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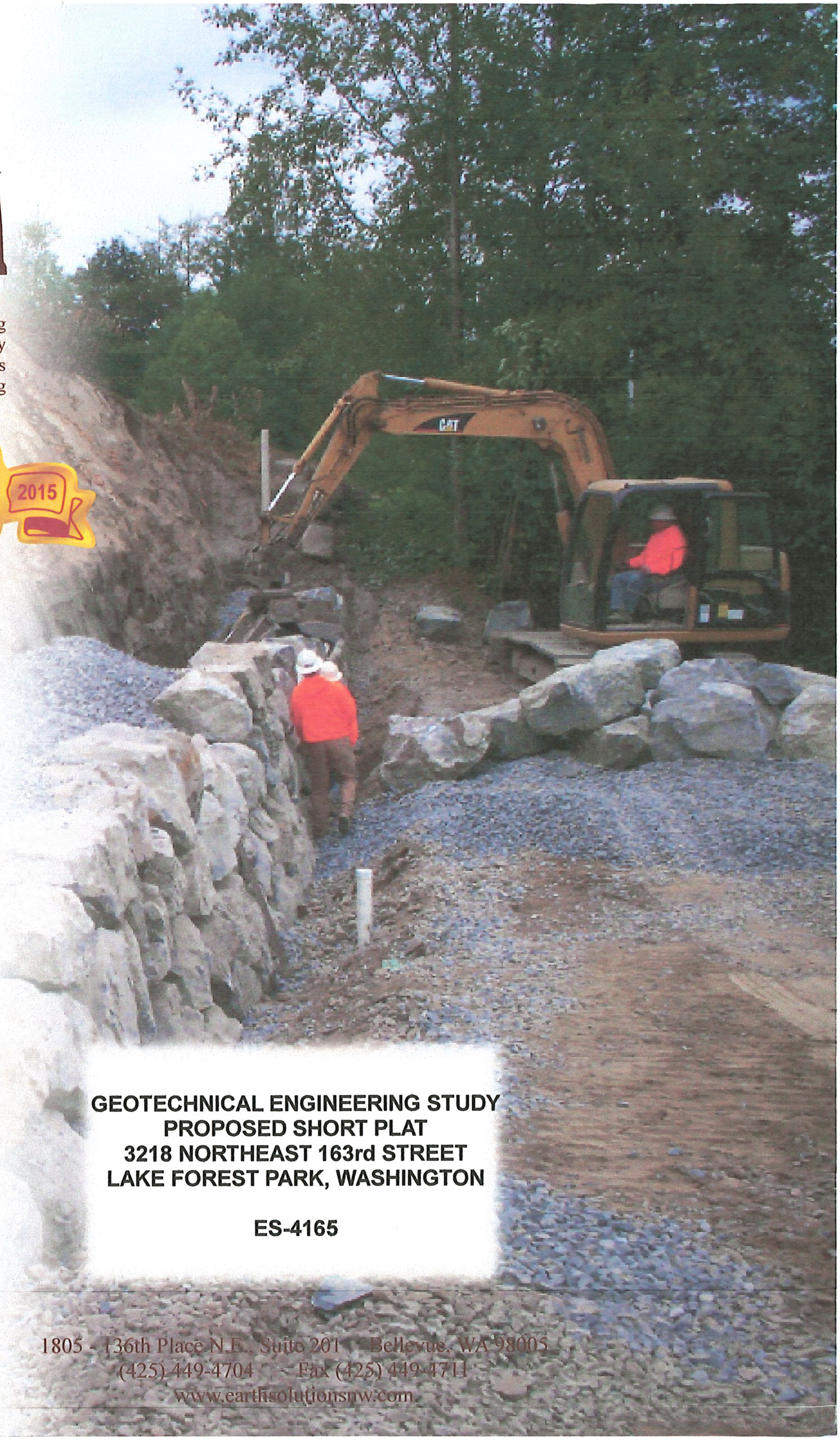

GEOTECHNICAL ENGINEERING STUDY
PROPOSED SHORT PLAT
3218 NORTHEAST 163rd STREET
LAKE FOREST PARK, WASHINGTON

ES-4165

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PREPARED FOR

MR. RICHARD HANSON

October 28, 2015

Keven D. Hoffmann, E.I.T.
Project Engineer

KYLE R. CAMPBELL
STATE OF WASHINGTON
37674
REGISTERED
PROFESSIONAL ENGINEER
10/28/15

Kyle R. Campbell, P.E.
Principal

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Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in-this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

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October 28, 2015
ES-4165

Mr. Richard Hanson
16970 – 65th Lane Northeast
Kenmore, Washington 98028

Earth Solutions NW LLC

- Geotechnical Engineering
- Construction Monitoring
- Environmental Sciences

Dear Mr. Hanson:

Earth Solutions NW, LLC (ESNW) is pleased to present this report titled "Geotechnical Engineering Study, Proposed Short Plat, 3218 Northeast 163rd Street, Lake Forest Park, Washington". In our opinion, construction of a residential short plat is feasible from a geotechnical standpoint. Our investigation indicates the site is underlain by both Vashon advance outwash and Vashon till. During our subsurface exploration completed on October 15, 2015, groundwater seepage was not encountered at the test pit locations. Nonetheless, it is our opinion discrete, perched seepage zones should be anticipated during construction depending on the time of year grading activities take place.

Based on the presence of medium dense to dense Vashon advance outwash at depth along the top of the identified steep slope hazard area, as well as our observations of generally good stability characteristics, it is our opinion the minimum buffer distance from the top of the steep slope hazard area may be reduced to 25 feet. All structures and buildings shall incorporate a 15-foot building setback boundary line as measured from the edge of the steep slope hazard area buffer, and the total "setback buffer" from site steep slopes shall be 40 feet.

In our opinion, the proposed residential structures may be supported atop conventional continuous and spread footing foundations bearing on competent native soil, recompacted native soil, or new structural fill. In general, competent native soil suitable for support of new foundations will be encountered within the upper two to three feet of existing grades. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of the soils to the specifications of structural fill, or overexcavation and replacement with a suitable structural fill material, will be necessary.

Infiltration into the native Vashon advance outwash is feasible from a geotechnical standpoint provided the proposed facility base elevations advance through the upper silty sands and into the relatively clean outwash deposits at depth. Infiltration into the native Vashon till is generally infeasible; however, the Vashon till can likely accommodate rain gardens (bioretention) and other limited-infiltration facilities.

Recommendations for foundation design, site preparation, drainage, and other pertinent development aspects are provided in this study. We appreciate the opportunity to be of service to you on this project. If you have questions regarding the content of this geotechnical engineering study, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

Keven D. Hoffmann, E.I.T.
Project Engineer

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APPENDICES

GEOTECHNICAL ENGINEERING STUDY
PROPOSED SHORT PLAT
3218 NORTHEAST 163RD STREET
LAKE FOREST PARK, WASHINGTON

ES-4165

INTRODUCTION

General

This geotechnical engineering study was prepared for the proposed residential short plat to be completed at 3218 Northeast 163rd Street in Lake Forest Park, Washington. The purpose of this study was to provide geotechnical recommendations for currently proposed development plans. Our scope of services for completing this geotechnical engineering study included the following:

- Completing subsurface test pits for purposes of characterizing site soils;
- Completing laboratory testing of soil samples collected at the test pit locations;
- Conducting engineering analyses, and;
- Preparation of this report.

The following documents and maps were reviewed as part of our report preparation:

- City of Lake Forest Park Municipal Code (LFPMC) Chapter 16.16 titled "Environmentally Sensitive Areas", 2005;
- Geologic Map of Northeastern Seattle (Part of the Seattle North 7.5' x 15' Quadrangle), King County, by Derek B. Booth, Kathy G. Troost, and Scott A. Schimel, 2009;
- Liquefaction Susceptibility of King County (Map 11-5), prepared by the King County Flood Control District, May 2010, and;
- Topographic Survey, prepared by Tyee Surveyors, LLC, dated September 8, 2015.

Project Description

We understand the subject property will be developed with a residential short plat and related infrastructure improvements. A preliminary, proposed development layout was not available for review at the time of report submission; however, the proposal will occur generally within the area between the setback buffer (from northerly facing steep slopes) and the southern property line. We anticipate a shared access driveway will be constructed along either the western or eastern property line in order to provide ingress and egress to each proposed residential lot. Stormwater will likely be managed by either a below-grade detention system, in-situ infiltration facilities, or some combination thereof. Connection to existing City utility systems may also be feasible.

At the time of report submission, specific grading and building load plans were not available for review; however, based on our experience with similar developments, the proposed residential structures will likely be two to three stories in height and constructed utilizing relatively lightly-loaded wood framing supported on conventional foundations. We anticipate the residential structures will incorporate slab-on-grade floors or crawl space construction at grade. We anticipate perimeter footing loads on the order of 1 to 2 kips per lineal foot (klf). Slab-on-grade loading is anticipated to be on the order of 150 pounds per square foot (psf).

If the above design assumptions are incorrect or change, ESNW should be contacted to review the recommendations in this report. ESNW should review final designs to confirm that our geotechnical recommendations have been incorporated into the plans.

SITE CONDITIONS

Surface

The subject site is located approximately 100 feet west of the intersection between Northeast 163rd Street and 33rd Avenue Northeast in Lake Forest Park, Washington. The approximate location of the property is illustrated on Plate 1 (Vicinity Map). The rectangular property is comprised of one tax parcel (King County Parcel No. 797990-0115) totaling approximately 51,000 square feet. The site is enveloped to the north by a ravine and stream corridor, to the west and east by single-family residential lots, and to the south by Northeast 163rd Street.

A single-family residence, barn, and related improvements currently occupy the subject site. We anticipate existing improvements will be removed in lieu of the proposed development. Site topographic change may be characterized as "gentle" within the southern, developed area of the site, with elevation change on the order of 10 feet or less. Site gradients increase to the north of the existing barn (on the order of 10 to 25 percent), and steep slopes, with gradients of 35 to 45 or more percent, are present further north on the property. Based on a cursory review of readily available GIS data, we estimate total grade change across the property is on the order of 110 feet. Existing vegetation is comprised primarily of dense, native tree and brush cover to the north of the existing residence.

Subsurface

An ESNW representative observed, logged, and sampled eight test pits, excavated at accessible locations within the topographically higher, southern portion of the site, on October 15, 2015 using a mini trackhoe and operator retained by our firm. The test pits were completed for purposes of assessing soil conditions, classifying site soils, and investigating the presence of groundwater below the existing ground surface (bgs). The approximate locations of the test pits are depicted on Plate 2 (Test Pit Location Plan). Please refer to the test pit logs provided in Appendix A for a more detailed description of subsurface conditions. Soil samples collected at the test pit locations were analyzed in accordance with both United States Department of Agriculture (USDA) and Unified Soil Classification System (USCS) methods and procedures.

Topsoil and Fill

Where undisturbed, forested conditions were encountered, topsoil was encountered generally within the upper six to eight inches of existing grades at the test pit (TP) locations. Where previous landscaping activities had occurred, topsoil was encountered within the upper two to three inches of existing grades. The topsoil was characterized by brown and dark brown color, the presence of fine organic material, and small root intrusions.

Fill was not explicitly encountered at the test pit locations during our fieldwork. It is possible fill may be encountered within proximity to existing improvements. Where fill is encountered during construction, ESNW should be consulted to evaluate the in-situ competency of the fill and/or the potential for the fill to be re-used as structural fill.

Native Soil

Underlying topsoil, native soils at the test pit locations were encountered as follows:

- Within the northern portion of the proposed development area (TP-1 through TP-5), the upper five to nine feet of native soils consisted chiefly of loose to medium dense, silty sand with gravel (USCS: SM) in a damp condition. Underlying the silty sand, medium dense to dense, poorly graded sand with and without significant silt content (USCS: SP-SM and SP, respectively) was encountered, extending to the termini of the test pits. The predominant grain size of the native soils is "fine" as indicated by laboratory testing. The soils at TP-1 through TP-5 are consistent with the typical makeup of Vashon advance outwash soils.

- Within the southern portion of the proposed development area (TP-6 through TP-8), native soils were comprised of loose to dense, silty sand with gravel (USCS: SM), consistent with the typical makeup of Vashon till soils. The upper two to four feet of the Vashon till was characterized as "weathered", with "unweathered" deposits extending to the termini of the test pits. The predominant grain size of the native soils is "fine" as indicated by laboratory testing. The in-situ moisture content of the native soils at TP-6 through TP-8 was characterized primarily as damp to moist.

Native soils extended to the maximum exploration depth of 10 feet bgs. Caving was not observed within the test pits at the time of our fieldwork.

Geologic Setting

In general, the referenced geologic map resource identifies Vashon till (Qvt) within the southern area of the site and Vashon advance outwash (Qva) within the northern area of the site. According to the geologic map resource, Vashon till is typically a compact diamict of silt, sand, and subrounded to well-rounded gravel which was glacially transported and deposited over ice. Vashon advance outwash is typically well-sorted sand and gravel which was deposited by streams issuing from the advancing ice sheet. Based on our observations at the test pit locations, it is our opinion site soils are consistent with the geologic mapping outlined in this section.

Groundwater

During our subsurface exploration completed on October 15, 2015, groundwater seepage was not encountered at the test pit locations. Nonetheless, it is our opinion discrete, perched groundwater seepage zones may be encountered during construction, particularly within excavations at depth for utility improvements (where necessary). Groundwater seepage rates and elevations fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, groundwater flow rates are higher during the wetter, winter months.

Environmentally Sensitive Areas

As part of our report completion, we investigated the presence of environmentally sensitive areas (ESAs) on site. Based on our review, the sole geotechnically relevant ESA on site is a steep slope hazard, due to the presence of northerly facing, descending steep slopes primarily within the northern half of the site.

Steep Slope Hazard

The City defines "steep slope hazard areas" as "areas not composed of consolidated rock with slope gradients of 40 percent or greater within a vertical elevation change of at least 10 feet". In accordance with the City definition, steep slopes are present within the northern half of the site. LFPMC Section 16.16.310A states a minimum buffer distance of 50 feet must be established horizontally from the top, toe, and along all sides of any slope 40 percent of greater. A minimum buffer distance reduction to 25 feet may be acceptable provided a "qualified professional" demonstrates the reduction will protect both the proposed development and adjacent developments, as well as proposed uses and the steep slope hazard area.

As indicated in the *Subsurface* section of this report, native soils along the top of the steep slope hazard area, specifically at TP-1 and TP-2, were comprised primarily of medium dense to dense Vashon advance outwash. Based on our visual observations, the native soils are competent and exhibit good stability characteristics. Due to the presence of relatively clean fine sand at depth, we anticipate the native soils remain relatively well drained throughout wet weather conditions. Accordingly, in consideration of these site-specific geotechnical observations and conclusions, it is our opinion the minimum buffer distance from the top of the steep slope hazard area may be reduced to 25 feet. All structures and buildings shall incorporate a 15-foot building setback boundary line (BSBL) as measured from the edge of the steep slope hazard area buffer, and the total "setback buffer" from site steep slopes shall be 40 feet.

Additional Considerations

LFPMC Section 16.16.310D requires that steep slope alterations shall:

1) Not decrease slope stability on the site or on adjoining properties, and;

2) Be subject to certification by a qualified professional that the landslide hazard area can be modified safely or that the development proposal eliminates or mitigates the landslide hazard risk to the property or adjacent property, and;

3) Not adversely impact other sensitive areas, such as streams, and;

4) Not result in an increase in peak surface water flows or sedimentation to adjacent properties.

ESNW can provide further evaluation of the proposed development, with respect to compliance with the LFPMC criteria outlined in this section, upon request. At the time of report preparation, specific lot layouts and preliminary site design information were not available for review; however, provided both the 25-foot minimum steep slope hazard area buffer and the 15-foot BSBL are incorporated into final designs, it is our opinion the proposal will likely satisfy the above-listed LFPMC criteria from a geotechnical standpoint.

DISCUSSION AND RECOMMENDATIONS

General

In our opinion, construction of a residential short plan on the subject site is feasible from a geotechnical standpoint. The primary geotechnical considerations associated with the proposed development include foundation support, slab-on-grade subgrade support, the suitability of using on-site soils as structural fill, and permanent stormwater management facility design and construction.

In our opinion, the proposed residential structures may be supported atop conventional continuous and spread footing foundations bearing on competent native soil, recompacted native soil, or new structural fill. In general, competent native soil suitable for support of new foundations will be encountered within the upper two to three feet of existing grades. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of the soils to the specifications of structural fill, or overexcavation and replacement with a suitable structural fill material, will be necessary.

Infiltration into the native Vashon advance outwash is feasible from a geotechnical standpoint provided the proposed facility base elevations advance through the upper silty sands and into the relatively clean outwash deposits at depth. Infiltration into the native Vashon till is generally infeasible; however, the Vashon till can likely accommodate rain gardens (bioretention) and other limited-infiltration facilities.

This study has been prepared for the exclusive use of Mr. Richard Hanson and his representatives. No warranty, expressed or implied, is made. This study has been prepared in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area.

Site Preparation and Earthwork

Initial site preparation activities will consist of installing temporary erosion control measures, establishing grading limits, removing existing structural improvements, and performing clearing and site stripping (as necessary). Subsequent earthwork activities will involve mass site grading and related infrastructure improvements.

Temporary Erosion Control

Prior to finished pavement installation, temporary construction entrances and drive lanes, consisting of at least 12 inches of quarry spalls, should be considered in order to minimize off-site soil tracking and to provide a stable access entrance surface. Geotextile fabric may also be considered underlying the quarry spalls for greater stability of the temporary construction entrance. Erosion control measures should consist of silt fencing placed around down gradient margins of the site. Soil stockpiles should be covered or otherwise protected to reduce soil erosion. Temporary approaches for controlling surface water runoff should be established prior to beginning earthwork activities. Additional Best Management Practices (BMPs), as specified by the project civil engineer and indicated on the plans, should be incorporated into construction activities.

Stripping

In general, where undisturbed, forested conditions were encountered, topsoil was observed within the upper six to eight inches of existing grades at the test pit locations. ESNW should be retained to observe site stripping activities at the time of construction in order to assess the required degree of stripping. Over-stripping should be avoided as it is unnecessary and may result in increased project development costs. Topsoil and organic-rich soil is neither suitable for foundation support nor for use as structural fill. Topsoil and organic-rich soil may be used in non-structural areas if desired.

In-situ Soils

From a geotechnical standpoint, in general, our field observations indicate on-site soils likely to be encountered during construction will be suitable for use as structural fill, provided the soil moisture content is at (or slightly above) the optimum level at the time of placement and compaction. Site soils nearest to existing surface grades should be considered moderately to highly moisture sensitive, and successful use of on-site soils as structural fill will largely be dictated by the moisture content at the time of placement and compaction.

In general, soil that is near, or slightly above, the optimum moisture content at the time of placement and compaction may be used as structural fill. Conversely, soil that is found to be dry at the time of installation will likely require moisture conditioning (typically achieved through the application of water) prior to soil compaction. Soil encountered during site excavations that is excessively over the optimum moisture content will likewise require moisture conditioning (typically achieved through soil aeration) prior to placement and compaction. It should be emphasized native material should never be placed and compacted dry of the optimum moisture content, especially in site utility trench applications. If the on-site soils cannot be successfully compacted, the use of an imported soil may be necessary.

Imported Soils

Where necessary, imported soil intended for use as structural fill should consist of a well-graded granular soil with a moisture content that is at or slightly above the optimum level. During wet weather conditions, imported soil intended for use as structural fill should consist of a well-graded granular soil with a fines content of 5 percent or less (defined as the percent passing the Number 200 sieve, based on the minus three-quarter inch fraction).

Subgrade Preparation

Following the removal of the existing structure and the associated outbuilding(s), grading activities will likely be necessary in order to establish proposed subgrade and/or finish grade elevations for the proposed structures. ESNW should observe the subgrades during initial site preparation activities to confirm soil conditions and to provide supplementary recommendations for subgrade preparation, where necessary. The process of removing the existing structures may produce voids where the old foundations are removed from and where crawl space areas may have been present. Complete restoration of voids from the old foundation areas must be executed as part of overall subgrade and building pad preparation activities. The following guidelines for preparing building subgrade areas should be incorporated into the final design:

- Where voids and related demolition disturbances extend below planned subgrade elevations, restoration of these areas should be completed using structural fill to restore voids or unstable areas resulting from the removal of existing structural elements.

- Recompact, or overexcavate and replace, areas of existing fill exposed at building subgrade elevations. Overexcavations should extend into competent native soils and structural fill should be used to restore subgrade elevations.

- ESNW should confirm subgrade conditions and the required level of recompaction, or overexcavation and replacement, during site preparation activities, as well as the overall suitability of prepared subgrade areas following site preparation activities.

Structural Fill

Structural fill is defined as compacted soil placed in foundation, slab-on-grade, and roadway areas. Fills placed to construct permanent slopes and throughout retaining wall and utility trench backfill areas are also considered structural fill. Soils placed in structural areas should be placed in loose lifts of 12 inches or less and compacted to a relative compaction of at least 90 percent, based on the laboratory maximum dry density as determined by the Modified Proctor Method (ASTM D1557). Soil placed in the upper 12 inches of slab-on-grade, utility trench, and pavement areas should be compacted to a relative compaction of at least 95 percent. More stringent compaction specifications may be required for utility trench backfill zones depending on the responsible utility district or jurisdiction.

Foundations

In our opinion, the proposed residential structures may be supported atop conventional continuous and spread footing foundations bearing on competent native soil, recompacted native soil, or new structural fill. In general, competent native soil suitable for support of new foundations will be encountered within the upper two to three feet of existing grades. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of the soils to the specifications of structural fill, or overexcavation and replacement with a suitable structural fill material, will be necessary.

Provided foundations will be supported as described above, the following parameters may be used for design:

- Allowable soil bearing capacity 2,500 psf
- Passive earth pressure 300 pcf (equivalent fluid)
- Coefficient of friction 0.35

A one-third increase in the allowable soil bearing capacity may be assumed for short-term wind and seismic loading conditions. The above passive pressure and friction values include a minimum factor-of-safety of 1.5. With structural loading as expected, total settlement in the range of one inch, as well as differential settlement of approximately one-half inch, is anticipated. The majority of the settlements should occur during construction as dead loads are applied.

Seismic Design

The 2012 International Building Code recognizes the American Society of Civil Engineers (ASCE) for seismic site class definitions. In accordance with Table 20.3-1 of the ASCE Minimum Design Loads for Buildings and Other Structures manual, Site Class D should be used for design.

The referenced liquefaction susceptibility map indicates the site and surrounding areas maintain either very low, low, or low to moderate liquefaction susceptibility. Liquefaction is a phenomenon where saturated or loose soils suddenly lose internal strength and behave as a fluid. This behavior is in response to increased pore water pressures resulting from an earthquake or other intense ground shaking. Based on our field observations, it is our opinion site susceptibility to liquefaction during a seismic event may be considered low. The Vashon advance outwash within the northern portion of the site was encountered primarily in a medium dense to dense state and without the presence of a uniformly established, shallow groundwater table. Competent Vashon till, as encountered within the southern portion of the site, is not typically susceptible to liquefaction during a seismic event.

Slab-on-Grade Floors

Slab-on-grade floors for the proposed residential structures should be supported on a firm and unyielding subgrade. Where feasible, native soil likely to be exposed at the slab-on-grade subgrade levels can be compacted in situ to the specifications of structural fill. Unstable or yielding areas of the subgrade should be recompacted, or overexcavated and replaced with suitable structural fill, prior to construction of the slab.

A capillary break consisting of at least four inches of free-draining crushed rock or gravel should be placed below the slab. The free-draining material should have a fines content of 5 percent or less (percent passing the Number 200 sieve, based on the minus three-quarter inch fraction). In areas where slab moisture is undesirable, installation of a vapor barrier below the slab should be considered. If a vapor barrier is to be utilized, it should be a material specifically designed for use as a vapor barrier and should be installed in accordance with the specifications of the manufacturer.

Retaining Walls

Retaining walls must be designed to resist earth pressures and applicable surcharge loads. The following parameters may be used for design:

- Active earth pressure (yielding condition) — 35 pcf (equivalent fluid)
- At-rest earth pressure (restrained condition) — 55 pcf
- Traffic surcharge* (passenger vehicles) — 70 psf (rectangular distribution)
- Passive earth pressure — 300 pcf (equivalent fluid)
- Coefficient of friction — 0.35
- Seismic surcharge — 7H psf**

* *Where applicable*
** *Where H equals the retained height (in feet)*

The above design parameters are based on a level backfill condition and level grade at the wall toe. Revised design values will be necessary if sloping grades are to be used above or below retaining walls. Additional surcharge loading from adjacent foundations, sloped backfill, or other relevant loads should be included in the retaining wall design.

Retaining walls should be backfilled with free-draining material that extends along the height of the wall and a distance of at least 18 inches behind the wall. The upper 12 inches of the wall backfill can consist of a less permeable soil, if desired. A perforated drain pipe should be placed along the base of the wall and connected to an approved discharge location. A typical retaining wall drainage detail is provided on Plate 3. If drainage is not provided, hydrostatic pressures should be included in the wall design.

Drainage

Although groundwater was not explicitly encountered at the test pit locations during our fieldwork, it is our opinion discrete, perched groundwater seepage zones should be anticipated within site excavations depending on the time of year grading operations take place, particularly within excavations at depth for site utilities (where necessary). Temporary measures to control surface water runoff and groundwater during construction would likely involve interceptor trenches and sumps. ESNW should be consulted during preliminary grading to identify areas of seepage and to provide recommendations to reduce the potential for instability related to seepage effects.

Finish grades must be designed to direct surface drain water away from structures and slopes. Water must not be allowed to pond adjacent to structures or slopes. In our opinion, due to the fine sandy nature of native soils, foundation drains should be installed along building perimeter footings. A typical foundation drain detail is provided on Plate 4.

Infiltration Feasibility

As indicated in the *Subsurface* section of this report, native soils encountered during our fieldwork were characterized primarily as either Vashon advance outwash or Vashon till within the northern and southern portions of the proposed development area, respectively. Subsequent to USDA textural analyses, the relatively clean Vashon advance outwash was further classified as either slightly gravelly sand or very gravelly sand, and the Vashon till was further classified as gravelly loamy sand. Irrespective of gravel content, the fines contents of the relatively clean Vashon advance outwash and Vashon till were on the order of 2 to 8 percent and 21 to 23 percent, respectively.

From a geotechnical standpoint, the Vashon advance outwash is feasible for infiltration facility design provided the proposed facility base elevations are advanced through the upper silty sands and into the relatively clean outwash deposits at depth. The Vashon till should not be considered an ideal geologic feature to accommodate infiltration, especially when encountered in a dense, compact state. It should be noted Vashon till can likely accommodate construction of rain gardens (bioretention) and other limited-infiltration facilities. ESNW can provide further evaluation of, and recommendations for, stormwater flow control BMPs upon request, including recommendations for design infiltration rates and completion of in-situ infiltration testing.

Excavations and Slopes

The Federal Occupation Safety and Health Administration (OSHA) and the Washington Industrial Safety and Health Act (WISHA) provide soil classification in terms of temporary slope inclinations. Soils that exhibit a high compressive strength are allowed steeper temporary slope inclinations than are soils that exhibit a lower compressive strength.

Based on the soil conditions encountered at the test pit locations, site soils are classified as Type C by OSHA and WISHA. Temporary slopes over four feet in height in Type C soils must be sloped no steeper than one-and-one-half horizontal to one vertical (1.5H:1V). Where encountered, the presence of perched groundwater may cause caving of the temporary slopes due to hydrostatic pressure. ESNW should observe site excavations to confirm soil types and allowable slope inclinations. If the recommended temporary slope inclinations cannot be achieved, temporary shoring may be necessary to support excavations.

Permanent slopes should be planted with vegetation to enhance stability and to minimize erosion and should maintain a gradient of 2H:1V or flatter. An ESNW representative should observe temporary and permanent slopes to confirm the slope inclinations are suitable for the exposed soil conditions. Supplementary recommendations with respect to excavations and slopes may be provided as conditions warrant.

Pavement Sections

The performance of site pavements is largely related to the condition of the underlying subgrade. To ensure adequate pavement performance, the subgrade should be in a firm and unyielding condition when subjected to proofrolling with a loaded dump truck. Structural fill in pavement areas should be compacted to the specifications previously detailed in this report. It is possible that soft, wet, or otherwise unsuitable subgrade areas may still exist after base grading activities. Areas containing unsuitable or yielding subgrade conditions will require remedial measures, such as overexcavation and replacement with crushed rock or structural fill, prior to pavement.

We anticipate new pavement sections will be subjected primarily to passenger vehicle traffic. For lightly loaded pavement areas subjected primarily to passenger vehicles, the following preliminary pavement sections may be considered:

- A minimum of two inches of hot mix asphalt (HMA) placed over four inches of crushed rock base (CRB), or;
- A minimum of two inches of HMA placed over three inches of asphalt treated base (ATB).

The HMA, ATB and CRB materials should conform to WSDOT specifications. All soil base material should be compacted to a relative compaction of 95 percent, based on the laboratory maximum dry density as determined by ASTM D1557. Final pavement design parameters, including recommendations for heavy traffic areas or access roads, may be provided once final traffic loading has been determined. Road standards utilized by the City of Lake Forest Park may supersede the recommendations provided in this report.

Utility Support and Trench Backfill

In our opinion, on-site soils will generally be suitable for support of utilities. Remedial measures may be necessary in some areas in order to provide support for utilities, such as overexcavation and replacement with structural fill, or placement of geotextile fabric. Groundwater seepage may be encountered within utility excavations and caving of trench walls may occur where groundwater is encountered. Depending on the time of year and conditions encountered, dewatering, as well as temporary trench shoring, may be necessary during utility excavation and installation.

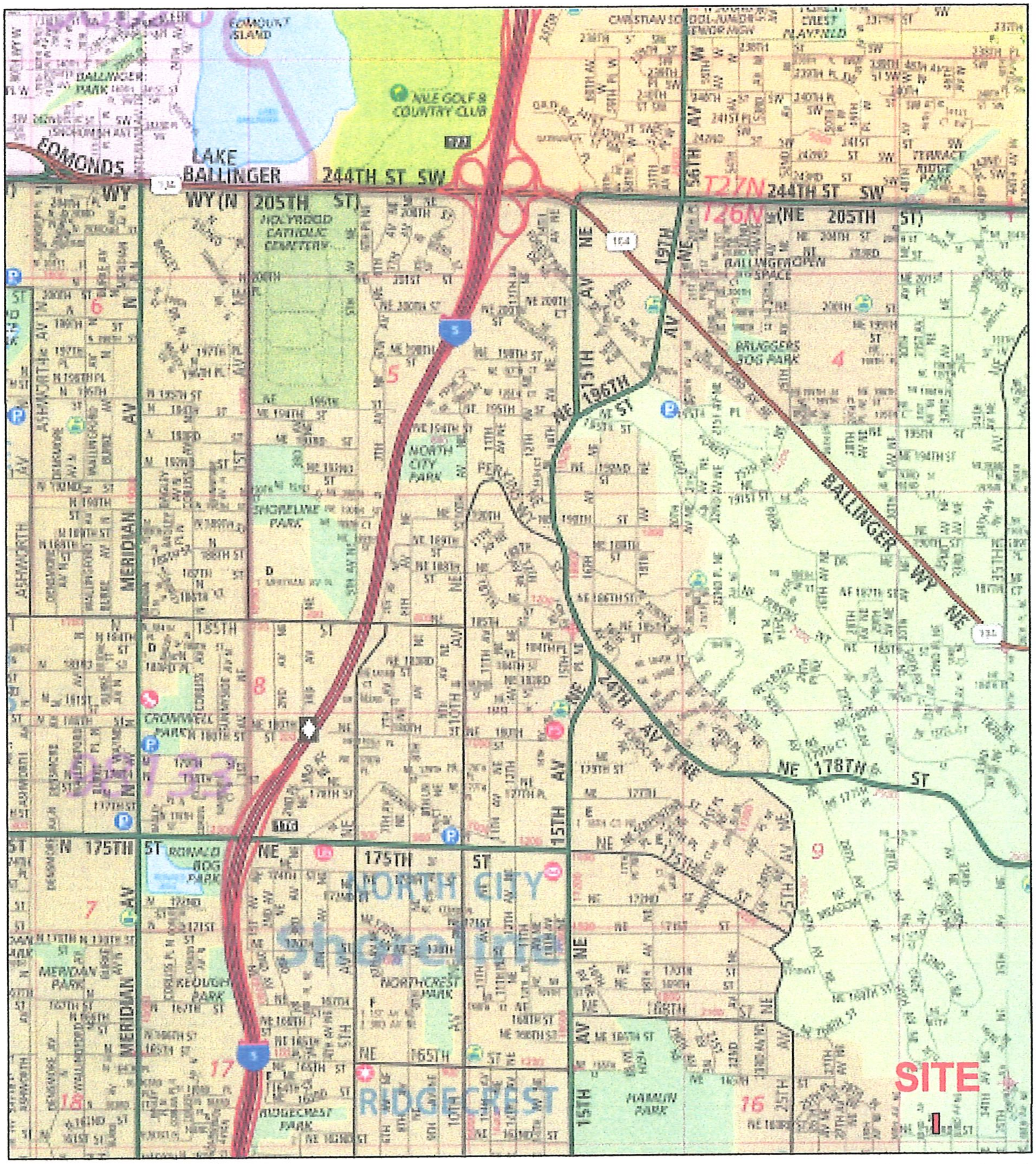
In general, on-site soils will likely be suitable for use as structural backfill throughout utility trench excavations provided the soil is at or near the optimum moisture content at the time of placement and compaction. Moisture conditioning of the soils may be necessary at some locations prior to use as structural fill. Each section of the utility lines must be adequately supported in the bedding material. Utility trench backfill should be placed and compacted to the specifications of structural fill as previously detailed in this report, or to the applicable specifications of the City of Lake Forest Park or other responsible jurisdiction or agency.

LIMITATIONS

The recommendations and conclusions provided in this geotechnical engineering study are professional opinions consistent with the level of care and skill that is typical of other members in the profession currently practicing under similar conditions in this area. A warranty is neither expressed nor implied. Variations in the soil and groundwater conditions observed at the test pit locations may exist and may not become evident until construction. ESNW should reevaluate the conclusions in this geotechnical engineering study if variations are encountered.

Additional Services

ESNW should have an opportunity to review final project plans with respect to geotechnical recommendations provided in this report. ESNW should also be retained to provide testing and consultation services during construction.



Reference:
Lake Forest Park, Washington
Map 475
By The Thomas Guide
Rand McNally
32nd Edition

NORTH

Earth Solutions NWLLC
Geotechnical Engineering, Construction Monitoring and Environmental Sciences

Vicinity Map
Hanson Short Plat
Lake Forest Park, Washington

Drwn. MRS	Date 10/22/2015	Proj. No. 4165
Checked KDH	Date Oct. 2015	Plate 1

NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

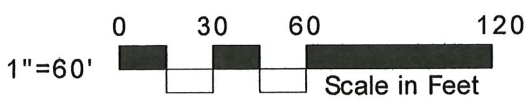
LEGEND

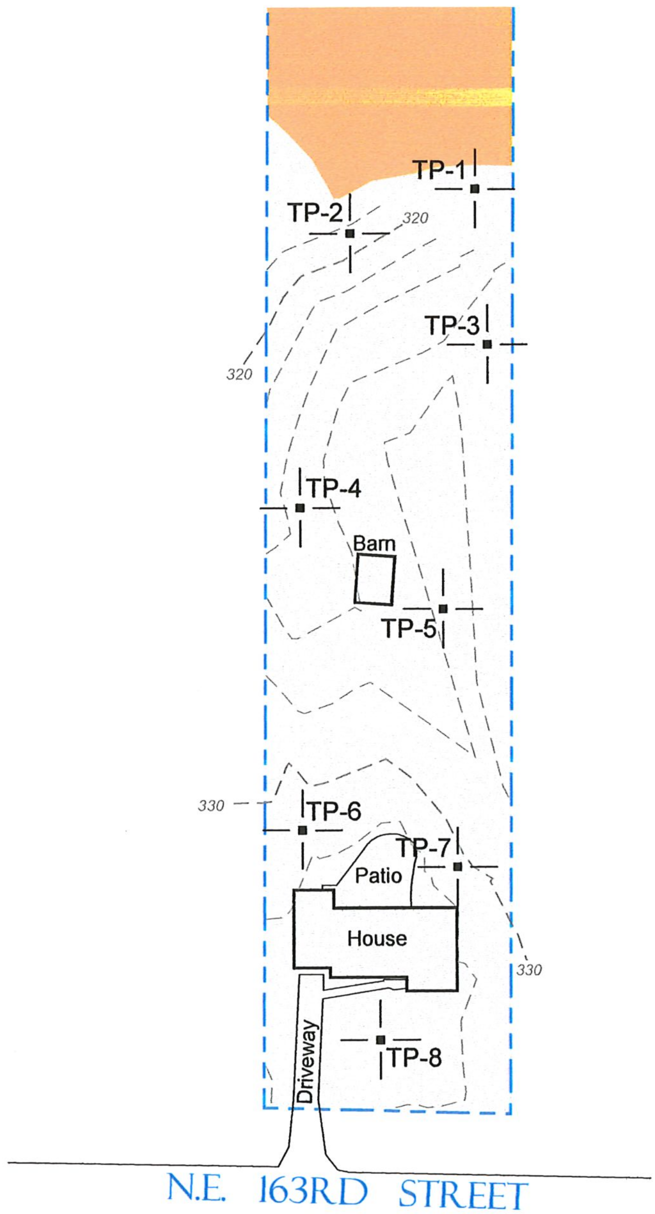
TP-1 — Approximate Location of ESNW Test Pit, Proj. No. ES-4165, Oct. 2015

Subject Site

Existing Building

Area of Slopes at 35% to 45%





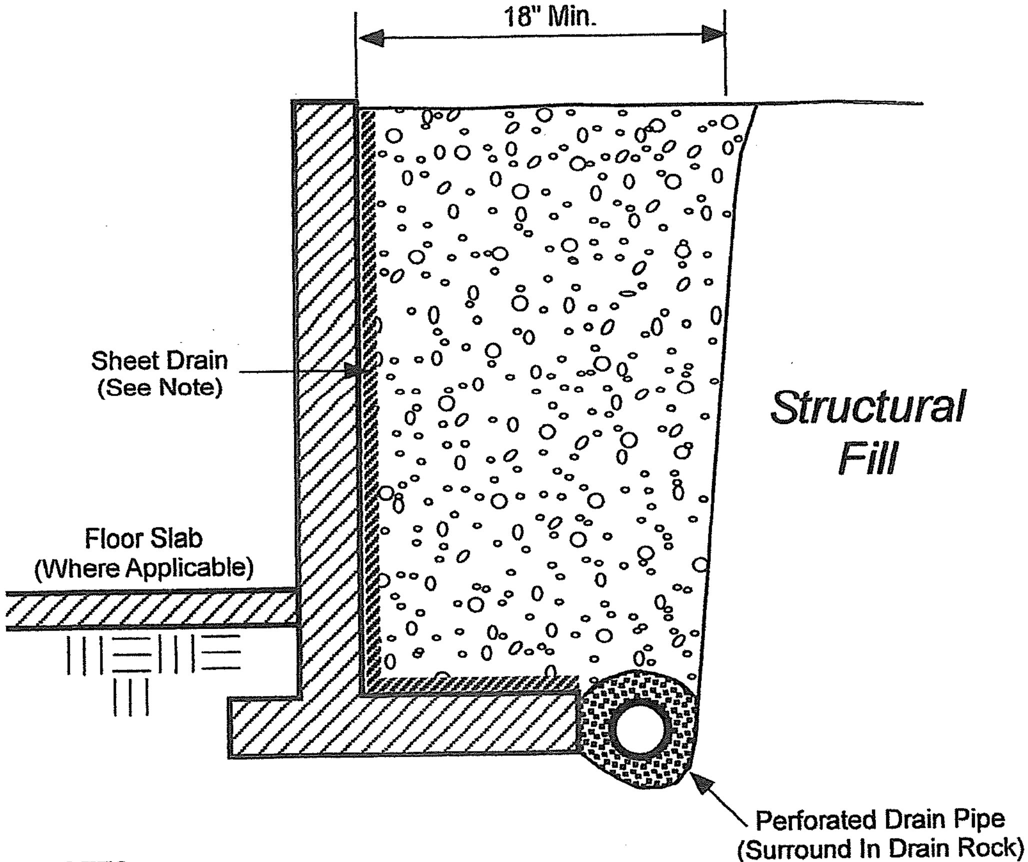
NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided by the client at the time of our study. ESNW cannot be responsible for subsequent design changes or interpretation of the data by others.

NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NW LLC
Geotechnical Engineering, Construction Monitoring and Environmental Sciences

Test Pit Location Plan
Hanson Short Plat
Lake Forest Park, Washington

Drwn. MRS	Date 10/22/2015	Proj. No. 4165
Checked KDH	Date Oct. 2015	Plate 2



NOTES:

- Free Draining Backfill should consist of soil having less than 5 percent fines. Percent passing #4 should be 25 to 75 percent.
- Sheet Drain may be feasible in lieu of Free Draining Backfill, per ESNW recommendations.
- Drain Pipe should consist of perforated, rigid PVC Pipe surrounded with 1" Drain Rock.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

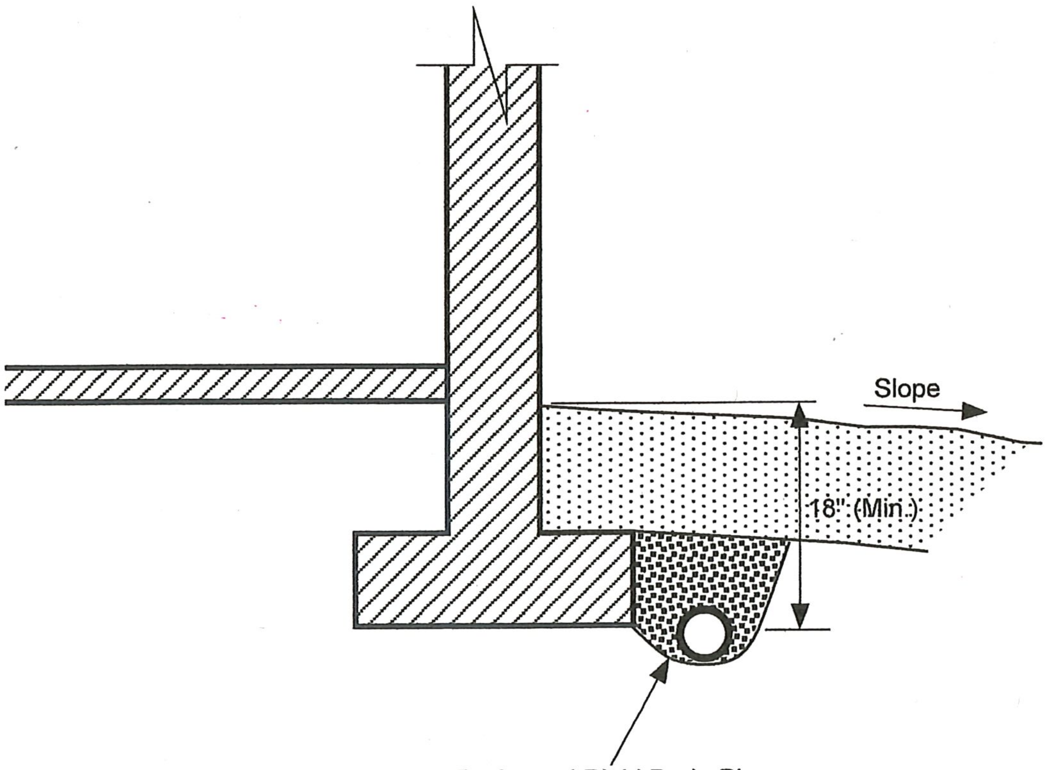
Free-Draining Structural Backfill

1-inch Drain Rock

Earth Solutions NW LLC
Geotechnical Engineering, Construction Monitoring and Environmental Sciences

RETAINING WALL DRAINAGE DETAIL
Hanson Short Plat
Lake Forest Park, Washington

Drwn. MRS	Date 10/22/2015	Proj. No. 4165
Checked KDH	Date Oct. 2015	Plate 3

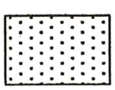


NOTES:

- Do NOT tie roof downspouts to Footing Drain.
- Surface Seal to consist of 12" of less permeable, suitable soil. Slope away from building.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:


Surface Seal; native soil or other low permeability material.


1" Drain Rock

Earth Solutions NW LLC
Geotechnical Engineering, Construction Monitoring and Environmental Sciences

FOOTING DRAIN DETAIL
Hanson Short Plat
Lake Forest Park, Washington

Drwn. MRS	Date 10/22/2015	Proj. No. 4165
Checked KDH	Date Oct. 2015	Plate 4

Appendix A

Subsurface Exploration
Test Pit Logs

ES-4165

The subsurface conditions at the site were explored on October 15, 2015 by excavating eight test pits using a mini trackhoe and operator retained by our firm. The approximate locations of the subsurface exploration test pits are illustrated on Plate 2 of this study. The test pit logs are provided in this Appendix. The test pits were advanced to a maximum depth of 10 feet bgs.

The final logs represent the interpretations of the field logs and the results of laboratory analyses. The stratification lines on the logs represent the approximate boundaries between soil types. In actuality, the transitions may be more gradual.

Earth Solutions NWLLC

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

DUAL SYMBOLS are used to indicate borderline soil classifications.

The discussion in the text of this report is necessary for a proper understanding of the nature of the material presented in the attached logs.

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-1

CLIENT Mr. Richard Hanson
PROJECT NAME Hanson Short Plat
PROJECT NUMBER 4165
PROJECT LOCATION Lake Forest Park, Washington
DATE STARTED 10/15/15 **COMPLETED** 10/15/15
GROUND ELEVATION 316 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY KDH **CHECKED BY** KDH
AT END OF EXCAVATION ---
NOTES Depth of Topsoil & Sod 6"- 8": duff, brush
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		0.6 Dark brown TOPSOIL, roots to 3' — 315.4
		MC = 3.80%	SP-SM		Brown poorly graded fine SAND with silt, loose, damp -cobbles, scattered small boulders to BOH 3.0 — 313.0
5		MC = 2.40% Fines = 18.80% MC = 2.90%	SM		Tan silty fine SAND with gravel, medium dense, damp [USDA Classification: gravelly loamy SAND] 8.5 — 307.5
10		MC = 7.60%	SP-SM		Tan poorly graded fine SAND with silt, medium dense to dense, damp 10.0 — 306.0

Test pit terminated at 10.0 feet below existing grade. No groundwater encountered during excavation.

Bottom of test pit at 10.0 feet.

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Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-2

CLIENT Mr. Richard Hanson
PROJECT NAME Hanson Short Plat
PROJECT NUMBER 4165
PROJECT LOCATION Lake Forest Park, Washington
DATE STARTED 10/15/15 COMPLETED 10/15/15
GROUND ELEVATION 318 ft TEST PIT SIZE
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY KDH CHECKED BY KDH
AT END OF EXCAVATION ---
NOTES Depth of Topsoil & Sod 6"- 8": brush, duff
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		0.6 Dark brown TOPSOIL, roots to 3' — 317.4
		MC = 7.60%	SM		Brown silty SAND, loose, damp -cobbles, small boulders to BOH
		MC = 2.00%			-becomes tan silty fine SAND with gravel, medium dense, damp
5		MC = 2.90% Fines = 1.80%			6.0 — 312.0
			SP		Tan poorly graded SAND, medium dense to dense, damp [USDA Classification: slightly gravelly SAND] 8.0 — 310.0
			SP-SM		Tan poorly graded fine SAND with silt, medium dense to dense, damp -iron oxide staining 10.0 — 308.0
10		MC = 4.60%			Test pit terminated at 10.0 feet below existing grade. No groundwater encountered during excavation. Bottom of test pit at 10.0 feet.

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-3

CLIENT Mr. Richard Hanson
PROJECT NAME Hanson Short Plat
PROJECT NUMBER 4165
PROJECT LOCATION Lake Forest Park, Washington
DATE STARTED 10/15/15 **COMPLETED** 10/15/15
GROUND ELEVATION 327 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY KDH **CHECKED BY** KDH
AT END OF EXCAVATION ---
NOTES Depth of Topsoil & Sod 6": duff, brush
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL, roots to 3.5'	
0.6			SM		Brown silty fine SAND with gravel, loose, damp	326.4
					-cobbles to BOH	
		MC = 3.90%			-becomes tan, medium dense	
5		MC = 3.70%			-becomes dense	
					-weak cementation	
7.0		MC = 2.50%	SP-SM		Tan poorly graded SAND with silt, medium dense to dense, damp	320.0
10.0		MC = 5.40%			Test pit terminated at 10.0 feet below existing grade. No groundwater encountered during excavation. Bottom of test pit at 10.0 feet.	317.0

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-4

CLIENT Mr. Richard Hanson
PROJECT NAME Hanson Short Plat
PROJECT NUMBER 4165
PROJECT LOCATION Lake Forest Park, Washington
DATE STARTED 10/15/15 **COMPLETED** 10/15/15
GROUND ELEVATION 325 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION —
LOGGED BY KDH **CHECKED BY** KDH
AT END OF EXCAVATION —
NOTES Depth of Topsoil & Sod 6": duff, wood debris
AFTER EXCAVATION —

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL, roots to 4'	
				0.6		324.4
			SM		Brown silty fine SAND, loose, damp -cobbles to BOH -becomes tan silty fine SAND with gravel, medium dense, damp	
		MC = 5.70%				
5						
				6.0		319.0
		MC = 7.00%			Test pit terminated at 6.0 feet below existing grade. No groundwater encountered during excavation. Bottom of test pit at 6.0 feet.	

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-5

CLIENT Mr. Richard Hanson
PROJECT NAME Hanson Short Plat
PROJECT NUMBER 4165
PROJECT LOCATION Lake Forest Park, Washington
DATE STARTED 10/15/15 **COMPLETED** 10/15/15
GROUND ELEVATION 328 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY KDH **CHECKED BY** KDH
AT END OF EXCAVATION ---
NOTES Depth of Topsoil & Sod 6"- 7": brush, duff
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION	
0			TPSL		0.6	Dark brown TOPSOIL, roots to 4'	327.4
		MC = 5.60%	SM		4.5	Brown silty fine SAND, loose, damp -cobbles to BOH -becomes medium dense	323.5
5		MC = 3.60% MC = 3.00% Fines = 4.00%	SP		7.0	Brown poorly graded SAND with gravel, dense, damp to moist -weak cementation -increased gravel content [USDA Classification: very gravelly SAND]	321.0

Test pit terminated at 7.0 feet below existing grade. No groundwater encountered during excavation.

Bottom of test pit at 7.0 feet.

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-6

CLIENT Mr. Richard Hanson
PROJECT NAME Hanson Short Plat
PROJECT NUMBER 4165
PROJECT LOCATION Lake Forest Park, Washington
DATE STARTED 10/15/15 **COMPLETED** 10/15/15
GROUND ELEVATION 331 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY KDH **CHECKED BY** KDH
AT END OF EXCAVATION ---
NOTES Depth of Topsoil & Sod 7": grass
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL	0.6	Dark brown TOPSOIL, roots to 4'
		MC = 5.90%	SM		Brown silty SAND with gravel, loose to medium dense, damp (Weathered Till) 330.4 -cobbles to BOH -becomes medium dense
5		MC = 4.60% Fines = 13.50%		5.5	-becomes tan, medium dense to dense, damp to moist (unweathered till) [USDA Classification: very gravelly loamy SAND]
					Test pit terminated at 5.5 feet below existing grade. No groundwater encountered during excavation. 325.5 Bottom of test pit at 5.5 feet.

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-7

CLIENT Mr. Richard Hanson
PROJECT NAME Hanson Short Plat
PROJECT NUMBER 4165
PROJECT LOCATION Lake Forest Park, Washington
DATE STARTED 10/15/15 **COMPLETED** 10/15/15
GROUND ELEVATION 331 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY KDH **CHECKED BY** KDH
AT END OF EXCAVATION ---
NOTES Depth of Topsoil & Sod 2": grass
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					Brown silty SAND, loose to medium dense, moist (Weathered Till) -trace gravel -scattered roots to 4' -cobbles to BOH -becomes medium dense
		MC = 9.30%	SM		
					-becomes tannish gray silty SAND with gravel, medium dense to dense (unweathered till)
5		MC = 8.70%		5.0	326.0
					Test pit terminated at 5.0 feet below existing grade. No groundwater encountered during excavation. Bottom of test pit at 5.0 feet.

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-8

CLIENT Mr. Richard Hanson
PROJECT NAME Hanson Short Plat
PROJECT NUMBER 4165
PROJECT LOCATION Lake Forest Park, Washington
DATE STARTED 10/15/15 **COMPLETED** 10/15/15
GROUND ELEVATION 333 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY KDH **CHECKED BY** KDH
AT END OF EXCAVATION ---
NOTES Depth of Topsoil & Sod 2"- 3": grass
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					Brown silty SAND with gravel, loose to medium dense, moist (Weathered Till)
		MC = 7.00% Fines = 17.80%	SM		[USDA Classification: gravelly loamy SAND] -becomes tannish gray, medium dense to dense (unweathered till) -weak to moderate cementation
					-becomes dense
		MC = 9.70%		4.5	328.5
					Test pit terminated 4.5 feet below existing grade. No groundwater encountered during excavation. Bottom of test pit at 4.5 feet.

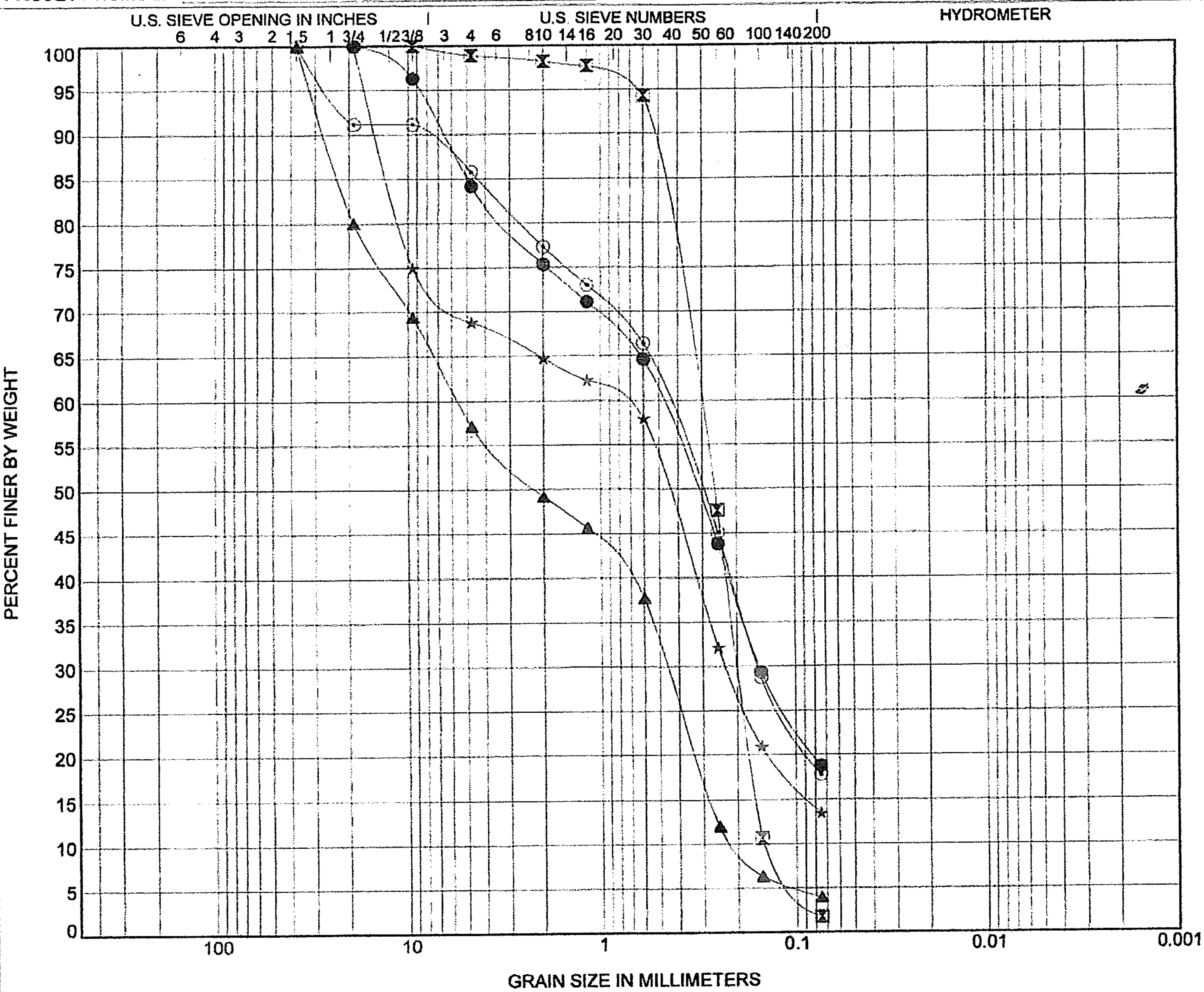
GENERAL BH / TP / WELL 4165.GPJ GINT US.GDT 10/22/15

GRAIN SIZE DISTRIBUTION

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, WA 98005
Telephone: 425-284-3300

CLIENT Richard Hanson **PROJECT NAME** Hanson Short Plat

PROJECT NUMBER ES-4165 **PROJECT LOCATION** Lake Forest Park



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	Cc	Cu
● TP-1	4.0ft.	USDA: Tan Gravelly Loamy Sand. USCS: SM with Gravel.		
⊠ TP-2	6.0ft.	USDA: Tan Slightly Gravelly Sand. USCS: SP.	0.85	2.21
▲ TP-5	7.0ft.	USDA: Brown Very Gravelly Sand. USCS: SP with Gravel.	0.18	26.69
★ TP-6	5.5ft.	USDA: Tan Very Gravelly Loamy Sand. USCS: SM with Gravel.		
⊙ TP-8	2.0ft.	USDA: Tannish Gray Gravelly Loamy Sand. USCS: SM.		

Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
● TP-1	4.0ft.	19	0.494	0.153					18.8	
⊠ TP-2	6.0ft.	9.5	0.316	0.196	0.143				1.8	
▲ TP-5	7.0ft.	37.5	5.587	0.461	0.209				4.0	
★ TP-6	5.5ft.	19	0.827	0.227					13.5	
⊙ TP-8	2.0ft.	37.5	0.462	0.156					17.8	

GRAIN SIZE USDA ES-4165.GPJ GINT US LAB.GDT 10/20/15

Appendix B

Laboratory Test Results

ES-4165

Report Distribution

ES-4165

<u>EMAIL ONLY</u>

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Kenmore, Washington 98028