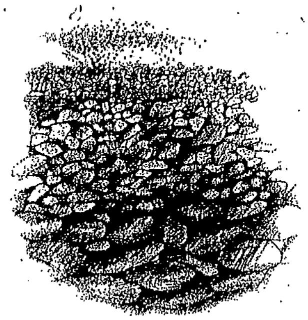
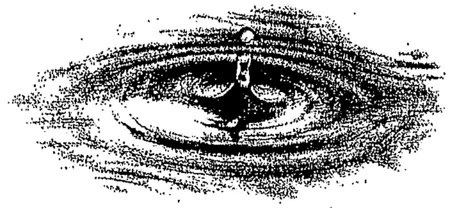
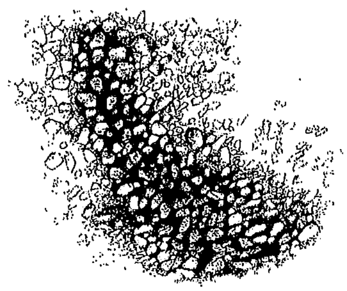


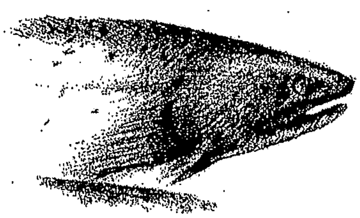
Geotechnical Engineering



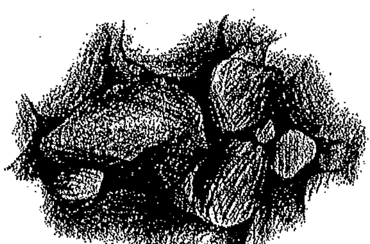
Water Resources



Solid and Hazardous Waste



Ecological/Biological Sciences



Geologic Assessments

Associated Earth Sciences, Inc.

Subsurface Exploration, Geologic Hazard, and
Preliminary Geotechnical Engineering Report

GEORGIAN HEIGHTS
PHASES III AND IV

Woodinville, Washington

Prepared for

Lakewood Construction

Project No. KE04174A
April 30, 2004

Associated Earth Sciences, Inc.

April 30, 2004
Project No. KE04174A

Lakewood Construction
P.O. Box 12648
Mill Creek, Washington 98082

Attention: Mr. Randolf Cherewick

Subject: Subsurface Exploration, Geologic Hazard, and Preliminary Geotechnical Engineering Report
Georgian Heights Phases III and IV
136th Avenue NE and NE 205th Street
Woodinville, Washington

Dear Mr. Cherewick:

We are pleased to present the enclosed copies of the above-referenced report. This report summarizes the results of our subsurface exploration, geologic hazard, and geotechnical engineering studies and offers recommendations for the preliminary design and development of the proposed project. Our recommendations are preliminary in that definite building locations and/or construction details have not been finalized at the time of this report.

We have enjoyed working with you on this study and are confident that the recommendations presented in this report will aid in the successful completion of your project. If you should have any questions or if we can be of additional help to you, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

Gary A. Flowers, P.G., P.E.G.
Principal

GAF/sn
KE04174A1
Projects\2004174\KE\WP - W2K

911 Fifth Avenue, Suite 100 • Kirkland, WA 98033 • Phone 425 827-7701 • Fax 425 827-5424

SUBSURFACE EXPLORATION, GEOLOGIC HAZARD, AND PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

GEORGIAN HEIGHTS PHASES III AND IV

Woodinville, Washington

Prepared for:
Lakewood Construction
P.O. Box 12648
Mill Creek, Washington 98082

Prepared by:
Associated Earth Sciences, Inc.
911 5th Avenue, Suite 100
Kirkland, Washington 98033
425-827-7701
Fax: 425-827-5424

April 30, 2004
Project No. KE04174A

I. PROJECT AND SITE CONDITIONS

1.0 INTRODUCTION

This report presents the results of our subsurface exploration, geologic hazard, and preliminary geotechnical engineering study for the subject project. Our recommendations are preliminary in that definite building locations and construction details have not been finalized at the time of this report. The location of the subject site is shown on the Vicinity Map, Figure 1. The proposed building lot and roadway locations, as well as the approximate locations of the explorations accomplished for this study, are presented on the Site and Exploration Plan, Figure 2. In the event that any changes in the nature, design, or locations of these features are planned, the conclusions and recommendations contained in this report should be reviewed and modified, or verified, as necessary.

1.1 Purpose and Scope

The purpose of this study was to provide subsurface data to be used in the preliminary design and development of the subject project. Our study included a review of available geologic literature, excavation of exploration pits, and performing geologic studies to assess the type, thickness, distribution, and physical properties of the subsurface sediments and shallow ground water conditions. Geotechnical engineering studies were also conducted to assess the types of suitable foundations, allowable foundation soil bearing pressures, anticipated settlements, basement/retaining wall lateral pressures, floor support recommendations, and drainage considerations. This report summarizes our current fieldwork and offers development recommendations based on our present understanding of the project.

1.2 Authorization

Verbal authorization to proceed with this study was granted by Mr. Randolf Cherewick of Lakewood Construction. Our study was accomplished in general accordance with our scope of work as discussed with Mr. Cherewick. This report has been prepared for the exclusive use of Lakewood Construction and their agents, for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering and engineering geology practices in effect at the time this report was prepared. No other warranty, express or implied, is made.

2.0 PROJECT AND SITE DESCRIPTION

The subject site consists of an L-shaped parcel of approximately 22 acres located near the southwest corner of the intersection of 136th Avenue NE and NE 205th Street in Woodinville, Washington (Figure 1). The long leg of the L lies in a north-south direction and is approximately 1,300 feet long and approximately 620 feet wide. The short leg of the L lies in an east-west direction and is approximately 940 feet long and approximately 360 feet wide. It is our understanding that the existing home fronting 136th Avenue NE (20130 136th Avenue NE) will remain in place. Much of the central portion of the site has been identified as wetlands. Consequently, development is planned to be limited to upland areas located in the western and southern portions of the property. The proposed development area in the southern portion of the property consists predominately of open pasture with scattered trees and a small livestock enclosure. The west end of this portion of the site is naturally forested. The upland area proposed for development in the western portion of the site is vegetated by mixed deciduous and coniferous forests with thick natural underbrush. The topography of the site is undulatory with slope gradients ranging from relatively flat-lying to approximately 20 percent.

This report was completed with an understanding of the project based on review of a preliminary, topographic site plan provided by Lakewood Construction. Additional information was obtained through verbal discussions with Mr. Randolf Cherewick of Lakewood Construction. It is our understanding that project plans call for the construction of single-family residences on approximately 42 lots to be constructed at the site. Vehicular access into the development will be provided by new roads entering the property off of 136th Avenue NE and NE 205th Street. Preliminary plans also include construction of storm water detention ponds in both the western and eastern portions of the site. The approximate locations of these ponds are shown on the Site and Exploration Plan, Figure 2. We understand that development of the site is planned in two phases. Phase III will be the first phase and consists of the eastern portion of the southeast area of the site. The remainder of the project site is known as Phase IV. Both the Phase III and Phase IV portions of the site are depicted on Figure 2.

3.0 SUBSURFACE EXPLORATION

Our field study included excavating a series of exploration pits to gain subsurface information about the site. The various types of sediments, as well as the depths where characteristics of the sediments changed, are indicated on the exploration logs presented in the Appendix. The depths indicated on the logs where conditions changed may represent gradational variations between sediment types in the field. Our explorations were approximately located in the field by measuring from staked surveyed locations and known site features shown on the previously referenced topographic site plan.

The conclusions and recommendations presented in this report are based, in part, on the exploration pits completed for this study. The number, locations, and depths of the explorations were completed within site and budgetary constraints. Because of the nature of exploratory work below ground, extrapolation of subsurface conditions between field explorations is necessary. It should be noted that differing subsurface conditions may sometimes be present due to the random nature of deposition and the alteration of topography by past grading and/or filling. The nature and extent of any variation between the field explorations may not become fully evident until construction. If variations are observed at that time, it may be necessary to re-evaluate specific recommendations in this report and make appropriate changes.

3.1 Exploration Pits

Exploration pits were excavated with a track-mounted excavator provided by the client. The pits permitted direct, visual observations of subsurface conditions. Materials encountered in the exploration pits were studied and classified in the field by an engineering geologist from our firm. All exploration pits were backfilled immediately after examination and logging. Selected samples were then transported to our laboratory for further visual classification and testing, as necessary.

4.0 SUBSURFACE CONDITIONS

The subsurface conditions at the project site were inferred from the field explorations accomplished for this study, visual reconnaissance of the site, and review of applicable geologic literature. As shown on the field logs, the exploration pits encountered a wide variety of glacial and postglacial sediments. Minor amounts of fill were also encountered in the southeastern portion of the site. The following section presents more detailed subsurface information organized from the shallowest (youngest) to deepest (oldest) sediment types.

4.1 Stratigraphy

Fill

Fill soils (those not naturally placed) were encountered in the southeastern portion of the site at the location of exploration pit EP-4. The existing fill soils at this location generally consisted of loose, silty sand with gravel. The existing fill soils were approximately 1 foot in thickness and are not suitable for foundation support.

Sod/Topsoil/Forest Duff

A surficial organic topsoil/forest duff layer was encountered at each of the exploration locations. In some areas of the site the topsoil layer was also capped by a layer of sod. The surficial organic sod/topsoil/forest duff layer ranged in thickness from approximately 3 inches to 1½ feet. Due to its high organic content these materials are not suitable for foundation support or for use in a structural fill.

EXHIBIT 31
PAGE 8 OF 45

Alluvium

Sediments encountered directly below the surficial forest duff/topsoil layer at the locations of exploration pits EP-5 and EP-6 generally consisted of loose to medium dense, silty sand with variable gravel content. These sediments were also observed to contain trace quantities of organic debris and scattered cobbles and boulders. Exploration pits EP-5 and EP-6 are located in the south-central portion of the site near the wetland boundary (Figure 2). We interpret these sediments to be representative of alluvium deposited subsequent to the most recent glaciation of the area approximately 12,500 years ago. At the location of exploration pit EP-5 the alluvium extended beyond the maximum depth explored of approximately 8 feet. At the location of exploration pit EP-6 the alluvium extended to a depth of 7 feet.

Vashon Recessional Outwash

Sediments encountered in the southeastern portion of the site, at the location of exploration pit EP-3, and in the western portion of the site, at the locations of exploration pits EP-10, EP-12, and EP-17, generally consisted of loose to medium dense, tan to grayish tan sand with variable gravel content and minor quantities of silt. We interpret these sediments to be representative of Vashon recessional outwash. The Vashon recessional outwash was deposited by meltwater streams that emanated from the retreating glacial ice during the latter portion of the Vashon Stade of the Fraser Glaciation, ending approximately 12,500 years ago. Where encountered in our explorations, the upper portion of the recessional outwash was observed to have been weathered to a reddish brown color and silty texture to depths ranging from approximately 1.5 to 2 feet below the existing ground surface. The recessional outwash sediments extended beyond the maximum depths explored of approximately 8 to 9 feet.

Vashon Ice Contact Sediments

Outside of the areas underlain by recent alluvium or Vashon recessional outwash, sediments encountered directly below the surficial topsoil generally consisted of medium dense to very dense, very moist, silty sand with gravel with areas of stiff to very stiff silt. We interpret these materials to be representative of Vashon ice contact sediments. Ice contact deposits consist of sediments deposited by water on, within, below, or marginal to glacial ice. At the locations of our explorations, the upper portion of the ice contact sediments was observed to be weathered. Typically the weathered thickness extended from the ground surface down to depths ranging from approximately 2 to 5 feet. The weathering was most typically evidenced by a slight reduction in relative density and, in some cases, a slightly different color. Generally, the upper portion of the weathered zone also contained abundant roots. It should be noted that the relative density of the ice contact sediments encountered in the western portion of the site tended to be lower than that observed in the southeastern development area. In most cases, this reduced density was also accompanied by an increased moisture content. At the locations of exploration pits EP-1, EP-2, EP-14, and EP-16 the ice contact sediments extended to depths ranging from approximately 6 to 8 feet. Where encountered elsewhere in our exploration pits the ice contact sediments extended beyond the maximum depths explored of approximately 7 to 9 feet.

EXHIBIT 31
PAGE 9 OF 45

Vashon Lodgement Till

Sediments encountered below the surficial duff layer at the location of exploration pit EP-7 generally consisted of very dense, moist, silty sand with gravel. We interpret these sediments to be representative of Vashon lodgement till. The Vashon lodgement till was deposited directly from basal, debris-laden glacial ice during the Vashon Stade of the Fraser Glaciation approximately 12,500 to 15,000 years ago. The high relative density characteristic of the Vashon lodgement till is due to its consolidation by the massive weight of the glacial ice from which it was deposited. At the location of exploration pit EP-7 the lodgement till sediments extended to a depth of approximately 8 feet. The portion of the lodgement till encountered within 4½ feet of the ground surface was observed at this location to be weathered to a loose to medium dense state to a depth of approximately 4½ feet.

Vashon Advance Outwash

In the southeastern portion of the site at the locations of exploration pits EP-1, EP-2, and EP-6, and in the western portion of the site at the locations of exploration pits EP-7, EP-14, and EP-16, sediments encountered below depths ranging from approximately 6 to 8 feet consisted of medium dense to dense sand with minor quantities of silt and variable gravel content. We interpret these sediments to be representative of Vashon advance outwash. The Vashon advance outwash was deposited by meltwater streams that emanated from the advancing glacial ice during Vashon time. At some locations, the Vashon advance outwash was also observed to contain silty lenses or strata. Depending upon location, the Vashon advance outwash sediments were overlain by either recent alluvium, Vashon ice contact sediments, or lodgement till. Where encountered in our explorations the advance outwash sediments extended beyond the maximum depths explored of approximately 8 to 14½ feet.

Review of the regional geologic map titled *Distribution and Description of the Geologic Units in the Bothell Quadrangle, Washington* by James Minard (1981) indicates that the area of the subject site is underlain by Vashon lodgement till, Vashon advance outwash, and recent alluvium. Our interpretation of the sediments encountered at the subject site are in general agreement with the regional geologic map.

4.2 Hydrology

Moderately rapid to rapid seepage was encountered in the Vashon advance outwash sediments at the locations of exploration pits EP-6, EP-7, EP-14, and EP-16. Where ground water seepage was encountered in this unit, the seepage extended over the full depth of penetration.

It was not clear whether this seepage was representative of the regional water table or a perched ground water condition. Zones of slow to rapid seepage were also encountered within the recent alluvium and the ice contact sediments at some of the exploration locations. The occurrence and depth at which the seepage was observed in these units was variable. In addition, the seepage was generally limited to discrete, thin, depth intervals. For these reasons it appears that the seepage within the ice contact and recent alluvium is representative of a perched ground water condition. Most commonly, the seepage within the ice contact sediments and recent alluvium was present within the near-surface weathered soils. Zones of deeper seepage were also observed at some locations. In general, zones of seepage were more prevalent in areas in close proximity to wetlands. It should be noted that the depth and occurrence of ground water seepage may vary in response to such factors as changes in season, precipitation, and site use.

II. GEOLOGIC HAZARDS AND MITIGATIONS

EXHIBIT 31
PAGE 11 OF 45

The following discussion of potential geologic hazards is based on the geologic, slope, and shallow ground water conditions as observed and discussed herein.

5.0 SEISMIC HAZARDS AND RECOMMENDED MITIGATION

Earthquakes occur in the Puget Lowland with great regularity. The vast majority of these events are small and are usually not felt by people. However, large earthquakes do occur as evidenced by the 1949, 7.2-magnitude event, the 2001, 6.8-magnitude event, and the 1965, 6.5-magnitude event. The 1949 earthquake appears to have been the largest in this region during recorded history and was centered in the Olympia area.

Generally, there are four types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture; 2) seismically induced landslides; 3) liquefaction; and 4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below.

5.1 Surficial Ground Rupture

The nearest known fault traces to the project site are the South Whidbey Island - Lake Alice Fault, located approximately 2 to 3 miles to the southwest, and the Seattle Fault, located approximately 12 miles to the south. Recent studies by the United States Geological Survey (USGS) (e.g., Johnson et al., 1994, *Origin and Evolution of the Seattle Fault and Seattle Basin, Washington,* Geology, v. 22, pp. 71-74; and Johnson et al., 1999, *Active Tectonics of the Seattle Fault and Central Puget Sound Washington – Implications for Earthquake Hazards*, Geological Society of America Bulletin, July 1999, v. 111, n. 7, pp. 1042-1053) have provided evidence of surficial ground rupture along a northern splay of the Seattle Fault. The recognition of this fault splay is relatively new and data pertaining to it are limited with the studies still ongoing. According to the USGS studies, the latest movement of this fault was about 1,100 years ago when about 20 feet of surficial displacement took place. This displacement can presently be seen in the form of raised, wave-cut beach terraces along Alki Point in West Seattle and Restoration Point at the south end of Bainbridge Island. The recurrence interval of movement along these fault systems is still unknown, although it is hypothesized to be in excess of several thousand years. Due to the suspected long recurrence interval, the potential for surficial ground rupture is considered to be low during the expected life of the proposed structure. No surficial faulting or earth rupture associated with the South Whidbey Island - Lake Alice Fault has been documented to date in the King County region.

5.2 Seismically Induced Landslides

It is our opinion that the potential risk of damage to the proposed development by seismically induced landsliding is low due to the low to moderate slope heights and gradients on the site, the subsurface conditions encountered, and the lack of any evidence of past slope movement in the area.

5.3 Liquefaction

It is our opinion that the risk of damage to structures by liquefaction is low in most areas due to the lack of adverse ground water conditions. Specifically, in those areas underlain by recent alluvium, recessional outwash, and ice contact sediments, ground water seepage was limited to thin, isolated zones, typically less than 6 inches in thickness. In addition, the gradation and moderate to high relative density of the ice contact sediments and lodgement till do not present a high risk of liquefaction. Saturated zones of substantial thickness were encountered within the advance outwash sediments; however, these sediments have been glacially consolidated and are not prone to liquefaction due to their moderately high to high relative density. No mitigation of liquefaction hazards at the site is warranted.

5.4 Ground Motion

It is our opinion that any earthquake damage to the proposed structures, when founded on suitable bearing strata in accordance with the recommendations contained herein, would be caused by the intensity and acceleration associated with the event and not any of the above-discussed impacts. Structural design of proposed buildings should follow 1997 *Uniform Building Code* (UBC) standards for Seismic Zone 3 (Z Factor=0.3) and S_D soil type.

Alternatively, guidelines presented in the 2003 *International Building Code* (IBC) Section 1615 may be used. Information presented in Figure 1615(1) of the IBC indicates a mapped spectral acceleration for short periods of $S_s = 1.4$. Information presented in Figure 1615(2) of the IBC indicates a mapped spectral acceleration for a 1 second period of $S_1 = 0.45$. Based on the results of subsurface exploration and on an estimation of soil properties at depth utilizing available geologic data, Site Class "D" in conformance with Table 1615.1.1 of the IBC may be used.

6.0 EROSION HAZARDS AND MITIGATION

The near-surface sediments at the site generally contain substantial quantities of silt and will be sensitive to erosion. In order to reduce the amount of sediment transport off the site during construction, the following recommendations should be followed.

1. Silt fencing should be placed around the lower perimeter of the cleared areas. The fencing should be periodically inspected and maintained as necessary to ensure proper function.

2. If possible, construction should proceed during the drier periods of the year.

3. Areas stripped of vegetation during construction should be mulched and hydroseeded, replanted as soon as possible, or otherwise protected. During winter construction, hydroseeded areas should be covered with clear plastic to facilitate grass growth.

4. If excavated soils are to be stockpiled on the site for reuse, measures should be taken to reduce the potential for erosion from the stockpile. This could include, but is not limited to, covering the pile with plastic sheeting, the use of low stockpiles in flat areas, and the use of straw bales/silt fences around pile perimeters.

III. PRELIMINARY DESIGN RECOMMENDATIONS

EXHIBIT 31
PAGE 14 OF 45

7.0 INTRODUCTION

Our exploration indicates that, from a geotechnical standpoint, the parcel is suitable for the proposed development provided the recommendations contained herein are properly followed. The foundation bearing stratum is relatively shallow and conventional spread footing foundations may be utilized. Due to the relatively loose condition of the recessional outwash and alluvial sediments, recompaction of these materials is recommended where they are present in foundation areas.

8.0 SITE PREPARATION

Following demolition of the existing structures, any remaining foundation elements should be removed. Site preparation of the planned building and pavement areas should also include removal of all trees, brush, debris, and any other deleterious materials. These unsuitable materials should be properly disposed of off-site. Additionally, any areas of organic topsoil should be removed and the remaining roots grubbed. Areas where loose surficial soils exist due to grubbing operations should be considered as fill to the depth of disturbance and treated as subsequently recommended for structural fill placement. Any buried utilities should be removed or relocated if they are under building areas. The resulting depressions should be backfilled with structural fill as discussed under the *Structural Fill* section of this report.

After stripping of the organic topsoil/forest duff layer and removal of roots, we recommend that the soil exposed in pavement areas be recompacted to at least 90 percent of the modified Proctor maximum dry density (ASTM:D 1557) using a 20-ton (minimum) vibratory roller. The recompacted area should then be proof-rolled with a fully loaded tandem-axle dump truck. Any soft or yielding areas identified during proof-rolling should be overexcavated and backfilled with structural fill. In areas where the pavement subgrade is wet (over optimum moisture) recompaction will be difficult or impossible to achieve and should not be attempted. This is particularly true in places underlain by the Vashon ice contact sediments. In lieu of recompaction the area should be overexcavated to firm bearing soils and blanketed by 2- to 4-inch crushed rock.

In our opinion, stable temporary construction slopes should be the responsibility of the contractor and should be determined during construction. For estimating purposes, however, we anticipate that temporary, unsupported cut slopes in the loose to medium dense fill or natural sediments can be planned at a maximum slope of 1.5H:1V (Horizontal:Vertical). Unsupported cut slopes in the dense to very dense glacially consolidated sediments can be made at a maximum slope of approximately 1H:1V. In areas of ground water seepage, flatter temporary cut slopes may be warranted. As is typical with earthwork operations, some sloughing and raveling may occur and cut slopes may have to be adjusted in the field. In addition, WISHA/OSHA regulations should be followed at all times. Permanent, unsupported cut or structural fill slopes should not exceed a gradient of 2H:1V.

EXHIBIT 31
PAGE 15 OF 46

Much of the on-site soils, particularly the fill and ice contact sediments, contain a high percentage of fine-grained material that makes them moisture-sensitive and subject to disturbance when wet. The contractor must use care during site preparation and excavation operations so that the underlying soils are not softened. If disturbance occurs, the softened soils should be removed and the area brought to grade with structural fill.

Consideration should be given to protecting access and staging areas with an appropriate section of crushed rock or asphalt treated base (ATB) during wet weather construction. If crushed rock is considered for the access and staging areas, it should be underlain by engineering stabilization fabric to reduce the potential of fine-grained materials pumping up through the rock and turning the area to mud. The fabric will also aid in supporting construction equipment, thus reducing the amount of crushed rock required. We recommend that at least 10 inches of rock be placed over the fabric.

9.0 STRUCTURAL FILL

Placement of structural fill may be required to establish desired grades in some areas. All references to structural fill in this report refer to subgrade preparation, fill type, placement, and compaction of materials as discussed in this section. If a percentage of compaction is specified under another section of this report, the value given in that section should be used.

After stripping, planned excavation, and any required overexcavation has been performed to the satisfaction of the geotechnical engineer/engineering geologist, the upper 12 inches of exposed ground should be recompacted to at least 90 percent of the modified Proctor maximum density using ASTM:D 1557 as the standard. If the subgrade contains too much moisture, adequate recompaction may be difficult or impossible to obtain and should probably not be attempted. In lieu of recompaction, the area to receive fill should be blanketed with washed rock or quarry spalls to act as a capillary break between the new fill and the wet subgrade. Where the exposed ground remains soft and further overexcavation is impractical, placement of an engineering stabilization fabric may be necessary to prevent contamination of the free-draining layer by silt migration from below.

After recompaction of the exposed ground is tested and approved, or a free-draining rock course is laid, structural fill may be placed to attain desired grades. Structural fill is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 8-inch loose lifts with each lift being compacted to at least 95 percent of the modified Proctor maximum density using ASTM:D 1557 as the standard. The on-site recessional outwash sediments and Vashon advance outwash sediments in the areas of exploration pits EP-1 and EP-2 are generally suitable for use as structural fill, generally contain only trace quantities of silt, and are not overly moisture-sensitive. The recent alluvium, lodgement till, and ice contact sediments do contain substantial quantities of silt and are considered moisture-sensitive. At the time of our exploration, the majority of these sediments exhibited moisture contents well above the optimum for maximum compaction and would require moisture conditioning prior to use as structural fill.

In the case of roadway and utility trench backfill, the structural fill should be placed and compacted in accordance with current local or county codes and standards. The top of all compacted fill should extend horizontally outward a minimum distance of 3 feet beyond the locations of perimeter footings or pavement edges before sloping down at a maximum angle of 2H:1V. Structural fill placed in foundation excavations must extend a minimum distance beyond the edges of the footings equal to the thickness of the fill placed.

The contractor should note that any proposed fill soils must be evaluated by Associated Earth Sciences, Inc. (AESI) prior to their use in fills. This would require that we have a sample of the material at least two business days in advance to perform a Proctor test and determine its field compaction standard. Soils in which the amount of fine-grained material (smaller than the No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve size) should be considered moisture-sensitive. Use of moisture-sensitive soils in structural fills should be limited to favorable dry weather conditions. In addition, construction equipment traversing the site when the soils are wet can cause considerable disturbance. If fill is placed during wet weather, or if proper compaction cannot be obtained, a select on-site and/or import material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil with the amount of fine-grained material limited to 5 percent by weight when measured on the minus No. 4 sieve fraction and at least 25 percent greater than the No. 4 sieve.

A representative from our firm should observe the stripped subgrade and be present during placement of structural fill to observe the work and perform a representative number of in-place density tests. In this way, the adequacy of the earthwork may be evaluated as filling progresses and any problem areas may be corrected at that time. It is important to understand that taking random compaction tests on a part-time basis will not assure uniformity or acceptable performance of a fill. As such, we are available to aid the owner in developing a suitable monitoring and testing frequency.

10.0 FOUNDATIONS

Spread footings may be utilized for building support when founded either directly on the medium dense to very dense ice contact or lodgement till sediments, on the unweathered recessional outwash or recent alluvial sediments prepared as described below, or on structural fill placed over these materials. Portions of the near-surface, weathered sediments typically contained abundant roots and should not be used for foundation support. Sediments suitable for foundation support were generally encountered at depths ranging from approximately ½ to 3½ feet. For footings founded in areas underlain by recent alluvium or recessional outwash, we recommend that the area below the footings be excavated a minimum of 2 feet beyond the footing edges. The exposed soil should then be recompacted to a dense, unyielding condition prior to footing placement. Compaction must be performed with a jumping jack (whacker) compactor or walk-behind-type vibratory roller, or equivalent. A plate compactor is not suitable for this purpose. If the exposed soils cannot be compacted to a dense, unyielding condition, it may be necessary to overexcavate a foot or more and replace with structural fill. The excavated native soils can be used as this foot of structural fill, provided it can be compacted to the minimum required density. In those areas where elevated soil moisture contents make recompaction impractical, we recommend that the structural fill consist of at least 1 foot of 2- to 4-inch crushed rock. In foundation areas underlain by the silty ice contact sediments where shallow ground water seepage is present, or where the soils are otherwise wet, it may be prudent to blanket the foundation subgrade with 2- to 4-inch crushed rock immediately following excavation to protect the subgrade from disturbance.

For footings founded either directly upon the medium dense to very dense, native sediments, recompacted recessional outwash or alluvium, or on structural fill as described above, we recommend that an allowable foundation soil bearing pressure of 2,000 pounds per square foot (psf) be utilized for design purposes, including both dead and live loads. An increase of one-third may be used for short-term wind or seismic loading. Perimeter footings for the proposed buildings should be buried a minimum of 18 inches into the surrounding soil for frost protection. No minimum burial depth is required for interior footings; however, all footings must penetrate to the prescribed stratum and no footings should be founded in or above loose, organic, or existing fill soils.

It should be noted that the area bounded by lines extending downward at 1H:1V from any footing must not intersect another footing or intersect a filled area that has not been compacted to at least 95 percent of ASTM:D 1557. In addition, a 1.5H:1V line extending down from any footing must not daylight because sloughing or raveling may eventually undermine the footing. Thus, footings should not be placed near the edge of steps or cuts in the bearing soils.

Anticipated settlement of footings founded as described above should be on the order of 1 inch. However, loose or disturbed soil not removed from footing excavations prior to footing placement could result in increased settlements. All footing areas should be inspected by AESI prior to placing concrete to verify that the design bearing capacity of the soils has been attained and that construction conforms with the recommendations contained in this report. Such inspections may be required by the governing municipality. Perimeter footing drains should be provided as discussed under the section on *Drainage Considerations*.

EXHIBIT 31
PAGE 18 OF 45

11.0 LATERAL WALL PRESSURES

All backfill behind walls or around foundation units should be placed as per our recommendations for structural fill and as described in this section of the report. Horizontally backfilled walls that are free to yield laterally at least 0.1 percent of their height may be designed using an equivalent fluid equal to 35 pounds per cubic foot (pcf). Fully restrained, horizontally backfilled rigid walls that cannot yield should be designed for an equivalent fluid of 50 pcf. If roadways, parking areas, or other areas subject to vehicular traffic are adjacent to walls, a surcharge equivalent to 2 feet of soil should be added to the wall height in determining lateral design forces. Walls that retain sloping backfill at a maximum angle of 2H:1V should be designed using an equivalent fluid pressure of 55 pcf for yielding conditions or 75 pcf for fully restrained conditions.

The lateral pressures presented above are based on the conditions of a uniform horizontal backfill consisting of the on-site, natural glacial sediments, or imported sand and gravel compacted to 90 percent of ASTM:D 1557. A higher degree of compaction is not recommended as this will increase the pressure acting on the wall.

Wall and footing drains must be provided for all retaining walls (including detention/infiltration vaults) as discussed under the section on *Drainage Considerations*. It is imperative that proper drainage be provided so that hydrostatic pressures do not develop against the walls. This would involve installation of a minimum 1-foot-wide blanket drain using imported, washed gravel against the walls or placement of an approved drainage mat. The wall drain must extend to within 2 feet of the ground surface and be placed to be continuous with the footing drain.

11.1 Passive Resistance and Friction Factors

Lateral loads can be resisted by friction between the foundation and the natural glacial sediments or supporting structural fill soils, and/or by passive earth pressure acting on the buried portions of the foundations. The foundations must be backfilled with compacted structural fill to achieve the passive resistance provided below. We recommend the following design parameters.

EXHIBIT 32
PAGE 19 OF 45

- Passive equivalent fluid = 250 pcf
- Coefficient of friction = 0.30

The above values are allowable and include a factor of safety of at least 2.0.

12.0 FLOOR SUPPORT

Slab-on-grade floors may be constructed either directly on the medium dense to very dense natural glacial sediments, recompacted recent alluvium or recessional outwash prepared as discussed previously in the *Foundations* section of this report, or on structural fill placed over these materials. Areas of the slab subgrade that are disturbed (loosened) during construction should be recompacted to an unyielding condition prior to placing the pea gravel, as described below.

If moisture intrusion through slab-on-grade floors is to be limited, the floors should be constructed atop a capillary break consisting of a minimum thickness of 4 inches of washed pea gravel. The pea gravel should be overlain by a 6-mil (minimum thickness) plastic vapor barrier. In addition, a minimum of 2 inches of clean sand should be placed over the vapor barrier to protect the integrity of the barrier during concrete placement, and to aid in the curing of the concrete. This sand layer should be kept dry prior to concrete placement. If ground water seepage is present or anticipated at the floor slab elevation, then the floor(s) should be underlain by a subslab drain. Recommendations for subslab drains are discussed in the *Drainage Considerations* section of this report.

13.0 DETENTION/INFILTRATION POND CONSIDERATIONS

It is our understanding that preliminary project plans include construction of a detention/infiltration pond in the southeastern portion of the property in the area of exploration pit EP-2 and a detention pond in the western portion of the site in the area of exploration pit EP-16 (Figure 2). Near-surface sediments encountered in exploration pit EP-2 consisted of Vashon ice contact sediments. The ice contact sediments were underlain at a depth of approximately 6 feet by clean sand and gravel interpreted to be representative of Vashon advance outwash. We understand that this pond may be designed as an infiltration pond. The ice contact sediments contain substantial quantities of silt and are not suitable for infiltration. In order to evaluate the feasibility of infiltration into the Vashon advance outwash, a sieve analysis was conducted on a sample collected from exploration pit EP-2 at a depth of 8 to 9 feet. The sieve analysis indicates that the sample consists of sand with gravel, trace silt, and would be classified under the United States Department of Agriculture (USDA) Soil Textural Classification System as a "sand". According to the Washington State Department of Ecology *Stormwater Management Manual for Western Washington* (August 2001), this textural classification equates to a short-term infiltration rate of 8 inches per hour. This should be considered an approximate value and should not be used for final infiltration pond design. Evaluation of a quantitative infiltration rate for final infiltration pond design was beyond the scope of this study but could be conducted by AESI upon request by Lakewood Construction. A copy of the sieve analysis results is included in the Appendix. It should be noted that silty lenses were observed in the advance outwash in exploration pit EP-2 over the depth interval from approximately 10 to 12 feet. The presence of these silty lenses will likely retard the rate of infiltration.

Sediments encountered at the location of exploration pit EP-16 also consisted of Vashon ice contact sediments underlain by Vashon advance outwash. However, at this location, the advance outwash sediments were saturated. Shallow, perched seepage was also encountered within the ice contact sediments at a depth of approximately 2 feet. Given the high silt content of the ice contact sediments and the saturated condition of the underlying advance outwash sand, storm water infiltration at this location will not be feasible. If a detention pond is constructed at the location of exploration pit EP-16, the design of the pond should account for inflow to the pond from the shallow seepage within the ice contact sediments, and from the advance outwash sediments if the base of the pond extends below the ice contact/advance outwash contact. Evaluation of ground water seepage rates into the pond was beyond the scope of this study. It should be noted that the ground water seepage from the advance outwash sediments at this location was observed to occur directly below the ice contact sediments. Because of their density and high silt content, the permeability of the overlying ice contact sediments is low and it is possible that ground water in the advance outwash is confined. If this is the case, the static ground water level in the advance outwash will be above ice contact/advance outwash contact (approximately 8 feet below the existing ground surface).

Although detention/infiltration pond construction details have not been finalized at the time of our study, we anticipate that construction of the ponds will entail excavation to the desired pond bottom elevation and may include perimeter fill berms. Preparation for placement of structural fill for pond berm construction will entail stripping of the surficial topsoil and excavation of the proposed fill area to firm, stable subsoil as described in the *Site Preparation* section of this report. Fill soils used for pond berm construction should contain a maximum of 60 percent sand, a minimum of 30 percent silt, and nominal gravel and cobble content. The fill should be placed as structural fill, compacted to a minimum of 95 percent of ASTM:D 1557 at a moisture content slightly above optimum, as described in the *Structural Fill* and *Site Preparation* sections of this report. Due to their high silt content, compaction of fill soils meeting the stated specification may be difficult to achieve during wet weather. The suitability of all pond berm fill should be verified by AESI prior to its use, using appropriate laboratory testing. If a storm water infiltration function is considered in the pond design, care should be taken to avoid placement of any berm fill or compaction within the excavated portion of the pond interior as this will limit the rate of infiltration.

Interior perimeter pond slopes subject to inundation should be made at a maximum gradient of 3H:1V. Exterior perimeter berm slopes should be made at a maximum gradient of 2H:1V. Perimeter pond berms should have a minimum top width of 6 feet. A key equal to the top of berm width with a minimum depth of 3 feet should extend below the base of the pond berm. Additionally, pond berm geometry should conform to local design standards. AESI would be available to perform a geotechnical review of the final pond plans once they are available.

14.0 DRAINAGE CONSIDERATIONS

All retaining and perimeter footing walls should be provided with a drain at the base of the footing elevation. Drains should consist of rigid, perforated, PVC pipe surrounded by washed pea gravel. The level of the perforations in the pipe should be set at the bottom of the footing and the drains should be constructed with sufficient gradient to allow gravity discharge away from the buildings. In addition, all retaining walls greater than 3 feet in height should be lined with a minimum 12-inch-thick washed gravel blanket or drainage mat that extends to within 2 feet of the surface and is continuous with the footing drain. Roof and surface runoff should not discharge into the footing drain system but should be handled by a separate, rigid, tightline drain. In planning, exterior grades adjacent to walls should be sloped downward away from the structures to achieve surface drainage.

Subslab drainage systems are recommended for any areas where floor slabs will be constructed at or below areas of ground water seepage (if any). We recommend that this be accomplished by grading the floor subgrade so that it slopes toward a central drainage trench constructed below the entire length of the floor slab area. A drainpipe consisting of rigid, perforated, PVC should be placed in the central trench. The pipe should be fully enveloped in washed pea gravel, sloped to drain, and placed in the trench such that the perforations in the pipe are set a minimum of 4 inches below the adjacent floor subgrade. The entire floor subgrade, including the area of the subslab drainage pipe, should then be blanketed with the crushed rock capillary break material as discussed in the *Floor Support* section of this report.

The footing and sub-slab drains should be tightlined to a suitable point of discharge.

15.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

Our recommendations are preliminary in that definite building locations and/or construction details have not been finalized at the time of this report. We are available to provide additional geotechnical consultation as the project design develops and possibly changes from that upon which this report is based. If significant changes in grading are made, we recommend that AESI perform a geotechnical review of the plans prior to final design completion. In this way, our earthwork and foundation recommendations may be properly interpreted and implemented in the design.

We are also available to provide geotechnical engineering and monitoring services during construction. The integrity of the foundations depends on proper site preparation and construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent.

We have enjoyed working with you on this study and are confident that these recommendations will aid in the successful completion of your project. If you should have any questions, or require further assistance, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

Timothy J. Peter, P.G., P.E.G.
Project Geologist

MATTHEW A. MILLER
STATE OF WASHINGTON
30284
REGISTERED
PROFESSIONAL ENGINEER
4-30-04
EXPIRES 2/8/06

Gary A. Flowers, P.G., P.E.G.
Principal

Matthew A. Miller, P.E.
Senior Geotechnical Engineer

Attachments:	Figure 1:	Vicinity Map
	Figure 2:	Site and Exploration Plan
	Appendix:	Exploration Logs
		Sieve Analysis Results

APPENDIX

Associated Earth Sciences, Inc.

VICINITY MAP
GEORGIAN HEIGHTS - PHASES 3 & 4
WOODINVILLE, WASHINGTON

FIGURE 1
DATE 4/04
PROJ NO. KE04174B

-4174 georgian heights\04174-vicinity.cdr page2

LOG OF EXPLORATION PIT NO. EP-1

EXHIBIT 31
PAGE 25 OF 45

Depth (ft)	DESCRIPTION
	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.
	Sod
	Weathered Vashon Ice Contact Sediments
1	Medium dense, very moist, tan, SILTY SAND with gravel (SM).
2	
3	
4	**Vashon Ice Contact Sediments**
5	Dense to very dense, very moist, tan, SILTY SAND with gravel (SM).
6	**Vashon Advance Outwash**
7	Medium dense, moist, tan, fine to medium SAND with gravel; few silt (SP).
8	
9	Bottom of exploration pit at depth 8 feet Minor caving below 6'. No seepage.
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

KCTP3 04174A-1.GPJ April 29, 2004

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE04174A
March 2004

LOG OF EXPLORATION PIT NO. EP-2

EXHIBIT 31
PAGE 26 OF 45

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Sod
1	**Weathered Vashon Ice Contact Sediments** Medium dense, very moist, tan, SILTY SAND with gravel (SM).
2	
3	
4	**Vashon Ice Contact Sediments** Dense to very dense, very moist, tan, SILTY SAND with gravel (SM).
5	
6	**Vashon Advance Outwash** Medium dense, moist, grayish tan SAND with gravel, trace silt (SW); few silt below 9'; contains lenses of silty sand with gravel at approximately 10' to 12'; becomes very moist with trace silt below 13'.
7	
8	
9	
10	
11	
12	
13	
14	
15	Bottom of exploration pit at depth 14.5 feet No caving. No seepage.
16	
17	
18	
19	
20	

KCTP3 04174A-1.GPJ April 29, 2004

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE04174A
March 2004

LOG OF EXPLORATION PIT NO. EP-3

EXHIBIT 31
PAGE 27 OF 46

Depth (ft)	DESCRIPTION
	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.
	Topsoil
1	**Weathered Vashon Recessional Outwash** Loose, moist, reddish brown, SILTY SAND, few gravel (SM); abundant roots.
2	**Vashon Recessional Outwash** Loose to medium dense, moist, grayish tan, fine to medium SAND, few gravel, trace silt (SP); with gravel below 4'.
3	
4	
5	
6	
7	
8	
9	
10	Bottom of exploration pit at depth 9 feet Frequent, massive caving during excavation. No seepage.
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

KCTP3 04174A-1.GPJ April 29, 2004

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE04174A
March 2004

LOG OF EXPLORATION PIT NO. EP-4

EXHIBIT 31
PAGE 28 OF 45

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Sod
	Fill
1	Loose, moist, dark brown, SILTY SAND with gravel (SM).
	Weathered Vashon Ice Contact Sediments
2	Loose, moist, reddish brown, SILTY SAND with gravel (SM); becomes medium dense, moist and tan below 2.5'; wet at base.
3	
	Vashon Ice Contact Sediments
4	Very dense, very moist, tan and brown mottling, SILTY SAND with gravel (SM); becomes blue-gray below 5'.
5	
6	
7	
	Vashon Advance Outwash
8	Dense, wet, tan, SILTY fine SAND (SM).
	Bottom of exploration pit at depth 8 feet No caving. Moderately rapid seepage below 7.5'.
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

KCTP3 04174A-1.GPJ April 29, 2004

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE04174A
March 2004

LOG OF EXPLORATION PIT NO. EP-5

EXHIBIT 31
PAGE 29 OF 45

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Forest Duff
1	**Weathered Alluvium** Loose, very moist, brown, SILTY SAND, little gravel, abundant roots; wet at base.
2	**Alluvium**
3	Loose to medium dense, very moist, grayish tan, SILTY SAND, few gravel (SM); with gravel below approximately 3'.
4	
5	Medium dense, very moist, blue-gray, SILTY SAND, little gravel; 4" thick lense of sandy silt with trace organics present at approximately 5'.5.
6	
7	
8	
9	Bottom of exploration pit at depth 8 feet Intermittent, massive caving 0' to 5'. Moderately rapid seepage at 2'.
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

KCTP3 04174A-1.GPJ April 29, 2004

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE04174A
March 2004

EXHIBIT 31
PAGE 32 OF 45

LOG OF EXPLORATION PIT NO. EP-6

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Topsoil
1	
2	**Alluvium** Medium dense, very moist, mottled, tan, SILTY SAND, little gravel (SM); becomes reddish tan below 4.5'.
3	
4	
5	
6	
7	Medium dense, very moist, blue-gray, SILTY SAND with gravel (SM); trace organics, scattered cobbles and boulders.
8	**Vashon Advance Outwash** Medium dense to dense, wet, blue-gray, medium SAND, trace silt (SP).
9	Bottom of exploration pit at depth 8 feet. Intermittent, massive caving throughout. Rapid seepage below 7'.
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE04174A
March 2004

KCTP3 04174A-1.GPJ April 29, 2004

LOG OF EXPLORATION PIT NO. EP-7

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Forest Duff
1	**Weathered Vashon Lodgement Till** Loose, moist, brown, SILTY SAND, little gravel (SM); abundant roots 0' to 2'; becomes medium dense, very moist and tan below 2.5'.
2	
3	
4	
5	**Vashon Lodgement Till** Very dense, moist, tan, SILTY SAND with gravel (SM).
6	
7	
8	**Vashon Advance Outwash** Dense, wet, tan, fine to medium SAND with little gravel, little silt (SM).
9	
10	Bottom of exploration pit at depth 9 feet No caving. Moderately rapid seepage 8' to 9'.
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

KCTP3 04174A-1.GPJ April 29, 2004

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE04174A
March 2004

LOG OF EXPLORATION PIT NO. EP-8

EXHIBIT 31
PAGE 32 OF 45

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION
	Topsoil
1	**Weathered Vashon Ice Contact Sediments**
2	Loose, wet, tan, SILTY fine SAND (SM); becomes medium dense and very moist below 3.5'.
3	
4	
5	**Weathered Vashon Ice Contact Sediments**
6	Very stiff, very moist, mottled tan, SANDY SILT with gravel (ML); increased gravel content below 6.5; scattered cobbles.
7	
8	Bottom of exploration pit at depth 7 feet Moderate seepage 1' to 3.5' accompanied by periodic caving.
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

KCTP3 04174A-1.GPJ April 29, 2004

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE04174A
March 2004

LOG OF EXPLORATION PIT NO. EP-9

EXHIBIT 31
PAGE 33 OF 45

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION
	Topsoil with abundant roots.
1	
2	**Weathered Vashon Ice Contact Sediments** Medium dense, very moist, mottled tan, SILTY SAND with gravel (SM).
3	
4	
5	**Vashon Ice Contact Sediments**
6	Dense, very moist, mottled tan, SILTY SAND with gravel (SM).
7	
8	
9	
10	Bottom of exploration pit at depth 9 feet No caving. No seepage.
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE04174A
March 2004

KCTP3 04174A-1.GPJ April 29, 2004

LOG OF EXPLORATION PIT NO. EP-10

EXHIBIT 31
PAGE 34 OF 45

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Forest Duff
1	**Weathered Vashon Recessional Outwash** Loose, moist, reddish tan, SILTY SAND with gravel (SM); contains abundant roots.
2	**Vashon Recessional Outwash**
3	Loose to medium dense, moist, tan SAND with gravel, trace silt (SW).
4	
5	
6	
7	
8	
9	Bottom of exploration pit at depth 8 feet Intermittent, massive caving. No seepage.
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE04174A
March 2004

KCTP3 04174A-1.GPJ April 29, 2004

LOG OF EXPLORATION PIT NO. EP-11

EXHIBIT 31
PAGE 35 OF 45

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Forest Duff
1	**Weathered Vashon Ice Contact Sediments** Loose, moist, reddish brown, SILTY SAND with gravel, abundant roots (SM).
2	
3	**Vashon Ice Contact Sediments** Medium dense, very moist, grayish tan, SILTY SAND with gravel (SM); becomes wet at approximately 4'; becomes mottled and dense at approximately 6'; wet at 6'.
4	
5	
6	
7	
8	
9	Bottom of exploration pit at depth 8 feet No caving. Slow, spotty seepage at 4' and again at 6'.
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE04174A
March 2004

KCTP3 04174A-1.GPJ April 29, 2004

LOG OF EXPLORATION PIT NO. EP-12

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Forest Duff
1	**Weathered Vashon Recessional Outwash** Loose, moist, reddish brown, SILTY SAND with gravel, abundant roots (SM).
2	
3	**Vashon Recessional Outwash** Loose to medium dense, moist, grayish tan SAND with gravel, trace silt (SW); few silt and scattered cobbles below 6'.
4	
5	
6	
7	
8	
9	Bottom of exploration pit at depth 8 feet Minor caving. No seepage.
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: RJP

Project No. KE04174A
March 2004

LOG OF EXPLORATION PIT NO. EP-13

EXHIBIT 31
PAGE 37 OF 45

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Forest Duff
1	**Weathered Vashon Ice Contact Sediments** Loose, moist to very moist, reddish brown, SILTY SAND with gravel (SM); wet at base; abundant roots 0' to 2'.
2	
3	**Vashon Ice Contact Sediments**
4	Medium dense, very moist to wet, tan, SILTY SAND with gravel (SM).
5	
6	
7	
8	
9	Bottom of exploration pit at depth 8 feet No caving. Moderately rapid to rapid seepage at 3'.
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE04174A
March 2004

EXHIBIT 31
PAGE 38 OF 45

LOG OF EXPLORATION PIT NO. EP-14

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Forest Duff
1	**Weathered Vashon Ice Contact Sediments** Loose, very moist, brown, SILTY SAND with gravel (SM); wet at base, abundant roots.
2	
3	**Vashon Ice Contact Sediments** Medium dense, very moist, blue-gray, SILTY SAND with gravel (SM).
4	
5	
6	
7	**Vashon Advance Outwash** Medium dense, wet, tan, medium SAND, few gravel, few silt (SP).
8	
9	Bottom of exploration pit at depth 8 feet Moderate to rapid seepage at 2.5' and again below 6.5'; running sand below 6.5'; intermittent caving 0' to 6.5'.
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE04174A
March 2004

KCTP3 04174A-1.GPJ April 29, 2004

LOG OF EXPLORATION PIT NO. EP-15

EXHIBIT 31
PAGE 39 OF 45

Depth (ft)	DESCRIPTION
	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.
	Topsoil; wet at base.
1	**Vashon Ice Contact Sediments**
	Medium dense, very moist, grayish brown, SILTY SAND with gravel (SM); becomes grayish tan at approximately 2.5'.
2	
3	
4	
5	
6	
7	Stiff, very moist, blue-gray SILT (ML); nonplastic; dilatent.
8	
9	Bottom of exploration pit at depth 8 feet Intermittent caving 0' to 5'. Slow seepage at 8".
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE04174A
March 2004

LOG OF EXPLORATION PIT NO. EP-16

EXHIBIT 31
PAGE 40 OF 45

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
0	Forest Duff
1	**Weathered Vashon Ice Contact Sediments** Loose, moist, reddish brown, SILTY SAND with gravel (SM); abundant roots; wet at base.
2–8	**Vashon Ice Contact Sediments** Medium dense, very moist, mottled tan, SILTY SAND with gravel (SM); becomes dense below 6.5'.
8–11	**Vashon Advance Outwash** Medium dense, wet, tan SAND, little gravel, trace silt (SW).
11	Bottom of exploration pit at depth 11 feet Moderate seepage at 2', rapid seepage below 8'.
12–20	

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE04174A
March 2004

KCTP3 04174A-1.GPJ April 29, 2004

EXHIBIT 31
PAGE 41 OF 45

LOG OF EXPLORATION PIT NO. EP-17

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION
	Forest Duff
1	**Weathered Vashon Recessional Outwash** Loose, moist, reddish brown, SILTY SAND, little gravel (SM); abundant roots.
2	
3	**Vashon Recessional Outwash** Loose to medium dense, moist, tan SAND with gravel, trace silt (SW); grades to a fine sand below 7'.
4	
5	
6	
7	
8	
9	Bottom of exploration pit at depth 8 feet Intermittent, massive caving. No seepage.
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE04174A
March 2004

KCTP3 04174A-1.GPJ April 29, 2004

LOG OF EXPLORATION PIT NO. EP-18

EXHIBIT 31
PAGE 42 OF 45

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Forest Duff
1	**Weathered Vashon Ice Contact Sediments** Loose, moist, reddish tan, SILTY SAND, little gravel (SM); abundant roots.
2	**Vashon Ice Contact Sediments**
3	Medium dense to dense, very moist, tan, SILTY SAND, few gravel (SM).
4	
5	
6	Dense, very moist, reddish tan SAND with gravel, with cobbles, and little silt (SM).
7	
8	
9	Bottom of exploration pit at depth 8 feet No caving. No seepage.
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Georgian Heights Phases III and IV
Woodinville, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE04174A
March 2004

GRAIN SIZE ANALYSIS - MECHANICAL

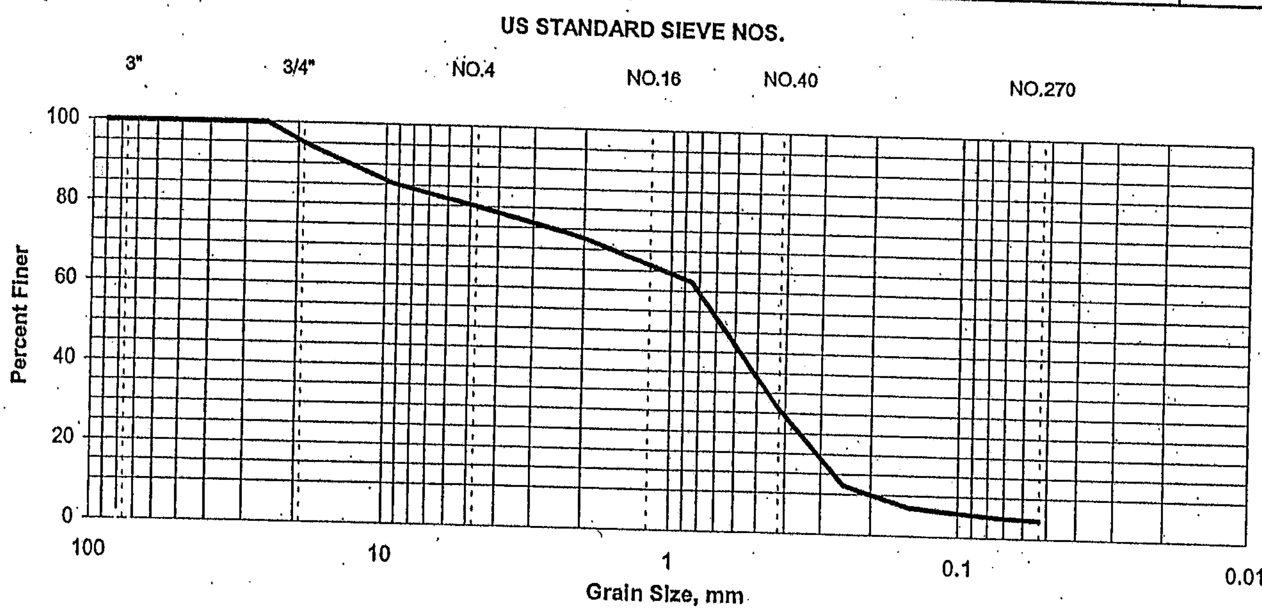
EXHIBIT 31
PAGE 43 OF 45

Date	Project	Project No.		USDA Soil Description
4/1/04	**Georgian Heights**	**KE04174A**		**SAND with gravel, trace silt**
Tested By	Location	EB/EP No	Depth	
RDT		**EP-2**	**8'-9'**	

Wt. of Dry Sample + Tare	990
Wt. of Tare	311
Wt. of Dry Sample	679

Moisture Content = 8.2%

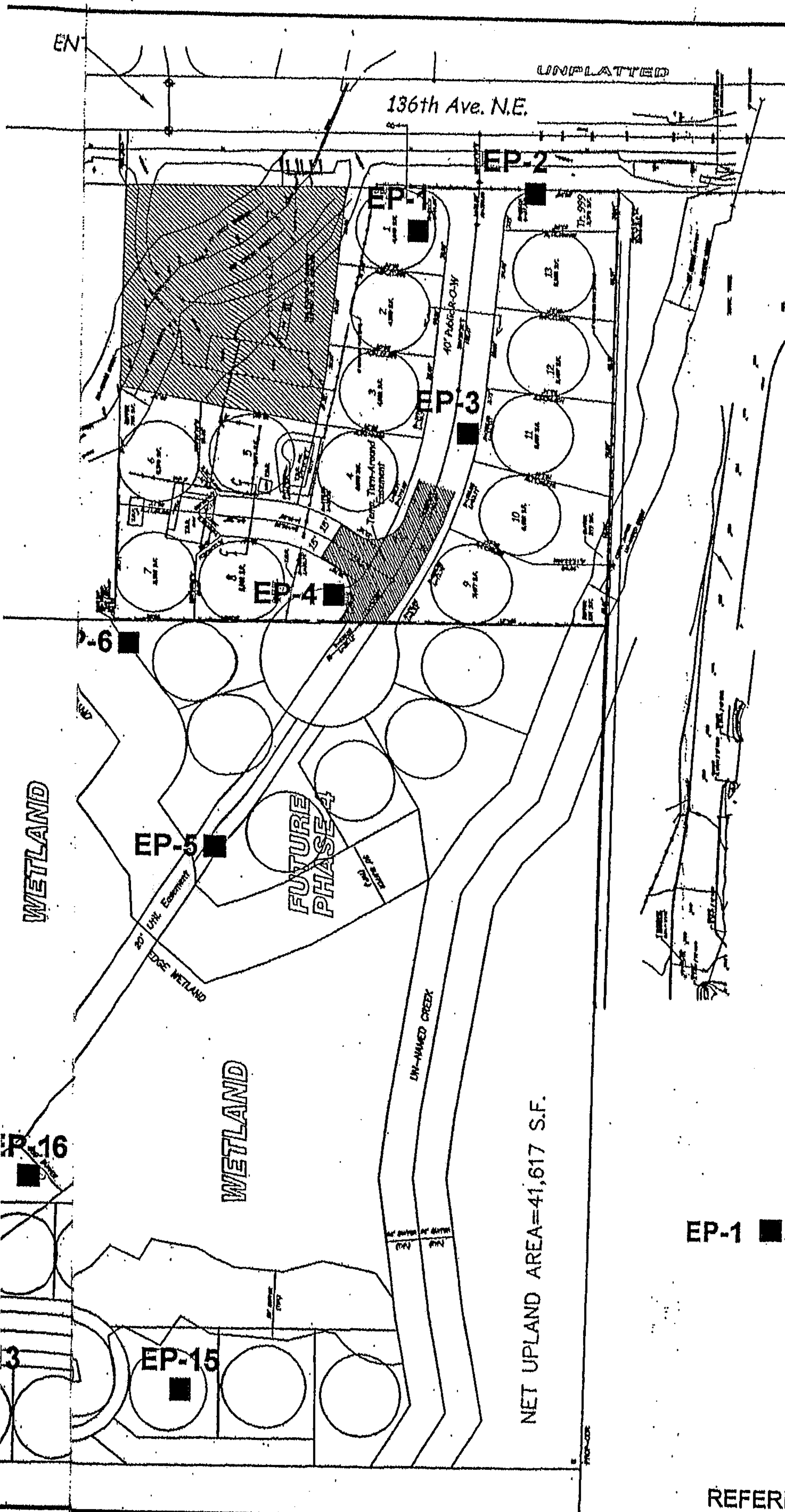
Sieve No.	Diam. (mm)	Wt. Retained (g)	% Retained	% Passing	Specification Requirements Minimum	Specification Requirements Maximum
3.5	90	0	0.0	100.0		
3	76.1	0	0.0	100.0		
2.5	64	0	0.0	100.0		
2	50.8	0	0.0	100.0		
1.5	38.1	0	0.0	100.0		
1	25.4	0	0.0	100.0		
3/4	19	33	4.9	95.1		
3/8	9.51	99	14.6	85.4		
#4	4.76	135	19.9	80.1		
#8	2.38	174	25.6	74.4		
#10	2	185	27.2	72.8		
#20	0.85	255	37.6	62.4		
#40	0.42	468	68.9	31.1		
#60	0.25	595	87.6	12.4		
#100	0.149	631	92.9	7.1		
#200	0.074	644	94.8	5.2		
#270	0.053	648	95.4	4.6		



GRAVEL		SAND			SILT OR CLAY
Coarse	Fine	Coarse	Medium	Fine	

ASSOCIATED EARTH SCIENCES, INC.

911 5th Ave., Suite 100 Kirkland, WA 98033 425-827-7701 FAX 425-827-5424



LEGEND

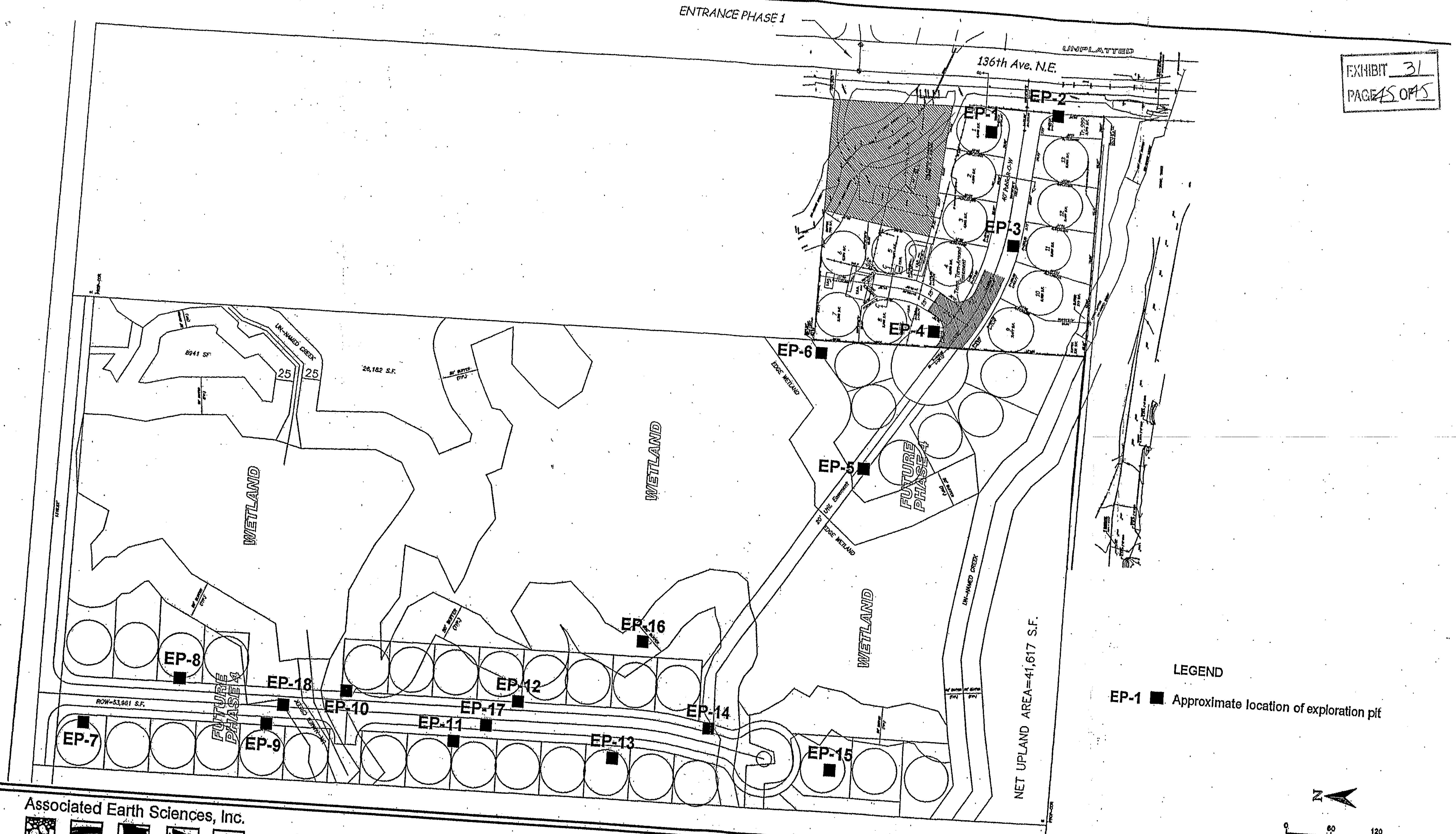
EP-1 ■ Approximate location of exploration pit

REFERENCE: BASE MAP PROVIDED BY CLIENT.

EXHIBIT 31
PAGE 44 OF 45

SORATION PLAN
GS PHASES III AND IV
WASHINGTON

FIGURE 2
DATE 4/04
PROJECT NO. KE04174A



REFERENCE: BASE MAP PROVIDED BY CLIENT.

Associated Earth Sciences, Inc.

SITE AND EXPLORATION PLAN
GEORGIAN HEIGHTS PHASES III AND IV
WOODINVILLE, WASHINGTON

FIGURE 2

DATE 4/04