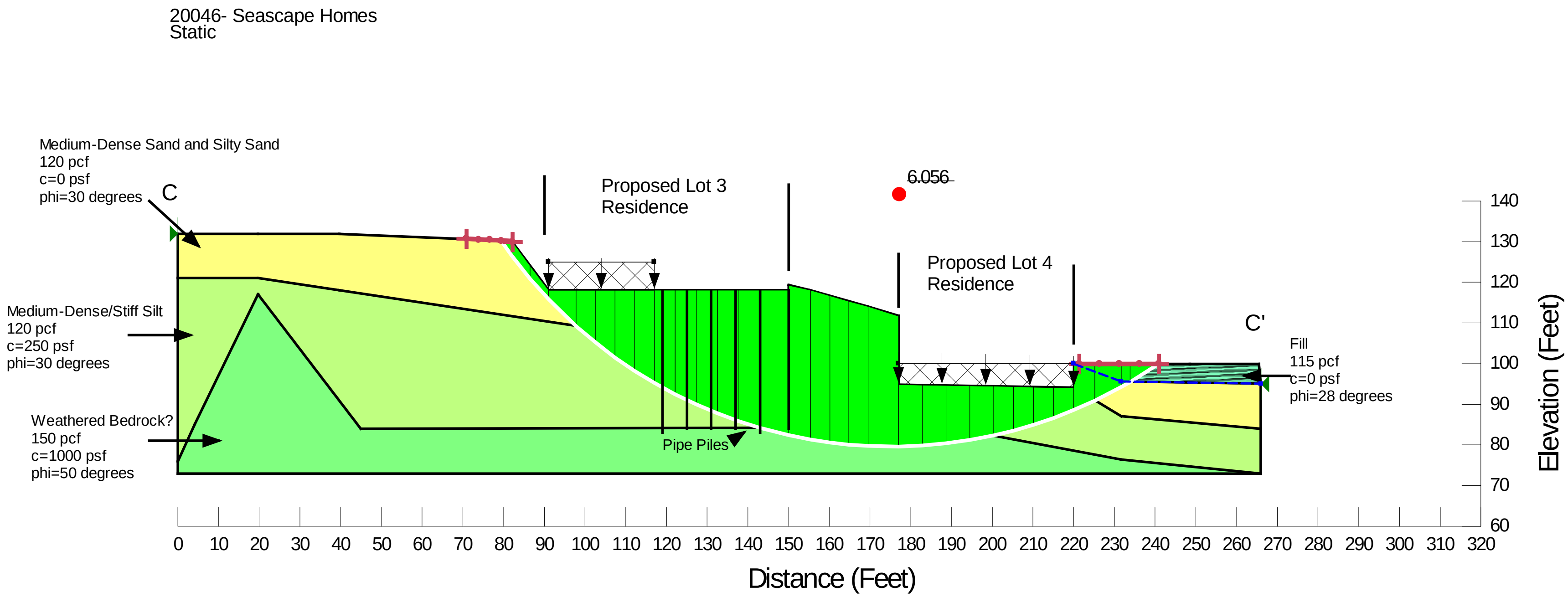

20046- Seascape Homes
Seismic
Medium-Dense Sand and Silty Sand
120 pcf
c=0 psf
phi=30 degrees
C
Medium-Dense/Stiff Silt
120 pcf
c=250 psf
phi=30 degrees
Weathered Bedrock?
150 pcf
c=1000 psf
phi=50 degrees
Proposed Lot 3
Residence
Proposed Lot 4
Residence
2.721
C'
Fill
115 pcf
c=0 psf
phi=28 degrees
Pipe Piles
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320
Distance (Feet)
60 70 80 90 100 110 120 130 140
Elevation (Feet)

20046- Seascape Homes
Static



20046- Seascape Homes
Seismic





20046- Seascape Homes
Static
Medium-Dense Sand and Silty Sand
120 pcf
c=0 psf
phi=30 degrees
C
Medium-Dense/Stiff Silt
120 pcf
c=250 psf
phi=30 degrees
Weathered Bedrock?
150 pcf
c=1000 psf
phi=50 degrees
Proposed Lot 3
Residence
6.056
Proposed Lot 4
Residence
C'
Fill
115 pcf
c=0 psf
phi=28 degrees
Pipe Piles
140
130
120
110
100
90
80
70
60
Elevation (Feet)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320
Distance (Feet)