Earth Solutions NW LLC

Geotechnical Engineering
Construction Observation/Testing
Environmental Services

PRELIMINARY GEOTECHNICAL ENGINEERING STUDY
PROPOSED AUTO CENTER
152XX SMOKEY POINT BOULEVARD
MARYSVILLE, WASHINGTON

ES-7099

15365 N.E. 90th Street, Suite 100 Redmond, WA 98052
(425) 449-4704 Fax (425) 449-4711
www.earthsolutionsnw.com

PREPARED FOR

Q-AUTO CENTER

January 28, 2020

Kyler T. Kelly
Staff Geologist

Henry T. Wright, P.E.
Senior Project Manager

PRELIMINARY GEOTECHNICAL ENGINEERING STUDY
PROPOSED AUTO CENTER
152XX SMOKEY POINT BOULEVARD
MARYSVILLE, WASHINGTON

ES-7099

Earth Solutions NW, LLC
15365 Northeast 90th Street, Suite 100
Redmond, Washington 98052
Phone: 425-449-4704 | Fax: 425-449-4711
www.earthsolutionsnw.com

Important Information about This

Geotechnical-Engineering Report

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

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include 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 personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

Earth Solutions NW LLC

Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

January 28, 2020
ES-7099

Q-Auto Center
20420 Highway 99
Lynnwood, Washington 98036

Attention: Mr. Allen Almassi

Dear Mr. Almassi:

Earth Solutions NW, LLC (ESNW) is pleased to present this report titled "Preliminary Geotechnical Engineering Study, Proposed Auto Center, 152XX Smokey Point Boulevard, Marysville, Washington". Based on the results of our investigation, the proposed grading and development of the subject site is feasible from a geotechnical standpoint. Our study indicates the site is underlain by loose to medium dense recessional outwash sand deposits. Five piezometers were installed throughout of the property for the purpose of seasonal high groundwater monitoring.

We understand existing site grades will be raised several feet to establish design elevations throughout the proposed development area. Fill heights on the order of five to seven feet above existing grades are currently proposed. Based on observed soil conditions and the anticipated structure type, the proposed structure can be supported on conventional spread and continuous foundations bearing on the newly placed structural fill; ESNW should further evaluate this recommendation when building plans are available.

Pertinent geotechnical recommendations are provided in this study. We appreciate the opportunity to be of service to you on this project. If you have any questions regarding the content of this geotechnical engineering study, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

Kyler T. Kelly
Staff Geologist

Table of Contents

ES-7099

Table of Contents

Cont'd

ES-7099

PRELIMINARY GEOTECHNICAL ENGINEERING STUDY
PROPOSED AUTO CENTER
152XX SMOKEY POINT BOULEVARD
MARYSVILLE, WASHINGTON

ES-7099

INTRODUCTION

General

This preliminary geotechnical engineering study (study) was prepared for the proposed auto center to be completed along the east side of Smokey Point Boulevard, roughly 90 feet north of the intersection with 152nd Street Northeast, in Marysville, Washington. The purpose of this study was to develop geotechnical recommendations for the proposed project. The scope of services for completing this study included the following:

- Excavating test pits to characterize soil and groundwater conditions;
- Laboratory testing of representative soil samples, and;
- Conducting engineering analyses.

The following documents and maps were reviewed as part of preparing this study:

- Site Plan, prepared by Land Technologies, Inc., undated;
- Geologic Map of the Arlington West 7.5 Minute Quadrangle, Snohomish County, Washington, compiled by James P. Minard, dated 1985;
- Marysville Municipal Code (MMC) Chapter 22E.010: Critical Areas Management;
- Web Soil Survey (WSS), online resource maintained by the Natural Resources Conservation Service under the United States Department of Agriculture (USDA);
- Marysville Geologic Hazards Map (May 2014), and;
- Snohomish County Liquefaction Susceptibility, endorsed by the Washington State Department of Natural Resources, dated October 2009.

Project Description

Based on the information provided to ESNW, roughly five to seven feet of structural fill will be placed across the subject site in preparation for a future auto center. Site improvements will also include construction of vehicle parking areas and utility installations.

At the time this report was prepared, specific building load values were not available; however, we anticipate the proposed structure will consist of relatively lightly loaded wood framing supported on conventional foundations. Based on our experience with similar developments, we estimate wall loads on the order of 2 to 4 kips per linear foot, column loads of 40 to 60 kips, and slab-on-grade loading of 150 pounds per square foot (psf). ESNW should review building plans when they are available and update the recommendations in this report as necessary.

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

SITE CONDITIONS

Surface

The subject site is located along the east side of Smokey Point Boulevard, roughly 90 feet north of the intersection with 152nd Street Northeast, in Marysville, Washington. The approximate location of the site is depicted on the Vicinity Map (Plate 1). The site consists of three tax parcels (Snohomish County parcel numbers 3105330020-0900, -5200, and -5300), totaling about 2.96 acres. The subject site is currently undeveloped and is lightly overgrown with tall grass, brambles, and scattered trees. The site is relatively level with total elevation change on the order of four feet or less.

Subsurface

A representative of ESNW observed, logged, and sampled six test pits, excavated at accessible locations within the property boundaries, on December 13, 2019, using a mini trackhoe and operator retained by our firm. The approximate locations of the test pits are illustrated on the Test Pit Location Plan (Plate 2). Please refer to the test pit logs provided in Appendix A for a more detailed description of subsurface conditions. Representative samples collected at the test pit locations were analyzed in general accordance with Unified Soil Classification System (USCS) and USDA methods and procedures.

Topsoil and Fill

Topsoil was observed extending to depths of approximately 6 to 12 inches below the existing ground surface (bgs). Vegetation roots extended below the topsoil zone and into the underlying soil. The topsoil was characterized by dark brown color and the presence of fine organic material.

Surficial fill was encountered at test pit locations TP-5 and TP-6 but was limited to the topsoil layer.

Native Soil

Underlying the topsoil and fill, native sand soils with varying amounts of silt (USCS: SP and SM) were encountered, consistent with Marysville recessional sands. The native soils were observed to become saturated at-depth. Moderate to severe caving was observed beginning at depths of approximately two and one-half to five feet bgs.

Geologic Setting

The referenced geologic map identifies Marysville sand member recessional outwash (Qvrm) across the site and surrounding areas. As described on the geologic map resource, Marysville sand member is typically well-drained, stratified to massive outwash sand, some fine gravel, and some areas of silt and clay. The referenced WSS resource identifies Custer fine sandy loam (Map Unit Symbol: 13) across the site and surrounding areas. The Custer fine sandy loam was formed in outwash plains. Based on our field observations, native soils on site are generally consistent with recessional outwash sands.

Groundwater

The groundwater table was encountered at depths of about four to six feet at the test pit locations. Groundwater table elevations fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, groundwater levels and flow rates are higher during the wetter, winter, spring, and early summer months.

Geologic Hazard Areas

The subject property was evaluated for the presence of geologic hazard areas in general accordance with the Chapter 20E.010 of MMC. Based on our review, the site neither lies within nor is immediately adjacent to geologic hazard areas. Based on the results of our subsurface exploration, it is our opinion the site is correctly mapped outside of geologic hazard areas.

DISCUSSION AND RECOMMENDATIONS

General

Based on observed soil conditions, the proposed grading and subsequent development activities are feasible from a geotechnical standpoint. Lightly loaded wood frame structures proposed in the future can be supported on conventional spread and continuous foundations bearing on the structural fill proposed for placement during the current development phase. Existing vegetation should be cleared, surficial organic material should be mowed, and fill areas should be static-rolled with a large drum roller prior to placing fill. Additional footing subgrade preparation may be necessary at the time of building construction; ESNW should further evaluate building support recommendations when building plans are available and during construction. The primary purpose of this report is to provide site preparation and earthwork recommendations for the current development phase and fill placement.

Site Preparation and Earthwork

Site preparation activities will consist of installing temporary erosion control measures and clearing and stripping the site. Grading activities will consist of fills on the order of five to seven feet. Earthwork will be completed to establish approximate design elevations for the future auto center.

Temporary Erosion Control

The following temporary erosion control measures should be considered:

- Temporary construction entrances and drive lanes, consisting of at least six inches of quarry spalls, should be considered to both minimize off-site soil tracking and provide a stable access entrance surface. Placing geotextile fabric underneath the quarry spalls will provide greater stability if needed.

- Silt fencing should be placed around the site perimeter.

- When not in use, soil stockpiles should be covered or otherwise protected to reduce the potential for soil erosion, especially during periods of wet weather.

- Temporary measures for controlling surface water runoff, such as interceptor trenches, sumps, or interceptor swales, should be installed prior to beginning earthwork activities.

- Dry soils disturbed during construction should be wetted to minimize dust and airborne soil erosion.

- When appropriate, permanent planting or hydroseeding will help to stabilize site soils.

Additional BMPs, as specified by the project civil engineer and indicated on the plans, should be incorporated into construction activities. Temporary erosion control measures may be modified during construction as site conditions require, as approved by the site erosion control lead.

Site Stripping and Grading

Due to the granular nature of the topsoil and the expected placement of six or more feet of structural fill, minimal stripping will be required in proposed fill areas. The following recommendations pertaining to site stripping and grading can be considered for this project:

- Clear existing vegetation;

- In areas where fill placement will be greater than six feet, stripping can consist of mowing groundcover vegetation and removing cuttings. Thicker stripping may be necessary in areas of existing tree vegetation due to thicker root layers;

- Static roll exposed soils to a firm and unyielding state prior to placement of fill, and;

- All fill should be placed and compacted for the support of the proposed development in accordance with the recommendations in this report and subsequent geotechnical reports.

Additional site preparation might be required once stripping and grading has started. ESNW should be contacted to evaluate the depth of stripping prior to placement of fill.

In-Situ and Imported Soils

The majority of the soils encountered during our subsurface exploration have a moderate sensitivity to moisture and the upper soils were generally in a moist to wet condition at the time of the exploration on December 13, 2019. Soils encountered during site excavations that are excessively over the optimum moisture content will require aeration or treatment prior to placement and compaction. Conversely, soils that are substantially below the optimum moisture content will require moisture conditioning through the addition of water prior to use as structural fill. Areas of upper loose and wet soil will not be compactible if grading is attempted during the wet season. An ESNW representative should determine the suitability of in-situ soils for use as structural fill at the time of construction.

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 (where the fines content is defined as the percent passing the Number 200 sieve, based on the minus three-quarter-inch fraction).

Wet Season Grading

If grading takes place during the wetter, winter or spring months, a contingency in the project budget should be included to allow for export of native soil and/or existing fill and import of structural fill as described below. Alternatively, cement treatment of wet material can be considered if accepted by the local jurisdiction.

Structural Fill

Structural fill placed and compacted during site grading activities should meet the following specifications and guidelines:

- Structural fill material — Granular soils*****
- Moisture content — At or slightly above optimum******
- Relative compaction (mass grading) — 90 percent (Modified Proctor)
- Loose lift thickness (maximum) — 12 inches

** The existing soil may not be suitable for use as structural fill unless at (or slightly above) the optimum moisture content at the time of placement and compaction*

*** Soil shall not be placed dry of optimum and should be evaluated by ESNW during construction*

With respect to underground utility installations and backfill, local jurisdictions may dictate the soil type(s) and compaction requirements. Unsuitable material or debris must be removed from structural areas if encountered.

Temporary Excavations and Slopes

Based on the soil conditions observed at the test pit locations, the following allowable temporary slope inclinations, as a function of horizontal to vertical (H:V) inclination, may be used. The applicable Federal Occupation Safety and Health Administration (OSHA) and Washington Industrial Safety and Health Act (WISHA) soil classifications are also provided:

- Loose soil and areas exposing groundwater seepage 1.5H:1V (Type C)
- Medium dense soil 1H:1V (Type C)

The presence of perched groundwater may cause localized sloughing of temporary slopes. The contractor should be prepared to encounter groundwater seepage during excavation activities. An ESNW representative should observe temporary and permanent slopes to confirm the slope inclinations are suitable for the exposed soil conditions and to provide additional excavation and slope recommendations as necessary. If the recommended temporary slope inclinations cannot be achieved, temporary shoring may be necessary to support excavations. Permanent slopes should be planted with vegetation (which helps to enhance stability and minimize erosion) and should maintain a gradient of 2H:1V or flatter.

Preliminary Foundation Recommendations

Based on observed soil conditions and the anticipated structure type, the proposed structure can be supported on conventional spread and continuous footings bearing on new structural fill proposed for placement during the current development phase. Additional footing subgrade preparation may be necessary at the time of building construction; ESNW should further evaluate building support and design recommendations when building plans are available and during construction.

Provided the structure will be supported as described above, the following parameters can be used for design of the new foundations:

- Allowable soil bearing capacity 2,500 psf
- Passive earth pressure 300 pcf (equivalent fluid)
- Coefficient of friction 0.40

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

Seismic Design Considerations

The 2018 International Building Code recognizes the American Society of Civil Engineers (ASCE) for seismic site class definitions. Based on the soil conditions observed at the test pit locations, 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 low to moderate liquefaction susceptibility. Liquefaction is a phenomenon where saturated and 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. In our opinion, site susceptibility to liquefaction may be considered moderate. The proposed structural fill pad will improve building support with respect to potential liquefaction impacts.

Slab-on-Grade Floors

Slab-on-grade floors for the proposed structure should be supported on well-compacted, firm, and unyielding subgrades. Unstable or yielding subgrade areas should be recompacted or overexcavated and replaced with suitable structural fill prior to slab construction.

A capillary break consisting of at least four inches of free-draining crushed rock or gravel should be placed below the slabs. The free-draining material should have a fines content of 5 percent or less (where the fines content is defined as the percent passing the Number 200 sieve, based on the minus three-quarter-inch fraction). In areas where slab moisture is undesirable, installation of vapor barriers below the slabs should be considered. If a vapor barrier is to be utilized, it should be a material specifically intended for use as a vapor barrier and should be installed per 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 (unrestrained 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 — 0.40
- Seismic surcharge — 6H psf******

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

The passive earth pressure and coefficient of friction values include a safety factor of 1.5. 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 may consist of a less permeable soil if desired. A perforated drainpipe 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

Based on our field observations, the shallow groundwater table is expected to be encountered roughly four to six feet bgs. If utility or vault excavations extend into the shallow groundwater table, active dewatering will be necessary. Groundwater should also be expected within shallower site excavations depending on the time of year grading operations take place. Temporary measures to control surface water runoff and groundwater seepage during construction would likely involve interceptor trenches and sumps. ESNW should be consulted during preliminary grading to identify areas of seepage and provide recommendations to reduce the potential for instability related to groundwater.

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. Grades adjacent to buildings should be sloped away from the buildings at a gradient of either at least 2 percent for a horizontal distance of 10 feet or the maximum allowed by adjacent structures. In our opinion, foundation drains should be installed along building perimeter footings. A typical foundation drain detail is provided on Plate 4.

Preliminary Infiltration Evaluation

As indicated in the *Subsurface* section of this study, native soils encountered during our fieldwork were characterized primarily as recessional outwash sand deposits. The following preliminary recommendations pertaining to infiltration feasibility can be considered for this project:

- The results of USDA textural analyses performed on representative soil samples indicate native soils consist of slightly gravelly loamy fine sand and slightly gravelly sand with fines contents ranging from 1.0 to 19.5 percent.

- A shallow groundwater table was encountered at depths of four to five feet bgs. Should infiltration be pursued, adequate separation between the shallow groundwater table and the infiltration system must be established to allow for infiltration feasibility.

During our fieldwork, five piezometers were installed along the corners and center of the property for the purpose of seasonal high groundwater monitoring. Where infiltration facilities are incorporated into final designs, ESNW should provide infiltration testing and related design recommendations based on the location and depth of the proposed facilities. For the Marysville sand deposits, allowable infiltration rates generally range between roughly 1.5 to 2.0 inches per hour. However, this should be confirmed during the appropriate phase of design and testing.

Preliminary 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. 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.

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).

For relatively high volume, heavily loaded pavements areas subjected to occasional truck traffic, the following preliminary pavement sections may be considered:

- A minimum of three inches of HMA placed over six inches of CRB, or;

- A minimum of three inches of HMA placed over four and one-half inches of ATB.

The HMA, ATB, and CRB materials should conform to WSDOT and/or City of Marysville (City) specifications. All soil base material should be compacted to at least 95 percent of the maximum dry density. Final pavement design recommendations can be provided once final traffic loading has been determined. City standards may supersede the recommendations provided in this report.

Utility Support and Trench Backfill

We understand that utility excavations will most likely occur within newly placed fill; however, if utility excavations extend into the groundwater table, active dewatering and remedial measures for proper support of the utilities will likely be needed.

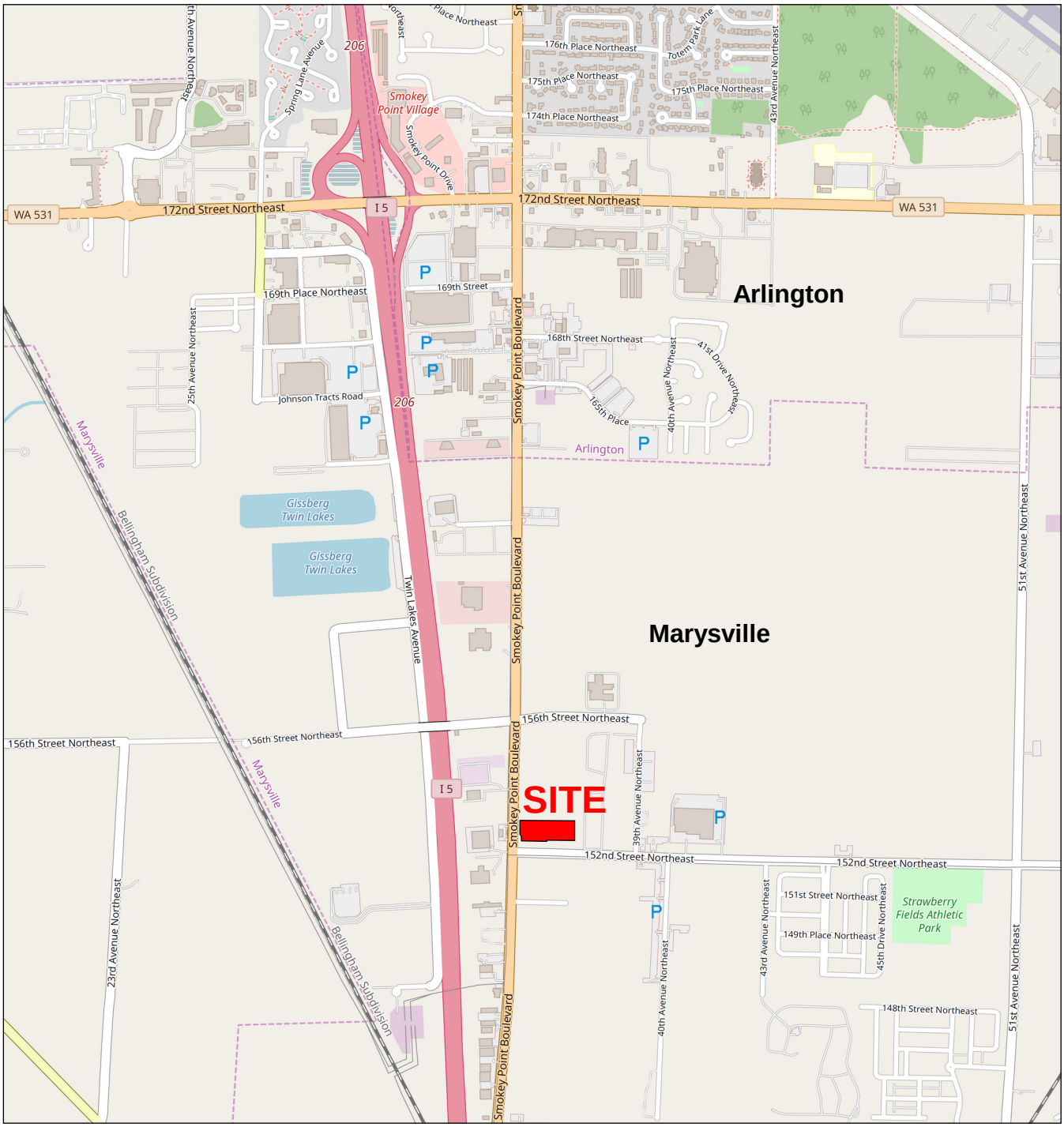
Native soil encountered within utility trench excavations may be suitable for use as structural backfill in the utility trench excavations provided the soil is a suitable granular material that is at (or slightly above) the optimum moisture content at the time of placement and compaction. Moisture conditioning of the soils may be necessary at some locations prior to use as structural fill, especially where groundwater seepage is encountered. Each section of 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 or another responsible jurisdiction or agency.

LIMITATIONS

The recommendations and conclusions provided in this 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 provided in this study if variations are encountered.

Additional Services

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



Reference:
Snohomish County, Washington
OpenStreetMap.org

NORTH

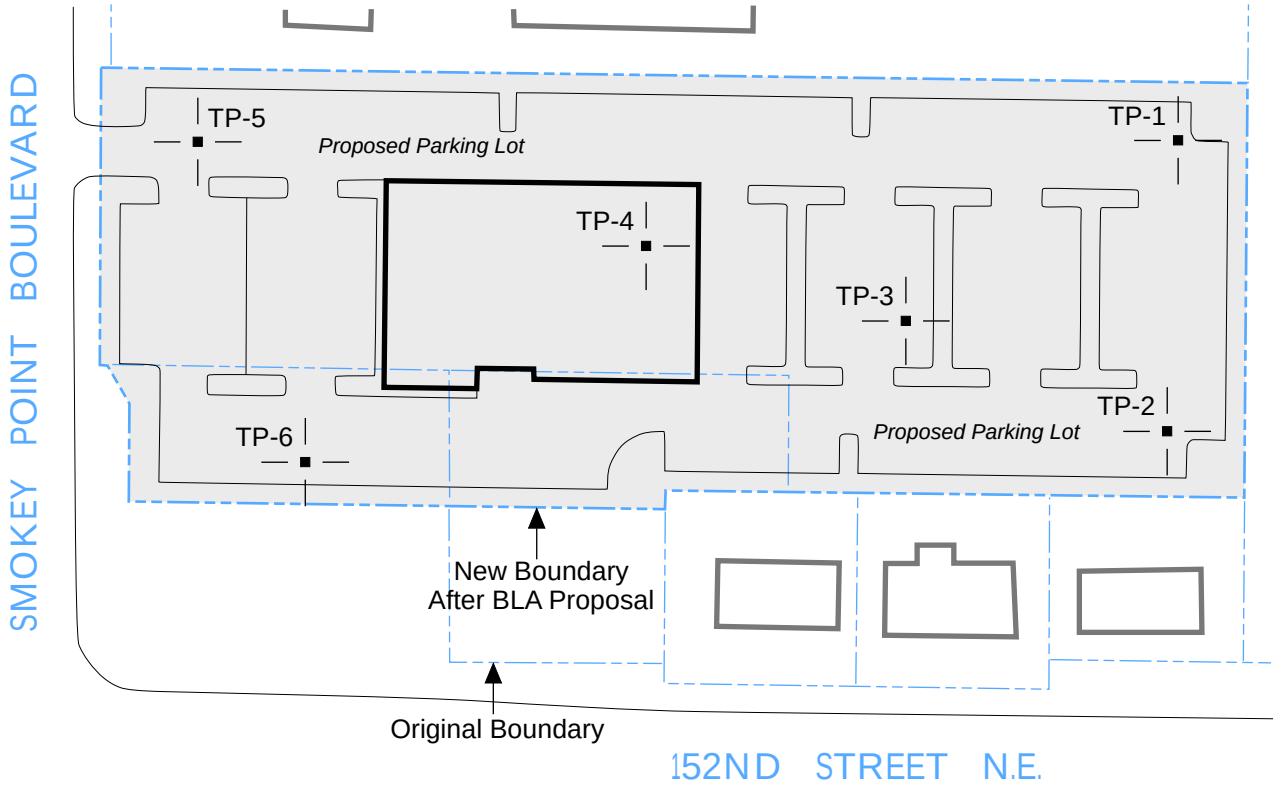
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Vicinity Map
Proposed Auto Center
Marysville, Washington

Drwn. CAM	Date 01/06/2020	Proj. No. 7099
Checked KTK	Date Jan. 2020	Plate 1



LEGEND

TP-1 — Approximate Location of ESNW Test Pit, Proj. No. ES-7099, Dec. 2019

Subject Site

Proposed Building

Existing Building

NORTH

1"=100'

0 50 100 200

Scale in Feet

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.

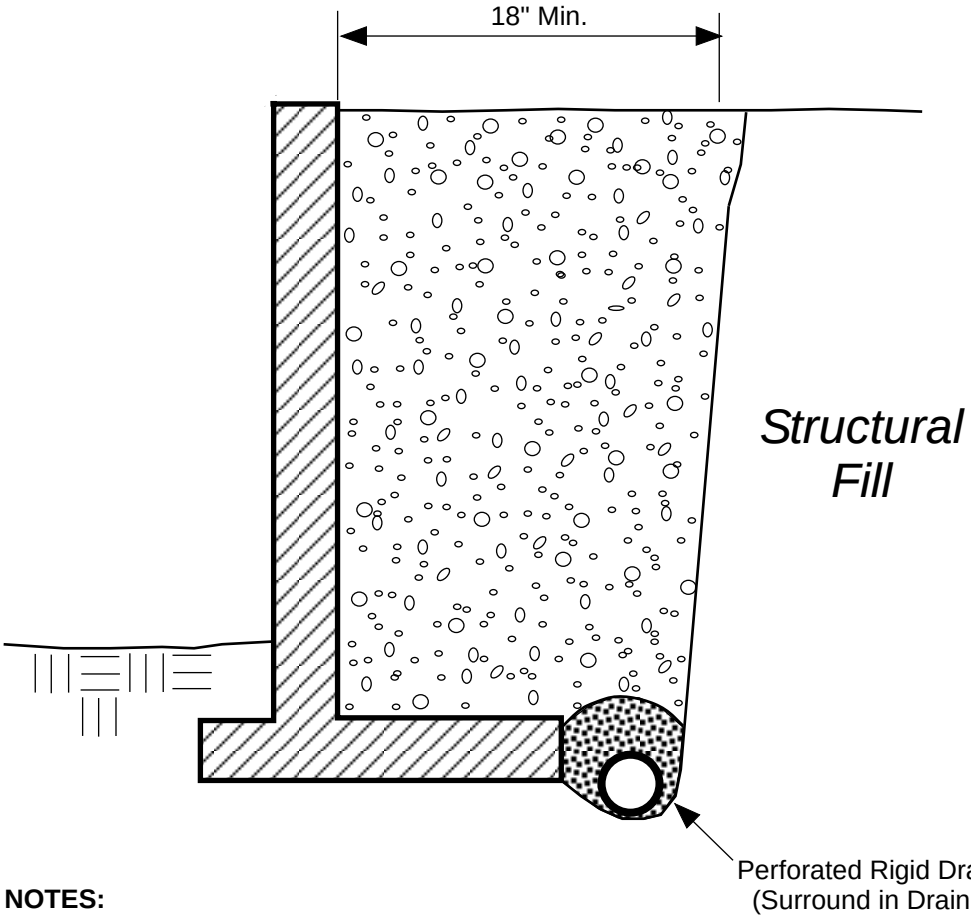
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Test Pit Location Plan
Proposed Auto Center
Marysville, Washington

Drwn. CAM	Date 01/06/2020	Proj. No. 7099
Checked KTK	Date Jan. 2020	Plate 2



NOTES:

- Free-draining Backfill should consist of soil having less than 5 percent fines. Percent passing No. 4 sieve 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-inch Drain Rock.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

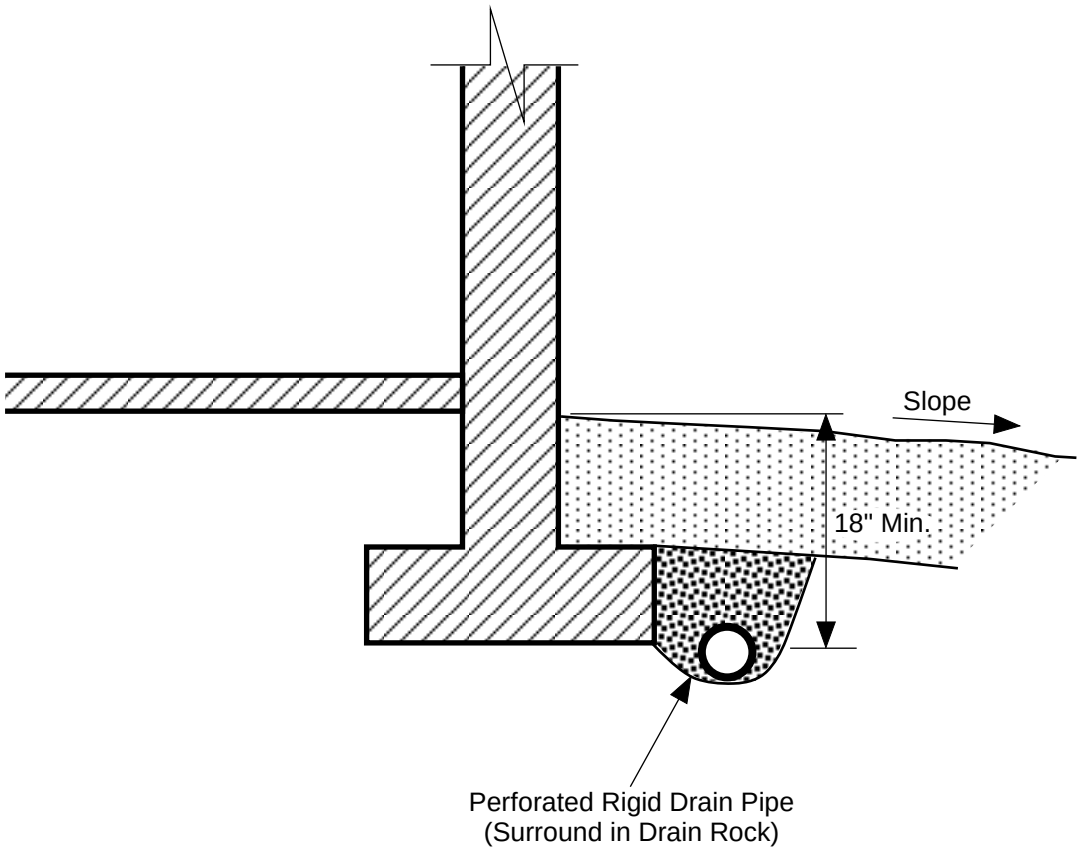
Free-draining Structural Backfill

1-inch Drain Rock

Earth Solutions NW LLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Retaining Wall Drainage Detail
Proposed Auto Center
Marysville, Washington

Drwn. CAM	Date 01/06/2020	Proj. No. 7099
Checked KTK	Date Jan. 2020	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-inch Drain Rock

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Footing Drain Detail
Proposed Auto Center
Marysville, Washington

Drwn. CAM	Date 01/06/2020	Proj. No. 7099
Checked KTK	Date Jan. 2020	Plate 4

Appendix A

Subsurface Exploration
Test Pit Logs

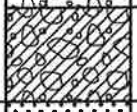
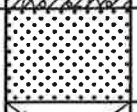
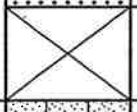
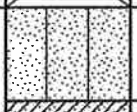
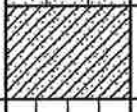
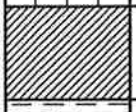
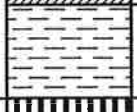
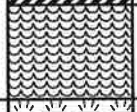
ES-7099

Subsurface conditions at the subject site were explored on December 13, 2019, by excavating six test pits using a mini trackhoe and operator retained by ESNW. The approximate locations of the 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 approximately seven and one-half 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 NW LLC

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	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
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	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
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	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
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	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
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-1

PROJECT NUMBER ES-7099 **PROJECT NAME** Proposed Auto Center

DATE STARTED 12/13/19 **COMPLETED** 12/13/19 **GROUND ELEVATION** 110 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating **GROUND WATER LEVELS:**

EXCAVATION METHOD

▽ **AT TIME OF EXCAVATION** 4.0 ft / Elev 106.0 ft

LOGGED BY KTK **CHECKED BY** HTW **AT END OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 12": brambles **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL	
					1.0	109.0
		MC = 14.70% Fines = 14.90%	SM		Brown silty SAND, loose to medium dense, moist [USDA Classification: slightly gravelly SAND] -heavy caving to BOH	
					3.0	107.0
		MC = 24.20%	SP		Gray poorly graded SAND, medium dense, wet ▽ -groundwater table	
5						
		MC = 20.20%			6.0	104.0
					Test pit terminated at 6.0 feet below existing grade. Groundwater table encountered at 4.0 feet during excavation. Caving observed from 2.5 feet to BOH. Bottom of test pit at 6.0 feet.	

Earth Solutions NW
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-2

PROJECT NUMBER ES-7099 **PROJECT NAME** Proposed Auto Center

DATE STARTED 12/13/19 **COMPLETED** 12/13/19 **GROUND ELEVATION** 110 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating **GROUND WATER LEVELS:**

EXCAVATION METHOD ▽ **AT TIME OF EXCAVATION** 5.0 ft / Elev 105.0 ft

LOGGED BY KTK **CHECKED BY** HTW **AT END OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 12": brambles **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		Dark brown TOPSOIL
					1.0 109.0
			SM		Brown silty SAND, loose to medium dense, moist
		MC = 14.80%			
					-moderate caving to BOH
					-abundant fine organics
		MC = 36.00%			-heavy iron oxide staining, silt lens
					4.5 105.5
5			SP		▽ Gray poorly graded SAND, medium dense, wet
					-groundwater table, becomes saturated
		MC = 25.60%			6.0 104.0
					Test pit terminated at 6.0 feet below existing grade. Groundwater table encountered at 5.0 feet during excavation. Caving observed from 3.0 feet to BOH. Bottom of test pit at 6.0 feet.

Earth Solutions NW
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-3

PROJECT NUMBER ES-7099 **PROJECT NAME** Proposed Auto Center

DATE STARTED 12/13/19 **COMPLETED** 12/13/19 **GROUND ELEVATION** 110 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating **GROUND WATER LEVELS:**

EXCAVATION METHOD ▽ **AT TIME OF EXCAVATION** 5.5 ft / Elev 104.5 ft

LOGGED BY KTK **CHECKED BY** HTW **AT END OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 6": brambles **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL	109.5
				0.5		
			SM		Brown silty SAND, loose to medium dense, moist to wet	
		MC = 22.80%			-light iron oxide staining	
					-moderate caving to BOH	
				4.0		106.0
5			SP		Gray poorly graded SAND with gravel, medium dense, moist to wet	
		MC = 18.70%			▽ -groundwater table, becomes saturated	
		MC = 17.70%		7.0		103.0
					Test pit terminated at 7.0 feet below existing grade. Groundwater table encountered at 5.5 feet during excavation. Caving observed from 3.0 feet to BOH. Bottom of test pit at 7.0 feet.	

Earth Solutions NW
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-4

PROJECT NUMBER ES-7099 **PROJECT NAME** Proposed Auto Center

DATE STARTED 12/13/19 **COMPLETED** 12/13/19 **GROUND ELEVATION** 110 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating **GROUND WATER LEVELS:**

EXCAVATION METHOD ▽ **AT TIME OF EXCAVATION** 5.0 ft / Elev 105.0 ft

LOGGED BY KTK **CHECKED BY** HTW **AT END OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 12": grass **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL, trace roots to 1.5'	
					1.0	109.0
			SM		Brown silty SAND, loose to medium dense, moist to wet	
		MC = 22.70%			-light iron oxide staining	
					3.0	107.0
			SP		Gray poorly graded SAND, medium dense, moist	
					-moderate caving to BOH	
5					▽ -groundwater table	
		MC = 27.40% Fines = 1.00%			[USDA Classification: slightly gravelly SAND]	
					6.0	104.0
					Test pit terminated at 6.0 feet below existing grade. Groundwater table encountered at 5.0 feet during excavation. Caving observed from 3.5 feet to BOH. Bottom of test pit at 6.0 feet.	

Earth Solutions NW
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-5

PROJECT NUMBER ES-7099 **PROJECT NAME** Proposed Auto Center

DATE STARTED 12/13/19 **COMPLETED** 12/13/19 **GROUND ELEVATION** 110 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating **GROUND WATER LEVELS:**

EXCAVATION METHOD

▽ **AT TIME OF EXCAVATION** 4.5 ft / Elev 105.5 ft

LOGGED BY KTK **CHECKED BY** HTW **AT END OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 12": grass **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL (Fill)	
				1.0	-metal debris	109.0
			SM		Brown silty SAND, loose to medium dense, wet	
					-light iron oxide staining	
		MC = 24.60% Fines = 19.50%			[USDA Classification: slightly gravelly loamy fine SAND]	
				3.5	-moderate caving from 3.5' to BOH	106.5
			SP		Gray poorly graded SAND, medium dense, wet	
5		MC = 24.20%			▽ -groundwater table	
		MC = 27.80%		6.5		103.5
					Test pit terminated at 6.5 feet below existing grade. Groundwater table encountered at 4.5 feet during excavation. Caving observed from 3.5 feet to BOH. Bottom of test pit at 6.5 feet.	

Earth Solutions NW
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-6

PROJECT NUMBER ES-7099 **PROJECT NAME** Proposed Auto Center

DATE STARTED 12/13/19 **COMPLETED** 12/13/19 **GROUND ELEVATION** 110 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating **GROUND WATER LEVELS:**

EXCAVATION METHOD ▽ **AT TIME OF EXCAVATION** 6.0 ft / Elev 104.0 ft

LOGGED BY KTK **CHECKED BY** HTW **AT END OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 6": grass **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL, trace roots to 1', metal debris (Fill)	109.5
				0.5		
			SM		Brown silty SAND, loose, moist to wet	
					-heavy iron oxide staining	
		MC = 27.10%				
				3.0		107.0
			SP		Gray poorly graded SAND, medium dense, moist to wet	
5					-moderate caving to BOH	
					▽ -groundwater table	
		MC = 21.70%		7.5		102.5
					Test pit terminated at 7.5 feet below existing grade. Groundwater table encountered at 6.0 feet during excavation. Caving observed from 5.0 feet to BOH. Bottom of test pit at 7.5 feet.	

Appendix B

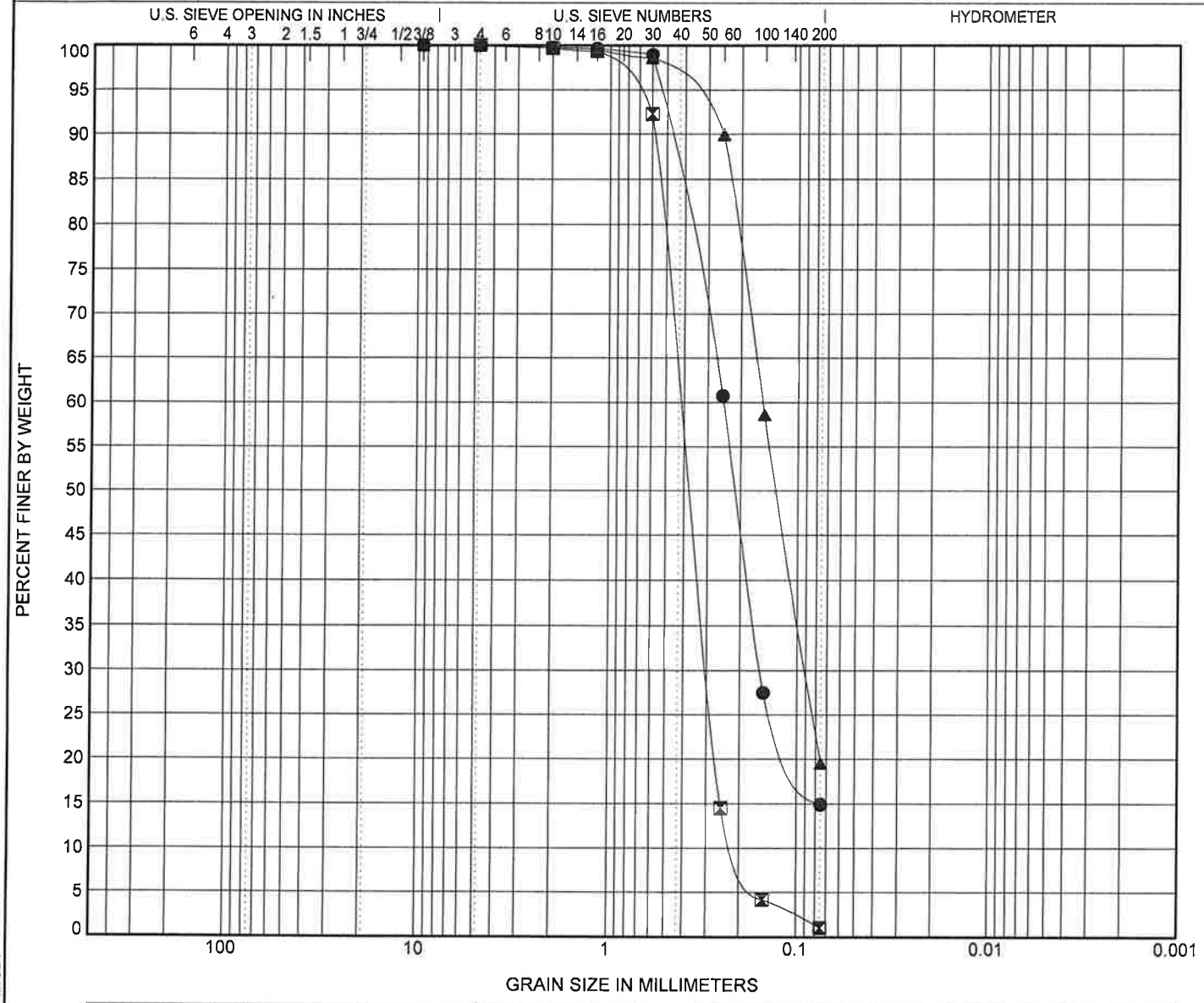
Laboratory Test Results

ES-7099

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-7099 **PROJECT NAME** Proposed Auto Center



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	Cc	Cu
● TP-01	2.00ft.	USDA: Brown Slightly Gravelly Sand. USCS: SM.		
⊠ TP-04	6.00ft.	USDA: Gray Slightly Gravelly Sand. USCS: SP.	1.06	2.09
▲ TP-05	2.50ft.	USDA: Brown Slightly Gravelly Loamy Fine Sand. USCS: SM		

Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
● TP-01	2.0ft.	9.5	0.247	0.156					14.9	
⊠ TP-04	6.0ft.	4.75	0.417	0.297	0.2				1.0	
▲ TP-05	2.5ft.	9.5	0.153	0.09					19.5	

GRAIN SIZE USDA ES-7099 PROPOSED AUTO CENTER.GPJ GINT US LAB.GDT 12/26/19

Report Distribution

ES-7099

EMAIL ONLY

Q-Auto Center
20420 Highway 99
Lynnwood, Washington 98036

Attention: Mr. Allen Almassi

EMAIL ONLY

Land Technologies, Inc.
18820 – 3rd Avenue Northeast
Arlington, Washington 98223

Attention: Mr. Merle Ash