GEOHAZARD AND PRELIMINARY GEOTECHNICAL REPORT
DRAYTON HILLSIDE III
BLAINE, WASHINGTON

JANUARY 27, 2009

FOR
SEMIAHMOO SOUTH, LLC

GEOENGINEERS

File No. 18329-001-00

GeoEngineers

January 27, 2009

Semiahmoo South, LLC
c/o Tin Rock Development
103 East Holly Street, Suite #417
Bellingham, Washington 98225

Attention: Blair Murray

We are pleased to submit two copies of our, "Geohazard and Preliminary Geotechnical Report, Drayton Hillside III, Blaine, Washington." The scope of services for our study is outlined in our proposal dated December 12, 2008, which was authorized by Werner K. Paulus of Semiahmoo South, LLC on December 22, 2008.

We appreciate the opportunity to provide services on this proposed development project. Please contact us if you have any questions about the information contained in this report or any other aspects of this project.

Sincerely,

GeoEngineers, Inc.

J. Robert Gordon, PE
Principal

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Geohazard and Preliminary Geotechnical Report
Drayton Hillside III
Blaine, Washington
File No. 18329-001-00

January 27, 2009

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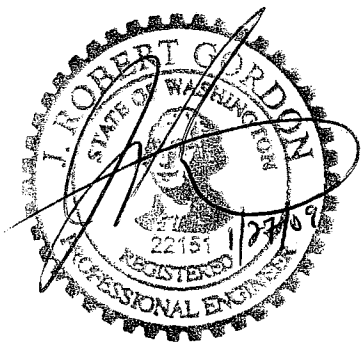

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GEOHAZARD AND PRELIMINARY GEOTECHNICAL REPORT
DRAYTON HILLSIDE III
BLAINE, WASHINGTON
FOR
SEMIAHMOO SOUTH, LLC

INTRODUCTION AND SCOPE

GeoEngineers is pleased to present the results of our geohazard and preliminary geotechnical engineering evaluation of the Drayton Hillside III project, located in the Birch Point area of Blaine, Washington (see Vicinity Map, Figure 1). As currently envisioned, the site development will include approximately 14 new multi-family building units with associated roadways and driveways.

The site is a north-facing slope above Drayton Harbor. Some of the steep site slopes have a history of instability and a large topographic feature referred to as the "amphitheater" has been historically identified as a large landslide. Accordingly, a Geologic Hazard Area Site Assessment must be completed at the site by local ordinance. The purpose of our services were to provide geologic and preliminary geotechnical engineering conclusions regarding the presence of geologic hazards, provide mitigation strategies to address the hazard as appropriate for the proposed development, and provide preliminary conclusions regarding geotechnical aspects of site development. Geologically hazardous area requirements for site development are presented in the Blaine Municipal Code Title 17 Land Use, Chapter 17.82 referred to in this report as the Critical Areas Ordinance (CAO).

Our scope of services included reviewing geologic maps and published references regarding soil conditions at the site, completing a geological reconnaissance at the site, reviewing our previously completed geotechnical explorations at the site, reviewing previous site explorations conducted by others, and providing conclusions regarding the presence of geologic hazards at the site and the potential impacts of the proposed development on site stability. Our specific scope of services is described in our proposal for the project dated December 12, 2008 which was authorized by Werner Paulus of Semiahmoo South, LLC on December 22, 2008.

PROJECT DESCRIPTION

The Drayton Hillside III project is located in Section 11 of Township 40 North, Range 1 West on a north-facing slope of the Birch Point peninsula overlooking Drayton Harbor, in Blaine, Whatcom County, Washington. The site is bounded by a drainage ditch and a pedestrian trail within the Old Drayton Harbor Road right-of-way owned by the City of Blaine to the east, Drayton Harbor Road and drainage channel to the west, Drayton Hillside Phase II residential development to the south, and Drayton Cove residential development to the north. The property is approximately 23 acres in size. Elevations at the site range from about 20 feet along Old Drayton Harbor Road to 185 feet along Drayton Harbor Road at the south end of the site. The overall site conditions are shown in the Site Plans, Figures 3A and 3B.

The proposed site development will include 14 new buildings located as shown in the Concept Site Plan, Figure 2. As currently envisioned, the new structures will include stacked four-story apartments with partially below-grade parking and at-grade townhouses. The structures will primarily be located in the upper northern portion of the site and lower southern portion of the site. Because of sloping site grades, some excavation and filling is likely to achieve a level building surface. The deepest excavations for the structures is anticipated to be on the order of 10 to 12 feet. The buildings will be connected by roadway and driveway areas that will also likely require some cut and fill and likely some retaining walls.

Detailed building foundation loads and site grading plans had not been developed at the time of this report.

GEOLOGIC HAZARD AREA DEFINITION

The methods of designating specific geologic hazard areas are in conformance with Blaine Municipal Code Title 17 Land Use, Chapter 17.82, Sections 17.82.090 regarding landslide areas, 17.82.100 regarding erosion areas, and 17.82.110 regarding seismic hazard areas.

SEISMIC HAZARD

Seismic hazard areas are classified as areas subject to a severe risk of earthquake damage as a result of seismically induced ground shaking, differential settlement or soil liquefaction. These areas are classified as having a high response to seismic shaking as determined by Easterbrook, shown on Engineering Characteristics of Geologic Materials, Western Whatcom County (USGS I-854-D) or other areas including landfills, filled wetlands, or alluvial deposits subject to liquefaction. We reviewed the above mentioned map and the site is mapped as a moderate to high response to seismic shaking.

For areas defined as a seismic hazard, the Code requires that sufficient information be submitted such that the City can determine if conditions exist such that require site analysis by a geotechnical engineer.

EROSION HAZARD

Erosion hazard areas are classified by the Blaine Municipal Code as sites designated by the USDA Soil Conservation Service as containing highly erodable soils. The site is identified as having a slight to moderate erosion potential based on the Soil Survey of Whatcom County; however, as discussed later in this report, our site reconnaissance suggests that the site does contain some highly erodable soils.

For areas defined as an erosion hazard, the Code requires that the application for development shall be accompanied with a report from a qualified consultant indicating measures to be taken to reduce erosion potential.

LANDSLIDE HAZARD

Landslide hazard areas are designated as those areas subject to landslides based on a combination of geologic, topographic and hydrologic factors, including:

- Lands indicated on the slope stability map in western Whatcom County (USGS I-854-C);
- Lands indicated as active slide areas, potential or suspected slide areas according to Map 10 of Critical Areas of Blaine and its Surrounding Area (Western 1991);
- Areas that include the following: slopes steeper than 15 percent; and hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment; and with stream or groundwater seepage;
- Areas of historic failures;
- Areas that have shown evidence of past movement during the Holocene Epoch;
- Slopes that are parallel or subparallel to lines of weakness;
- Areas with greater than 80 percent slope subject to rockfall during seismic events;
- Areas potentially unstable because of rapid stream incision and stream bank erosion;
- Areas with 40 percent slope or greater with a vertical relief of 10 or more feet except areas with consolidated rock.

We reviewed the USGS I-854-C Map Showing Slope Stability in Western Whatcom County, Washington. The site is mapped as Class 2 which represents marginal stability for slopes greater than 15 percent that are underlain by unconsolidated clayey sediments and is mapped by the Costal Zone Atlas as intermediately stable. Additionally, large portions of the site have slopes greater than 40 percent. By Blaine Municipal Code definition, therefore, the site is considered a landslide hazard area.

For areas defined as a landslide hazard, the Code requires that:

- The development proposal causes no increase in surface water discharge or sedimentation on other properties and shall not decrease slope stability on other properties;
- Disturbance of trees and vegetation shall be minimal in order to prevent erosion, stabilize slopes, and preserve the natural character of the area;
- Structures shall conform to the natural contour of the slope and foundations shall be tiered or otherwise designed to generally conform to the existing topography of the site;
- Structures must be designed and clustered where possible to reduce disturbance and maintain natural topographic character; and
- Structures and improvements shall be located to preserve the most sensitive portion of the site and its natural landforms and vegetation.

LITERATURE REVIEW

We reviewed the following maps and reports to aid our geologic hazards evaluation.

- USGS topographic map of the Birch Point 7.5 minute quadrangle.
- Geologic compilation map of the Bellingham 1:100,000 quad (Lapen, 2000).
- Geologic Map of Western Whatcom County, Washington (Easterbrook, 1976).
- Washington Coastal Zone Atlas (Ecology, 1977).
- Map Showing Engineering Characteristics of Geologic Materials in Western Whatcom County, Washington (Easterbrook, 1976).
- Map Showing Slope Stability in Western Whatcom County, Washington (Easterbrook, 1976).
- USDA Soil Conservation Survey (SCS) for Whatcom County (1992)

We also briefly reviewed several geotechnical reports for the site and nearby properties. These included geotechnical site studies completed by Cascade Geotechnical (1992 and 1993), GeoTest Services (2002), Shannon & Wilson (1999) and GeoEngineers (1998), and other evaluations in the area completed by GeoEngineers (2002 and 2003). A detailed summary of references cited is presented at the end of this report.

The following descriptions of regional setting and site conditions incorporate information from these background sources, as well as our field observations and subsurface exploration.

REGIONAL SETTING

GEOLOGIC HISTORY

The site is situated within the Fraser-Nooksack lowland, which is part of a regional-scale topographic basin known as the Georgia Depression and greater Puget-Willamette Lowland physiographic province. This depression extends from Vancouver Island and the San Juan Islands on the west and south, to the inland cordilleran ranges of the Southern Coast Belt terrain, including the Coast Mountains of British Columbia and the North Cascades. The surface terrain of the Georgia-Puget Lowlands was shaped by several advances of continental ice sheets from the north, as well as the effects of post-glacial meltwater and interglacial streams, marine submergence and wave erosion.

During the most recent continental glaciation the ice sheet was up to about 6,000 feet thick over the project area. Under the weight of the ice the underlying land surface was depressed, resulting in a general reduction in elevation of at least 600 feet and consolidation of the underlying sediments. As the glacier melted and retreated, the depressed landforms experienced isostatic rebound and sea level began rising in response to the release of water from ice. With the rise in sea level, the Fraser-Nooksack lowlands were inundated by marine waters about 13,500 years ago (13.5 ka), and subject to deposition of glacial-marine and fluvial sediments (described below). As this sediment was accumulating, rebound continued, pushing the land above sea level to its present elevation by about 11.3 ka. Sea level also continued to rise until about 5 ka, providing the currents and wave action that formed the steep coastal bluffs.

The Birch Point peninsula is bordered by the drowned lowlands of Drayton Harbor and Birch Bay. The peninsula has a regionally planar upper plateau, slightly tilted to the south and southwest from a high point of about 270 feet elevation near the north edge. Moderate to steep coastal bluffs form the northeast, northwest, and southwest margins of the peninsula; lower slopes decline to sea level on the southeast side, along Birch Bay.

GEOLOGY

Birch Bay Peninsula is composed of primarily glacially derived sediment. These sediments are mapped primarily as emergence (beach) deposits underlain by Everson glaciomarine drift (GMD). Our detailed site evaluation and other experience in the project vicinity confirmed this geology, with added definition of glacially consolidated soils. This is a different interpretation of site geology than offered by previous geotechnical consultants. The general site stratigraphy includes the following units from youngest (upper) to oldest (lower): Emergence/Beach Deposits, Bellingham (glaciomarine) Drift, Vashon Advance Outwash, and Cherry Point Formation. The Vashon Advance Outwash and Cherry Point silt are glacially consolidated soil units. The geologic unit descriptions are provided in the following sections.

Emergence (Beach) Deposits

The Emergence Beach Deposits have been interpreted as the product of reworking of GMD deposits as the land rose above sea level. During this emergence period, waves and currents acted on the upper GMD deposits, then located on the sea floor and in the subtidal, intertidal, and upper beach zones, washing away a large proportion of the fine sediment and leaving a coarse lag of sand, gravel and scattered boulders.

The thickness of the unit typically ranges from 3 to 7 feet, with distinct to gradational contacts with the GMD. The material is mostly brownish, medium to coarse sand with gravels, cobbles and boulders.

These deposits can be loose and permeable, and contain up to several feet of seasonal groundwater perched over the relatively impermeable GMD.

Glaciomarine Drift (GMD)

The GMD consists of unsorted, nonstratified silt and clay with varying amounts of sand, gravel, cobbles and occasional boulders. GMD is derived from sediment melted out of floating glacial ice that was deposited on the sea floor. This material locally contains shells and wood. GMD was deposited during the Everson Interstade approximately 11,000 to 12,000 years ago while the land surface was depressed 500 to 600 feet from previous glaciations. The thickness is indicated as a maximum of 70 feet, although we have observed this unit to be thicker in Whatcom County. The upper portion of this unit in upland areas, sometimes to about 15 feet of depth, is typically stiff to very stiff as a result of desiccation or partial ice contact loading. However, below 10 to 15 feet, the glaciomarine drift profile grades to soft to medium stiff. Hydrologically, GMD slows, or prevents, the downward percolation of groundwater throughout the region, forming a perched water table in the overlying soils when exposed at the ground surface.

Glacial Advance Outwash

Soil interpreted to be glacially consolidated Vashon Advance Outwash (also referred to as Esperance Sand in reference documents) was encountered in the explorations at the site. Soil defined as glacial advance outwash typically consists of clean sand although silt and fine-grained sand can be present, particularly in the lower portions of the unit. Sorting, cross and horizontal stratification, and cut and fill structures are distinctive features of glacial outwash. Advance outwash was transported by meltwater and deposited in streams and pools emanating from the face of an advancing glacier. This unit has been glacially overridden, and typically exhibits relatively high shear strength, high permeability, and is susceptible to erosion when exposed on steep slopes.

Cherry Point Formation

The Cherry Point Formation consists of glacially consolidated clay and silt with layers of well sorted fine sand. This unit is thought to be pre-Fraser sediment deposited in quiet lake water. The unit has been encountered in driller's logs on Lummi Island (Aspect, 2006) and near Cherry Point east of Ferndale (DOE, 2006). GeoEngineers has observed exposures of this unit at sea level along the north shore of Birch Point Peninsula.

SEISMICITY

Based on our review of geologic maps, we did not identify any known faults in the immediate vicinity of the project area. However, the absence of mapped faults in the area does not preclude the potential threat of ground shaking within the property, nor does it prelude the presence of hidden or unidentified faults. The regional Georgia-Puget Lowlands are affected by several related seismotectonic systems. The Georgia—Puget Lowlands are affected by several related seismotectonic systems. The Cascadia subduction complex extends offshore west of Vancouver Island; shallow earthquakes of magnitude (M) 8-9 occur in this system with recurrence intervals of several centuries (most recently on January 26, 1700; Clague, 1997; Atwater and others, 1999). Movement related to subduction also occasionally triggers deep faulting below the lowlands, including the Nisqually quake of February 28, 2001 (M 6.8). Historic earthquakes within continental crust have also caused severe shaking in the region, such as during the North Cascades event of December 15, 1872 (estimated M 6.5 to 7; Bakun and others, 2002), and the June 23, 1946 quake under east-central Vancouver Island (M 7.3).

Recent seismic research has also identified faults in the Puget Lowland and Georgia Depression. The Vedder Moutain fault and the Sumas fault, located along the sides of the Sumas Valley in Whatcom County, are larger and more active than previously known. The Vedder Mountain fault extends from British Columbia into Washington along the margin of Vedder Mountain, continues southwesterly across Whatcom County and appears to continue westward to Sucia Island in the San Juan Islands and beyond. The fault is at least 65 miles long and may be considerably longer. The Sumas fault parallels the Vedder Mt. fault and extends southwesterly from British Columbia through Sumas and across Whatcom County (Easterbrook et al., 2000). Easterbrook et al. indicate the Sumas and Vedder Mountain faults are presently active. A magnitude 5.0 earthquake occurred along the extension of the Sumas fault in 1964 and a magnitude 6.0 earthquake occurred along the distal trace of the Vedder Mountain fault in the San Juan Islands in 1909. Earthquakes have also occurred along the trace of the Vedder Mountain fault since 1964. Several shallow faults that experienced late Holocene movement have been discovered in the North Cascades, including the Macaulay Creek fault, which may be responsible for the unusual number of earthquakes in the area east of Deming, including a M 5.2 quake on April 14, 1990 (Dragovich and others, 1997).

Farther south, the Devils Mountain fault, Strawberry Point fault, Utsalady Point fault, Southern Whidbey and Seattle fault systems seem capable of movement, and the latter triggered a major earthquake in about 900 AD (estimated M 7).

Large earthquakes can cause landslides, as they did during the events mentioned above, along with the 1949 Olympia and 1965 Seattle quakes (Schuster and Chleborad, 1988; Chleborad and Schuster, 1989). This would be especially likely if an earthquake occurs during the wet season, as happened in many of these events. Debris slides, rockfalls and rock avalanches can be shaken loose by major, shallow and/or local earthquakes, and many probable seismic landslides are found in the North Cascades (Pringle and others, 1998). Shaking can also trigger landslides in coastal bluffs, such as the Tacoma Narrows landslide that moved in both 1949 (Chleborad, 1994) and 2001.

BIRCH POINT COASTAL BLUFF LANDFORMS AND SLOPE STABILITY

The uplands and steep slopes along Drayton Harbor at the site and properties in the project vicinity have steep slopes dropping down to the shoreline along Drayton Harbor. These steep slopes are classified as intermediately stable in the CZA. Potentially unstable landforms have been identified during geotechnical studies by GeoEngineers and others for the site and nearby properties.

The slopes are the product of long-term geomorphic processes, occurring over about 10,000 years as post-glacial rise of sea level in the Strait of Georgia has allowed waves and currents to erode into the bluffs along the shorelines. Geologic materials in the vicinity, particularly the glaciomarine drift, are sufficiently resistant to erosion to maintain relatively high, steep slopes. But oversteepened slopes eventually erode, due to long-term strength loss from weathering, significant precipitation events, groundwater seepage, and earthquakes. Erosion can entail varying volumes and rates: a few individual clasts at a time sloughing off a steep bluff face; slabs of cohesive materials detaching from the surfaces of steep slopes (debris topple or fall); slow movement of soil layers on moderate slopes (creep); more rapid sliding of soil masses on steeper slopes (debris slide); or displacement and movement of large blocks of material (deep translational slides, rotational slides, earth flows) (see Turner and Schuster, 1996). Individual movements on coastal bluffs in weakly cemented sediments are typically small masses failing due to tensile forces acting on material undergoing loss of cohesion (e.g. Hampton, 2002), but such smaller movements can cumulatively involve large areas of slope. In rare cases, geologic conditions in the Puget Lowlands permit large segments of slope up to hundreds of feet wide to move at once (Chleborad, 1994; Gerstel and others, 1997; Shannon & Wilson, 2000).

The conditions and landslide types at Birch Point are similar to those in much of the Puget Sound. The more common terms for these types are given in parentheses.

1. **High bluff peel-off (earth fall or topple):** Occurs on the faces of near-vertical bluffs, usually in resistant material such as GMD or till that stands steeply (but possible in more cohesive sands or gavels). Slabs up to a few feet thick peel off and topple or fall in tension under forces of weathering; water from surface or shallow subsurface flow can contribute to the movement locally. Debris accumulates on the footslopes (contributing to colluvial soil) of the beach (subject to removal by waves). This process is operative on the steep, straight bluffs, particularly in the GMD that is usually near the top.
2. **Shallow colluvial sliding (debris slide and debris flow):** Thin layers of loose colluvial soils can slide, especially from slopes steeper than about 70 percent (1.43H:1V), typically during storm periods when pore-water pressures rise. The material slides or flows downhill onto gentler gradients. These processes probably occur on many of the same steep, straight slopes as the bluff peel-offs.
3. **Groundwater blow-out (debris flow, earth flow):** In layers of permeable materials overlying a less permeable layer, seepage of perched groundwater toward the free face can cause pore-water pressures sufficient to cause sliding at the bluff; the saturated material then slides or flows down over the lower slope. Over time, this process commonly forms a prominent midslope bench as the looser material is excavated off the slope and the upper bluff retreats back into the plateau. We did not observe features of this landslide type at the site or nearby properties.
4. **Deep-seated landslides (rotational slide, deep translational slide, large earth flow):** These can involve tens of feet along the slope in native geologic material and/or overlying colluvium or landslide debris. These slides usually have curved failure surfaces, though their shapes and positions are at least partly controlled by stronger materials such as rock, glacial till, and GMD and the local water tables (perched or sea-level). Movement is commonly intermittent, with individual episodes affecting some of the semi-independent blocks of material; and progressive, as the movement or removal of some blocks affects the stability of adjacent areas and the main scarp. Water entering the landslide body from upslope or seepage can also affect this kind of landslide. A large bowl-shaped feature located in the southeast portion of the site has been interpreted by some to be an ancient, deep-seated landslide. This area is identified as the "Amphitheater" shown in Figure 3B. Because this area was identified by other consultants as a potential slide area, considerable exploration was conducted in this area, including installation and monitoring of a slope inclinometer.

SITE CONDITIONS

GENERAL

Our interpretation of the geologic/hydrogeologic conditions at the site is based on a review of information in the available literature, review of previous reports completed for the site, several geologic/site reconnaissance events by our staff over the years associated with different proposed projects, our test pit and boring explorations, and our experience on the site and other projects in the area. Gradients of the steep slopes were determined using a site-specific topographic survey map and clinometer and therefore should be considered approximate. Site features are labeled in Figures 3A and 3B. A summary is provided below:

SURFACE CONDITIONS

Surface conditions for this study were evaluated at various times between 2006 and 2009 during both summer and winter months. Vegetation at the site consists primarily of various conifers with deciduous species. Principle conifer species include western red cedar, hemlock and Douglas fir. Deciduous species include alder, big leaf maple and scattered cottonwood. Understory vegetation consists of stinging nettles, ferns, shrubs and scattered areas of grasses.

The upland portion of the site is level to moderately sloping with an overall downward gradient toward the northeast with inclinations ranging between approximately 20 and 40 percent (5H:1V [horizontal to vertical] and 2.5H:1V). Two north-to-south trending remnant logging trails are located at the site. The lower trail following closely with the top of the bluff. The trails are covered with forest duff and sparse to locally dense understory vegetation.

The site includes potentially unstable landforms including steep bluffs, "bedrock hollows", the "amphitheater" feature, and erosional site features. These specific site features are described in the following report sections.

Potentially Unstable Landforms

Steep Bluff. A steep bluff is present along the northeast portion of the site, adjacent to the Old Drayton Harbor Road Trail. Old Drayton Harbor Road was constructed by cutting into the bluff along the shore of Drayton Harbor. The oversteepened bluff area above the road has a history of slide events. The steep bluff ranges from 65 percent (1.5H:1V) to approximately 100 percent (1H:1V) or steeper, and from 20 to 60 feet high. The steep bluff is susceptible to shallow peel-off events (#1 previously discussed) and colluvial sliding (#2). The steep bluff shows indications recent slope movement such as exposed soil and accumulation of colluvium at the toe of the slope. The feature appears to be the result of surficial topsoil and underlying weathered GMD sloughing downslope due to the oversteepened geometry of the bluff, shallow perched groundwater within the weathered materials overlying the non-weathered GMD, and seasonal groundwater seepage from the non-weathered material. Portions of the steep bluff have eroded somewhat and form shallow bedrock hollows as described below.

Slow groundwater seepage was observed in places in the GMD exposed in the face of the steep bluff. Groundwater seepage was not observed in the non-weathered GMD within the base of the feature. Some horsetail plants were growing in places on or near the bluff.

Bedrock Hollow. A series of "bedrock hollows" are located along top of the steep bluff at the northeast portion of the site. The term "bedrock hollow" is used in this report in accordance with the Forest Practices Board Manual terminology conventions. It should be noted that bedrock exposures are not present at the site and that the underlying material consists of glacial deposits. The features range from approximately 50 to 150 feet wide and 150 to 250 feet long. The inclination of the base of these features, perpendicular to the topographic lines, is approximately 30 to 35 percent (3.3 H:1V to 2.9H:1V) and the inclinations of the sidewalls of these features are approximately 35 to 45 percent (2.9H:1V to 2.2H:1V).

These features are moderately vegetated with mature and young deciduous trees and some mature western red cedars and Douglas fir trees are also growing within the feature. The mature trees have trunks with diameters up to about 30 inches. The trunks of the conifer trees within these features are generally straight. Some leaning deciduous trees and pistol butted young cedar trees within some of the bedrock hollows may be an indication of soil creep. Additional deciduous trees were tilting in the down slope in what appeared to be the fill prism along the old logging road.

In the northernmost bedrock hollow, water was observed during a winter site visit flowing from a wet area in the base of the low area over the top of the steep bluff. GMD is exposed in the face of the bluff below the wet area. Slow groundwater seepage was observed in the face of the bluff between silty sand and silt layers during our various site reconnaissance visits. Seepage was not observed higher up on the slopes of the bedrock hollow or in the other bedrock hollows.

Based on our site evaluation, the bedrock hollow appears to be the result of long-term erosion and historical landsliding occurring following deglaciation, with no evidence of landslide activity for well over 100 years.

Amphitheater. The southern portion of the site is occupied by a large bowl-shaped feature identified in previous geotechnical reports as the "amphitheater". This feature is approximately 700 feet across and extends approximately 550 feet up from the Old Drayton Harbor Road trail. The upper slopes and sidewalls of the bowl have overall slope gradients of about 50 percent (2H:1V) with some isolated steeper areas. The bottom of the feature has an overall gradient of about 20 percent (5H:1V).

The trunks of the mature conifer trees within this feature are generally straight with some pistol butted young cedar trees that may be an indication of surficial soil creep. Numerous leaning and fallen deciduous trees were observed, in some places near relatively vertical conifers. These deciduous trees are interpreted to have fallen due to a shallow root structure that did not extend sufficiently into the glacial soils to support the tree.

Two southern drainage swales (near TP-3 and GEI-14/TP-10 in the Site Plan) were observed to be dry during site visits during January of 2007 and January 2009. As noted in the Groundwater Conditions section of the report, no groundwater was observed to a depth of 50 feet in a piezometer installed at GEI-14.

The amphitheater is bounded to the south by a large, well establish drainage channel. Review of bathymetric data shows a broad slightly raised area in the beach sediments near the base of this channel. Although interpreted by some to be possible uplifted evidence of a large deep-seated slope failure within the amphitheater, we interpret this to be accumulated sediment from the drainage channel. A younger erosional feature was observed (as noted in the next section and shown in Figure 3B) on the north side of the amphitheater.

Based on our site evaluation, the amphitheater appears to be the result of long-term erosion and possibly a historical landslide(s) that occurred likely following deglaciation. We did not encounter evidence of deep seated recent movement nor did we find significant accumulation of colluvium in the base of the bowl in our explorations.

Erosional Features. A large drainage channel is located at the south side of the amphitheater extending across the property boundary. The channel has incised on the order of 20 to 40 feet with relatively steep sideslopes at a gradient of 60 percent (1.6H:1V).

A younger erosional feature is located on the north side of the amphitheater. The erosional feature is about 160 feet long and up to about 20 feet wide and 10 feet deep. Additional headward erosion, above this feature, was noted during our recent site visits, although no groundwater seepage source was noted in this area. A shallow drainage channel exists on the west side of Drayton Harbor Road. We understand that this channel occasionally overflows during periods of heavy rainfall and sheetflows across the roadway at this location. This conclusion is supported based on evidence of surface flow from the road and within the surface vegetation after storm events. At the time of our recent visit in January 2009,

within days of a period of heavy rainfall after a snow melt ("rain on snow event"), there was no water flowing in this erosional feature.

Groundwater seepage was observed on the slope about 80 feet to the south of this younger erosional feature as shown in Figure 3B. The seepage flowed down the slope and collected into a drainage way. Some areas of new erosion and deposition were observed occurring lower on the slope below about elevation 60 feet.

General Site Summary

In general, movement on Puget Lowland coastal bluff landslides is more likely during intense storms and very wet winters (Gerstel and others, 1997; Shannon & Wilson, 2000). Local information suggests that failure at the Birch Point bluffs likewise occurs during extraordinarily wet periods (such as January 1997), but can probably happen in almost any wet season. Some of the larger features, if the result of landsliding activity, are probably prehistoric, as suggested by the presence of old trees on the bluffs and within the bedrock hollows. Without a full landslide history, we can only make general observations regarding landslide rates on this area. Based on our field observations, reviewing aerial photos, and experience and knowledge of the site we note that:

1. Rapid retreat of the bluff is very unlikely, because the aerial photographs indicate that the bluff and shoreline positions have been fairly stable. However, it is recognized that frequent slough activity has occurred along the steeper sections of the slopes above the trail/old roadway.
2. The bluff faces to the northeast toward Drayton Harbor, so that wave energy is much lower than that affecting the west- and southwest-facing bluffs along Birch Point. Significant toe erosion has occurred along Drayton Harbor Road south of the project site. This is the result of soft clay exposed at the beach (GeoEngineers provided evaluation and repair recommendations for Whatcom County Public Works on this recent project). We did not observe aggressive toe erosion occurring in the project vicinity and the site is buffered by the trail/old roadway. Few areas on the beach display significant accumulations of material.
3. The composition and size of the trees on and above the bluffs, where it is relatively undisturbed, suggests sporadic and intermittent movement, related to surficial creep. There are areas of tilted trees or trees with undercut root wads at the tops of the steep slopes.

SUBSURFACE CONDITIONS

The site subsurface conditions have been extensively explored between about 1990 and 2006. A large number of shallow test pits, typically less than 15 feet deep have been advanced across the site. A lesser number of deeper borings have also been completed by GeoEngineers and other consultants, and published in previous reports. GeoEngineers completed a series of 14 borings in August through October 2006. The explorations extended between 30 and 90 feet bgs. Descriptions of these most recent field explorations, laboratory testing procedures and explorations logs are presented in Appendix A. A site plan with a compilation of known site explorations is presented in Figures 3A and 3B. As previously described, the generalized subsurface soil profile includes Emergence Beach Deposits, Glaciomarine Drift, Advance Outwash and Cherry Point Formation. Two subsurface cross sections, A-A' and B-B' are presented in Figures 4 and 5.

The forest duff/topsoil thickness was observed at the site to vary between about ½ to and 2 feet across the site. The Emergence Beach Deposits typically ranged from about 5 to 10 feet thick, although it was logged to a maximum depth of about 20 feet where it may include a gradational contact with the

underlying GMD. This unit consists of sand to silty sand with variable gravel content and is typically loose to medium dense, but also includes some dense soil. GMD was encountered in the site explorations. The unit was generally comprised of sandy to silty clay and sandy silt but includes silty and clayey sand. The GMD is typically very stiff/medium dense. However, where the unit was thicker, it graded to medium stiff in some of the borings.

Our explorations encountered glacially consolidated soil interpreted to be coarser grained Advance Outwash, and finer grained Cherry Point Formation, sometimes referred to as Cherry Point Silt. Borings GEI-1, GEI-2, GEI-5, GEI-9, GEI-10, GEI-11, GEI-12, GEI-13, and GEI-14 all encountered dense to very dense and very stiff to hard Advance Outwash and/or Cherry Point Formation.

GROUNDWATER CONDITIONS

The groundwater conditions are shown on the individual logs. A summary of our observations, measurements and our interpretation of the groundwater conditions at various locations is presented below:

- Slow to rapid groundwater seepage was observed from about 2 to 10 feet below ground surface (bgs) in many of the test pits. The seepage is typically within the granular Emergence Beach Deposit overlying the relatively impermeable GMD unit.

- Groundwater seepage was observed in several borings at the approximate depths indicated below at the time of drilling:

    - 13 feet in GEI-2 (perched within the Emergence Beach Deposits over the GMD);
    - Possibly at 8.5 feet in GEI-4 and GEI-7 (perched within the Emergence Beach Deposits over the GMD);
    - 41.5 feet in GEI-10 (perched within a sandy zone of the Cherry Point Formation);
    - 30 feet in GEI 12 (perched within a sandy zone of the Cherry Point Formation);
    - 50 feet in GEI-13 (perched within a sandy zone of the Cherry Point Formation);
    - 30.5 feet in GEI-14 (perched within a clayey zone of the Vashon Advance Outwash);
    - Groundwater seepage was not observed in the other borings during drilling.

- Piezometers were installed in GEI-6, GEI-10 and GEI-14 to approximate bottom of the exploration. The piezometer monument to GEI-10 has been damaged and prevented access. We measured groundwater at 2.1 feet bgs in GEI-6, and found no groundwater (dry) in GEI-14 during a monitoring visit January 12, 2009. The groundwater in GEI-6 is within the GMD, and is likely the result of a surficially perched condition flooding the piezometer considering the lack of groundwater observed during drilling and the unsaturated condition of the soils determined at the time of drilling.

We interpret the predominant groundwater condition encountered to be “perched” groundwater within the upper granular (Emergence Beach Deposits) and surficial weathered soil horizons. However, some isolated wet zones were also observed within the glacially consolidated soils; based on the observations of the soils below these zones and moisture contents indicating unsaturated conditions, we conclude that these isolated wet zones are representative of isolated perched zones within that geologic formation. Groundwater conditions should be expected to vary as a function of season, precipitation, and other factors.

SLOPE STABILITY MODELING

GeoEngineers conducted slope stability modeling of the existing hillside using a limit equilibrium slope stability program and the existing slope and geologic profile along Sections A-A' and B-B', shown in Figures 4 and 5, using the soil parameters in the table below. Soil strength was estimated based on the logs of the explorations, blow count N-value data collected during the subsurface exploration program, correlation with soil index properties, review of strength testing on the site soils, and our experience.

Table 1. Soil Parameters for Slope Stability Modeling

Soil Unit	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (psf)
Emergence (beach) deposit	125	30	0
Stiff to very stiff glaciomarine drift	135	15	1000
Soft to medium stiff glaciomarine drift	130	15	400
Vashon Advance Outwash	130	36	0
Cherry Point Formation	125	20	1000

STATIC ANALYSIS

Our analyses were performed using the computer program XSTABL, developed by Interactive Software Designs. The program has the capability of analyzing slope stability for two-dimensional profiles under a wide range of failure surface geometries, soil layers and groundwater conditions. The limit equilibrium based computer stability program was used to randomly generate and evaluate circular and/or block (wedge) failures within the area of interest. The slopes were analyzed under static and seismic (pseudostatic) loading conditions to determine safe slope configurations.

The factor of safety obtained from the computer modeling is the ratio of the shear strength of the soils along the failure surface to the shear forces experienced on the failure surface due to the weight of the failure block. When the ratio of these forces (the factor of safety) is greater than 1, the slope is stable as modeled. Desirable factors of safety values used in this type of analyses are typically 1.5 or greater for slopes in the static condition and 1.2 for the seismic condition.

Our analysis included evaluation of large global slope failure, and smaller failures on the upper and lower portions of the slopes. Our analysis also included evaluation at observed groundwater levels and an assumed "high" groundwater elevation.

SEISMIC ANALYSIS

The potential effect of seismic loading on the global stability of the hillside was analyzed assuming a peak horizontal ground acceleration of 0.23g for a seismic event with a probability of exceedance of 10 percent in a 50 year period (USGS 2002) representing a 1-in-475 year event. The horizontal forces developed during earthquake shaking were represented by a "pseudo-static" seismic coefficient, k_h. A pseudostatic slope stability analysis adds a constant horizontal force to each failure block that is analyzed. This force is equal to the weight of the failure block multiplied by the pseudostatic acceleration coefficient. The horizontal acceleration used in seismic stability analysis for natural soil slopes is typically assumed to be approximately one-half of the free-field acceleration. Accordingly, the seismic coefficient used in our stability analysis of the hillside was 0.12g.

The justification for using one-third to one-half of the PGA is that during an earthquake, the majority of the acceleration time history is typically only a fraction of the PGA. Typically only one or two cycles of an earthquake motion produce ground accelerations at or near the PGA. A pseudostatic acceleration coefficient of 50 percent of the PGA is the current standard of practice in the field of geotechnical engineering for pseudostatic slope stability analyses. Marcuson (1981) suggests that appropriate pseudostatic coefficients for dams (earth slopes) should correspond to one-third to one-half of the maximum earthquake acceleration (PGA) because earthen slopes do not act as a rigid body. Hynes-Griffin and Franklin (1984) concluded that earth dams with pseudostatic factors of safety greater than 1.0, when using a pseudostatic seismic coefficient of 50 percent of the PGA, would not develop large deformations. Case histories have shown this prediction to be reasonable.

STABILITY RESULTS

As discussed above, our stability analyses considered larger global slope stability as well as smaller failure on the upper and lower portion of the existing slopes, low and high groundwater conditions, and static and seismic loading conditions.

The results of our static slope stability analyses indicate that the factor of safety at the site for all cases analyzed is greater than 1.5 and acceptable for the project. The results of our seismic stability analyses indicate that the factors of safety for all cases analyzed are greater than 1.2, and acceptable for the project. This is generally consistent with previous slope stability analyses. As previously stated, we did not observe groundwater in the glacially consolidated soils with the exception of isolated perched zones. Our deep piezometer (GEI-14) is dry. If we assume a worst case condition of high groundwater, our analyses indicate static and seismic factors of safety of 1.5 and 1.1, respectively. It is our opinion that these are acceptable considering that we have no evidence to suggest that this condition would ever exist.

The upper Beach Emergence Deposit over the GMD is subject to considerable seepage. The seepage forces create instability when these soils are in a steep condition. This occurs at the site above Old Drayton Harbor Road, and this area has a history of instability in the site vicinity. As described below, we recommend a setback from these oversteepened areas to avoid the unstable areas. .

CONCLUSIONS AND RECOMMENDATIONS

We conclude that the proposed project is feasible based on our interpretation of existing information, our observations during this study, and our modeling. We have tailored our discussion to address geologic hazards as presented in the Blaine Municipal Code, and we present associated impacts and mitigation strategies. We discussed our conclusions and recommendations with the developer so that the proposed development as shown in Figure 2 is configured to be consistent with our mitigation strategies. We have also presented preliminary geotechnical design considerations. We recommend that a follow-up design level geotechnical report be prepared once more detailed design information becomes available.

The upland areas of the site are underlain by shallow, loose to dense granular Emergence Beach Deposits and medium stiff to very stiff GMD with deeper deposits of dense to very dense Advance Outwash and very stiff to hard Cherry Point Formation. The geologic conditions at this site are typically “globally” stable, i.e., resist deep-seated slope stability failures. Our slope stability modeling indicates that the site conditions provide an adequate factor of safety against slope failure under static and seismic conditions for the proposed development shown in Figure 2. It is our opinion that the proposed Drayton Hillside III development will not adversely affect slope stability at the site, and the stormwater system and drainage improvements recommended will capture surface water and improve slope stability.

SEISMIC HAZARD IMPACTS AND MITIGATION

We conclude that conventional seismic design practices in current building codes are adequate for design based on the relatively dense/stiff soil conditions encountered during subsurface explorations performed at the site. The structure foundations will be supported on non-saturated medium dense to dense silty sand or stiff to very stiff silt/clay, which are not susceptible to liquefaction, lateral spreading, or surface fault rupture. The present codes provide sufficient design considering new faults being mapped in Whatcom County.

EROSION HAZARD IMPACTS AND MITIGATION

The granular emergence deposits and finer grained glacial soils on steep slopes have a high susceptibility to erosion if disturbed. Our site reconnaissance confirms that uncontrolled surface water on site slopes can result in severe erosion. Surface water should be prevented from flowing across disturbed areas and not directed toward the slopes during or after construction. Temporary erosion control measures should be used during construction depending on the weather, location, soil type, and other factors. Temporary erosion protection (for example, straw, plastic, or rolled erosion control products [RECPs]) may be necessary to reduce sediment transport until vegetation is established or permanent surfacing applied. Appropriate best management practices (BMPs) should be incorporated into the temporary erosion and sediment control plan by the civil engineer. All finished slopes should be protected and/or vegetated before the rainy season. Typical erosion control practices required by current regulations and good earthwork practices are sufficient to mitigate the erosion risk during and after site development.

LANDSLIDE HAZARD IMPACTS AND MITIGATION

As discussed previously, our analyses indicate that the site within the development area is not at significant risk of deep seated or other landslide instability that would affect the proposed building locations. The bluff slopes are oversteepened and therefore at risk of shallow landsliding, which has occurred in the past. The hollows located on the subject property that are immediately above the Old Drayton Harbor have not likely had erosion or landsliding occurrences for over 100 years based on our observations. These areas may have experienced naturally occurring slope failures over the thousands of years since retreat of the glaciers. Landslides at the site are most likely to occur along the oversteepened slopes immediately above Old Drayton Road, or other localized oversteepened areas, especially where seeps or spring discharges from more permeable geologic units bearing water (e.g. Emergence Beach Deposits) overlie less permeable geologic units (e.g. GMD). We established a building setback considering the type of landsliding that could occur at the site in this area. We also recommend some limited protection in the amphitheater area, as described subsequently.

Building Setbacks

We conclude that the building areas as currently proposed have a very low risk of impact from landslide activity. Mitigation against landslide hazards is typically accomplished by using building setbacks from toes and tops of slopes and/or incorporating grading and foundation strategies that avoid adverse impacts. Based on our site evaluation and stability analysis, we recommend a minimum 40 foot setback from the identified potentially unstable landforms previously discussed. The limits of the unstable landforms and recommended minimum setback line are presented in Figures 2, 3A and 3B. In our opinion, siting the proposed structures outside of the setback line in accordance with our other recommendations will not adversely impact existing slope stability or stability of adjacent slopes.

The proposed roadways and driveways are generally located outside of the building setback line. If roadways or cut/fill prisms cross into the identified setback area some additional stabilization, such as reinforced slopes or retaining walls, may be necessary for long-term performance of the roadway. The only area identified at this time is where the roadway crosses a relatively steep slope into the amphitheater area. The roadway does not cross the steep bluff area toward the water where instability has been observed, but a steep slope area into the amphitheater area. We conclude that this road can be constructed using cut and fill techniques that will not adversely affect slope stability. We recommend that specific recommendations be provided in the geotechnical design report.

Drainage Improvements

Some of the landslide and erosion hazard present at the site are the result of dispersal of stormwater drainage onto existing slopes. Mitigation for this condition will include capturing and redirecting stormwater runoff away from slopes and to suitable detention facilities. Stormwater from all new structures should also be directed into the stormwater system and away from slopes.

As discussed previously, we interpret some site erosion (Erosion Feature shown in Figure 3B) to be the result of stormwater from the ditch along the west side of Drayton Harbor Road overflowing and running onto the site. In our opinion, redirecting this overflow stormwater from the slopes is critical to reducing the erosion and landslide hazard at the site to acceptable levels and improvements to the upper Drayton Harbor Road have been proposed and may have been completed at this time. A groundwater seep was observed southeast of the Erosion Feature in Figure 3B, and some mitigation may be required during construction. To prevent erosion impacts, surface water should be prevented from flowing directly over the slopes at the site. Some additional drainage considerations will be appropriate during final design and discussed on a preliminary basis below.

Debris Barrier

Where buildings are constructed at the base of steep native slopes where some erosion or sloughing could occur, it is appropriate to protect against shallow debris-flow type failures by constructing a debris impact barrier. The two upper most structures within the amphitheater should be constructed with such design considerations. A debris impact barrier could consist of extending the cast-in-place concrete retaining wall to the back of the building 3 to 5 feet higher than the adjacent ground surface in order to intercept landslide debris that could impact the building from upper portions of the slope. Where feasible, the debris impact barrier or berm could also be constructed offset from the building to create a catchment area adjacent to the building to collect any debris that overtops the wall. We recommend that specific recommendations be provided in the geotechnical design report.

PRELIMINARY GEOTECHNICAL DESIGN CONSIDERATIONS

This section of the report provides a summary of preliminary geotechnical design considerations for the project as we understand it and shown in Figure 2. The buildings are located to be in conformance with our recommendations. Once the project has gone through the entitlement process, we recommend that a project specific design level geotechnical report be submitted

Earthquake Engineering

- The project will be designed utilizing the current International Building Code (IBC). We conclude that the project is classified as Site Class D as defined in the current (2006) IBC. The IBC provides sufficient design considerations for this project.

Shallow Foundations

- Residences should be founded on medium dense to dense or stiff glacial soils, or on structural fill placed over these materials.
- Conventional shallow spread footing design for residential construction will likely be appropriate for the lighter townhome structures.
- Conventional shallow spread footings will also likely be appropriate for the heavier four story apartments with parking garages where the buildings are underlain by dense or very stiff glacially consolidated soils. The upper soil units, and the medium stiff glaciomarine drift, are not likely suitable to support the multi-story units with parking garages. It is possible that deep foundations or some kind of ground improvement techniques may be necessary. We recommend that building specific recommendations be provided in the geotechnical design report.

Below Grade Walls and Retaining Structures

- Conventional cast-in-place concrete cantilevered retaining walls could be used for moderate height grade transitions or for foundation basement walls on the project on the flatter portion of the site. Taller walls or walls with steeper backslopes may require temporary shoring to maintain site stability. Because the site is sloping, it will be appropriate to consider stability of the maximum temporary slope inclinations.

Earthwork

- Typical stripping depths ranging from ½ to 2 feet deep are expected based on the explorations performed. Some deeper stripping may be required in areas of trees.
- The glacial silty sands, clays and silts are generally moisture sensitive and difficult to work with during wet weather. It will be difficult to impossible to properly compact these soils in excessively wet conditions. Therefore, these site soils will not be suitable as structural fill under wet conditions. We recommend that the earthwork for the project be completed during the drier late summer/early fall months in order to minimize grading costs.
- We expect that all of the soils encountered across the site can be removed with conventional excavating equipment. However, if deep utilities are necessary, a large track-mounted excavator may be more efficient. Large cobbles and boulders can occur within the GMD soils, but are sporadic.
- We recommend a maximum permanent slope inclination of 2H:1V in the upper granular native soils or in structural fill used to construct permanent slopes. It will be possible to use slopes as steep as 0.75H:1V where the stiff clay is encountered.
- We expect that moderate grading will be proposed for the project. Rockeries can be used to face cuts up to about 6 to 8 feet high, if facing dense native materials. We expect that mechanically stabilized earth (MSE) walls will be appropriate for higher roadway fills to limit the downsope fill prism. If significant fills and retaining walls are proposed, additional geotechnical exploration in these areas may be appropriate.
- Some of the on-site soils will be suitable for use as structural fill. In particular, the granular Emergence Beach Deposits are a good borrow source. The upper stiff GMD is also suitable for deeper fill sections for roadways.
- Silt fencing and other techniques as appropriate should be used downslope from construction areas where obvious sediment transport routes exist, such as areas where the inclinations of

slopes attenuate surface flow during wet weather. Disturbance of existing vegetation adjacent to the building envelope should be permanently stabilized with mulching, sod, or similar materials. These recommendations are intended to minimize the likelihood of erosion and sediment transport of surficial soils proximal to and on the steep slopes.

Drainage

- We recommend that perimeter-footing drains be included around all buildings because of the possibility of perched groundwater conditions. The perimeter footing drains should be lower than the ground surface elevation on the interior of the building. To minimize groundwater conditions in the crawl spaces, a layer of pea gravel with a minimum thickness of 4 inches may be placed within the interior of the building footprint and the vapor barrier placed over the pea gravel layer. Where cuts intercept seepage, an underslab drain may also be appropriate below slabs-on-grade.
- Roadways should be constructed with an adequate free-draining subbase to protect the roadway from the seasonally perched groundwater in the upland areas where GMD is present and where soft ground conditions exist. It is possible that upslope edge drains may be appropriate to intercept perched groundwater.
- Any cuts into the weathered horizon at the site will likely intercept perched ground water during the wet season. It may be necessary to install ditches, interceptor trench drains along cut areas or in other areas to intercept the shallow groundwater and route it to a suitable discharge during construction. It may be appropriate to design interceptor trench drains at the top of the cut to the roadway down to the amphitheater area.
- Surface water should be prevented from flowing across disturbed areas and not directed toward the slopes during construction.
- Under no circumstances should stormwater be discharged where it will create a concentrated flow and/or cause erosion. The stormwater should not be discharged onto slopes steeper than 10 percent.
- Any outfalls to the ditch along the Old Drayton Harbor Road trail should have an appropriate energy dissipator sufficient to prevent erosion of the ditch.
- Catch basin systems should be designed and constructed to be low maintenance and have redundant inlets to reduce the potential for plugging by debris.

LIMITATIONS

We have prepared this report for use by Semiahmoo South, LLC and other members of the design team for use in design of this project.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted geotechnical practices in this area at the time the report was prepared. No warranty or other conditions express or implied, should be understood. Please refer to the appendix titled Report Limitations and Guidelines for Use for additional information pertaining to use of this report.

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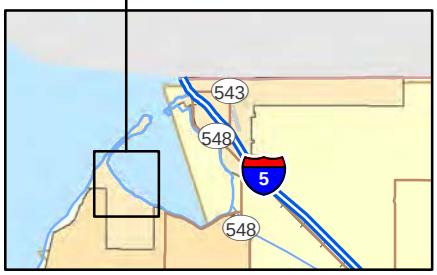
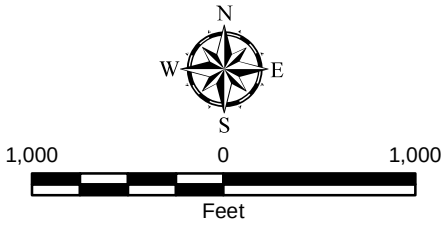




Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: ESRI Data & Maps, Street Maps 2005

Transverse Mercator, Zone 10 N North, North American Datum 1983
North arrow oriented to grid north

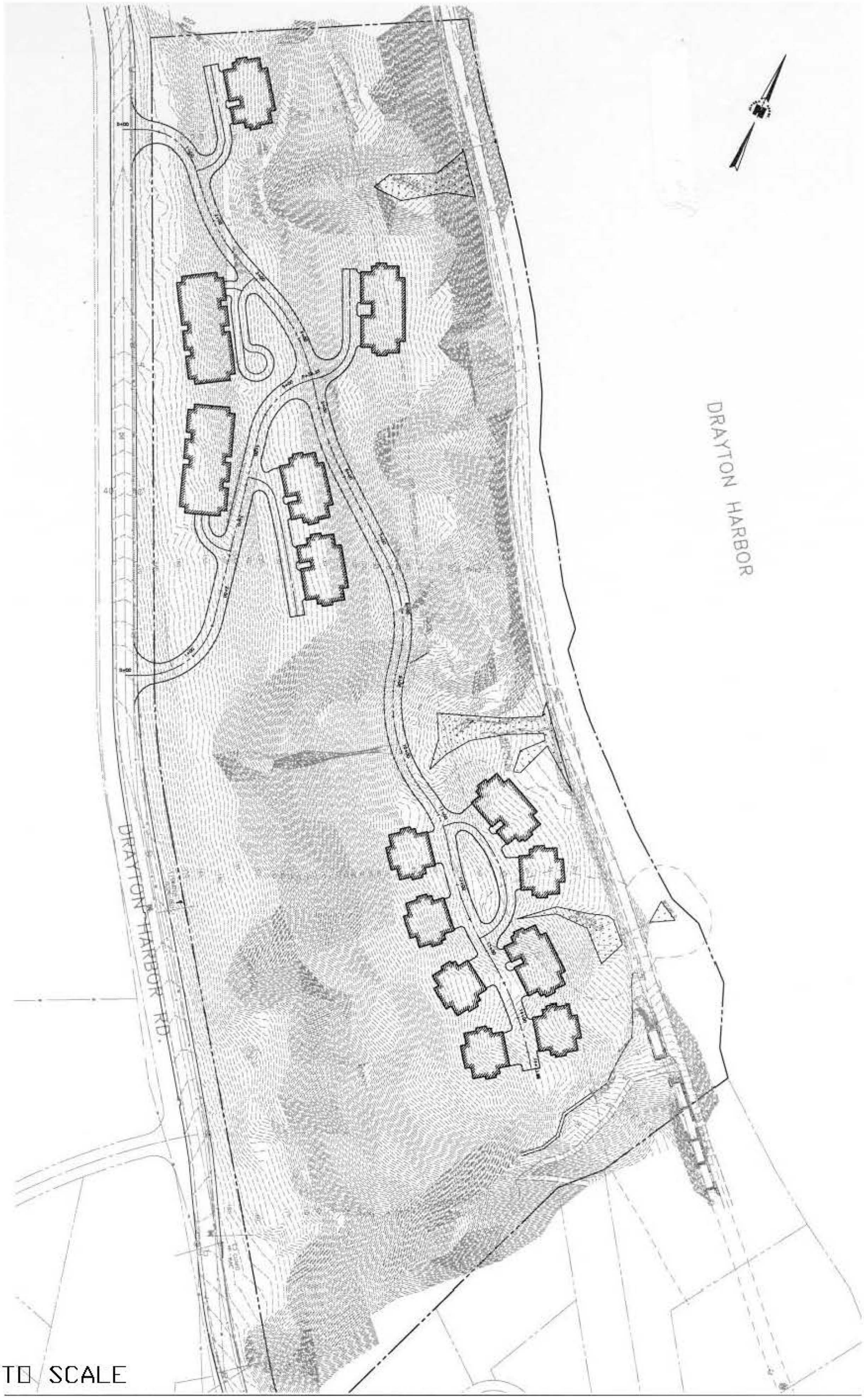
Vicinity Map

Drayton Hillside III
Blaine, Washington

GEOENGINEERS

Figure 1

Office: BELL Path: P:\18\18329-001\00\working\1832900100 VM F1.mxd SWC:IMS 01/13/2009



Notes:
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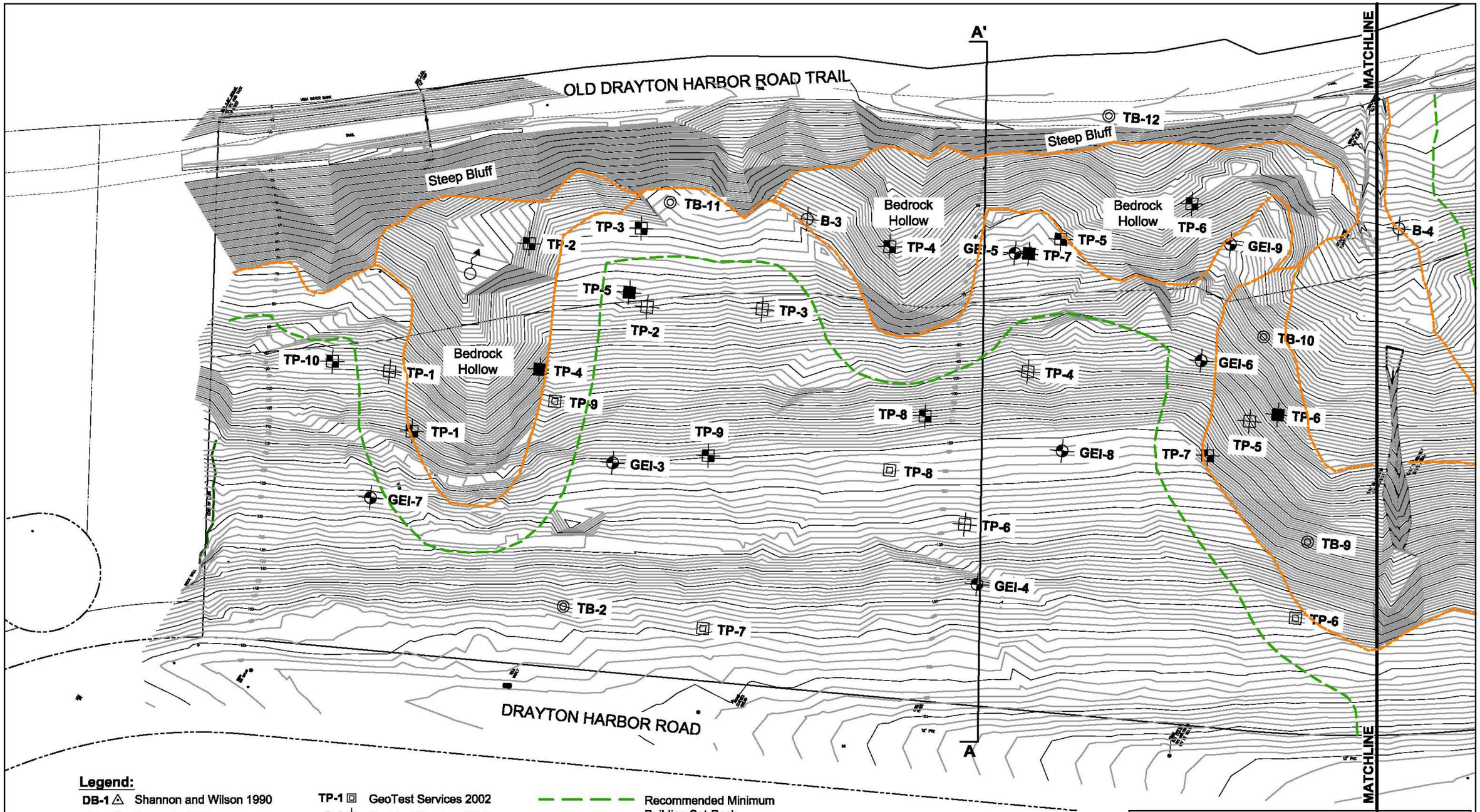
Reference: Drawing provided by IBI Group, dated January 8, 2009.

Concept Site Plan

Drayton Hillside III
Blaine, Washington

GEOENGINEERS

Figure 2



Legend:

DB-1	Shannon and Wilson 1990	TP-1	GeoTest Services 2002		Recommended Minimum Building Set-Back
TB-2	Cascade 1992	B-1	GeoTest Services 2002		Limits of Geologic Hazard
TP-1	Cascade 1993	TP-1	GeoEngineers 2005		Seepage
TP-1	GeoEngineers 1998	GEI-1	GeoEngineers 2006		

Notes:
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Reference: Drawing provided by IBI Group, dated February 2007.

80 0 80
Feet

Site Plan

Drayton Hillside III
Bellingham, Washington

GEOENGINEERS

Figure 3A

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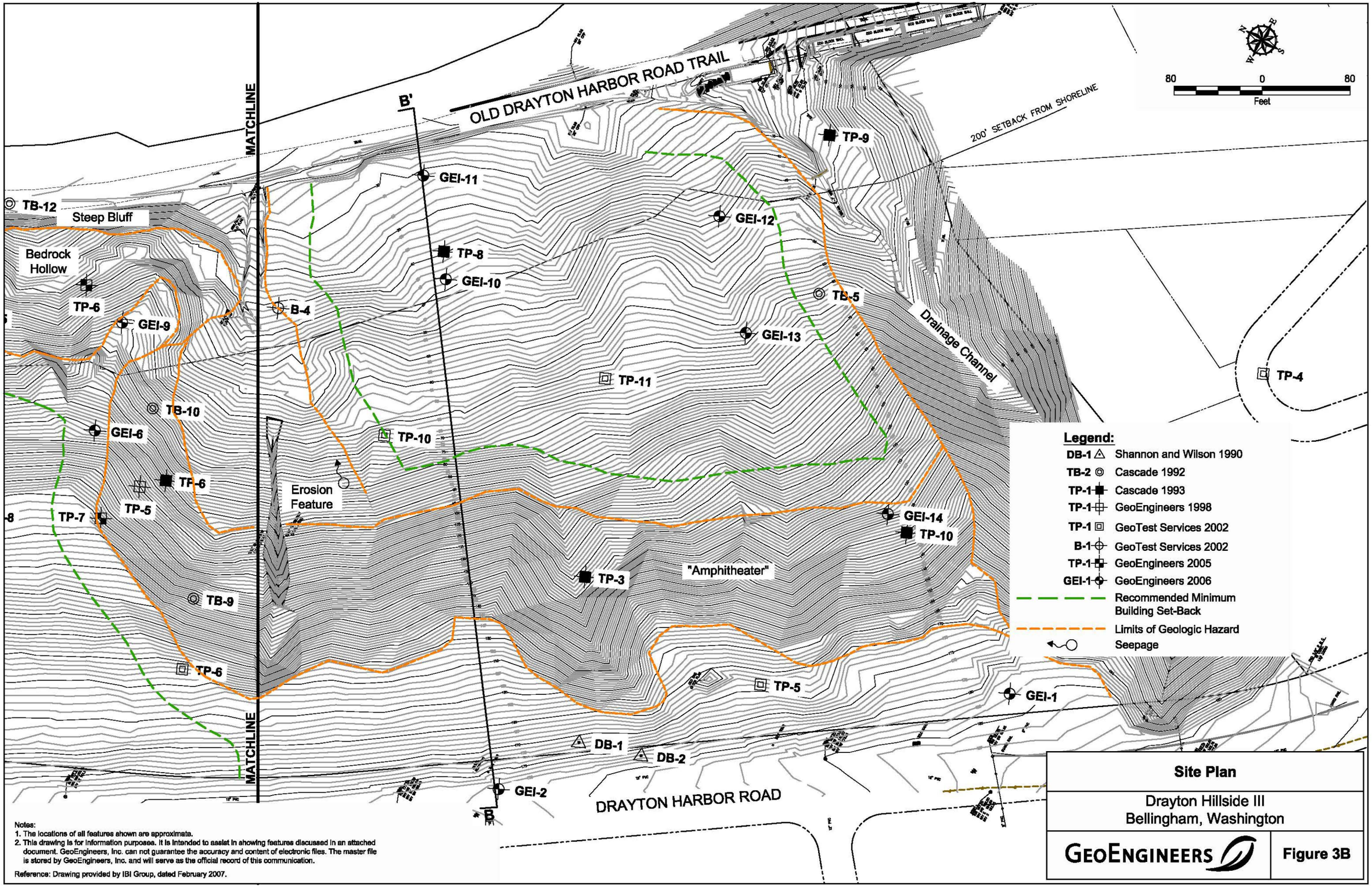

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Reference: Drawing provided by IBI Group, dated February 2007.

Site Plan

Drayton Hillside III
Bellingham, Washington

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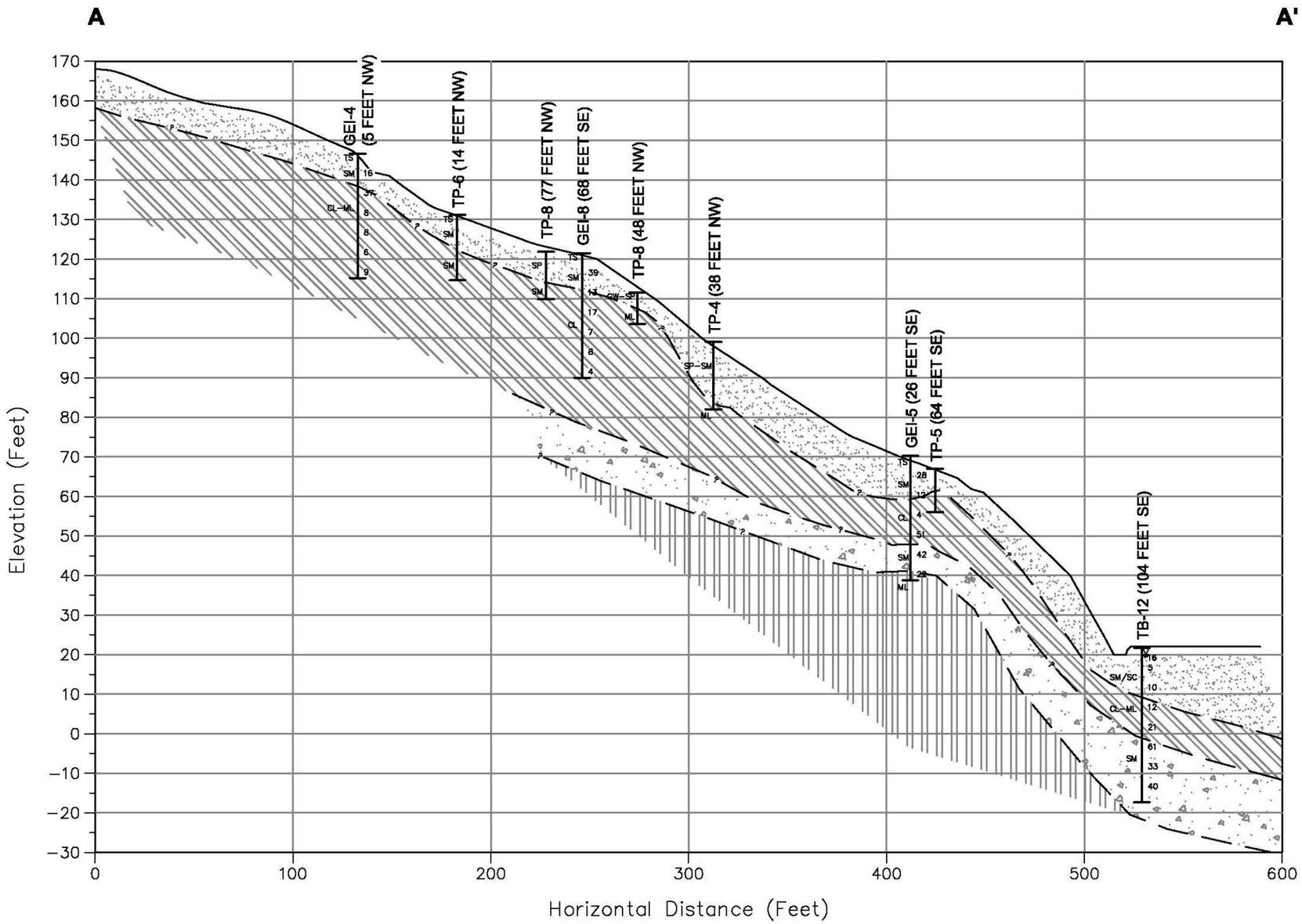
Figure 3B

BELL\P:\18329001\00\CAD\1832900100.dwg SWC:MWJ 01/21/09



Legend:

Emergence Deposits: Loose to dense sand and silty sand with gravel

Bellingham Glaciomarine Drift: Medium stiff to very stiff sandy clay with clayey sand and sandy silt

Vashon Advance Outwash: Dense to very dense sand and silty sand

Cherry Point Formation: Very Stiff to hard silt and silty fine sand

TB-12 — Exploration Number

Soil Classification Symbol — SM

N-SPT Blow Count — 16, 5, 10, 12, 21, 50, 33, 40

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

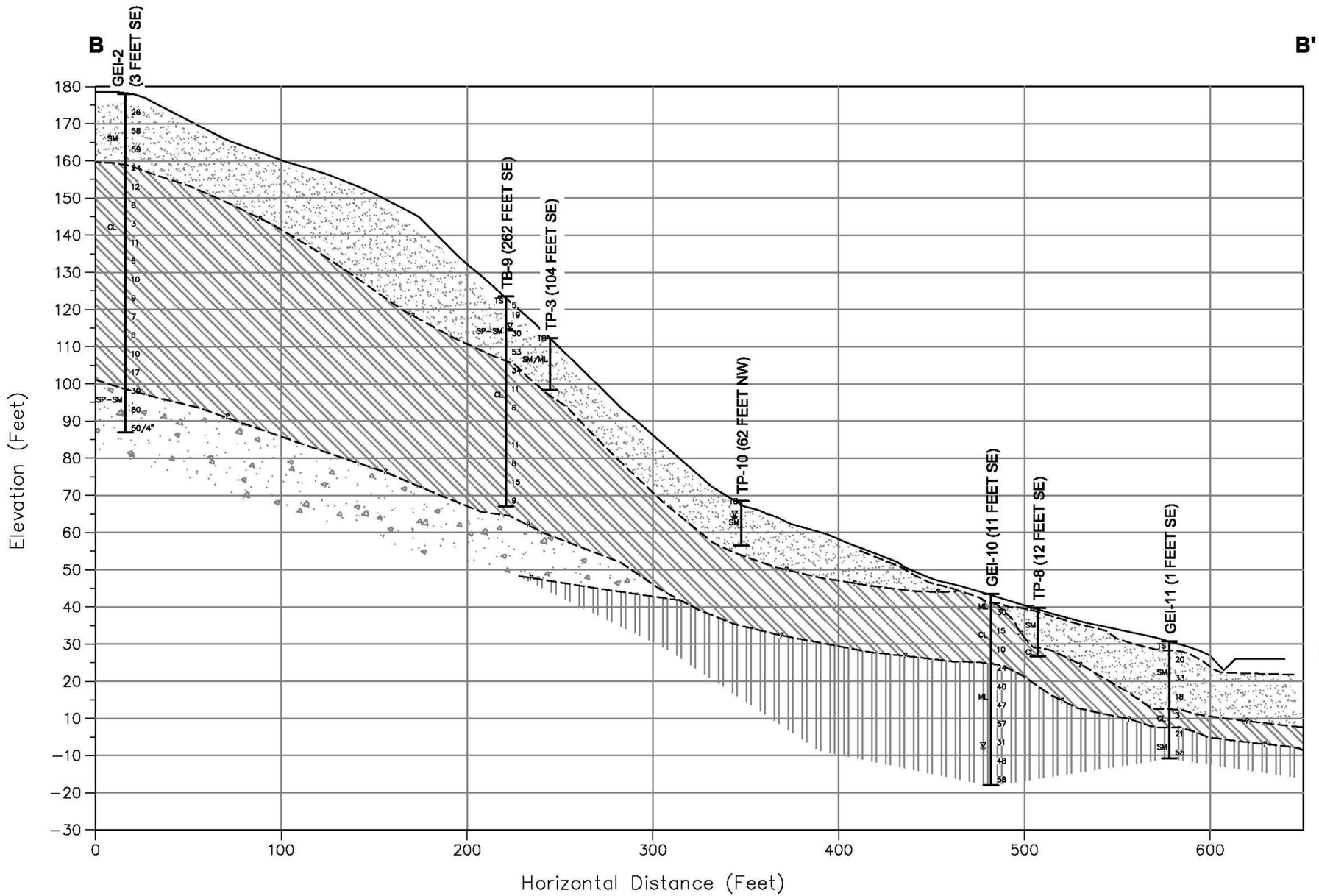
Cross Section A-A'

Drayton Hillside III
Bellingham, Washington

GEOENGINEERS

Figure 4

BELL\P:\18329001\00\CAD\1832900100.dwg SWC:MWJ 01/22/09



Vertical Scale - 1'=30'
Horizontal Scale - 1'=60'
2x Vertical Exaggeration

Legend:

Emergence Deposits:
Loose to dense sand and silty sand with gravel

Bellingham Glaciomarine Drift:
Medium stiff to very stiff sandy clay with clayey sand and sandy silt

Vashon Advance Outwash:
Dense to very dense sand and silty sand

Cherry Point Formation:
Very Stiff to hard silt and silty fine sand

TB-9 — Exploration Number

Soil Classification Symbol — SM — N-SPT Blow Count

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Cross Section B-B'

Drayton Hillside III
Bellingham, Washington

GEOENGINEERS

Figure 5

BELL\P:\18329001\00\CAD\1832900100.dwg SWC:MWJ 01/22/09

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Appendix A

Field Explorations and Laboratory Testing

APPENDIX A
FIELD EXPLORATIONS AND LABORATORY TESTING

FIELD EXPLORATIONS

Subsurface soil and groundwater conditions were evaluated across the site at various times by completing at total of 14 borings. Subsurface conditions were explored near Drayton Harbor Road by drilling two borings (GEI-1 and GEI-2) on August 28 through August 30, 2006. Subsurface conditions were also explored throughout the site by drilling 12 borings (GEI-3 through GEI-14) on October 3 through 5, 2006.

Borings GEI-1 and GEI-2 were completed using mud rotary drilling methods. These borings were advanced to between 86½ and 91½ feet below ground surface (bgs). An inclinometer was installed at GEI-1. Borings GEI-3 through GEI-14 were completed to depths of 21½ to 51½ feet using a hollow-stem auger. Piezometers were installed at GEI-6, GEI-10, and GEI-14. All the drilling equipment was subcontracted to GeoEngineers, Inc. The approximate locations of the borings are shown in the Site and Exploration Plan, Figures 3a and 3b. Exploration locations were located in the field by taping or pacing from existing site features. The locations should be considered approximate.

The borings were continuously monitored by an engineering geologist from our firm who examined and classified the soils encountered, obtained representative soil samples, observed groundwater conditions and prepared a detailed log of each exploration. Soils encountered were classified visually in general accordance with ASTM D-2488-90, which is described in Figure A-1. An explanation of the symbols for the borings is also shown in Figure A-1.

The logs of the borings completed for the geotechnical evaluation are presented in Figures A-2 through A-6. The exploration logs are based on our interpretation of the field and laboratory data and indicate the various types of soils encountered. They also indicate the depths at which these soils or their characteristics change, although the change might actually be gradual. If the change occurred between samples in the borings the depth was inferred.

LABORATORY TESTING

Soil samples obtained from the field explorations were transported to our laboratory and examined to confirm or modify field classifications, as well as to evaluate index properties of the soil samples. Representative samples were selected for laboratory testing consisting of the determination of the moisture content, grain size analysis, percent fines, moisture and density and Atterberg limits. Moisture content tests were completed in general accordance with ASTM D 2216 for representative samples obtained from the explorations. The results of these tests are presented on the exploration logs in Appendix A at the depths at which the samples were obtained and in Figures A-2 through A-15.

Sieve analyses were performed on a selected sample in general accordance with ASTM D422. The wet sieve analysis method was used to determine the percentage of soil greater than the U.S. No. 200 mesh sieve. The sample tested is designated with a “SA” at the respective sample depth in the boring log. The results of the sieve analyses were plotted, classified in general accordance with the USCS, and presented in Figures A-16 through A-20.

The fines content (material passing a U.S. No. 200 sieve) was determined for selected soil samples recovered from the borings. The testing was performed in general accordance with ASTM D1140. The results of the fines content determination, as a percent of total dry weight, are presented on the summary

borings logs. The samples on which the fines content was determined are designated with a "%F=" in the column labeled "Other Tests and Notes" on the summary logs.

Atterberg limits testing was performed on selected fine-grained soil samples. The tests were used to classify the soil as well as to evaluate index properties. The liquid limit and the plastic limit were estimated through a procedure performed in general accordance with ASTM D4318. Samples tested are designated with an "AL" at the respective sample depth in the boring logs. The results of the Atterberg limits testing are summarized in Figure A-21 and A-22.

SOIL CLASSIFICATION CHART

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

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	CC	Cement Concrete
	AC	Asphalt Concrete
	CR	Crushed Rock/ Quarry Spalls
	TS	Topsoil/ Forest Duff/Sod

Measured groundwater level in exploration, well, or piezometer

Groundwater observed at time of exploration

Perched water observed at time of exploration

Measured free product in well or piezometer

Stratigraphic Contact

Distinct contact between soil strata or geologic units

Gradual change between soil strata or geologic units

Approximate location of soil strata change within a geologic soil unit

Sampler Symbol Descriptions

2.4-inch I.D. split barrel

Standard Penetration Test (SPT)

Shelby tube

Piston

Direct-Push

Bulk or grab

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

A "P" indicates sampler pushed using the weight of the drill rig.

Laboratory / Field Tests

%F	Percent fines
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
OC	Organic content
PM	Permeability or hydraulic conductivity
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen
NT	Not Tested

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

KEY TO EXPLORATION LOGS

GEOENGINEERS

Figure A-1

Date(s) Drilled	8-28-2006	Logged By	S. Cool	Checked By	S. Cool
Drilling Contractor	Holocene Drilling, Inc.	Drilling Method	Mud Rotary	Sampling Methods	Dames & Moore
Auger Data	-	Hammer Data	300 lb hammer/30 in drop	Drilling Equipment	Truck-mounted Drill Rig
Total Depth (ft)	86.5	Surface Elevation (ft)	185	Groundwater Elevation (ft)	Not Determined
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Elevation feet	Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
185	0							SM	Red-brown mixed silt gravel and sand (medium dense, moist) (possible fill/disturbed soil)			
180	5	■	2	16	1					8		
								SP-SM	Gray-brown gravelly fine to course sand with silt; lense/pod of silt (very dense, moist to wet) (Emergence Deposit)			
175	10	■	4	62	2					12		
								ML/CL	Gray sandy clayey silt to silty clay with gravel (medium stiff to stiff, moist) [Bellingham (glaciomarine) Drift]			
170	15	■	18	13	3					14	124	Tv=0.44
165	20	■	18	7	4							Water on rods
		■	18	6	5							
160	25											

Notes: See Figure A-1 for explanation of symbols.

V6_GTBORING P:\18\18329001\00\GINT\18329001 00B.GPJ GEIV6_1.GDT 1/28/09

LOG OF BORING GEI-1

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-2
Sheet 1 of 3

Elevation feet	Depth feet	Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
160	25	■	18	5		6							
		■	18	11		7					16	120	Tv=0.57
155	30	■	18	9		8					15		
150	35	□	0	6		9							
									SM	Gray-brown gravelly silty sand (dense, moist) (Vashon Advance Outwash)			
145	40	■	18	38		10					7		
									SP-SM	Gray-brown fine to medium sand with silt to trace silt and trace gravel (very dense, moist)			
140	45	■	18	72		11					10	120	SA
135	50	■	18	72		12					4		
130	55	■	18	64		13					4	109	SA

LOG OF BORING GEI-1 (continued)

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-2
Sheet 2 of 3

V6_GTBORING P:\18\18329001\00\GINT\18329001 00B.GPJ GEIV6_1.GDT 1/28/09

Elevation feet	Depth feet	SAMPLES Interval Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
125	60	6	50/3"	14				- gravelly	5		
120	65	15	86/3"	15					3		
							ML	Light brown and orange silt with sand to trace sand (hard, moist)			
115	70	17	80/11"	16					20		
								- becomes gray			
110	75	18	42	17					26	102	SA
105	80	11	50/5"	18			SP-SM	Gray-brown fine to course sand with silt and gravel (very dense, moist)	7		
100	85	17	90/11"	19					5	110	

LOG OF BORING GEI-1 (continued)

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-2
Sheet 3 of 3

Date(s) Drilled	8-30-2006	Logged By	S. Cool	Checked By	S. Cool
Drilling Contractor	Holocene Drilling, Inc.	Drilling Method	Mud Rotary	Sampling Methods	Dames & Moore
Auger Data	-	Hammer Data	300 lb hammer/30 in drop	Drilling Equipment	Truck-mounted Drill Rig
Total Depth (ft)	91.5	Surface Elevation (ft)	179	Groundwater Elevation (ft)	166
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Elevation feet	Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	0							SM/GM	Gray silty sandy gravel to gravelly sand (medium dense, moist) (fill)			
								SP-SM	Gray-brown gravelly fine to coarse sand with silt and occasional cobbles (medium dense to very dense, moist) (Emergence Deposit)			
175												
	5		0	26	1							
170												
	10		18	58	2					5		
												Water on rods
165									- decreased gravel content and increased silt content			
	15		18	59	3				- orange staining	16	121	SA
									- grades from wet to moist			
160								ML	Gray fine sandy silt with trace fine gravel (very stiff, moist) [Bellingham (glaciomarine) Drift]			
	20		18	24	4					15	123	Tv=0.36
								CL-ML	Gray sandy silty clay and trace gravel (soft to medium stiff, moist)			
155												
	25											

Notes: See Figure A-1 for explanation of symbols.

LOG OF BORING GEI-2

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-3
Sheet 1 of 4

V6_GTBORING P:\18\18329001\00\GINT\18329001 00B.GPJ GEIV6_1.GDT 1/28/09

Elevation feet	Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	25		0	12		5							
			18	7		6					15	122	Tv=0.53
150													
	30		18	8		7					17		
			18	4		8					19	112	Tv=0.42
145													
	35		18	3		9				- sandy lense near tip			
			18	6		10					13		
140													
	40		18	11		11			CL-ML	Gray sandy silty clay with gravel (medium stiff to stiff, moist)	14	126	Tv=0.37
135													
	45		18	6		12							
130													
	50		18	10		13					17		
125													
	55		18	9		14					16	120	Tv=0.21

LOG OF BORING GEI-2 (continued)

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-3
Sheet 2 of 4

V6_GTBORING P:\18\18329001\00\GINT\18329001 00B.GPJ GEIV6_1.GDT 1/28/09

Elevation feet	Depth feet	Interval Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
120											
	60	18	7	15							
115											
	65	0	6	16				- disturbed sample			No recovery
110											
	70	0	10	17							No recovery
		0	12	18							No recovery
105											
	75	18	17	19				- clay becomes stiffer, increased sand and gravel content to gravelly clayey silty sand	17	119	SA
100							SM/GM	Gray-brown silty gravelly sand to sandy gravel with cobble (dense, moist) (Vashon Advance Outwash)			
	80	6	39	20					8		
95							SP-SM	Light brown fine to medium sand with silt to trace silt (very dense, moist)			
	85	18	80	21					3	108	SA

LOG OF BORING GEI-2 (continued)

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-3
Sheet 3 of 4

Elevation feet	Depth feet	SAMPLES Interval Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
90	90	6	50/4"	22				- becomes very gravelly with pod of clay	4		
85	95										
80	100										
75	105										
70	110										
65	115										

LOG OF BORING GEI-2 (continued)

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-3
Sheet 4 of 4

Date(s) Drilled	10-5-2006	Logged By	A. Fickeisen	Checked By	S. Cool
Drilling Contractor	Boretec, Inc.	Drilling Method	Hollow Stem auger	Sampling Methods	SPT
Auger Data	-	Hammer Data	140 lb hammer/30 in drop	Drilling Equipment	M55 Track-mounted Drill rig
Total Depth (ft)	31.5	Surface Elevation (ft)	±120	Groundwater Level (ft. bgs)	Not Determined
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Elevation feet / Depth feet	SAMPLES Interval Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
0						SM	Dark brown silty fine sand with organic matter (loose to medium dense, moist) (topsoil)			
						SP-SM	Brown fine sand with silt (loose, moist) (Emergence Deposit)			
5	6	2	1					20		
						CL-ML	Gray sandy silty clay with occasional gravel (very stiff to hard, moist) [Bellingham (glaciomarine) Drift]			
10	9	54	2					10		
15	16	21	3					12		AL, SA
							- decreasing silt content			
						CL	Gray silty clay with sand (medium stiff to stiff, moist)			
20	16	11	4					18		
25										

Notes: See Figure A-1 for explanation of symbols.

LOG OF BORING GEI-3

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-4
Sheet 1 of 2

V6_GTBORING P:\18\18329001\00\GINT\18329001 00B.GPJ GEIV6_1.GDT 1/28/09

Elevation feet	Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	25		18	7		5					17		
	30		18	6		6					18		AL, %F=56
	35												
	40												
	45												
	50												
	55												

LOG OF BORING GEI-3 (continued)

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-4
Sheet 2 of 2

Date(s) Drilled	10-4-2006	Logged By	A. Fickeisen	Checked By	S. Cool
Drilling Contractor	Boretec, Inc.	Drilling Method	Hollow Stem auger	Sampling Methods	SPT
Auger Data	-	Hammer Data	140 lb hammer/30 in drop	Drilling Equipment	M55 Track-mounted Drill rig
Total Depth (ft)	31.5	Surface Elevation (ft)	±145	Groundwater Level (ft. bgs)	Not Determined
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Elevation feet	Depth feet	SAMPLES Interval Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	0						SM	Dark brown silty fine sand with organic matter (medium dense, moist) (topsoil)			
							SM	Rust-brown silty fine to medium sand with occasional gravel (medium dense, moist) (Emergence Deposit)			
	5	8	16	1					10		
								- increased moisture, possible seepage			
	10	9	37	2			CL-ML	Gray sandy silty clay and occasional gravel (hard, moist) [Bellingham (glaciomarine) Drift]	18		
							CL	Gray silty clay with fine sand and occasional gravel (medium stiff to stiff, moist)			
	15	18	8	3					15		
	20	18	8	4					18		
	25										

Notes: See Figure A-1 for explanation of symbols.

LOG OF BORING GEI-4

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-5
Sheet 1 of 2

V6_GTBORING P:\18\18329001\00\GINT\18329001 00B.GPJ GEIV6_1.GDT 1/28/09

Elevation feet	Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	25		18	6		5				- becomes moist to wet	18		
	30		9	9		6					17		
	35												
	40												
	45												
	50												
	55												

LOG OF BORING GEI-4 (continued)

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-5
Sheet 2 of 2

Date(s) Drilled	10-4-2006	Logged By	A. Fickeisen	Checked By	S. Cool
Drilling Contractor	Boretec, Inc.	Drilling Method	Hollow Stem auger	Sampling Methods	SPT
Auger Data	-	Hammer Data	140 lb hammer/30 in drop	Drilling Equipment	M55 Track-mounted Drill rig
Total Depth (ft)	31.5	Surface Elevation (ft)	±75	Groundwater Level (ft. bgs)	Not Determined
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Elevation feet / Depth feet	SAMPLES: Interval Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
0						SM	Dark brown silty fine sand with occasional gravel and organic matter (medium dense, moist) (topsoil)			
						SM	Brown silty fine sand with occasional fine gravel (medium dense, moist) (Emergence Deposit)			
5	9	28	1					7		
10	16	12	2a, 2b			ML	Brown fine sandy silt with occasional gravel (stiff, moist to wet) [Bellingham (glaciomarine) Drift]	13, 20		
						CL	Gray clay with fine sand and occasional gravel (medium stiff, moist to wet) [Bellingham (glaciomarine) Drift]			
15	18	4	3				- trace shell fragments	24		AL, %F=53
20	9	51	4a, 4b			SM	Gray silty fine sand (dense to very dense, moist) (Vashon Advance Outwash)	21, 8		
25										

Notes: See Figure A-1 for explanation of symbols.

LOG OF BORING GEI-5

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-6
Sheet 1 of 2

V6_GTBORING P:\18\18329001\00\GINT\18329001 00B.GPJ GEIV6_1.GDT 1/28/09

Elevation feet	Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	25		16	42		5					13		SA
									ML	Gray silt with clay and fine sand (very stiff, moist) (Cherry Point Formation)			
	30		14	22		6					21		
	35												
	40												
	45												
	50												
	55												

LOG OF BORING GEI-5 (continued)

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-6
Sheet 2 of 2

Date(s) Drilled	10-4-2006	Logged By	A. Fickeisen	Checked By	S. Cool
Drilling Contractor	Boretec, Inc.	Drilling Method	Hollow Stem auger	Sampling Methods	SPT
Auger Data	-	Hammer Data	140 lb hammer/30 in drop	Drilling Equipment	M55 Track-mounted Drill rig
Total Depth (ft)	21.5	Surface Elevation (ft)	±85	Groundwater Level (ft. bgs)	Not Determined
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Elevation feet	Depth feet	SAMPLES Interval Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	0						SM	Dark brown silty fine sand with organic matter (medium dense, moist) (topsoil)			
							ML	Brown fine sandy silt with occasional gravel (hard, moist) [Bellingham (glaciomarine) Drift]			
	5	18	33	1a					15		
				1b			CL	Brown sandy silty clay with occasional gravel (stiff to very stiff, moist)	14		
	10	18	28	2					22		
								- some orange staining			
	15	18	14	3					19		SA
	20	18	30	4					20		Blowcount overstated
	25										

Notes: See Figure A-1 for explanation of symbols.

LOG OF BORING GEI-6P

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-7
Sheet 1 of 1

V6_GTBORING P:\18\18329001\00\GINT\18329001 00B.GPJ GEIV6_1.GDT 1/28/09

Date(s) Drilled	10-4-2006	Logged By	A. Fickeisen	Checked By	S. Cool
Drilling Contractor	Boretec, Inc.	Drilling Method	Hollow Stem auger	Sampling Methods	SPT
Auger Data	-	Hammer Data	140 lb hammer/30 in drop	Drilling Equipment	M55 Track-mounted Drill rig
Total Depth (ft)	31.5	Surface Elevation (ft)	±130	Groundwater Level (ft. bgs)	Not Determined
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Elevation feet	Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	0							SM	Dark brown silty fine sand with organic matter (medium dense, moist) (topsoil)			
								SP-SM	Brown with orange staining fine sand with silt (medium dense, moist) (Emergence Deposit)			
	5		8	15	1					20		
									- increased moisture, possible seepage			
								SM/ML	Gray silty fine sand to fine sandy silt and occasional gravel (dense/stiff, moist) [Bellingham (glaciomarine) Drift]			
	10		9	40	2					11		
	15		2	14	3					12		SA
								CL	Gray silty clay with sand and occasional fine gravel (medium stiff to stiff, moist)			
	20		18	11	4					14		
	25											

Notes: See Figure A-1 for explanation of symbols.

LOG OF BORING GEI-7

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-8
Sheet 1 of 2

V6_GTBORING P:\18\1832900\00\GINT\1832900100B.GPJ GEIV6_1.GDT 1/28/09

Elevation feet	Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	25		18	8		5					18		
	30		17	7		6					18		
	35												
	40												
	45												
	50												
	55												

LOG OF BORING GEI-7 (continued)

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-8
Sheet 2 of 2

Date(s) Drilled	10-4-2006	Logged By	A. Fickeisen	Checked By	S. Cool
Drilling Contractor	Boretec, Inc.	Drilling Method	Hollow Stem auger	Sampling Methods	SPT
Auger Data	-	Hammer Data	140 lb hammer/30 in drop	Drilling Equipment	M55 Track-mounted Drill rig
Total Depth (ft)	31.5	Surface Elevation (ft)	±120	Groundwater Level (ft. bgs)	Not Determined
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Elevation feet / Depth feet	SAMPLES: Interval Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
0						SM	Dark brown silty fine sand with organic matter (medium dense, moist) (topsoil)			
						SM	Brown silty fine to medium sand with clay (dense, moist) (Emergence Deposit)			
5	14	39	1					14		SA
10	18	13	2			CL	Gray silty clay with sand and occasional gravel (medium stiff to stiff, moist) [Bellingham (glaciomarine) Drift]	16		
15	16	17	3				- very stiff at 15 feet	14		
20	18	7	4					21		
25										

Notes: See Figure A-1 for explanation of symbols.

LOG OF BORING GEI-8

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-9
Sheet 1 of 2

V6_GTBORING P:\18\1832900\00\GINT\1832900100B.GPJ GEIV6_1.GDT 1/28/09

Elevation feet	Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	25		18	8		5							
	30		18	4		6				- soft to medium stiff, sand and silt content decreases	19		
	35												
	40												
	45												
	50												
	55												

LOG OF BORING GEI-8 (continued)

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-9
Sheet 2 of 2

Date(s) Drilled	10-4-2006	Logged By	A. Fickeisen	Checked By	S. Cool
Drilling Contractor	Boretec, Inc.	Drilling Method	Hollow Stem auger	Sampling Methods	SPT
Auger Data	-	Hammer Data	140 lb hammer/30 in drop	Drilling Equipment	M55 Track-mounted Drill rig
Total Depth (ft)	31.5	Surface Elevation (ft)	±70	Groundwater Level (ft. bgs)	Not Determined
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Elevation feet	Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	0							SM	Dark brown silty fine sand with organic matter (medium dense, moist) (topsoil)			
								CL	Brown fine sandy silty clay with occasional gravel (stiff to very stiff, moist) [Bellingham (glaciomarine) Drift]			
	5		18	25	1					16		
	10		18	19	2					19		
	15		18	18	3					21		
	20		18	21	4					18		
								SM	Gray silty fine sand and occasional gravel (very dense, moist) (Vashon Advance Outwash)			
	25											

Notes: See Figure A-1 for explanation of symbols.

LOG OF BORING GEI-9

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-10
Sheet 1 of 2

V6_GTBORING P:\18\18329001\00\GINT\18329001 00B.GPJ GEIV6_1.GDT 1/28/09

Elevation feet	Depth feet	SAMPLES: Interval Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	25	16	50/5"	5					10		SA
							ML	Gray fine sandy silt with fine sand lenses (hard, moist) (Cherry Point Formation)			
	30	16	89	6					15		
	35										
	40										
	45										
	50										
	55										

LOG OF BORING GEI-9 (continued)

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-10
Sheet 2 of 2

Date(s) Drilled	10-4-2006	Logged By	A. Fickeisen	Checked By	S. Cool
Drilling Contractor	Boretec, Inc.	Drilling Method	Hollow Stem auger	Sampling Methods	SPT
Auger Data	-	Hammer Data	140 lb hammer/30 in drop	Drilling Equipment	M55 Track-mounted Drill rig
Total Depth (ft)	51.5	Surface Elevation (ft)	±50	Groundwater Level (ft. bgs)	41.5
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Elevation feet / Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
0							SM	Brown silty fine sand with organic matter (medium dense, moist) (topsoil)			
							ML	Light brown-gray fine sandy silt with iron stains(very stiff, moist) [Bellingham (glaciomarine) Drift]			
5		9	30	1					14		
							CL	Brown fine to medium sandy clay with silt and occasional gravel (stiff, moist)			
10		9	15	2					20		
15		18	10	3				- becomes gray	18		
							ML	Gray fine sandy silt; non plastic (very stiff, moist) (Cherry Point Formation)			
20		12	24	4					15		
							SM	Gray silty fine sand (dense, moist)			
25											

Notes: See Figure A-1 for explanation of symbols.

LOG OF BORING GEI-10

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-11
Sheet 1 of 2

V6_GTBORING P:\18\18329001\00\GINT\18329001 00B.GPJ GEIV6_1.GDT 1/28/09

Elevation feet / Depth feet	SAMPLES: Interval Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
25	17	40	5					15		
						SM/ML	Gray silty fine sand to fine sandy silt (dense to very dense/very stiff to hard, moist)			
30	18	47	6					17		
35	16	57	7					17		
							- interbedded silt with silty fine sand			
40	16	31	8					21		SA
							- faint lamination - becomes moist to wet			
45	18	48	9				- becomes wet	27		
50	18	58	10				- sand lense encountered	20		
55										

LOG OF BORING GEI-10 (continued)

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-11
Sheet 2 of 2

Date(s) Drilled	10-3-2006	Logged By	A. Fickeisen	Checked By	S. Cool
Drilling Contractor	Boretec, Inc.	Drilling Method	Hollow Stem auger	Sampling Methods	SPT
Auger Data	-	Hammer Data	140 lb hammer/30 in drop	Drilling Equipment	M55 Track-mounted Drill rig
Total Depth (ft)	31.5	Surface Elevation (ft)	±30	Groundwater Level (ft. bgs)	Not Determined
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Elevation feet / Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
0							SM	Dark brown silty fine sand with organic matter (medium dense, moist) (topsoil)			
							SM	Light brown silty fine sand (medium dense, dry to moist) (Emergence Deposit)			
5	■	9	20	1					7		
							SW-SM	Red-brown fine to coarse sand with silt and gravel (dense, moist)			
10	■	6	33	2					6		SA
15	■	9	18	3				- becomes gray, silt content increases	5		
							CL-ML	Gray silty clay with fine sand and trace gravel (soft, moist) [Bellingham (glaciomarine) Drift]			
20	■	18	3	4					27		AL, SA
							ML/CL	Gray clayey silt to silty clay; homogeneous (very stiff, moist) (Cherry Point Formation)			
25											

Notes: See Figure A-1 for explanation of symbols.

LOG OF BORING GEI-11

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-12
Sheet 1 of 2

V6_GTBORING P:\18\18329001\00\GINT\18329001 00B.GPJ GEIV6_1.GDT 1/28/09

Elevation feet	Depth feet	SAMPLES: Interval Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	25	18	21	5					23		AL, %F=95
							SM	Gray silty fine sand (very dense, moist)			
	30	10	55	6					19		SA
	35										
	40										
	45										
	50										
	55										

LOG OF BORING GEI-11 (continued)

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-12
Sheet 2 of 2

Date(s) Drilled	10-3-2006	Logged By	A. Fickeisen	Checked By	S. Cool
Drilling Contractor	Boretec, Inc.	Drilling Method	Hollow Stem auger	Sampling Methods	SPT
Auger Data	-	Hammer Data	140 lb hammer/30 in drop	Drilling Equipment	M55 Track-mounted Drill rig
Total Depth (ft)	31.5	Surface Elevation (ft)	±55	Groundwater Level (ft. bgs)	30
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Elevation feet / Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
0							SM	Dark brown silty fine sand with organic material (medium dense, moist) (topsoil)			
							CL	Brown sandy clay with silt and occasional gravel (stiff, moist) [Bellingham (glaciomarine) Drift]			
5		18	15	1					22		
							SP-SM	Brown fine to coarse sand with silt and gravel (very dense, moist) (Vashon Advance Outwash)			
10		8	50/6"	2							Minimal sample recovery; soil description partially inferred from drill action and soil cuttings
15		2	50/6"	3							
							ML/CL	Gray silty clay to clayey silt; homogeneous (very stiff, moist) (Cherry Point Formation)			
20		18	24	4					23		
							SM/ML	Gray-brown silty fine sand to sandy silt with orange staining in lenses (dense/very stiff, moist)			
25											

Notes: See Figure A-1 for explanation of symbols.

LOG OF BORING GEI-12

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-13
Sheet 1 of 2

V6_GTBORING P:\18\18329001\00\GINT\18329001 00B.GPJ GEIV6_1.GDT 1/28/09

Elevation feet	Depth feet	SAMPLES: Interval Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	25	18	31	5			ML	Gray silt with fine sand (hard, wet)	18		
	30	15	48	6					24		
	35										
	40										
	45										
	50										
	55										

LOG OF BORING GEI-12 (continued)

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-13
Sheet 2 of 2

Date(s) Drilled	10-3-2006	Logged By	A. Fickeisen	Checked By	S. Cool
Drilling Contractor	Boretec, Inc.	Drilling Method	Hollow Stem auger	Sampling Methods	SPT
Auger Data	-	Hammer Data	140 lb hammer/30 in drop	Drilling Equipment	M55 Track-mounted Drill rig
Total Depth (ft)	51.5	Surface Elevation (ft)	±75	Groundwater Level (ft. bgs)	Not Determined
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Elevation feet / Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
0							SM	Dark brown silty fine sand with organic matter (medium dense, moist) (topsoil)			
							SM	Light brown silty fine sand with occasional gravel (dense, moist) (Emergence Deposit)			
5		16	34	1					13		
							SP-SM	Brown fine to coarse sand with sile and gravel (very dense, moist) (Vashon Advance Outwash)			
10		6	50/5"	2					8		Minimal sample recovery; soil description partially inferred from dril action and soil cuttings
15		2	50/4"	3							
20		2	50/3"	4							
							SM	Brown silty fine sand (dense, wet)			
25											

Notes: See Figure A-1 for explanation of symbols.

LOG OF BORING GEI-13

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-14
Sheet 1 of 2

V6_GTBORING P:\18\18329001\00\GINT\18329001 00B.GPJ GEIV6_1.GDT 1/28/09

Elevation feet / Depth feet	SAMPLES: Interval Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
25	16	34		5					18		
							ML	Gray silt with fine sand (very stiff, moist) (Cherry Point Formation)			
30	17	27		6					22		
								- faint lamination with silty fine sand			
35	18	29		7					20		AL, %F=85
40	18	75		8a			SM	Gray silty fine sand (very dense, moist)	22		
				8b					17		
							ML	Gray silt; homogeneous (hard, moist) - fine sand near tip			
45	18	34		9					23		
50	18	31		10					24		
55											

LOG OF BORING GEI-13 (continued)

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-14
Sheet 2 of 2

V6_GTBORING P:\18\18329001\00\GINT\18329001 00B.GPJ GEIV6_1.GDT 1/28/09

Date(s) Drilled	10-3-2006	Logged By	A. Fickeisen	Checked By	S. Cool
Drilling Contractor	Boretec, Inc.	Drilling Method	Hollow Stem auger	Sampling Methods	SPT
Auger Data	-	Hammer Data	140 lb hammer/30 in drop	Drilling Equipment	M55 Track-mounted Drill rig
Total Depth (ft)	51.5	Surface Elevation (ft)	±125	Groundwater Level (ft. bgs)	30.5
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Elevation feet / Depth feet	SAMPLES: Interval Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
0						SM	Dark brown silty fine sand with organic material (medium dense, moist) (topsoil)			
						ML	Brown fine to medium sandy silt with clay and occasional fine gravel (medium dense, moist) [Bellingham (glaciomarine) Drift]			
5	9	25	1					13		
10	9	19	2					19		SA
						CL	Brown clay with fine sand, silt and occasional fine gravel (hard, moist)			
15	10	50/4"	3					18		Minimal sample recovery; soil description partially inferred from dril action and soil cuttings
						SP-SM	Brown fine to coarse sand with silt and gravel (very dense, moist) (Vashon Advance Outwash)			
20	6	50/1"	4							
25										

Notes: See Figure A-1 for explanation of symbols.

LOG OF BORING GEI-14P

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-15
Sheet 1 of 2

V6_GTBORING P:\18\18329001\00\GINT\18329001 00B.GPJ GEIV6_1.GDT 1/28/09

Elevation feet	Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	25		0	50/5"		5							
									SM	Brown silty fine sand with clay (very dense, wet)			
	30		16	50		6					19		
									SP-SM	Brown fine to medium sand with silt (very dense, moist)			
	35		13	58		7					7		
	40		12	56		8					5		SA
	45		12	79		9					12		
	50		10	63		10					7		
	55												

LOG OF BORING GEI-14P (continued)

GEOENGINEERS

Project: Drayton Harbor Phase III
Project Location: Blaine, Washington
Project Number: 18329-001-00

Figure: A-15
Sheet 2 of 2

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Appendix B
Previous Site Explorations

APPENDIX B
PREVIOUS SITE EXPLORATIONS

Included in this section are logs from selected previous explorations completed in the immediate vicinity of this site by other firms. The explorations referenced here are:

Cascade Geotechnical, Inc., 1992, Feasibility Study, Drayton Harbor Hillside Project, Drayton Harbor Road, Blaine, Washington: report prepared for the Semiahmoo Company, job number 9205-04G, July 24, 1992

Cascade Geotechnical, Inc., 1993, Additional Geotechnical Study, Areas #3, #4, and #5, Drayton Harbor Hillside project, Blaine, Washington: report prepared for the Semiahmoo Company, job number 9205-04G, May 20, 1993

GeoEngineers, Inc., 1998, Geotechnical Engineering Services, Building Setback Considerations, Proposed Plat of Zone 8, Blaine, Washington: report prepared for the Semiahmoo Company; file number 4994-002-73; February 10, 1998

GeoEngineers, Inc., 2005, Geotechnical report, Drayton Hillside Phase III, Blaine Washington, Washington: report prepared for Wiley, Inc; file number 11589-001-00; June 1, 2005

GeoTest Services, Inc., 2002, Limited Geotechnical Slope Setback Study, Drayton Hillside Phases 2 & 3, Blaine, Washington: report prepared for Trillium Corporation, job number 2056, April 11, 2002

Shannon & Wilson, Inc., 1990, Geotechnical Report, Drayton Harbor Road Relocation, Blaine, Washington: report prepared for Associated Project Consultants, March 1990

GeoEngineers

Appendix C

Report Limitations And Guidelines For Use

APPENDIX C
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This appendix provides information to help you manage your risks with respect to the use of this report.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES, PERSONS AND PROJECTS

This report has been prepared for the exclusive use of Semiahmoo South, LLC, Tin Rock Development, and their authorized agents. This report may be made available to project team members and the regulatory agencies for review. This report is not intended for use by others, and the information contained herein is not applicable to other sites.

GeoEngineers structures our services to meet the specific needs of our clients. For example, a geotechnical or geologic study conducted for a civil engineer or architect may not fulfill the needs of a construction contractor or even another civil engineer or architect that are involved in the same project. Because each geotechnical or geologic study is unique, each geotechnical engineering or geologic report is unique, prepared solely for the specific client and project site. Our report is prepared for the exclusive use of our Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against open-ended liability claims by third parties with whom there would otherwise be no contractual limits to their actions. Within the limitations of scope, schedule and budget, our services have been executed in accordance with our Agreement with the Client and generally accepted geotechnical practices in this area at the time this report was prepared. This report should not be applied for any purpose or project except the one originally contemplated.

A GEOTECHNICAL ENGINEERING OR GEOLOGIC REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

This report has been prepared for the proposed Drayton Hillside III Development site as described in this report. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, do not rely on this report if it was:

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

For example, changes that can affect the applicability of this report include those that affect:

- the function of the proposed structure;
- elevation, configuration, location, orientation or weight of the proposed structure;
- composition of the design team; or
- project ownership.

[1] Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences, www.asfe.org

If important changes are made after the date of this report, GeoEngineers should be given the opportunity to review our interpretations and recommendations and provide written modifications or confirmation, as appropriate.

SUBSURFACE CONDITIONS CAN CHANGE

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by manmade events such as construction on or adjacent to the site, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. Always contact GeoEngineers before applying a report to determine if it remains applicable.

MOST GEOTECHNICAL AND GEOLOGIC FINDINGS ARE PROFESSIONAL OPINIONS

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied our professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. Our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

GEOTECHNICAL ENGINEERING REPORT RECOMMENDATIONS ARE NOT FINAL

Do not over-rely on the preliminary construction recommendations included in this report. These recommendations are not final, because they were developed principally from GeoEngineers' professional judgment and opinion. GeoEngineers' recommendations can be finalized only by observing actual subsurface conditions revealed during construction. GeoEngineers cannot assume responsibility or liability for this report's recommendations if we do not perform construction observation.

Sufficient monitoring, testing and consultation by GeoEngineers should be provided during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether or not earthwork activities are completed in accordance with our recommendations. Retaining GeoEngineers for construction observation for this project is the most effective method of managing the risks associated with unanticipated conditions.

A GEOTECHNICAL ENGINEERING OR GEOLOGIC REPORT COULD BE SUBJECT TO MISINTERPRETATION

Misinterpretation of this report by other design team members can result in costly problems. You could lower that risk by having GeoEngineers confer with appropriate members of the design team after submitting the report. Also retain GeoEngineers to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering or geologic report. Reduce that risk by having GeoEngineers participate in pre-bid and preconstruction conferences, and by providing construction observation.

DO NOT REDRAW THE EXPLORATION LOGS

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

GIVE CONTRACTORS A COMPLETE REPORT AND GUIDANCE

Some owners and design professionals believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering or geologic report, but preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with GeoEngineers and/or to conduct additional study to obtain the specific types of information they need or prefer. A pre-bid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might an owner be in a position to give contractors the best information available, while requiring them to at least share the financial responsibilities stemming from unanticipated conditions. Further, a contingency for unanticipated conditions should be included in your project budget and schedule.

CONTRACTORS ARE RESPONSIBLE FOR SITE SAFETY ON THEIR OWN CONSTRUCTION PROJECTS

Our geotechnical recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and to adjacent properties.

READ THESE PROVISIONS CLOSELY

Some clients, design professionals and contractors may not recognize that the geoscience practices (geotechnical engineering or geology) are far less exact than other engineering and natural science disciplines. This lack of understanding can create unrealistic expectations that could lead to disappointments, claims and disputes. GeoEngineers includes these explanatory "limitations" provisions in our reports to help reduce such risks. Please confer with GeoEngineers if you are unclear how these "Report Limitations and Guidelines for Use" apply to your project or site.

GEOTECHNICAL, GEOLOGIC AND ENVIRONMENTAL REPORTS SHOULD NOT BE INTERCHANGED

The equipment, techniques and personnel used to perform an environmental study differ significantly from those used to perform a geotechnical or geologic study and vice versa. For that reason, a geotechnical engineering or geologic report does not usually relate any environmental findings, conclusions or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding a specific project.

BIOLOGICAL POLLUTANTS

GeoEngineers' Scope of Work specifically excludes the investigation, detection, prevention or assessment of the presence of Biological Pollutants. Accordingly, this report does not include any interpretations, recommendations, findings, or conclusions regarding the detecting, assessing, preventing or abating of Biological Pollutants and no conclusions or inferences should be drawn regarding Biological Pollutants, as they may relate to this project. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria, and viruses, and/or any of their byproducts.

If Client desires these specialized services, they should be obtained from a consultant who offers services in this specialized field.