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GEOTECHNICAL REPORT
LANDSLIDE ON US 101 AT MP 326
LILLIWAP, WASHINGTON

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EXECUTIVE SUMMARY

This report presents the results of the geotechnical investigation of the landslide at MP 326 along US 101 on the Olympic Peninsula. The MP 326 landslide developed in early to mid-February 1999 and resulted in the closure of US 101 in early March. The site investigation included geologic mapping, aerial photograph interpretation, borings, piezometers, inclinometers, laboratory testing, installation of emergency horizontal drains, and surface geophysics.

The data implies that the landslide was a progressive block slide failing on a weak zone near the top of a hard clay layer. The recent landslide is believed to have occurred within a larger ancient landslide mass that extends further north and south along the hillside above US 101. Due to record rainfall high groundwater levels developed that are considered the trigger causing the landslide.

The recommended remediation consists of a combination of horizontal drains and surface grading to be implemented in 1999 possibly supplemented with a limited toe buttress in the future. The need to construct a toe buttress in the future will depend on the effectiveness of the drains and the performance of the landslide over the 1999-2000 winter season. It is not considered appropriate to install the buttress during the 1999 construction season. This opinion is based on the fact that the buttress may not be required pending the effectiveness of the drains, contractual timing constraints, and the desire not to cut into the toe of the slopes until all the drains have been installed and are fully effective. A key aspect of this approach will be monitoring of the landslide to assess the need for a toe buttress in the short term and to monitor the continued effectiveness of the drains in the long term.

Figures 16 and SL6 are missing from this report (noted 8/2/2007).

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1. INTRODUCTION

This report presents the results of the geotechnical investigation of the landslide at MP 326 along US 101 on the Olympic Peninsula. The work was completed under WSDOT Consultant Agreement Y-6875 and was authorized as Task Assignment AG. The work included an extensive exploration program, laboratory testing, stability analyses, geologic interpretations, and development of engineering recommendations to stabilize the landslide. The primary purposes of the work were: 1) Determine the subsurface conditions, 2) Evaluate the landslide mechanism, 3) Develop stabilization recommendations considering both short-term measures to be implemented during the 1999 construction season and possible additional work to be done in subsequent years, and 4) Develop criteria for the landslide monitoring system.

As shown on Figure 1, the landslide is located off of US 101 at MP 326 just north of Lilliwap, Washington on the Olympic Peninsula adjacent to Hood Canal. Through this area, US 101 is located just above Hood Canal along the toe of a steep hillside rising several hundred feet to the west. As shown on Figure 2, the landslide extends along US 101 about 1,400 feet (427 m) and upslope a horizontal distance of about 400 to 500 feet (123 to 152 m) with a vertical rise of about 150 to 250 feet (46-76 m). The majority of the slide movements occurred starting in mid-February and continuing through March 1999. During this period slide debris flowed onto the roadway requiring the road to be closed.

Sections 2 through 5 summarize the investigation program, evaluation of the subsurface conditions, and assessment of the slide mechanism. Section 6 discusses the general stabilization concepts while Sections 7 and 8 present specific design recommendations.

2. SUBSURFACE INFORMATION

2.1 General

The subsurface information included published geologic maps, surface geologic mapping, aerial photograph interpretation, borings, piezometers, inclinometers, laboratory testing, installation of emergency horizontal drains, and surface geophysics.

Figure 2 shows the locations of the explorations and major mapped slide features. The locations of the emergency horizontal drains are shown on Figure 11. The subsections below summarize the information with the detailed data presented in the Appendices A through D.

2.2 Surface Mapping and Aerial Photograph Interpretation

During July 1999, Golder staff geologists completed a site reconnaissance of the overall slide area. The purpose was to identify the major scarps and ground ruptures, areas of seepage, and map exposed soils. In addition to this work, post slide aerial photos flown by WSDOT were reviewed.

The results of this work are summarized on Figure 2 showing the mapped scarps with the direction of movement. The figure also shows locations of observed seeps. The information depicted on Figure 2 represents the approximate conditions in July 1999.

Although not observed by Golder or shown on Figure 2, WSDOT staff reported observing heavy seepage from the midslope area just west of WSDOT boring location H-1-99 in early April 1999.

2.3 Boring Program

2.3.1 General

The boring program consisted of explorations at twelve locations as shown on Figure 2. At all of these locations, the boreholes were completed as inclinometers. At eleven of the locations, piezometers were installed in an adjacent separate drill hole. The borehole cluster of one piezometer and one inclinometer each were distributed in four lines trending generally northwest- southeast in the direction of landslide movement. The uppermost borehole clusters in the southern three lines were located behind the active landslide headscarp in order to determine the in-place soil and groundwater conditions outside the active landslide mass. The remainder of the borehole clusters were located on the active landslide or on Highway 101.

All but one of the borings (WSDOT H-1-99) was drilled by Crux Subsurface, Inc. out of Spokane, Washington under contract to WSDOT between April 28 and June 6, 1999. The drilling of the inclinometers and piezometers utilized a combination of HQ (3.5 inch [8.9 cm]) and HWT (4.5 inch [11.4 cm]) casing advancer, and HQ (2.5 inch [6.35 cm])

coring techniques. The drills consisted of a Crux-built 2500 drill and a Burley 4500. The drills were assembled and disassembled and were transported to the drill sites in pieces using a Bell Jet Ranger helicopter provided by Aero-Copters, Inc. out of Boeing Field in Seattle. Boring H-1-99 was drilled and logged by the WSDOT.

A summary of the boring elevations and depths indicating which holes have piezometers or inclinometers is presented in Table 1.

2.3.2 Borings

The inclinometer holes were sampled and represent the geotechnical data borings. The piezometer holes were generally drilled without sampling. A Golder geologist was present during all drilling activities to observe and document the drilling activities, record the soil and groundwater conditions, the engineering characteristics of the soils, and collect samples at all of the borings except the WSDOT boring (H-1-99).

Soil samples were generally collected using Standard Penetration Tests (SPT) where a 2-inch (5.1 cm) diameter split-spoon sampler was driven 18 inches (45.7 cm) using a 140-pound hammer in accordance with the ASTM D-1586 test method. The number of blows of the hammer required to drive the sampler every 6 inches was recorded, and the number of blows needed to drive the lower 12 inches (30.5 cm) were used to determine the SPT "N" values (blow counts). The collected soil samples were placed in plastic containers and shipped to Golder's Redmond, Washington facility for storage, additional classification, and selected laboratory testing. SPTs were the most common sampling method. Soil cores and Shelby tubes were also collected at selected intervals.

When difficult drilling conditions were encountered (poor recovery or difficulty in advancing the hole), the material was cored continuously using HQ size coring equipment. HQ-coring, in some cases, provided a more continuous column of sample for inspection. In other cases, where core recovery was poor, or density confirmation was desired, SPT samples were collected in conjunction with the coring. Typically, the core was drilled in 5-foot runs, and the material was logged in general accordance with Golder's standard core logging procedures. The majority of the core samples were retained in core boxes and shipped to Golder's Redmond facility for storage. Selected portions of the core samples were stored in plastic ziploc bags to limit moisture loss.

Shelby tubes were also pushed to collect relatively undisturbed samples near or across the anticipated landslide planes. These 2.5 inch (6.35 cm) ID thin wall samplers were collected in general accordance with ASTM D-1587. The Shelby tubes were pushed to their full 18 or 24-inch (45.7 or 61.0 cm) length or until they met refusal. The Shelby tubes were carefully withdrawn from the borings, capped immediately, and kept upright during transport to minimize disturbance of the samples.

The detailed field logs were edited, finalized, and included in Appendix A. The log of WSDOT boring H-1-99 was prepared by WSDOT and interpreted by Golder based on WSDOT's field log and examination of the samples.

2.3.3 Piezometer Data

The piezometer boreholes were drilled to depths ranging from about 23 to 52 feet (75.9 to 170.6 m) bgs in the toe area of the active landslide, from about 72 to 115 feet (236.2 to 377.2 m) bgs in the middle portion of the slide, and from about 96 to 240 feet (314.9 to 787.2 m) bgs above the active landslide headscarp.

Boreholes for the piezometer installations were drilled within about 5 feet of the inclinometer boreholes. The piezometers were constructed using 1.5-inch outside diameter (O.D.) Schedule 40 PVC. The screens were generally 0.020 machine slotted Schedule 40 PVC. The slotted section was backfilled with 10/20 silica sand. The screens were set at the desired depths to monitor the groundwater conditions. Seals were constructed above the monitored interval up to ground surface using bentonite granules and/or bentonite grout sealing materials. Details of the piezometer construction for each borehole are included on the borehole logs presented in Appendix A.

A summary of groundwater levels measured through August 1999 is presented on Table 2. Plots of groundwater depth versus time are included in Appendix B. In piezometers GA-2A, GA-5A, GA-6A, GA-11A, and H-1-99, slug tests were performed to estimate the permeability. The results of these tests are summarized on Table 3. As discussed in Section 2.5 and shown on Figure 11, WSDOT installed emergency horizontal drains during May and June 1999. These drains likely impacted the groundwater levels measured in piezometers near the drains. Section 4.7.3 discusses this in more detail.

2.3.4 Inclinometer Data

The inclinometer boreholes were drilled to depths ranging from about 51 to 74 feet (15.5 to 22.6 m) bgs in the toe area of the active landslide, from about 96 to 150 feet (bgs in the middle portion of the slide, and from about 174 to 276 feet (53.1 to 84.1 m) bgs above the active landslide headscarp.

The inclinometer casing was manufactured by Slope Indicator Company located in Bothell, Washington. The casing lengths came in 10-foot sections and were fastened together with snap joints with O-rings. The casing was assembled in the borehole, charged with water, and clean SPT sampling rod was lowered to the bottom of the casing before grouting (cementing) the casing in place. The casing was cemented in place using a lime/cement mixture. Where grout loss was anticipated, powdered bentonite was added to the mix. The grout batches were pumped down the steel drill casing to the bottom of the boring. The drill casing was then pulled out of the boring. Baseline inclinometer readings and subsequent readings were collected by WSDOT field personnel after allowing the grout to set for at least a 10-hour period. The collected data was then processed by WSDOT and forwarded to Golder for review.

Plots of the inclinometer data through August 1999 are presented in Appendix A. Since the inclinometers were installed after the slide had essentially stabilized, the data does not in any way reflect the total magnitude of the slope movements. The movements

indicated by the inclinometer data through August 1999 are very small and can only be used to infer the likely location of the failure plane. In several of the inclinometers, the data does not clearly indicate the failure plane since the movements are so small and/or inconsistent. The inclinometers will be monitored in the future as part of the overall long-term monitoring program as discussed in Section 8.

2.4 Seismic Refraction Survey

The seismic refraction survey consisted of six shot lines, three oriented approximately north-south across the width of the landslide and three oriented approximately east-west across the landslide. The locations of the seismic lines in relation to the boring locations are shown on Figure 12. Figure 12 also plots the top of a high velocity layer that is interpreted to represent the top of the hard glaciolacustrine deposits. Although the geophysical data is in reasonable agreement with the borings, the Figure 12 contours should be considered as only an approximate elevation of the top of the glaciolacustrine deposits since the high velocity layer could also represent a very dense zone within the units overlying the clays.

Appendix C summarizes the seismic investigation and discusses the results in detail.

2.5 Horizontal Drain Data

WSDOT installed a series of horizontal drains during April/May 1999 as part of an emergency effort to stop the landsliding at MP 326. A series of four drain arrays were installed and are identified as Drain array A, B, C, and D on Figure 11. Since only the location of the heads of the drains and initial drain inclination/orientation are known, the limits of the arrays shown on Figure 11 are only approximate. The drains are generally on the order of 300 to 400 feet long and drilled at an inclination of between 5 to 10 degrees. The drain discharges were measured periodically after installation. The data is summarized on Table 4 with representative plots of discharge versus time shown in Appendix B.

As shown on Table 4, the combined flows of the three arrays in the main central area of the landslide (A, B and C) has decreased from about 100 gpm in early June to about 70 gpm in early July 1999. Two drains in the most southerly array accounted for about half of the total flow. The back end of the drains appear to be located above the landslide plane with the lower sections primarily in the transition units and the upper sections in either transition beds or in the overlying coarse landslide debris unit. The upper sections of the two drains that produced half of the total flow appear to be located within the coarser soils above the transition beds. Array D located in the northern section of the landslide has produced limited flow with only one of the drains producing flow with a flow rate of about 3.6 gpm in July 1999.

2.6 Laboratory Data

Limited laboratory testing was performed consisting of grain size, water contents and Atterberg limits. In addition, a residual angle direct shear test was performed on a silty clay soil sample within the active slide plane. The test results indicated a residual angle of about $\phi'_R = 24$ degrees. The test was performed by pre-cutting the sample to simulate a defined failure plane.

The laboratory results are included in Appendix D.

3. SITE CONDITIONS

3.1 Geological Setting

The recent geologic history of the Puget Sound Lowland region has been dominated by several glacial episodes. The most recent, the Vashon stade of the Fraser glaciation, is responsible for most of the present day geologic and topographic conditions. The Puget lobe of the Cordilleran ice sheet deposited a heterogeneous assemblage of proglacial lacustrine deposits, advance outwash, lodgment till, and recessional outwash upon either bedrock or older pre-Vashon sediments and bedrock. As the glacier retreated northward, it uncovered a sculpted landscape of elongate uplands and intervening valleys. Post glacial deposits include: alluvium deposited within active stream channels, modern lacustrine deposits, organic silt and local peat deposits within kettle depressions, drainages, and outwash channels; volcanic mudflow deposits and landslide deposits.

From the crest of the steep slope at around 400 feet above the MP 326 landslide site, the undulating ground surface rises gently toward the west and northwest to an elevation of approximately 800 feet where the glaciated terrain intersects the steep bedrock slopes of the Olympic Mountains. The glaciated terrain located between the MP 326 site and the base of the Olympic Mountain slopes appears to be a glacial sediment filled bedrock trough trending approximately from the west at Lake Cushman to the east toward the site. A bedrock ridge located within this trough splits the trough in two. Lilliwap Swamp is located on the north side and Price Lake is located on the south side of the bedrock ridge. Carson (1976) has mapped the glacial terrain as being underlain primarily by Vashon lodgment and ablation tills. Based on the outcrop pattern on Carson's map and field observations, an extensive deposit of granular advance outwash likely underlies the tills that mantle the ground surface and extends toward site. Granular sediments interpreted as Vashon advance outwash sediments are exposed in the head scarp area of the MP 326 landslide.

The most recent landslide activity at MP 326 appears to be located within a larger area of ancient landslide deposits, probably associated with the withdrawal of the Vashon lobe of the Cordilleran ice sheet approximately 10,000 years ago. Carson (1975) has mapped the slopes upon which the current MP 326 landslide is located as being underlain primarily by old landslide deposits.

3.2 Seismic Setting

3.2.1 General

The project site is located within an active convergent plate margin that has been termed the Cascadia Subduction zone. Along the Cascadia Subduction Zone, the oceanic Juan de Fuca Plate is actively subducting beneath the continental North American plate off shore from the Washington Coast. This general tectonic setting has resulted in three sesimogenic sources:

- Intraplate earthquakes that are located within the subducted Juan de Fuca plate,
- Earthquakes that occur along the interface between the actively subducting Juan de Fuca plate and the North American plate, and
- Earthquakes located within the overriding North American plate.

The best documented of these seismic sources are the intraplate earthquakes originating within the subducting Juan de Fuca plate. This seismic source is responsible for the two largest historic earthquake to have occurred in the Puget Sound Lowland, the 1949 earthquake with a M 7.1 located near Olympia, Washington, and the magnitude 6.5 Seattle earthquake in 1965. These earthquakes typically occur at depths ranging from 50 to 60 km.

The second seismic source area along the subduction zone between the Juan de Fuca plate and the North American plate has not exhibited historic activity. However, research that began in the mid-1980s (Atwater, B., 1987, 1992; and Heaton, T.H. and Hartzell, S.H., 1992) and others has suggested that prehistoric earthquakes have occurred along the Cascadia Subduction zone producing earthquakes with magnitudes as large as M =8 or 9.

The third source of earthquakes located within the overriding North American plate are thought by some (Bucknam, R.C. and others, 1992) to be seismic sources in response to localized uplift in the North American plate. Bucknam and others (1992) conclude these shallow North American plate earthquakes can produce earthquakes of magnitude 7 or larger in the Puget Sound region.

3.2.2 1999 Satsop Earthquake

An earthquake occurred on July 2, 1999 in the Satsop area of Washington State. According to the U.S. Geological Survey National Earthquake Information Center, the earthquake had a moment magnitude (Mm) 5.7 to 5.9 and was located approximately 8.2 km north of Satsop at a epicentral depth of 40 km. The fault plane solution indicated a normal displacement along a fault with a strike of 355 degrees and dipping 60 degrees to the east. The hypocenter is approximately 40-km distance from the US 101 landslide sites. Golder calculated an attenuated acceleration from the earthquake source to the site as around 0.07g.

Inclinometer data collected during the ongoing monthly instrumentation monitoring by WSDOT at the MP 322 landslide some 4 miles north of the MP 326 indicated that an unstable portion of the landslide may have moved about an inch due to the event. A published nomograph by Keefer (1984) based on 40 historic earthquakes shows the relationship between epicentral distance as a function of earthquake magnitude for three general landslide types. In addition, a simple Newmark analysis was completed to assess the movement and inferred static FS at the time of the event. Based on the nomograph and the Newmark analysis, it is credible that the seismic event caused the sudden movement. The inferred static FS would have been on the order of 1.05.

No such seismically induced landslide movements were observed at the MP 326 landslide. This is consistent with MP 326 having a static FS of about 1.15 during the summer of 1999.

3.2.3 Recommended Project Design Event

Based on published USGS seismic risk curves (10 percent chance of exceedance in 50 years) and judgement, the recommended design event for the slide is a magnitude 6.5 with a design maximum acceleration of about 0.2g.

3.3 Surface Conditions

The site is located along and upslope of US 101 as shown on Figures 1 and 2. In general, the area is heavily vegetated with second growth trees and brush. There are several houses on the hillside above the highway. US 101 is located at the toe of the hillside adjacent to Hood Canal. In general, the highway is at about elevation 25 to 23 feet (7.6 to 7.0 m) with the hillside rising at about 2H:1V to 3H:1V up to about elevation 400 feet (122 m) above Hood Canal. In the southern two-thirds of the landslide where the glaciolacustrine soils are exposed, the slopes immediately above the highway are much steeper.

Due to the significant slope movements, the landslide area has numerous scarps, cracks, and areas of disturbed material. There are several areas of closed depressions caused by grabens forming between ground cracks. The largest feature is the depression that has formed where the house collapsed in the southwest portion of the slide near GA-1. In the general toe area where the material flowed onto the highway, the surface is particularly disturbed with areas of entangled trees and very soft, wet ground. The worst area appears to be an area about 150 feet (45.7 m) wide above the roadway near Section A-A'. This area is designated as "Disturbed Area" on Figure 21 and is over-steepened, underlain by loose landslide debris, and is considered unstable.

3.4 Landslide History

Ground movements were initially observed in about the southern area of the landslide in early February of 1999 with the headscarp located about 150 feet (45.7 m) upslope from US 101 and the toe just above the highway. Over the next several weeks, movement was observed to progress upslope and further to the north with a series of headscarps eventually joining to form a continuous single slide mass. The slide seemed to grow in stages with the major movement occurring in early March 1999. During this movement, the house located near GA-1 was destroyed and debris began material flowing onto US 101 closing the road. The toe of the landslide occurred above the road in the southern two-thirds of the landslide and at or below the roadway in the northern one-third. The road closure was caused by slide debris flowing onto the roadway with the debris composed of wet saturated soil, water, and trees.

During the month of March, the slide appeared to stabilize due to a combination of emergency horizontal drains installed and a reduction in rainfall. The total slide movements cannot be accurately determined since the inclinometers were installed after the majority of the movements had occurred. However, based on ground observations and the amount of debris on the roadway, it is estimated that the total slide movements were on the order of 5 to 10 feet (1.5 to 3 m).

3.5 Rainfall

The Hood Canal area experienced record setting rainfall during the winter of 1998-1999. The nearest reporting rainfall gauge is situated at the Cushman Powerhouse, located approximately 5 miles south of the MP 326-landslide site.

The period of particularly heavy precipitation began in early November 1998 culminating in a monthly total of nearly 32 inches (81.3 cm) and continued through the end of February. The total cumulative rainfall for this four-month period (November 1998 through February 1999) was 107.6 inches (273.0 cm). The average annual rainfall for this area of Hood Canal is approximately 88 inches (223.5 cm) per year.

3.6 Slide Geometry

The general topography and surface features of the slide are shown on Figure 2. The gross overall slope from the toe of landslide to the upper scarp averages about 24 to 26 degrees or about 2H:1V. Within this mass, the current slopes range from less than 10 degrees to over 35 degrees as mapped. Where the very hard glaciolacustrine unit is exposed above the US 101, the localized slopes are much steeper on the order of 0.5H:1V to 1H:1V. As observed in the field, there are near-vertical slopes at scarps throughout the landslide mass. The overall width of the landslide along US 101 is about 1,400 feet (427 m) and extends upslope a horizontal distance of about 400 to 500 feet with a vertical rise of about 150 to 250 feet (45.7 to 76.2 m). The toe of the landslide occurs above the road in the southern two-thirds of the landslide and at or below the roadway in the northern one-third. Some bulging and deformation of the pavement section occurred within part of the northern one-third of the landslide.

The toe scarp in the extreme north part extends upslope behind several homes with the upslope horizontal extent of the landslide reduced to about 150 to 200 feet (45.7 to 61.0 m). In this area the hillside is steeper, on the order of 35 degrees.

4. SUBSURFACE CONDITIONS

4.1 General

Three primary stratigraphic units were encountered at the MP 326 site. From the youngest to the oldest, these include coarse grain glaciofluvial outwash (Vashon advance outwash), finer grained granular transition beds, and hard Vashon glaciolacustrine deposits. A fourth minor stratigraphic unit was encountered in limited borings and appears to be a dense older (pre-Vashon) till-like deposit termed glaciofluvial drift in this report. Similar deposits have been mapped along US 101 by Carson (1976) as possibly Salmon Springs drift. The landslide material is composed of disturbed and mobilized portions of these units with the majority of the landslide consisting of outwash and transition bed soils. Detailed discussion of these stratigraphic units are presented in the following subsections.

The mapped limits of the landslide as well as the drilling and cross-section locations are shown on Figure 2. Figures 3 through 7 show the interpreted Cross-Sections A-A', B-B', C-C', D-D', and E-E'. Figures 8 through 10 show inferred contours of the contacts between the stratigraphic units.

4.2 Landslide Deposits

The composition of the landslide deposits are quite variable and primarily reflect the composition of the original in place strata. Figure 8 present the interpreted base of the landslide deposits. The interpretation of the base of the landslide was based on a combination of surface features, inclinometer data, soil density, sample appearance, and judgment. The thickness of the landslide soils range from 60 to over 80 feet (18.3 to 24.4 m) in the main portion of the landslide (see Section B-B') to 20 to 40 feet (6.1 to 12.2 m) in the northern and southern areas of the slide.

The majority of the landslide material was coarse grained, reflecting the remobilized nature of the glaciofluvial deposits. The lower portion of the landslide deposits was generally finer grained reflecting the finer grain sediments of the transition beds. Locally, the failure plane appeared to dip slightly into the underlying glaciolacustrine soils. Much of the landslide debris occurred as large intact blocks of glaciofluvial deposits. The coarser grained landslide deposits range from sandy gravel to gravely sand with a trace to little silt. The finer grained landslide deposits generally range from fine to medium sand with a trace to little silt and clayey silt to silty clay.

In general, the soils were loose to compact at shallow depths grading to compact to very dense with depth. SPT values were often in excess of 50 b/ft at depth indicating the intact block nature of portions of the landslide mass. However, even at depth, localized zones of low blow count material were encountered indicating the true nature of the material as disturbed landslide deposits.

4.3 Glaciofluvial Outwash

The deposits were exposed in the head scarp of the landslide and within numerous scarplets and grabens within the landslide mass. The soils were generally composed of compact to very dense, thickly interbedded, fine to coarse subrounded to rounded gravel with a little to some fine to coarse sand, trace to little silt and fine to coarse sand with a trace to some silt with a little to some subrounded fine to coarse gravel. The soil was occasionally interstratifed with interbeds of finer grained sediments ranging from medium sand to sandy silt and minor interbeds of silty clay to clayey silt. Iron oxide staining was common.

Figure 9 shows the interpreted base of the glaciofluvial deposits and top of the underlying Transition Beds. Within the landslide mass, these contours represent the base of the mobilized glaciofluvial deposits while upslope of the headscarp they represent the base of the intact glaciofluvial soils. The thicknesses of these soils are variable across the site ranging from about less than 40 feet (12.2 m) in the eastern portion of the landslide to over 100 feet (30.5 m) behind the landslide head scarp.

4.4 Transition Beds

The Transition Beds represents a general fining downward sequence from the glaciofluvial outwash deposits. Exposures of these sediments are limited to the area along the crest of the existing highway cut slope. The Transition Beds generally ranged from dense to very dense, interbedded to laminated fine to medium sand with a trace to some silt to silt with some sand. As was observed in the glaciofluvial deposits, iron oxide staining was common.

Figures 10 and 12 show the interpreted top of the glaciolacustrine deposits and base of the Transition Beds. Figure 10 shows the interpreted top of the glaciolacustrine deposits based strictly on the subsurface boring information. Figure 12 is the interpreted top of the glaciolacustrine deposits based on the results of the seismic refraction survey. Figure 12 actually shows the upper surface of the high velocity layer (7,216 feet per second [2,189 m per second]) from the seismic refraction survey which in most cases closely approximates the upper surface of the hard glaciolacustrine deposits. Minor variations occur when high velocity zones are located above the actual glaciolacustrine deposits. Within the landslide mass, these contours represent the base of the mobilized Transition Beds while upslope of the headscarp they represent the base of the intact soils. The thickness of the Transition Bed soils are variable across the site ranging from about less than 20 feet (6.1 m) in the eastern portion of the landslide to over 40 feet (12.2 m) behind the landslide head scarp.

4.5 Glaciolacustrine Deposits

Glaciolacustrine deposits were exposed in the steep slopes just above the highway in the southern two-thirds of the slide area and underlie the Transition Beds. Figures 10 and 12 show the inferred top of the glaciolacustrine unit. The contact between the

Glaciolacustrine deposits and the overlying Transition Beds/landslide debris dips to the north. In the southern two-thirds of the landslide along the highway, the contact was exposed above the highway. In the vicinity of Boring GA-7/7A, the contact dips and drops in elevation to the approximate elevation of the highway. As encountered in the exploration program, these deposits varied from in excess of 55 feet (16.8 m) thick in Boring GA-8 located behind the head scarp to as thin as 7 feet (2.1 m) beneath the landslide debris in Boring GA-2.

Figures 10 and 12 clearly show that the top of the glaciolacustrine deposits is an undulating erosional contact. This surface is irregular and has several well-defined channels incised into the upper surface of the deposit that have subsequently been infilled by Transitional Bed and glaciofluvial deposits. Two distinct channels are evident on Figure 12. The deepest and best defined channel is located south of the approximate location of cross-section B–B′ near Boring GA-5 and opens to the east near the vicinity of Boring GA-6. A second, less well defined, trough is located near Boring GA-8 and opens to the east toward Boring H-1-99. These troughs tend to focus groundwater flow into distinct areas where the groundwater discharges as springs.

The glaciolacustrine deposits were generally massive to laminated, locally jointed sediments ranging from silty clay to clayey silt with a trace of sand and rounded gravel and cobble size clasts as drop stones. Atterberg limit results indicate that the soils are lean clays that plot on about the A-line with PI values in the range of 15 to 20 percent. In general the soil was very stiff to hard with SPT values often over 50 b/ft. However, occasional localized zones of lower blow counts occurred at depth possibly indicating deeper ancient slide planes. A residual angle direct shear test was performed on a sample of the glaciolacustrine unit within the inferred failure zone. The test results indicated a residual angle of about $\phi'_R = 24$ degrees which is consistent with results from similar low plasticity soils in the Puget Sound area.

4.6 Glaciofluvial Drift

These deposits were exposed in the lower portion of the approximate southern one-half of the existing cut slope and likely occur below the glaciolacustrine elsewhere in the landslide area. These sediments were typically very dense, nonstratified, fine to coarse sand with a little to some subangular to rounded fine to coarse gravel with a little to some clayey silt and exhibited an overall till-like appearance.

These deposits were not fully penetrated by any of the borings. The thickest section (46 feet [14 m]) was encountered in Boring GA-7.

4.7 Groundwater Conditions

4.7.1 General

The site is located at the toe of a large hillside rising hundreds of feet to the northwest. Thus, it is located in a groundwater discharge zone with the ground carrying

groundwater from an extensive recharge area possibly extending all the way to Lake Cushman some 5.5 miles (8.8 km) to the west. In fact, Lake Cushman itself may be a major source of recharge due to infiltration of Lake water and could contribute to the instability of the slopes above US 101 in the area.

An understanding of the groundwater conditions is critical to assessing the landslide behavior and developing stabilization options. Of particular interest are water levels that triggered the landslide in February 1999. Unfortunately, the piezometers were installed after the landslide movement stopped and the water levels decreased. Thus, there is no direct data on the maximum water levels that triggered the slide.

4.7.2 Observed Seeps

In the spring of 1999, where the landslide toe is above the roadway, seeps occurred at about the base of the inferred landslide indicating that the groundwater surface appears to daylight on the slope along the landslide plane. Where the landslide surface is at or below the road, the observed seeps were at about the roadway level. There was no evidence of seepage occurring at the transition bed and overlying coarser landslide debris unit. This was a bit surprising due to the implied permeability contrast between the two units and the inferred thickness of saturated sands and gravels in the main landslide mass.

Reportedly when the slope was still moving, surface seeps were observed near the location of WSDOT boring H-1-99 at an elevation of about 105 feet (32.0 m). It was assumed that these seeps occurred near the toe of the steep slope some 30 feet (91 m) behind the boring location. When the piezometer at H-2-99 was installed and read on April 13, the groundwater level was at depth was 15 feet (4.6 m) below the ground surface or about elevation 90 feet (27.4 m). Considering the localized topography, if the groundwater table was at a depth of about 10 feet (3.1 m) at the boring, it would likely have daylighted at the toe of the slope. Stability analysis of a section located through boring H-1 indicate that the phreatic surface likely did daylight at the toe of the slope behind the house at failure.

During the period that slide debris was moving onto the road, significant seepage flows were observed. In general it appeared that as soil failed onto the road, it would release trapped water that would then saturated the soils resulting in essentially a mud flow. Golder observed smaller events of this type in early June.

During heavy rain events, there is little evidence of surface runoff or surface erosion. It appears that the rainfall quickly infiltrated into the ground due to the high permeability of the near surface soils.

4.7.3 Piezometer Data

In general, the piezometers were sealed in the transition units as summarized on Table 2. The groundwater elevations in the summer of 1999 ranged from about 30 to 40 feet

(9.1 to 12.2 m) near the road to 120 feet (36.6 m) below the headscarp. The average gradient was on the order of 20 percent (13 degrees). Table 2 and Appendix B show about two to three months of groundwater data. During this period, the groundwater levels dropped with the drop ranging from less than a foot to a maximum of about 18 feet (5.5 m) at H-1-99. The greatest drops appear to be in the central area of the landslide near the horizontal drains although GA-1, in the southern area away from the drains, dropped about 12 feet (3.7 m). Since the piezometers were installed after the landslide occurred, the maximum measured levels do not represent the maximum actual levels prior to failure.

Installation of the emergency horizontal drains impacted the groundwater levels in the vicinity of the drains. Only four piezometers are located in close proximity to horizontal drains. In two of these piezometers, the current groundwater levels are at about the inferred drain invert level indicating an effective drain. The other two have current water levels 10 to 30 feet (3.1 to 9.1 m) above the inferred drain level.

4.7.4 Interpretation of Groundwater Regime

Based on field observations and piezometer data, groundwater appears to be perched along the top of the hard, low permeability glaciolacustrine deposits. Groundwater discharging as springs is clearly evident along the crest of the highway cut where the top of the glaciolacustrine deposits and the base of the landslide daylights in the slope. Where the base of the landslide dips to the level of the roadway, observed groundwater seeps are located at about the roadway level. Figure 11 shows the interpreted elevations of the groundwater surface during the early summer 1999.

As discussed in Section 4.5, the top of the glaciolacustrine unit forms several trough shaped depressions which likely represent ancient erosion surfaces. These features are believed to concentrate the groundwater flow, which may be responsible for the zones of high seepage at the toe and may explain why the failure initiated where it did.

The total thickness of saturated soils overlying the landslide plane in the summer of 1999 ranged from 25 to 50 feet (7.6 to 15.2 m) through the central area of the landslide and 10 to 20 feel (3.1 to 6.1 m) along the southern and northern sections. However, much of the saturated zone occurs within the finer grained Transition Beds. The saturated thickness of the overlying gravelly sand unit is only about 5 to 20 feet (1.5 to 6.1 m) through the central area of the landslide and less than a few feet along the southern and northern sections. The small scale permeability of the coarse landslide debris material is likely on the order of 10^{-2} cm/sec with the permeability of the Transition Beds likely being on the order of 10^{-4} to 10^{-5} cm/sec. These estimates are based on the results of the slug tests, grain size results, and judgment. However, on a macro scale the permeability of the transition unit may be much higher due to ground fractures.

Although no shallow piezometers are installed, it is likely that localized zones of shallow perched groundwater may occur during periods of heavy precipitation. This would be caused by localized layers of lower permeability soils perching the water above the deeper groundwater levels.

5. LANDSLIDE MECHANISM AND STRENGTH PARAMETERS

5.1 Landslide Mechanism

The data implies that the landslide was a progressive block slide failing on a weak zone near the top of the glaciolacustrine clays. The recent landslide is believed to have occurred within in a larger ancient landslide mass that extends further north and south along the hillside above US 101. The high groundwater levels that resulted in high seepage pressures are considered the trigger causing the landslide. As discussed in Section 3.5, the area had experienced record rainfalls that likely resulted in groundwater levels that were higher than had occurred for many years. Long-term seepage from Lake Cushman as well as the original cuts made to construct US 101 may have also contributed to the failure.

It is not possible to determine the precise sequence of the landslide development. However, based on the available data and experience on similar slides, it is postulated that the landslide sequence likely involved the following:

1. The landslide involved re-activation of an ancient landslide mass. The landslide plane occurred just below the granular soils within a disturbed, softened zone in the underlying glaciolacustrine soils. Since the material had failed previously, it had been strain softened and likely occurred at the material's residual strength.
2. Due to heavy prolonged rain, high seepage pressures in the toe area caused an initial block landslide extending about 100 to 150 feet (30.5 to 45.7 m) upslope of the toe.
3. As this block failed, it moved outward leaving a headscarp with ground cracks extending some depth below grade. As it moved, the ground cracked and released large volumes of trapped water. Numerous debris flows occurred when this released seepage and other "trapped" pockets of water carried landslide debris downslope.
4. The movement of the initial block unloaded the passive zone supporting the upslope ground. This reduced the stability of the upslope ground resulting in another second block landslide. As the second block landslide occurred, it pushed the lower block and unloaded the next upper block. This caused the next block to fail and push additional material out at the overall toe area.

5.2 Back-Analysis Main Slide Area

By assuming that the factor of safety (FS) was 1.0 at failure, it is possible to back-analyze the soil strength parameters with slope stability calculations. Stability analyses using the computer code XSTABLE was completed on numerous stability sections with a variety of search routines. Judgment was required to assess the relative strengths of the units and the location of the groundwater table at failure. In general, it was assumed that the maximum groundwater table at the time of failure was on the order of 10 to 15 feet (3.1 to 4.6 m) higher than shown on Figure 11 in the toe area and about 20 to 25 feet (6.1 to 7.6

m) higher at the back of the landslide. This resulted in steep gradients with surface seepage in the toe area. The assumption is also consistent with the observed seeps in early April near H-1-99. Table 5 presents the results of the stability analyses for Section B-B′ which is considered the most representative critical section. Appendix E includes XSTABLE printouts from Section B-B′. Table 5 presents each case evaluated for Section B-B′, the assumed strength parameters, and assumed groundwater table. The results are either the calculated factor of safety (FS) or the yield acceleration (Ay). Ay was reported for the seismic cases and is defined as the applied horizontal acceleration that reduces the FS to about 1.0. The ration of Ay to the design peak acceleration and earthquake magnitude can be used to estimate the seismically induced slope movements.

For the main slide area, it was assumed that a smaller block failed first with subsequent blocks failing as the landslide progressed upslope. Search routines consistently showed that a smaller landslide block had a lower FS. As shown on Table 5, the calculated FS at failure for the small initiation block was 0.99 while the calculated FS for the entire block was FS = 1.05. These results combined with the observations imply that the landslide was a progressive failure with two or three main events. Reasonable consistent results were obtained with granular landslide units having a $\phi' = 36$ degrees and the landslide plane having a residual $\phi_R' = 25$ degrees. These values seem reasonable considering the high SPT values in the granular landslide debris and the low plasticity of the clays. The residual angle direct shear test results indicated $\phi_R' = 24$ degrees. These parameters combined with the summer 1999 groundwater table implies a FS of 1.14 for the initiation block in Section B-B′ in the main slide area.

5.3 Northern Steep Slide Section

The extreme northern section of the landslide appears to be different than the main landslide area. The boring data implies that in this area the failure plane is relatively shallow and occurs within the granular transition unit and not within the underlying glaciolacustrine soils. In addition, surface topography is steep averaging about 35 degrees. The back-analysis of the landslide for Section D-D' indicates a strength of over $\phi' = 36$ degrees along the failure plane.

The data implies that the failure occurred in granular soils due to steep slopes and high seepage pressure. The failure of the main landslide may have imposed a shear load on the soil that initiated the landslide. Table 4 presents the results of the stability analyses while Appendix E includes specific XSTABLE results.

6. RECOMMENDED STABILIZATION ALTERNATIVE

6.1 General

The purpose of any stabilization work by WSDOT will be to protect US 101 and minimize the risk of future road damage and closures. Stabilizing all sections of the landslide, such as the extreme northern section, is not a WSDOT priority if the additional landslide movements are unlikely to impact the road. It is also understood that the desired calculated static FS is 1.25. Stability under seismic condition was assumed not to depend on a minimum FS but rather on a requirement of ground movement will not close the road.

In the assessment of the options, consideration was given to the timing and practicality of the work including short-term stability risks, impacts to public, and the need for road closures. It was assumed that all major earthwork must be done during the "dry" construction season. Thus, important factors relate to what work can be completed during the 1999 summer/fall construction season and what work must be delayed for the future.

A wide range of options was considered initially, including various subsurface drainage methods, toe buttresses, deep soil improvement, raising the road grade to form a buttress, structural stabilization solutions, and debris walls. However, based on judgment, past experience and discussions with WSDOT, the recommended remediation consists of a combination of horizontal drains and surface grading to be implemented in 1999 possibly supplemented with a limited toe buttress in the future. The need to construct a toe buttress in the future will depend on the effectiveness of the drains and the performance of the landslide over the 1999-2000 winter season. It is not considered appropriate to install the buttress during the 1999 construction season. This opinion is based on the fact that the buttress may not be required pending the effectiveness of the drains, contractual timing constraints, and the desire not to cut into the toe of the slopes until all the drains have been installed and are fully effective.

A key aspect of this approach will be monitoring of the landslide to assess the need for a toe buttress in the short term and to monitor the continued effectiveness of the drains in the long term.

Based on discussions with WSDOT, stabilization work will not include the extreme northern section of the slide where the toe is located well above the highway. This decision is based on the very low risk that future movements of this section of the slide would impact the roadway.

6.2 Recommended 1999 Stabilization Work

The recommended stabilization work to be implemented during the 1999 construction season include:

- HORIZONTAL DRAINS: The intent of the drains will be to drain the slope and limit the maximum future groundwater table to levels consistent with a calculated FS of about 1.25. A set of closely placed 300 to 400 foot (91.4 to 121.9 m) long drains are recommended just above the inferred failure plane to maximize the groundwater drawdown levels. A second set of drains is also recommended at a wider spacing and located just above the contact between the Transition Bed soils within the permeable glaciofluvial outwash sands and gravels. The purpose of these upper drains is to drain most of the actual water flow volumes and reduce the head within the underlying Transition Beds. Figure 13 shows a typical idealized section with the drains.
- GENERAL SITE REGRADING: This work will involve site grading to eliminate any closed depressions and minor regrading in selected areas on the site to facilitate drainage and eliminate any significant surficially unstable areas. In addition, in the unstable toe area designated as "Disturbed Area" on Figure 21, loose unstable soils should be stripped from the slope, the slope flatted to the extent practical, and then covered with rockfill.
- 1999/2000 MONITORING: This will include monitoring of piezometers, inclinometers, surface displacement monitoring, and horizontal drain discharge over the 1999-2000 winter season. In addition to the existing piezometers, installation of several additional piezometers are recommended.

If the drains are fully effective in reducing the maximum groundwater table to a maximum of about 5 feet above the failure plane in the toe area and 10 feet (3.65 m) above the failure plane in the headscarp area, the calculated FS will be about 1.25.

The calculated yield acceleration (Ay), which is defined as the acceleration that reduces the FS to 1.0, was calculated to be about 0.1g assuming effective drains. With a design A_{max} of 0.2g, a Newmark analysis implies that the seismic ground displacement will be on the order of several inches which is considered acceptable. Table 5 summarizes the XSTABLE stability runs supporting these conclusions while Appendix E includes representative XSTABLE results.

6.3 Future Stabilization Work

Depending on the effectiveness of the drains as determined from the monitoring data, additional stabilization work may be warranted in the future. The specific requirements will depend on the monitoring data and the behavior of the landslide over the 1999/2000 winter season. If required, the additional work will likely consist of additional drains and/or a toe buttress. If additional horizontal drains are determined to be necessary, the work would likely consist of adding more upper drains by decreasing the spacing and/or extending the area treated.

General comments about a toe buttress include:

- FUNCTION: A toe buttress will act as an effective toe drain and add additional sliding resistance to the slide block. Due to the large size of the landslide, a very

large buttress would be required to significantly improve the calculated stability of the entire landslide mass. However, it is felt that the landslide mechanism involves failure of an initial small wedge that then progresses upslope. The buttress would be designed to improve the calculated FS of this initial slide block estimated to extend about 150 feet (45.7 m) back from the toe.

- TYPE: The buttress could consist of a rockfill buttress or an MSE wall buttress. The advantage of the MSE wall option is that it reduces the extent of the required temporary cuts and increases the resistance by increasing the depth of resisting soil weight on any potential failure surface.
- GEOMETRY AND CONSTRUCTION ISSUES: A slightly different design will be required depending on whether the failure plane occurs at or above the roadway. Based on the current grades, the case of where landslide plane occurs above the road appears to present a more difficult condition since the slopes are steeper. A major consideration is the constructibility of the buttress. Temporary cuts will be required significantly increasing the earthwork volumes and possibly destabilizing the landslide. It is assumed that 1H:1V temporary cuts in the native soils would be feasible provided the full drainage system was installed and the work is done in the dry summer months, the slope was carefully monitored and an allowance was made for localized sloughing failures. This would require a safe setback distance from US 101, temporary wall barriers and/or road closure.
- EXAMPLE DESIGN: Figure 22 shows the general geometry of an MSE buttress for two conditions including areas with the toe of the landslide located at the roadway level and areas where the toe of the landslide is above the roadway.
- INITIAL DESIGN DETAIL FOR HORIZONTAL DRAINS: The 1999 horizontal drain installation will be completed prior to any buttress construction. The design details should consider the possibility that a buttress may be added in the future and the design should be planned to facilitate the construction without destroying the drains.

The need for, size and location of the buttress depends on the results of the 1999/2000 winter season monitoring data. For the purposes of this report, it was assumed that the buttress would have to increase the calculated FS of the initiation failure block from 1.15 to 1.25. XSTABLE runs indicate that an MSE fill buttress would have to have a height of about 15 to 20 feet (4.6 m) with the assumed geometry shown on Figure 22. The XSTABLE runs are summarized on Table 5 with representative runs included in Appendix E.

7. STABILIZATION CRITERIA 1999 CONSTRUCTION SEASON

7.1 General

This section presents specific design criteria for the stabilization work to be completed during the 1999 construction season prior to the fall/winter rains. The work includes four main components: 1) Horizontal drains, 2) Limited Site Regrading, and 3) Stabilization of "Disturbed Area." Section 8 discusses the required short and long-term, slide-monitoring program.

7.2 Horizontal Drains

7.1.1 Lower Horizontal Drains

The lower drains will involve installation of a lower set of closely spaced horizontal drains installed just above the exposed toe of the landslide and inclined upward to approximately follow the contact between the Transition Beds and the underlying glaciolacustrine clay unit. This normally will also represent the landslide plane except locally where the actual landslide plane appears to extend below the top of the clay. These drains can be installed in parallel along an access road at the base of the toe of the landslide or in several arrays from a series of access pits.

Figure 15 shows the elevation and locations for both the beginning (head) and end (tip) of the drains. The required entrance elevations, inclinations, and lengths can be calculated based on this Figure and the horizontal orientation of the specific drains. Design criteria include:

- SPACING: The intent is to cover the landslide area with drains at about a maximum spacing of 25 feet (7.0 m).
- LENGTH: The intent is to install the drains to extend to about the back scarp of the landslide which will result in projected upslope lengths on the order of 300 to 400 feet as shown on Figure 15. The actual lengths of individual drains may be longer particularly for drains installed at high lateral orientations to the fall line. Due to the inclination of the back landslide plane, the drains need only extend to about 100 feet (30.5 m) from the mapped upper landslide head scarp.
- DIAMETER: Minimum inside diameter 1.5 inches (3.81 cm).
- LOCATIONS: The intent is to install the drains at about the location where the landslide plane "daylights" on the slope in the southern two-thirds of the landslide and near the toe of the slope above the roadway in the northern one-third of the main landslide. Figure 15 shows the recommended entrance locations for the drains.
- INCLINATIONS: The intent is to have the drains located within the Transition Bed soils just above the landslide plane. The inclinations for specific drains can be determined based on Figure 15.

- DRAIN GEOMETRY: The drains can be installed from a series of arrays or simply placed perpendicular to the slopes at a uniform spacing. A series of shorter arrays are required if arrays are used to avoid any undrained areas between the main arrays. The choice of drain geometry and the specific drain locations should be based on constructibility, cost and maintenance considerations. If arrays are used, intermediate short arrays will be required to provide adequate drain coverage. Figure 20 shows typical drain geometries.
- DRAIN DISCHARGE AND MAINTENANCE ACCESS: The drain discharge should be collected and drained to a safe discharge point to avoid slope damage from possible high discharge rates. This can usually be done with a manifold for parallel drain installations or single discharge pipe at each array location. It is necessary for each drain to be accessible to both monitor the discharge rate and to allow drain flushing.

7.1.2 Upper Horizontal Drains

The upper drains should be located near the base of the upper coarse sand and gravel landslide debris just above the inferred top of the finer grained Transition Bed unit. These drains should be installed in the central portion of the landslide mass. The maximum spacing of these drains should be 40 feet (12.2 m) and then should extend back to the estimated location of the landslide plane.

As with the lower drains, both parallel drains and arrays can be installed with the choice based on constructibility, cost and maintenance considerations. Figure 16 shows the recommended location, length and elevation of the drains.

7.1.3 Accommodating Future Buttress Construction

As discussed in Section 6.3, it is possible that a toe buttress may be constructed in the future to increase slope stability. This would involve some slope excavation and placement of fill to form a rockfill or an MSE fill buttress. The specific design details of the drains must consider this possible future work.

Several options should be considered including:

- ARRAYS/MANHOLE: The drains could be installed from arrays with the arrays collected in a manhole. If an MSE wall buttress is constructed, the wall would be designed and constructed to avoid the Manhole drains. This would require modification to the normal soil reinforcement locations but can readily be done. The manhole height could be increased as the fill is placed to provide access to the drains after completion of the buttress.
- CAREFUL CONSTRUCTION AND EXTENSION OF DRAINS: The buttress contractor could be required not to avoid damaging the drains and required to extend the drain pipes into a new manifold system accessible after the buttress is completed. This will add to the construction cost as the contractor will have to carefully excavate around the drains and include a contingency for repairing

damaged pipes. It may be appropriate to install steel casing around the lower 20 to 40 feet (6.1 to 12.2 m) of pipe to provide partial protection during future excavation.

It is recommended that the as-built drain locations be surveyed to provide future contractors with data on the drain locations as discussed below. This information will also be required to properly evaluate drain effectiveness.

7.1.4 Construction Monitoring and Field Modifications

The drain installation should include the following procedures:

- At 50-foot (15.2-m) intervals during installation, the driller should take a water pressure measurement in the casing to determine the tip elevation and actual average inclination of the pipe. The operator has some ability to increase or decrease the inclination by varying the drill speed and pressure. Drains that are installed significantly above or below the intended target may have to be replaced and/or abandoned before completion.
- The drilling conditions should be monitored by an experienced WSDOT geotechnical inspector to allow a general assessment of the soils encountered.
- The discharge rates from each drain should be monitored after installation and periodically thereafter.
- Some of the drains may produce no flow or large flows. In addition, based on past experience, drains may meet refusal before reaching their design lengths. Based on the actual conditions encountered, it may be appropriate to add more drains and/or modify the inclinations. The discharge rate, measured tip elevations, and drilling behavior will be vital in assessing the need for and type of field design changes.
- After installation, an as-built drain plan should be prepared. The general vertical alignment can be determined based on the tip elevations measured every 50 feet (15.2 m) during installation. The horizontal alignment can be determined with geophysical methods by inserting a wire with a low current into each drain and using surface geophysical instruments. The as-built data is considered essential in interpreting the piezometer information and effectiveness of the drains.

The monitoring data and field assessments are an essential part of the overall remediation work. Due to the nature of horizontal drain installations and the complex site conditions, without the monitoring and field changes the effectiveness of the entire remediation work will be compromised.

7.1.5 Long-Term Drain Performance and Maintenance

Horizontal drains require long-term monitoring, periodic flushing, and possible replacement. With time horizontal drain effectiveness tends to decrease and individual drains can become completely ineffective. This can be due to mechanical and/or biological clogging, slope movement that breaks the pipe, and/or other effects. Regardless of the reasons, drain performance monitoring and maintenance must be considered a permanent requirement that forms an essential part of the overall remediation work. Without a continuous maintenance program, the drains may eventually become ineffective and the slope susceptible to additional failure and road closure.

Based on the results of the monitoring program, drains will require flushing to remove biologic and/or soil clogging material. It is possible that flushing will not be totally effective in re-establishing the drain. If this becomes a significant problem involving several drains in critical areas, new horizontal drains would have to be installed.

Section 8 presents recommendations for long-term monitoring to assess the effectiveness of the drains.

7.2 Remediation of "Unstable Area" Above Highway

There is about a 150-foot (45.7 m) wide section above the roadway that appears to be over-steepened, underlain by loose landslide debris, and is considered unstable. This was discussed in Section 3.3 and is shown as "Disturbed Area" on Figure 21. It is recommended that the loose unstable soils are stripped from the slope, the slope flatted to the extent practical, and then covered with rockfill.

The details of the work should be based on field conditions using judgment to minimize impacts and costs while obtaining a stable slope. The general intent is to remove the loose, unstable soils and debris and cover with a rockfill layer. This will likely require partial road closure to minimize the risks of debris flows impacting traffic.

7.3 General Site Regrading And Erosion Protection

This work will involve site grading to eliminate any major depressions which could pond water and minor regrading in selected areas on the site to facilitate drainage and eliminate any significant surficially unstable areas.

The details of the work should be based on field conditions using judgment to minimize impacts and costs. The general intent is to:

- Regrade the obvious depressions to promote drainage such as the deep graben in the area of the destroyed house in the upper southern area of the landslide. This earthwork can likely be completed with simple regrading without the need to import or export material.

- Remove unstable debris and soils from the slopes just above US 101 that may develop into debris flows in the fall/winter rains. Localized placement of rockfill and/or geotextiles may be warranted. This may result in some import or export of materials.
- Localized regrading on the main landslide mass. Based on the lack of observed surface runoff and erosion, the general regrading on the main landslide mass can be minimized to a few selected areas which are readily accessible or present a high risk of failing in the fall rains.

8. INSTRUMENTATION AND MONITORING

To properly assess the effectiveness of the drains and monitor the long-term slope stability conditions, an effective monitoring program must be put in place and monitored indefinitely. WSDOT is planning to install an automated, remote telemetry monitoring system to facilitate gathering data and reduce the reaction time when action levels are exceeded. This will likely involve remote monitoring of four piezometers, three inclinometers, and the flow from three drain manifolds. Data from these instruments will be collected continuously with the data transmitted periodically to WSDOT for use in assessment and for archive records or immediately if selected action levels are exceeded.

The monitoring program should include:

- ADDITIONAL PIEZOMETERS: It is recommended that an additional four piezometers are installed in an area about 150 to 200 feet (45.7 to 61 m) upslope from the highway to improve the evaluation of the effectiveness of the drains in stabilizing the initiation slide block. The locations should be spaced above the toe of the main landslide area between Sections A-A' and C-C' shown on Figure 2.
- SURFACE SURVEY POINTS AND OBSERVATIONS: This involves establishing surface monitoring points at key locations on the landslide. These can be surveyed yearly and/or after other data implies slope movements. In addition, the general slide area should be inspected every time the site is visited to take readings for any evidence of movement with a detail ground reconnaissance yearly.
- PIEZOMETER DATA: All of the piezometers should be monitored periodically with the data evaluated to assess drain effectiveness and to calculate the implied slope stability FS. As a minimum the piezometers should be read four times a year for the first five years with additional data obtained if unusual precipitation events occur or other data implies slope movements. These readings should be taken in the early fall when the levels should be low, once in late November or early December, once in late February or early March and once in May. After five years, the frequency of readings and the number of piezometers read should be re evaluated.
- INCLINOMETER DATA: For the first five years, all of the inclinometers should be read yearly with additional readings taken in the vicinity of any suspected movements. In addition, inclinometers GA-2, GA-6, GA-5, GA-9 and H-1-99 located in the highest risk areas should be read at about the same frequency as the piezometers. After five years, the frequency of readings and the number of inclinometers read should be re evaluated.
- HORIZONTAL DRAIN DISCHARGE RATES: For two years the discharge rates from each individual drain should be measured three times a year. This would include once in the early fall when the rates should be low, once in late November or early December, and once in late February or early March. In addition, the total flow into collection manifolds should be read whenever the piezometers are read. This data will be used to develop an understanding of the pattern of the flow rates and assist in determining if drains are becoming clogged

in the future. After this initial two-year period, the frequency of readings and the need to measure individual drains should be re-evaluated. It may be possible to simply measure the cumulative flow of each array to identify if clogging is occurring with an individual drain measured only if a problem is indicated. Although the cumulative rates are important, a decrease in a discharge from a drain with limited flow production can be important since it is seepage heads, not flow rates that cause landslides. Thus, the discharge rates need to be evaluated in conjunction with the other slope data.

- DATA EVALUATION: An all too common problem with long-term monitoring programs is that the data is collected but not evaluated in a timely manner. The tendency to do this also increases with time as lack of problems can result in a general complacency. WSDOT should develop a protocol for the timely review and evaluation of the data. It is recommended that the protocol makes a specific individual responsible for the work and require a yearly written report.

A set of threshold values involving decreases in drain flows, rising piezometer levels, inclinometer movements and/or surface movements should be established which require a detailed assessment and possible action. Until the drains are installed and actual monitoring data is obtained it is felt to be premature to make specific action level recommendations. Rather it is recommended that preliminary action levels are developed after the drains and additional piezometers are installed and the data from the late November or early December readings are taken. This will involve an assessment of the data collected at that time combined with a re-evaluation of the slope stability. These results will form the basis of assessing the various action levels.

Once the action levels are established the criteria should be reassessed yearly and may be revised in the future as more data is collected. An emergency plan should also be developed to allow a rapid response if conditions are determined to be critical. This might include rapid mobilization of a drain contractor, partial road closure, additional monitoring, etc.

9. USE OF THE REPORT

This report has been prepared exclusively for the use of WSDOT and their consultants for specific application to this project. The Golder field borings were performed in general accordance with locally accepted geotechnical engineering practice to provide information for the areas explored. There are possible variations in the subsurface conditions between the borings and variations with in the groundwater conditions with time. In addition to Golder's explorations, we relied on the log of a WSDOT boring and general observations made by WSDOT personnel before our involvement.

As discussed in Sections 7.2.4, 7.2.5, and 8.0 construction monitoring of drain installations, long-term monitoring of the slope behavior, and long-term maintenance of the drains form an essential part of the overall recommended slope stabilization work. Without this monitoring and maintenance, the recommended stabilization, even if implemented as designed, will not provide for acceptable control of the landslide.

10. REFERENCES

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Carson, R. J. (1976): Geologic Map of North Central Mason County, Washington; Washington Department of Natural Resources, Division of Geology and Earth Resources Open File Report OF 76-2.

Carson, R.J. (1975): Slope Stability Map of North-Central Mason County, Washington, Washington Department of Natural Resources, Division of Geology and Earth Resources Open File Report 75-4.

Heaton, T.H. and Hartzell, S.H. (1992): Journal of Geophysical Research 97, 1901.

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TABLE 1

Summary of Exploratory Boreholes

Borehole Number	Collar Elevation (feet MSL)	Depth to Bottom of Hole (feet bgs)	Elevation of Bottom of Hole (feet MSL)	Piezometer Sand Pack Depth Range (feet bgs)	Piezometer Sand Pack Elevation Range (feet MSL)	Comments
GA-1	191.0	144.0	47.0	NA	NA	Inclinometer
GA-1A	191.0	96.0	95.0	74 to 95	117 to 96	
GA-2	137.2	101.8	35.4	NA	NA	Inclinometer
GA-2A	137.0	72.0	65.0	60 to 70	77 to 67	
GA-3	81.3	51.5	29.8	NA	NA	Inclinometer
GA-3A	81.3	23.0	58.3	12 to 22	79.3 to 69.3	
GA-4	347.9	275.7	72.2	NA	NA	Inclinometer
GA-4A	347.9	240.0	107.9	188 to 238	159.9 to 109.9	
GA-5	175.0	150.0	25.0	NA	NA	Inclinometer
GA-5A	175.0	115.0	60.0	103 to 113	72 to 62	
GA-6	93.8	71.8	22.0	NA	NA	Inclinometer
GA-6A	94.0	52.0	42.0	40 to 50	54 to 44	
GA-7	31.0	45.5	-14.5	34 to 44	-3 to -13	
GA-7A	31.0	45.0	-14.0	NA	NA	Inclinometer
GA-8	243.7	226.0	17.7	NA	NA	Inclinometer
GA-8A	243.0	169.0	74.0	149 to 169	94 to 74	
GA-9	65.6	57.0	8.6	NA	NA	Inclinometer
GA-9A	66.0	32.0	34.0	20 to 30	46 to 36	
GA-10	180.0	96.0	84.0	NA	NA	Inclinometer
GA-10A	180.0	75.0	105.0	53 to 73	127 to 107	
GA-11	127.0	74.4	52.6	NA	NA	Inclinometer
GA-11A	127.0	52.0	75.0	40 to 50	87 to 77	
GA-12	127.0	52.0	75.0	NA	NA	Inclinometer
H-1-99	102.7	88.0	14.7	12 to 88	90.7 to 14.7	Installed by WSDOT

Notes: MSL = Mean Sea Level
bgs = Below Ground Surface

TABLE 2

Summary of Horizontal Drain Flows

	FLOW RATES (GPM)					
Drain #	6/4/99	6/7/99	6/9/99	6/11/99	6/15/99	7/1/99
A1	Dry	Dry	Dry	Dry	Dry	Dry
A2	33.8	33.8	33.8	33.8	33.8	22.5
A3	19.3	16.9	16.9	19.3	12.3	13.5
A4	5.4	4.8	3.6	3.6	3.1	2.9
A5	2.9	2.4	2.8	1.8	1.6	1
A6	4.4	4.1	3.9	3.6	3.3	2.7
Total A	65.8	62	61	62.1	54.1	42.6
B1	2.3	2.1	1.9	1.8	1.7	1.4
B2	3.3	3.3	2.6	2.5	2.2	1.6
Total B	5.6	5.4	4.5	4.3	3.9	3
C1	3.8	3.6	3.1	3.1	2.9	2.3
C2	3.4	3.6	3.5	3.2	3	4.7
C3	7.5	7.9	7.5	7.1	6.4	6.1
C4 & C6	8.4	8.4	6.8	6.1	7.9	6.8
C5	5.4	5.6	5.2	5.2	5.2	4.7
Total C	28.5	29.1	26.1	24.7	25.4	24.6
D1	Dry	Dry	Dry	Dry	Dry	Dry
D2	Dry	Dry	Dry	Dry	Dry	Dry
D3	Dry	Dry	Dry	Dry	Dry	Dry
D4	Drip	Drip	Drip	Dry	Dry	Drip
D5 & D8	4.8	5.4	4.7	4.2	3.9	3.6
D6	Dry	Dry	Dry	Dry	Dry	Dry
D7	Dry	Dry	Dry	Dry	Dry	Dry
D9	Dry	Dry	Dry	Dry	Dry	Dry
D10	Dry	Dry	Dry	Dry	Dry	???
Total D	4.8	5.4	4.7	4.2	3.9	3.6
Cummulative Totals	104.7	101.9	96.3	95.3	87.3	73.8

GRAPH OF HORIZONTAL DRAIN FLOWS

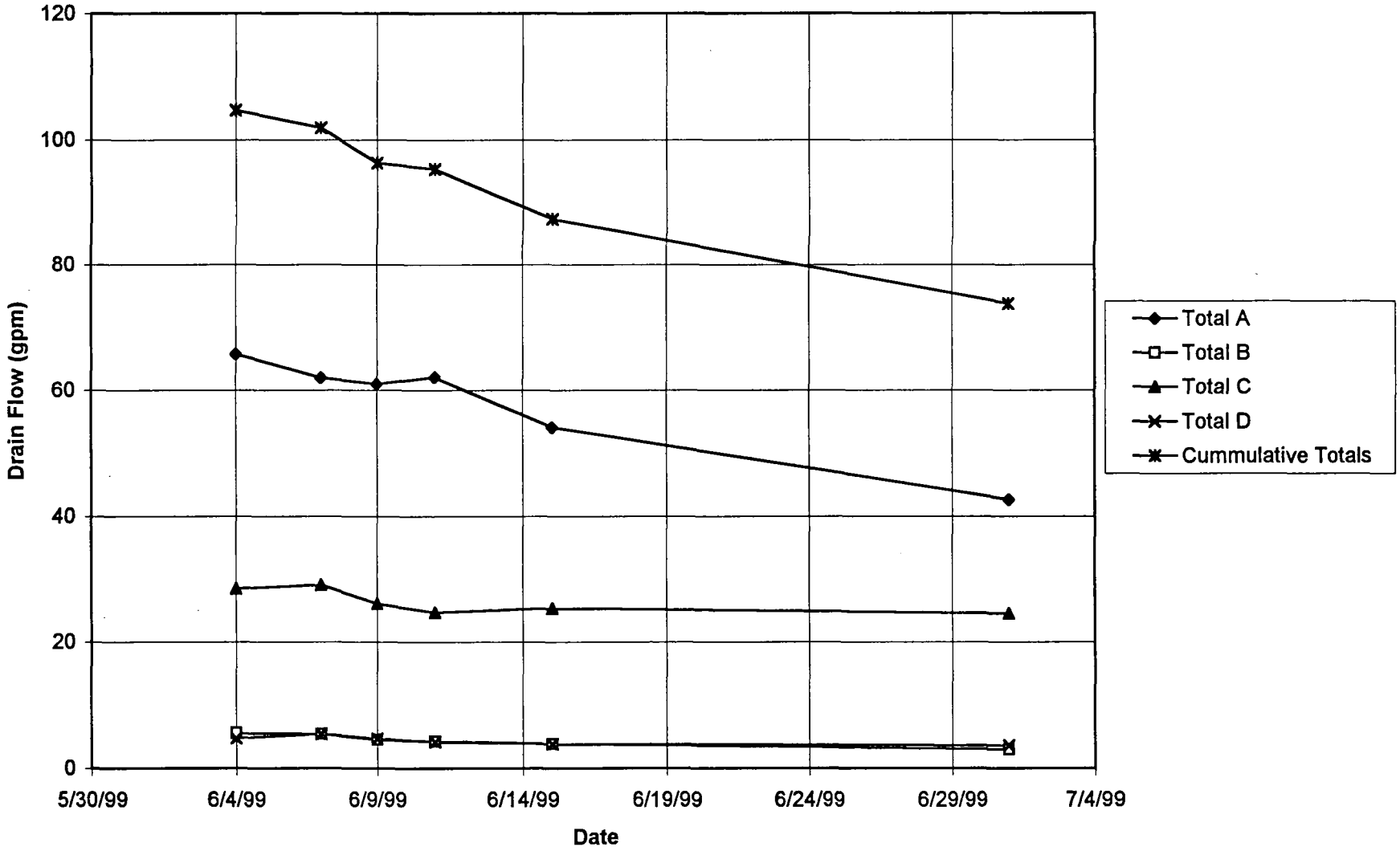
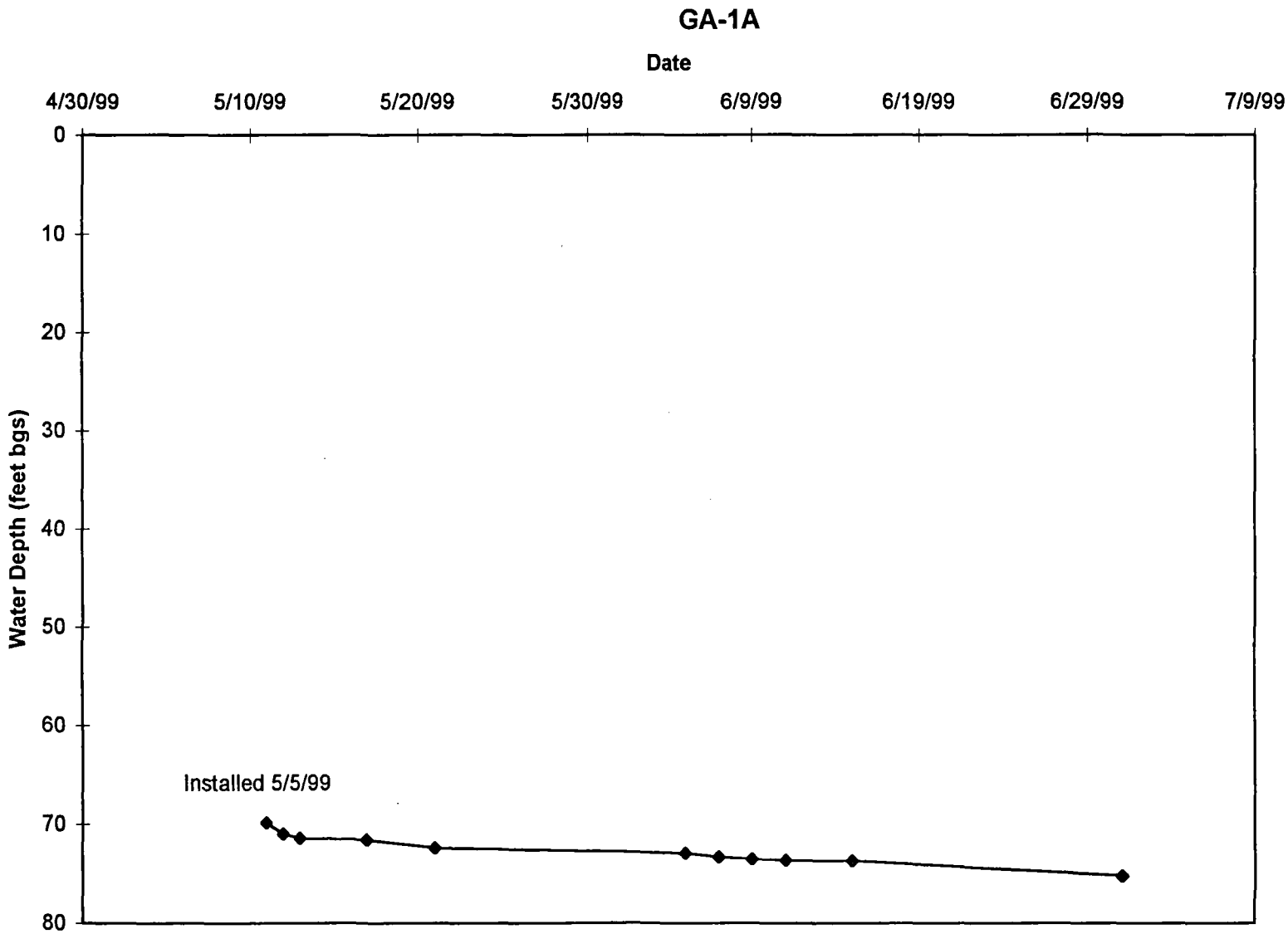
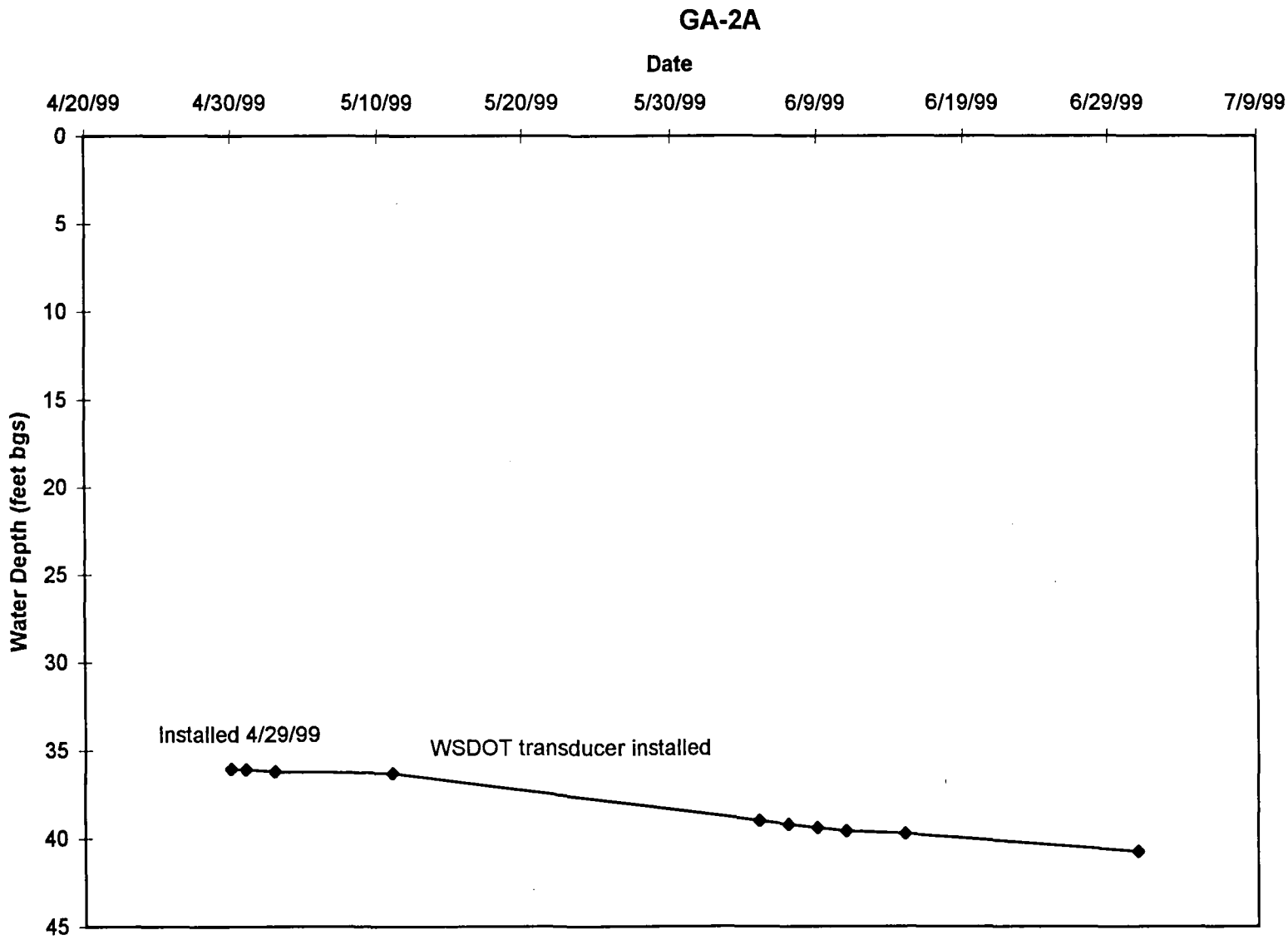


TABLE 3

Summary of Water Levels

Piezometer Number	Date															
	4/13/99	4/30/99	5/1/99	5/3/99	5/7/99	5/11/99	5/12/99	5/13/99	5/17/99	5/21/99	6/5/99	6/7/99	6/9/99	6/11/99	6/15/99	7/1/99
GA-1A	N/A	N/A	N/A	N/A	N/A	69.84	70.94	71.42	71.58	72.4	72.94	73.29	93.52	93.62	93.69	75.22
GA-2A	N/A	36.06	36.1	36.2	N/A	36.3	N/A	N/A	N/A	N/A	39	39.22	39.38	39.57	39.74	40.75
GA-3A	N/A	7.6	7.54	7.6	N/A	7.75	N/A	7.8	7.83	7.86	8.05	8.1	8.11	8.16	8.18	8.32
GA-4A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	199.69	199.77	200.04	199.77	200.8
GA-5A	N/A	N/A	N/A	N/A	N/A	54	54.28	54.58	54.95	56.5	56.6	56.84	56.99	47.14	57.4	58.7
GA-6A	N/A	N/A	N/A	N/A	23.35	23.94	23.6	23.76	24.13	24.4	28.44	28.86	29.16	29.46	N/A	30.7
GA-7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.2	5.04	5.22	N/A	5.79	5.82	N/A	6.13	6.1
GA-8A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	103.7	107.4	107.11	108	108.34	108.48	108.78	108.83	110.33
GA-9A	N/A	N/A	N/A	N/A	13.5	N/A	14.26	13.32	19.74	21.18	22.84	22.98	23.05	23.18	23.26	23.68
GA-10A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	48.35	49.19	49.35	49.4	49.62	49.67	50.61
GA-11A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	30.24	30.41	30.74	30.79	30.86	30.89	30.87	31.14
H-1-99	15.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	31.74	32.05	32.51	33.11	36.48


GA-1A
Date
4/30/99
5/10/99
5/20/99
5/30/99
6/9/99
6/19/99
6/29/99
7/9/99
Water Depth (feet bgs)
0
10
20
30
40
50
60
70
80
Installed 5/5/99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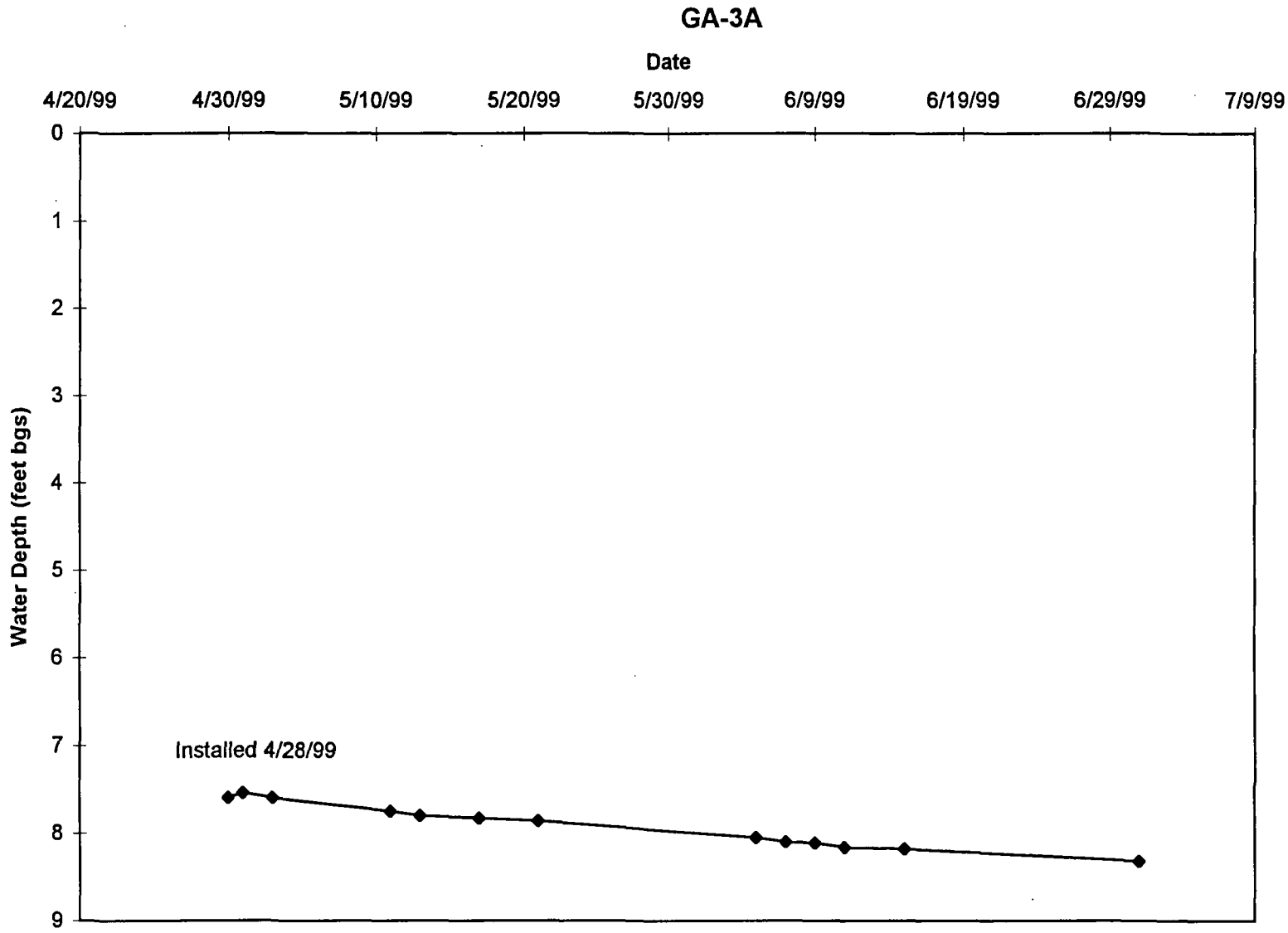
Date
4/20/99
4/30/99
5/10/99
5/20/99
5/30/99
6/9/99
6/19/99
6/29/99
7/9/99
Water Depth (feet bgs)
0
5
10
15
20
25
30
35
40
45
Installed 4/29/99
WSDOT transducer installed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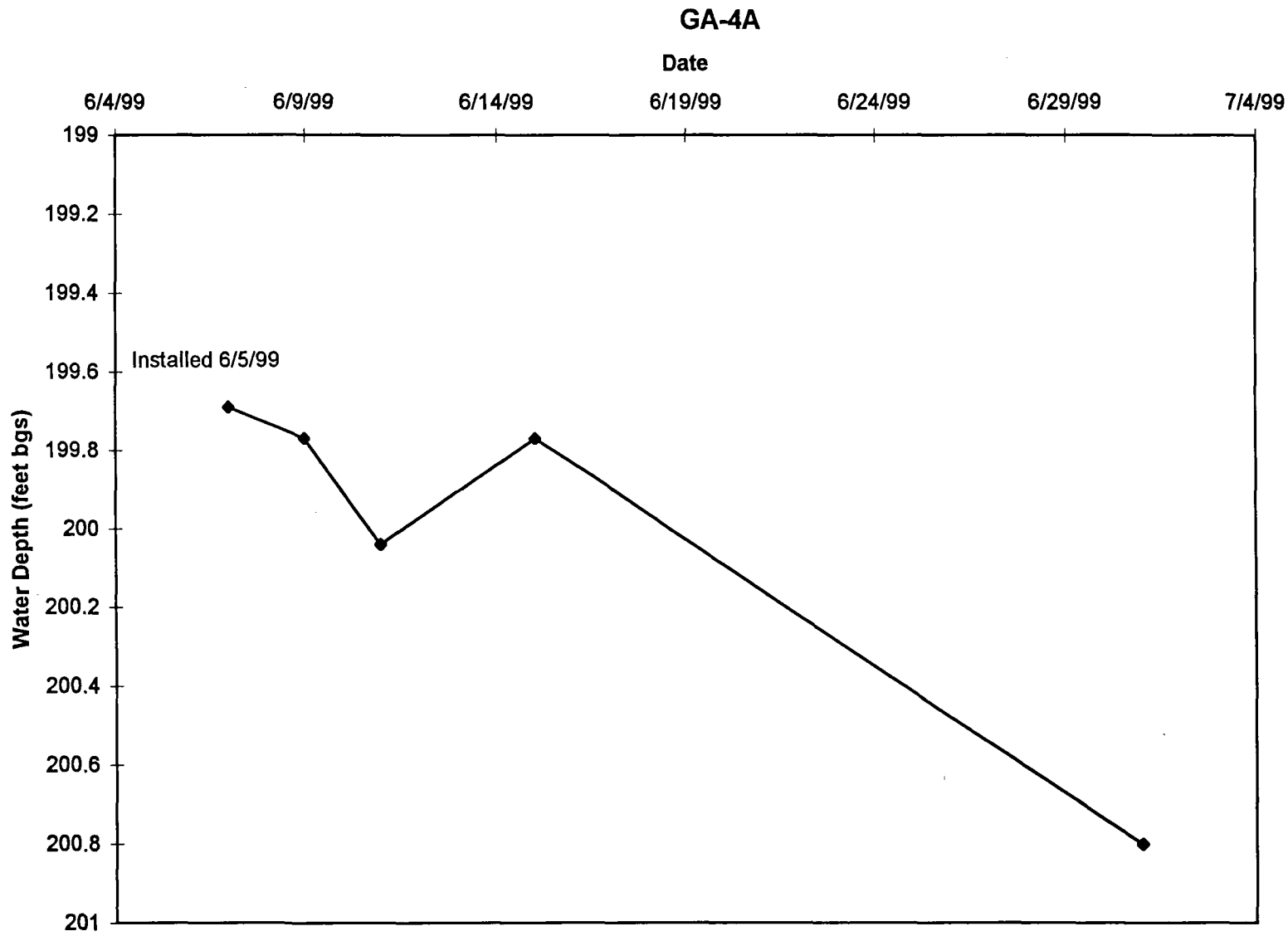
Date
4/20/99
4/30/99
5/10/99
5/20/99
5/30/99
6/9/99
6/19/99
6/29/99
7/9/99
Water Depth (feet bgs)
0
1
2
3
4
5
6
7
8
9
Installed 4/28/99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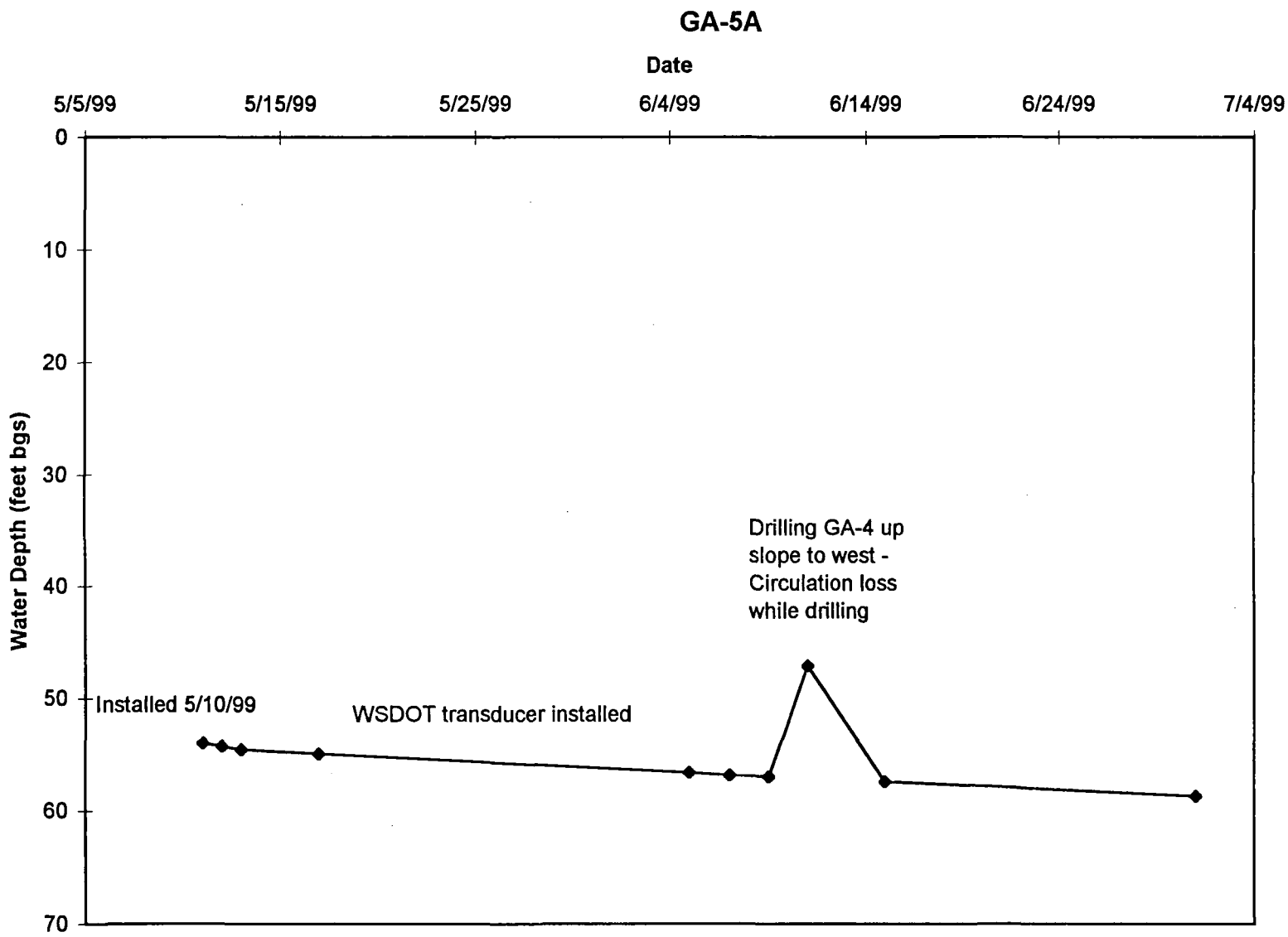
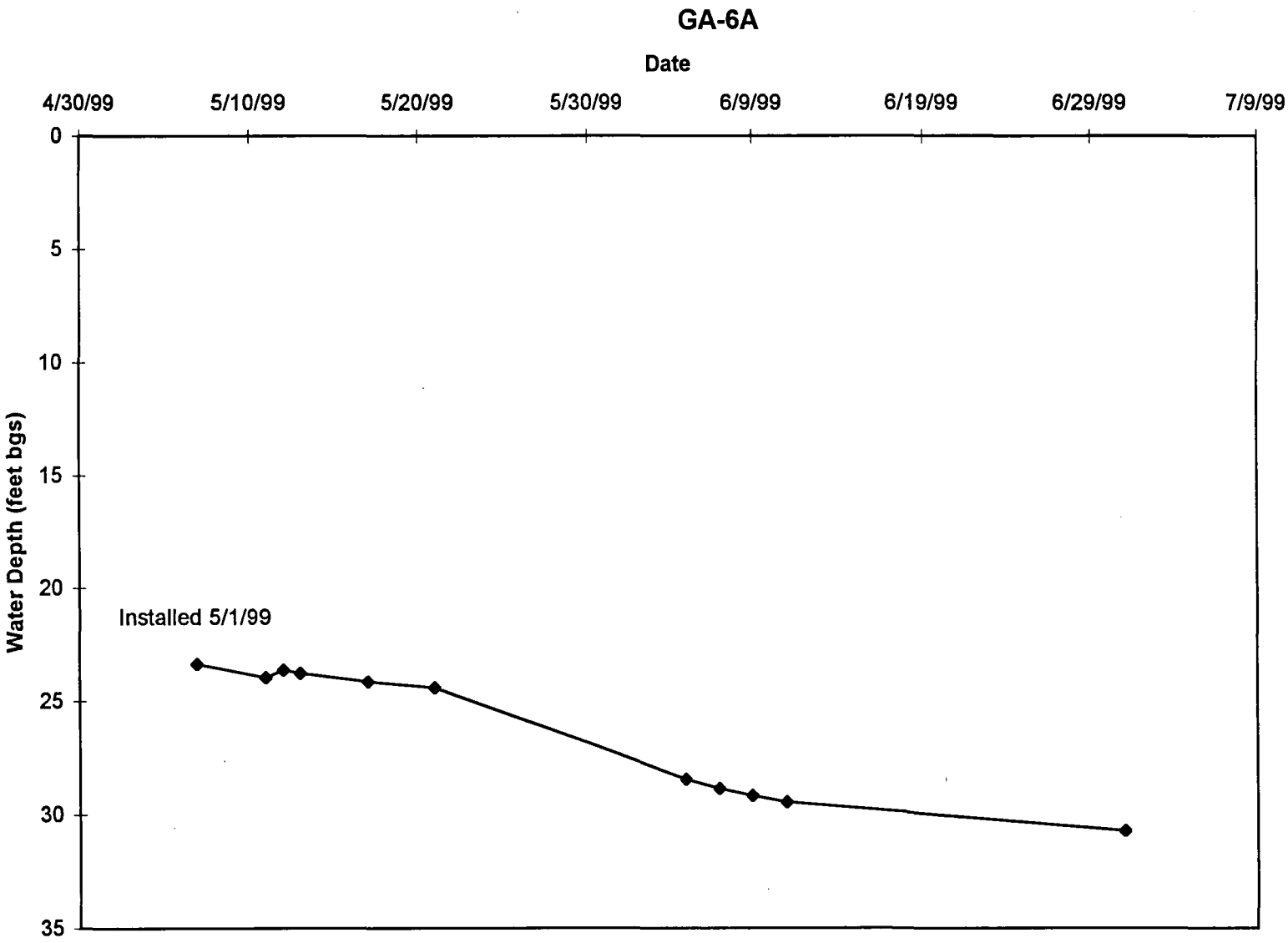
Date
6/4/99
6/9/99
6/14/99
6/19/99
6/24/99
6/29/99
7/4/99
Water Depth (feet bgs)
199
199.2
199.4
199.6
199.8
200
200.2
200.4
200.6
200.8
201
Installed 6/5/99


GA-5A
Date
5/5/99
5/15/99
5/25/99
6/4/99
6/14/99
6/24/99
7/4/99
Water Depth (feet bgs)
0
10
20
30
40
50
60
70
Installed 5/10/99
WSDOT transducer installed
Drilling GA-4 up slope to west - Circulation loss while drilling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Date
4/30/99
5/10/99
5/20/99
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6/9/99
6/19/99
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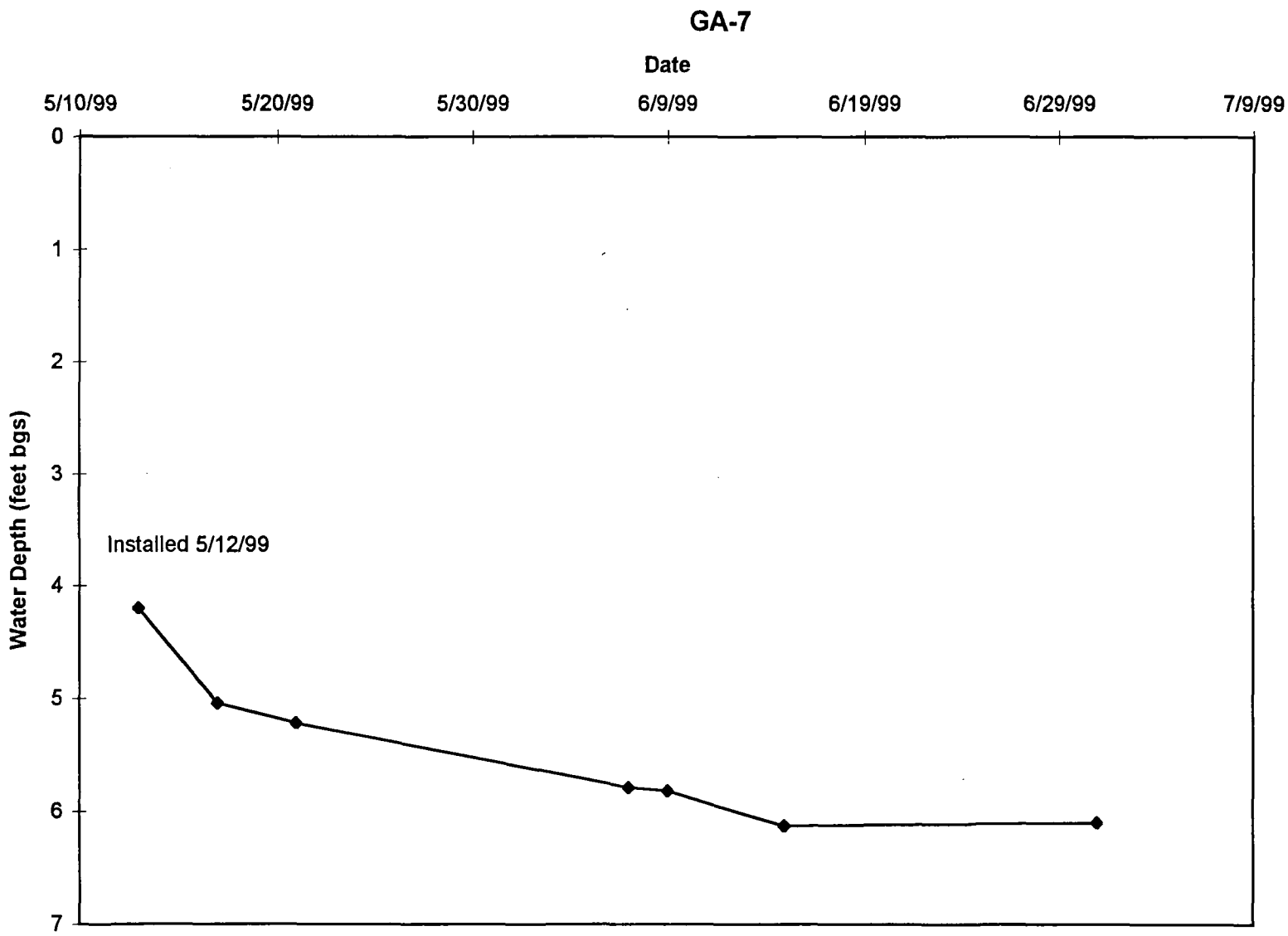
25
30
35
Installed 5/1/99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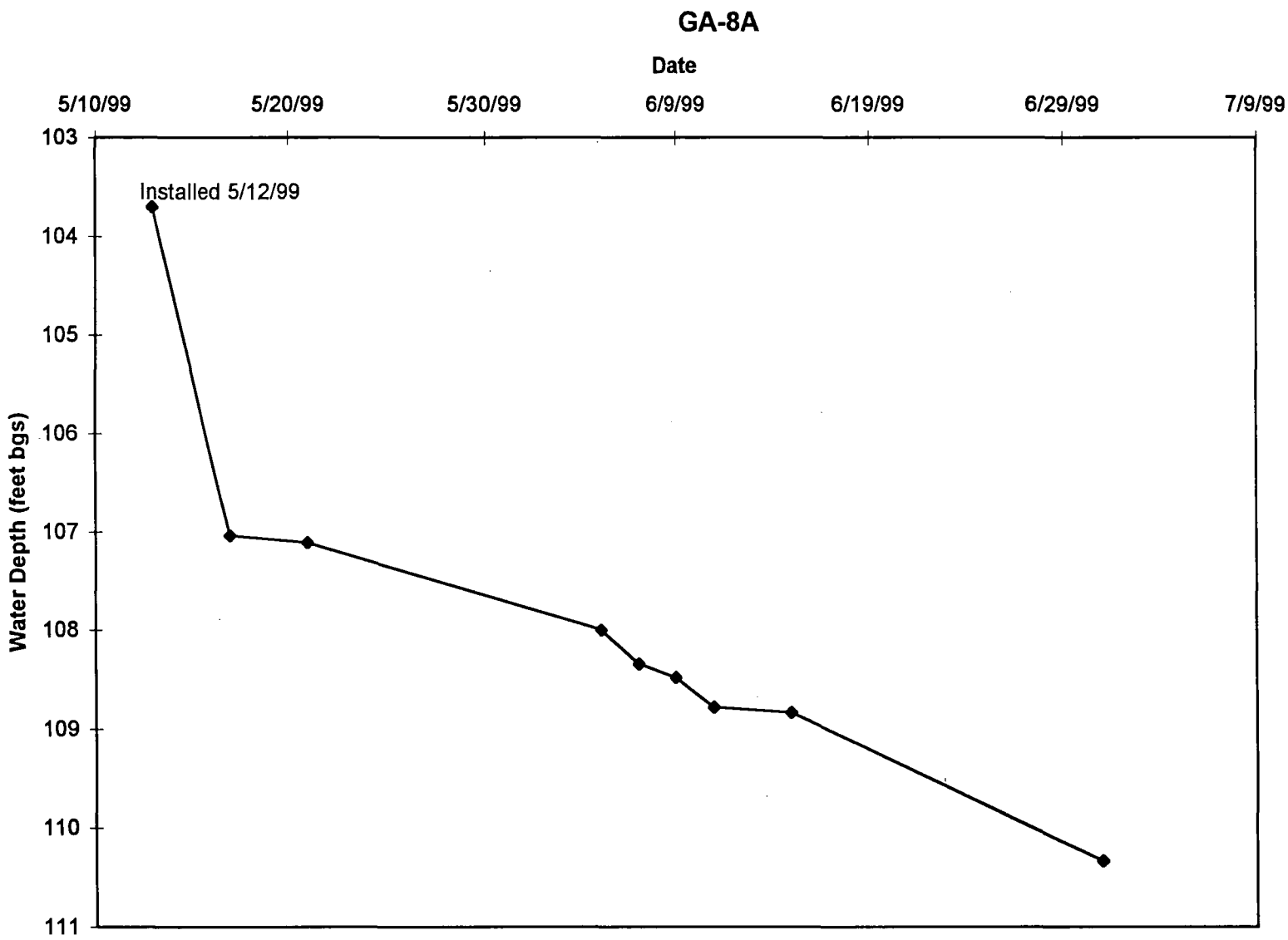
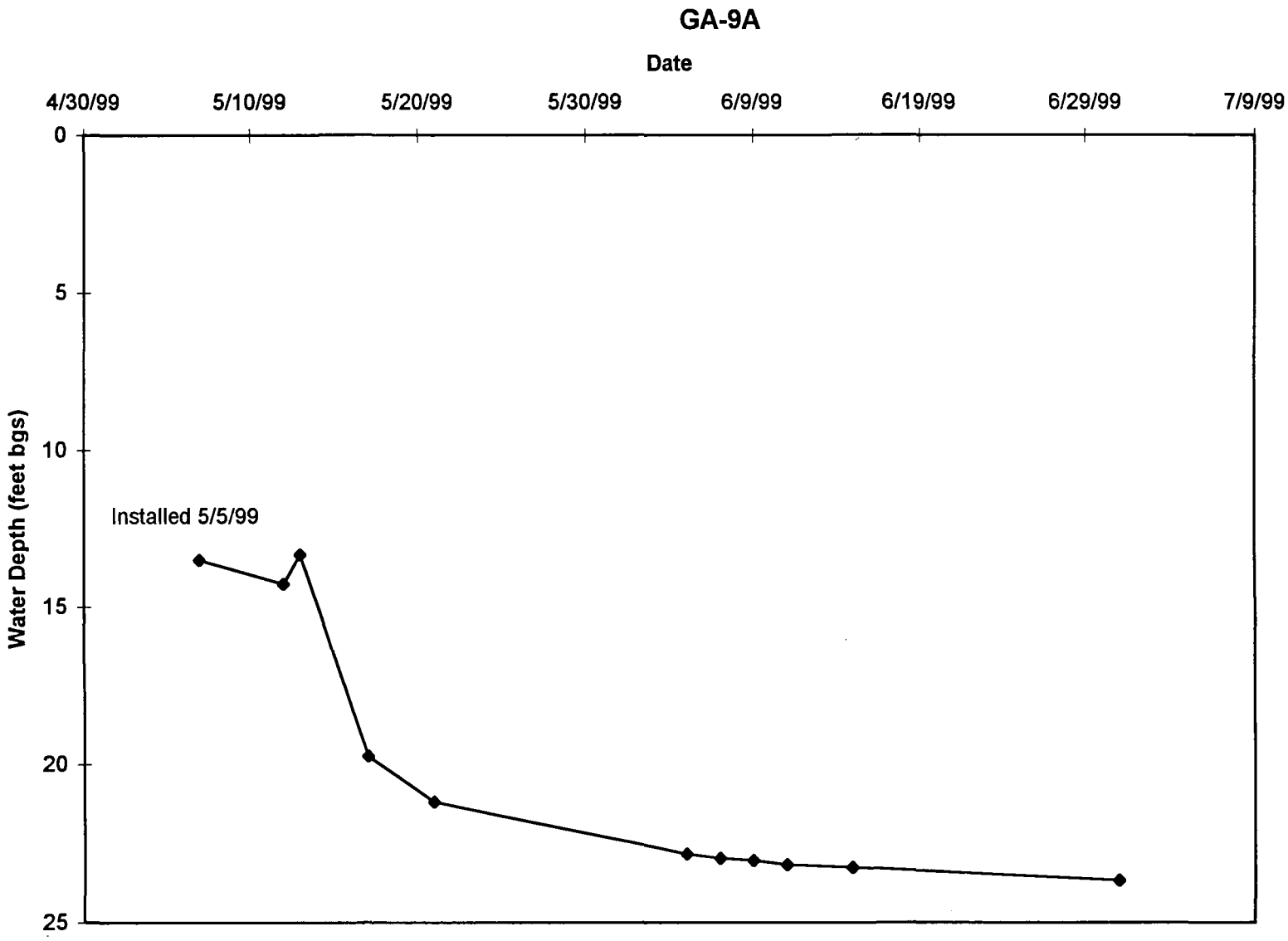
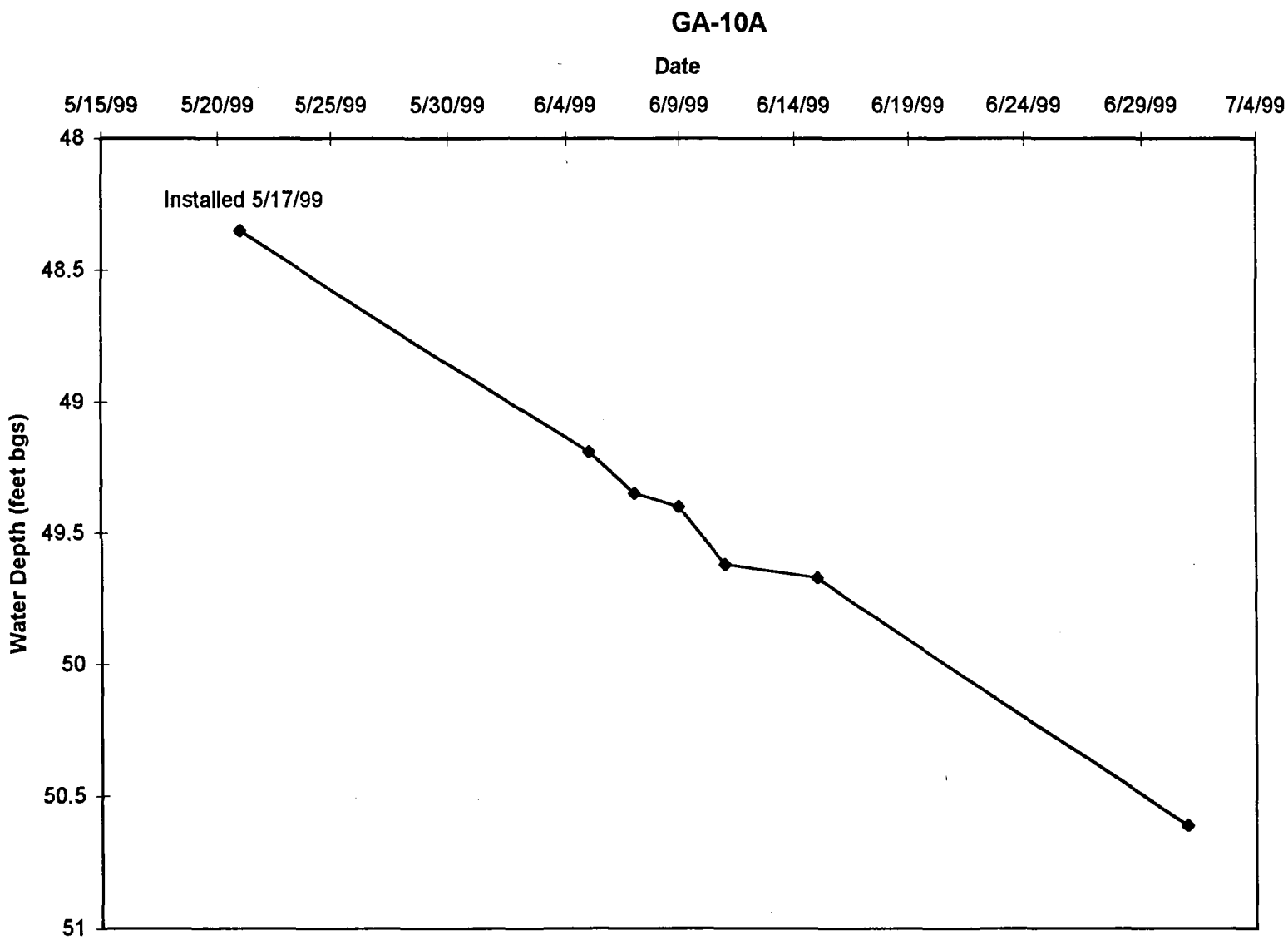
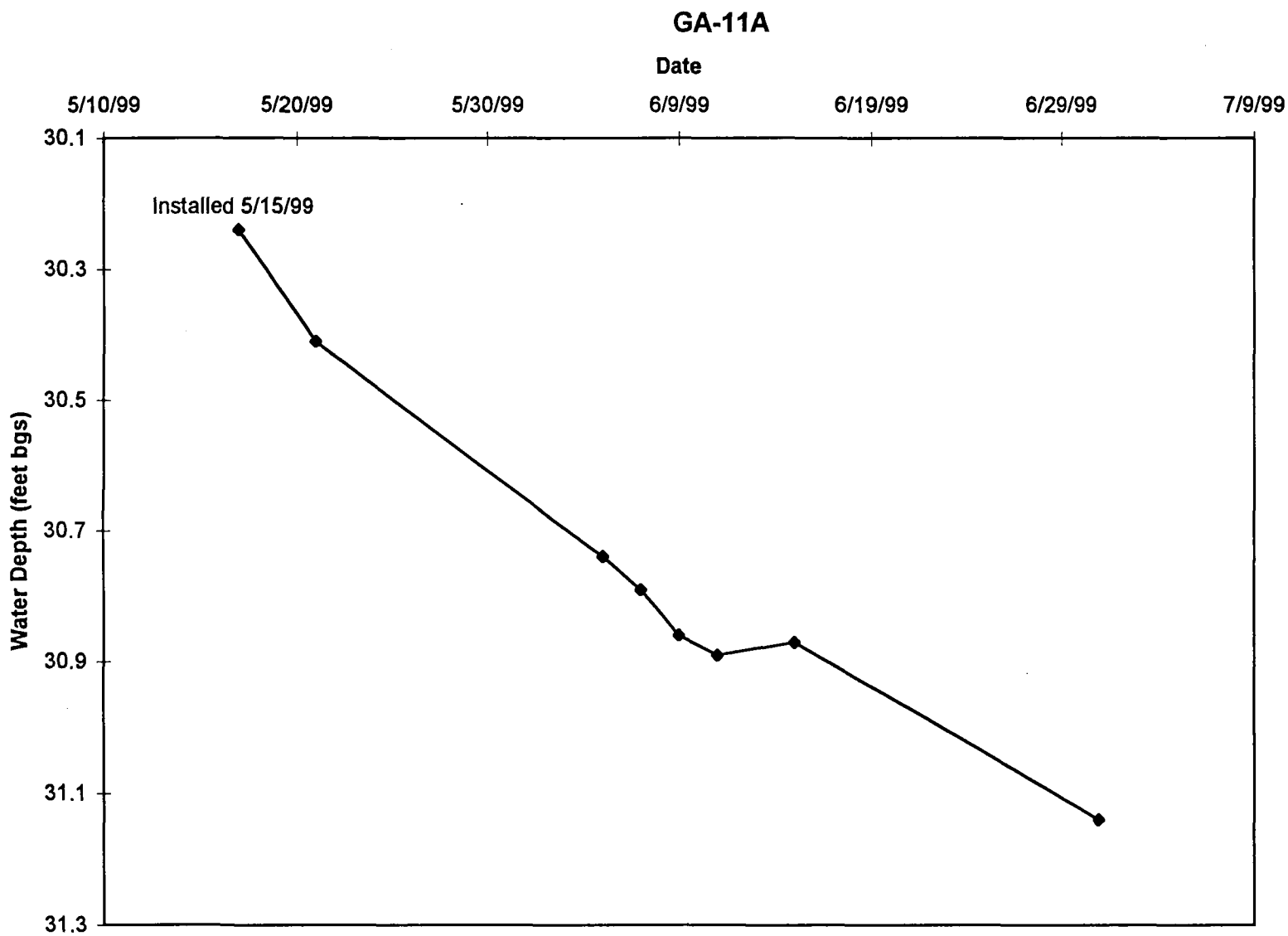
Date
5/10/99
5/20/99
5/30/99
6/9/99
6/19/99
6/29/99
7/9/99
Water Depth (feet bgs)
0
1
2
3
4
5
6
7
Installed 5/12/99


GA-8A
Date
5/10/99
5/20/99
5/30/99
6/9/99
6/19/99
6/29/99
7/9/99
Water Depth (feet bgs)
103
104
105
106
107
108
109
110
111
Installed 5/12/99


GA-9A
Date
4/30/99
5/10/99
5/20/99
5/30/99
6/9/99
6/19/99
6/29/99
7/9/99
Water Depth (feet bgs)
0
5
10
15
20
25
Installed 5/5/99


GA-10A
Date
5/15/99
5/20/99
5/25/99
5/30/99
6/4/99
6/9/99
6/14/99
6/19/99
6/24/99
6/29/99
7/4/99
Water Depth (feet bgs)
48
48.5
49
49.5
50
50.5
51
Installed 5/17/99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Date
5/10/99
5/20/99
5/30/99
6/9/99
6/19/99
6/29/99
7/9/99
Water Depth (feet bgs)
30.1
30.3
30.5
30.7
30.9
31.1
31.3
Installed 5/15/99

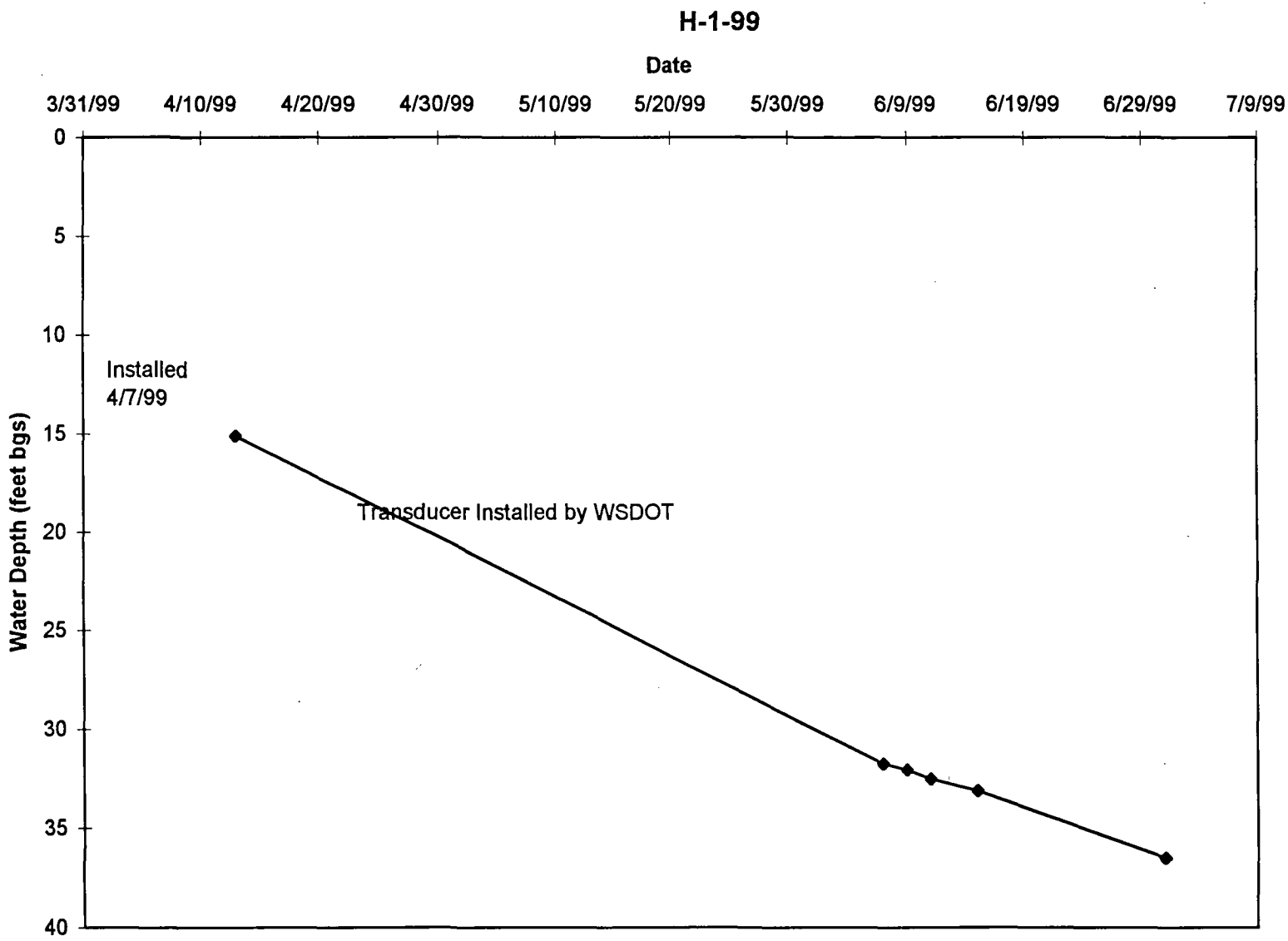

H-1-99
Date
3/31/99
4/10/99
4/20/99
4/30/99
5/10/99
5/20/99
5/30/99
6/9/99
6/19/99
6/29/99
7/9/99
Water Depth (feet bgs)
0
5
10
15
20
25
30
35
40
Installed
4/7/99
Transducer Installed by WSDOT

Table 4

326 Landslide
Slug Test Results

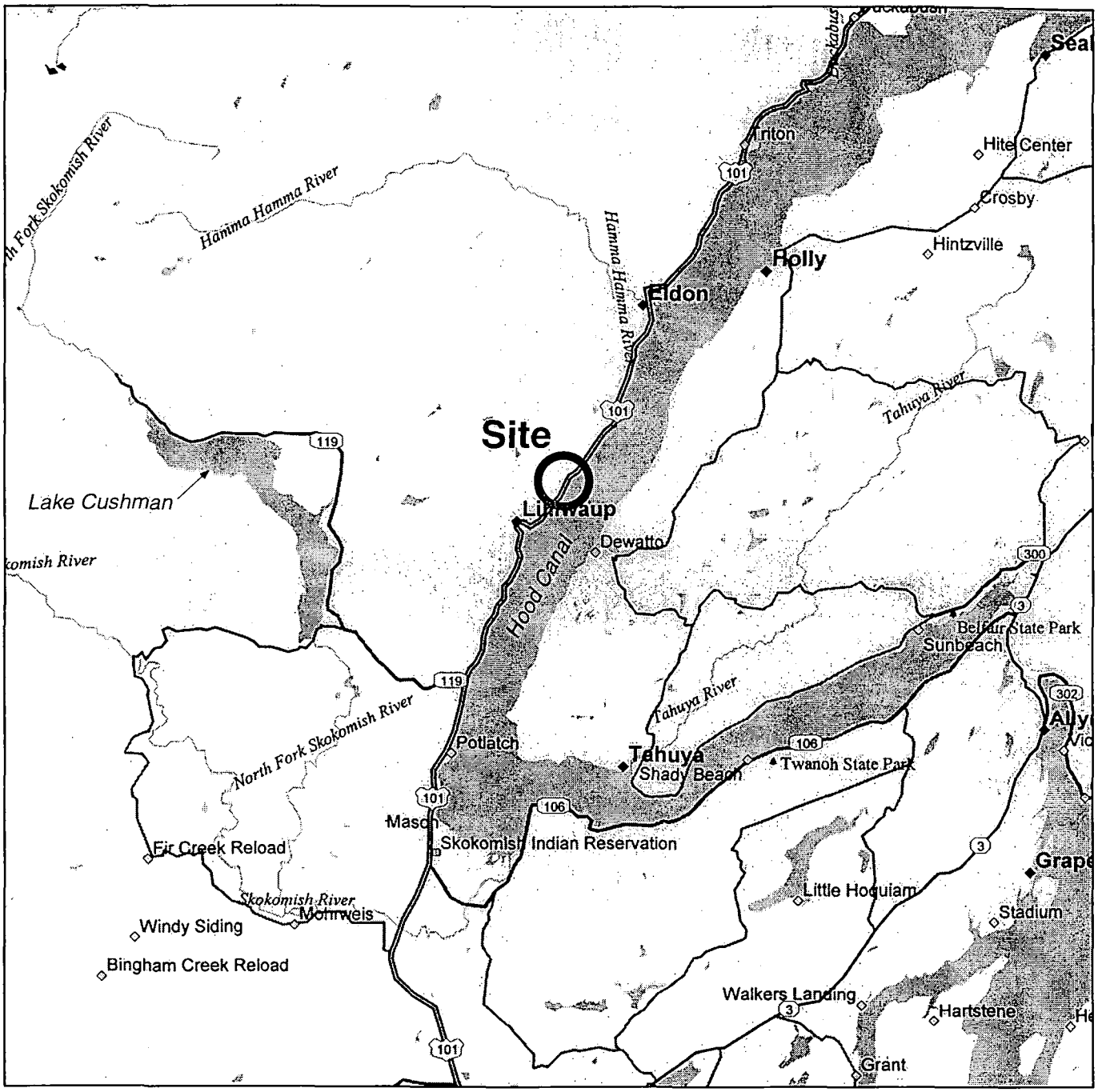
Well ID	Screened Unit	Water Level 6/8/99 (ft bgs)	Sand Pack	Test #	Test Type	Solution	Hydraulic Conductivity (ft/s)	Hydraulic Conductivity (ft/day)	Hydraulic Conductivity (cm/s)	Hydraulic Conductivity (m/s)
GA-2A	GLACIOFLUVIAL	29.38	55 - 72 ft bgs	2	rising head	Unconfined - Hvorslev	3.36E-05	4.83E-02	1.02E-03	1.02E-05
	LANDSLIDE DEBRIS		17 ft			Unconfined - Bouwer-Rice	3.11E-05	4.47E-02	9.46E-04	9.46E-06
	med. SAND to fine sandy		(lower 2 ft in clay)							
	SILT with occasional									
	1 cm thick CLAYEY SILT									
	interbeds									
GA-5A	GLACIOFLUVIAL	56.75	101 - 115 ft bgs	1	rising head	Unconfined - Hvorslev	1.99E-05	2.87E-02	6.07E-04	6.07E-06
	LANDSLIDE DEBRIS		14 ft			Unconfined - Bouwer-Rice	1.98E-05	2.85E-02	6.03E-04	6.03E-06
	silty fine SAND, trace			2	rising head	Unconfined - Hvorslev	4.29E-05	6.18E-02	1.31E-03	1.31E-05
	coarse sand					Unconfined - Bouwer-Rice	4.27E-05	6.14E-02	1.30E-03	1.30E-05
GA-6A	GLACIOFLUVIAL	29.40	38 - 52 ft bgs	1	rising head	Unconfined - Hvorslev	2.79E-05	4.02E-02	8.50E-04	8.50E-06
	LANDSLIDE DEBRIS		14 ft			Unconfined - Bouwer-Rice	2.35E-05	3.39E-02	7.17E-04	7.17E-06
	silty fine SAND, trace			2	rising head	Unconfined - Hvorslev	2.46E-05	3.54E-02	7.49E-04	7.49E-06
	fine to coarse gravel,					Unconfined - Bouwer-Rice	2.07E-05	2.98E-02	6.32E-04	6.32E-06
	trace cobbles									
GA-11A	GLACIOFLUVIAL	29.38	31.5 - 52 ft bgs	1	rising head	Unconfined - Hvorslev	1.41E-05	2.04E-02	4.31E-04	4.31E-06
	LANDSLIDE DEBRIS		20.5 ft			Unconfined - Bouwer-Rice	1.11E-05	1.59E-02	3.37E-04	3.37E-06
	silty fine to med. SAND,			2	rising head	Unconfined - Hvorslev	1.33E-05	1.92E-02	4.06E-04	4.06E-06
	some gravel to					Unconfined - Bouwer-Rice	1.04E-05	1.50E-02	3.17E-04	3.17E-06
	very fine sandy SILT									
						min	1.04E-05	1.50E-02	3.17E-04	3.17E-06
						max	4.29E-05	6.18E-02	1.31E-03	1.31E-05
						average	2.26E-05	3.25E-02	6.88E-04	6.88E-06

Table 5 - Summary of XSTABLE Results

Case	Friction Angle Slide Debris	Friction Angle Failure Plane	Water Table	FS	XSTABLE Designation
SECTION B-B'					
Section B-B' Initiation Block]					
At failure	36	25	Toe: 10' above 8/99, 20' above at headscarp	0.99	BBF1
Summer 1999	36	25	Based on 8/99 data	1.14	BBN1
Summer 1999 During Earthquake	36	25	Based on 8/99 data	Ay=.05g	BBN1S
Fully Effective Drains	36	25	Lower about 10' at toe, 20 at headscarp from 8/99	1.24	BBD1
Fully Effective Drains, Seismic	36	25	Lower about 10' at toe, 20 at headscarp from 8/99	Ay=.075g	BBD1S
Section B-B' Entire Block					
At failure	36	25	Toe: 10' above 8/99, 20' above at headscarp	1.05	BBF1
Summer 1999	36	25	Based on 8/99 data	1.16	BBN
Fully Effective Drains	36	25	Lower about 10' at toe, 20 at headscarp from 8/99	1.3	BBD
Fully Effective Drains, Seismic	36	25	Lower about 10' at toe, 20 at headscarp from 8/99	Ay=.105g	BBDS
Section B-B' Buttress, Initiation Block					
No buttress, elevated watertable	36	25	Assumed 5 ft above 8/99 data	1.05	BBEL
With 15' High MSE Toe Buttress	36	25	Assumed 5 ft above 8/99 data	1.28	BB1BUT
Section B-B' Buttress, Entire Block					
No buttress, elevated watertable	36	25	Assumed 5 ft above 8/99 data at toe, 10' at scarp	1.11	BBE
With 15' High MSE Toe Buttress	36	25	Assumed 5 ft above 8/99 data at toe, 10' at scarp	1.115	BBUT
SECTION D-D'					
At failure	36	36	Assumed at about the mid depth of the slide mass	1.03	DDF
Summer 1999	36	36	At about 10 feet above the failure plane	1.12	DDN

NOTES:

1. See Appendix E for XSTABLE plots.
2. Section B-'B' runs used a block search routine
3. Section D-D' used a specific define failure plane routine.
4. For the seismic cases, Ay was calculated. Ay is the applied horizontal acceleration that reduces the FS to about 1.0. The ratio of Ay to the peak ground acceleration and earthquake magnitude can be related to the slope movement.

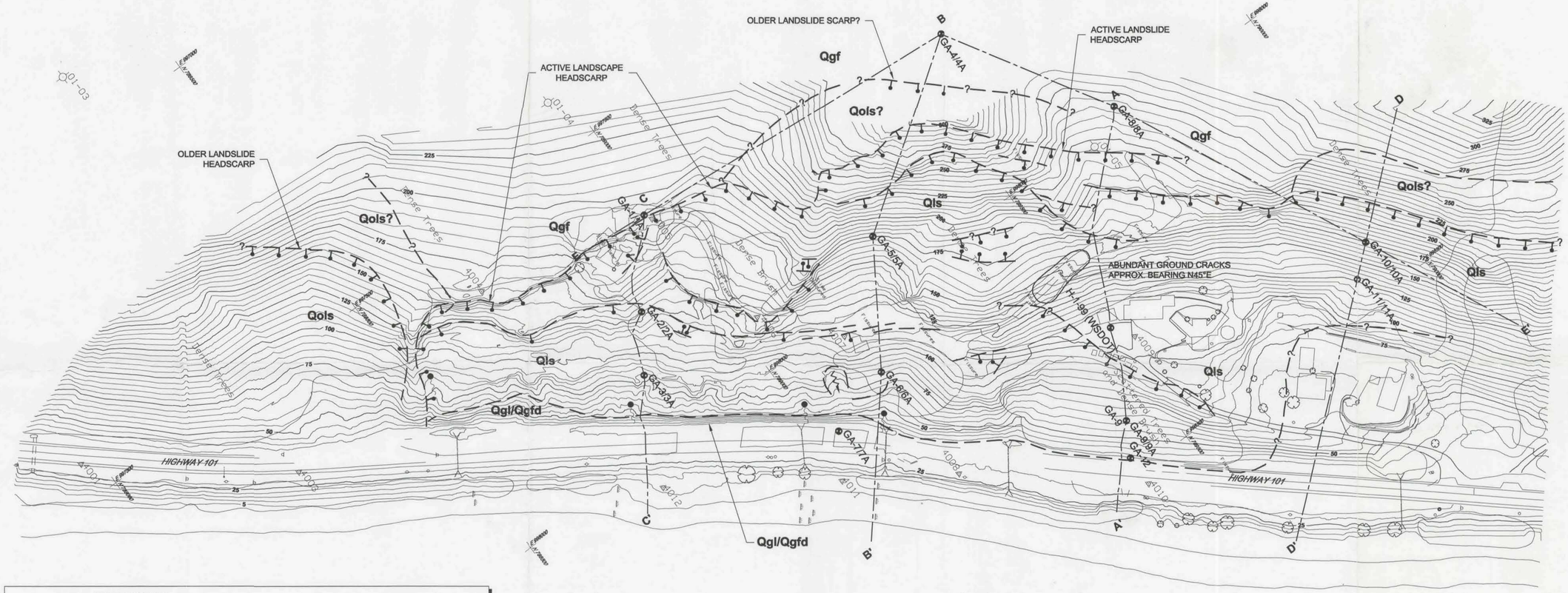


NOT TO SCALE

FIGURE 1
SITE LOCATION MAP
WSDOT/MP 326/WA

PROJECT NO. 993 1467.500 DRAWING NO. 85089 DATE 8/24/99 DRAWN BY TK

Golder Associates



EXPLANATION

Qls LANDSLIDE DEBRIS: Compact to dense, light olive brown to light olive gray, nonstratified to thickly bedded, fractured, sandy GRAVEL ranging to gravelly sand with a trace to little silt; grades downward generally to fine to medium sand trace to little silt and clayey silt ranging to silty clay.

Qols OLDER LANDSLIDE DEBRIS: Compact to dense, brownish orange, nonstratified, mottled, gravelly SAND little silt, contains angular blocks of dense, laminated silty fine SAND, FeOx staining common.

Qgf GLACIOFLUVIAL DEPOSIT: Compact to very dense, light olive brown to light olive gray, thickly interbedded fine to coarse subrounded to rounded GRAVEL little to some fine to coarse sand, trace to little silt; and fine to coarse SAND trace to some silt, little to some subrounded to rounded fine to coarse gravel; occasional interbeds of fine to medium SAND ranging to sandy SILT; minor interbeds of SILTY CLAY ranging to CLAYEY SILT; some interbeds containing till-like fabric observed in GA-4; FeOx staining common.

Qgl/Qgfd GLACIOLACUSTRINE DEPOSITS AND GLACIOFLUVIAL DRIFT: Very dense and hard, light olive gray to light olive brown, laminated to massive, jointed, SILTY CLAY ranging to CLAYEY SILT, trace sand, trace rounded gravel to cobble sized dropstones; and fine to coarse SAND, little to some subangular to rounded fine to coarse gravel, little to some clayey silt.

N

0 30 60 METERS
0 100 200 FEET

EXPLANATION

B — — B' LOCATION OF GEOLOGIC CROSS SECTION

SEEPAGE

CULVERT

LANDSLIDE SCARP (BAR AND BALL ON DOWNDROPPED BLOCK)

? — — ? GEOLOGIC CONTACT: DASHED WHER APPROXIMATELY LOCATED, QUERIED WHERE UNCERTAIN

SPECIAL NOTE:
Data concerning the location of the elevation of the various stratigraphic horizons have been obtained at exploration locations only. The interpretation between these locations has been inferred from geologic evidence and so may vary from that shown.

FIGURE **2**

SITE PLAN SHOWING LIMITS OF LANDSLIDE MASS

WSDOT/MP 326/WA

Golder Associates

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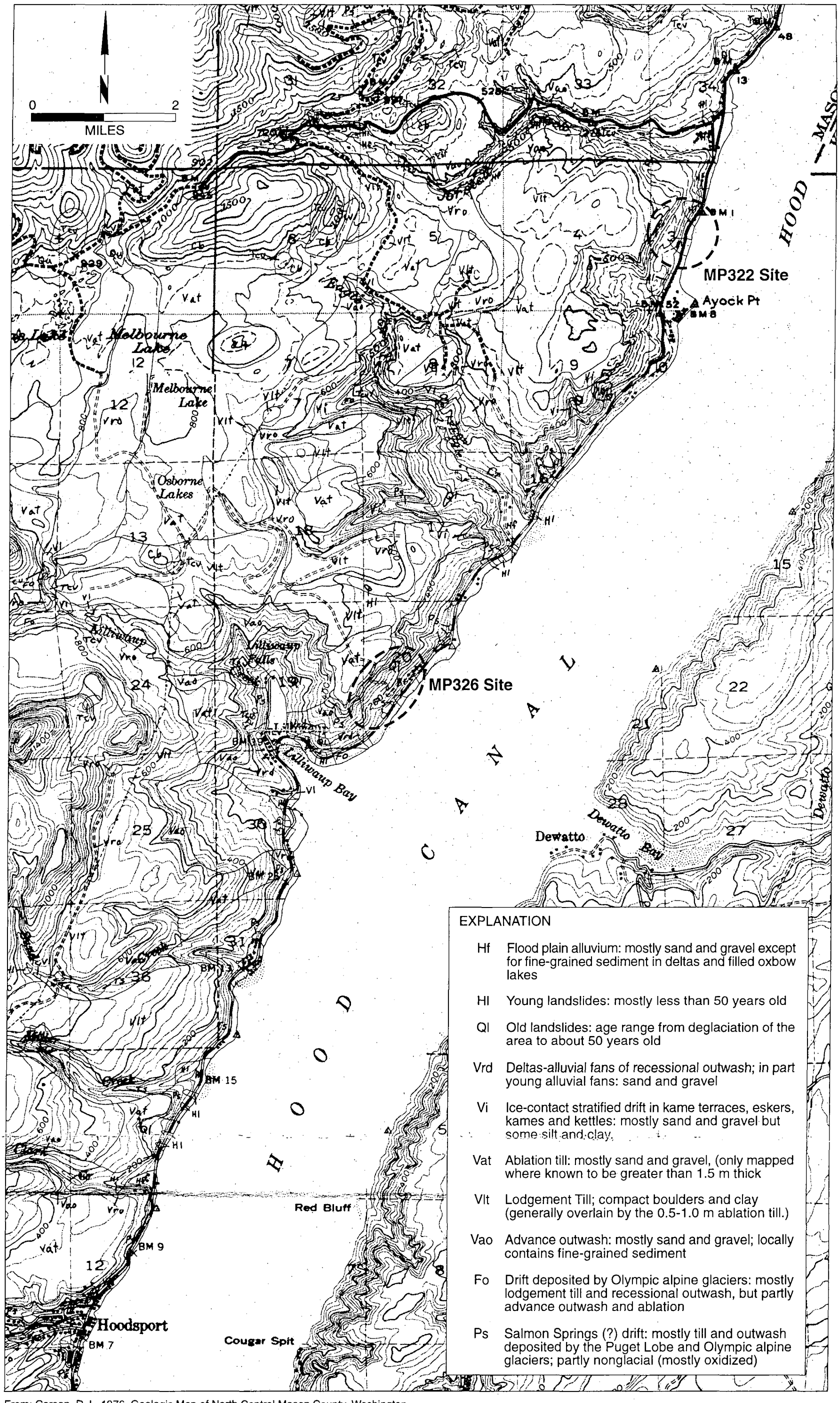
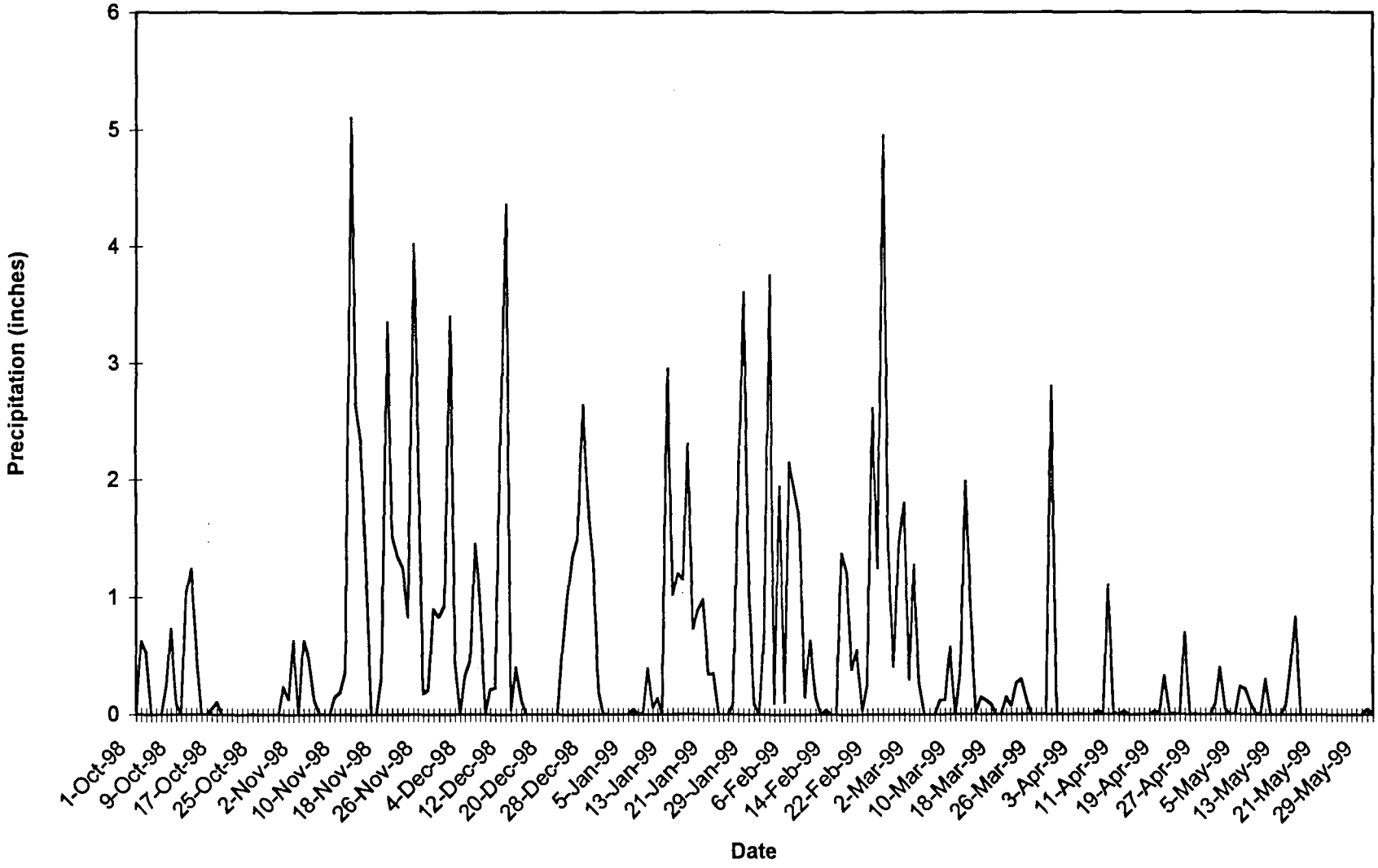


From: Carson, R.J., 1976, Geologic Map of North Central Mason County, Washington

FIGURE 3
REGIONAL GEOLOGIC MAP (CARSON, 1976)
WSDOT/MP326/WA

Figure 4
Daily Precipitation Cushman Powerhouse 2



Aerial view of southern end of MP326 Landslide. View to the west.

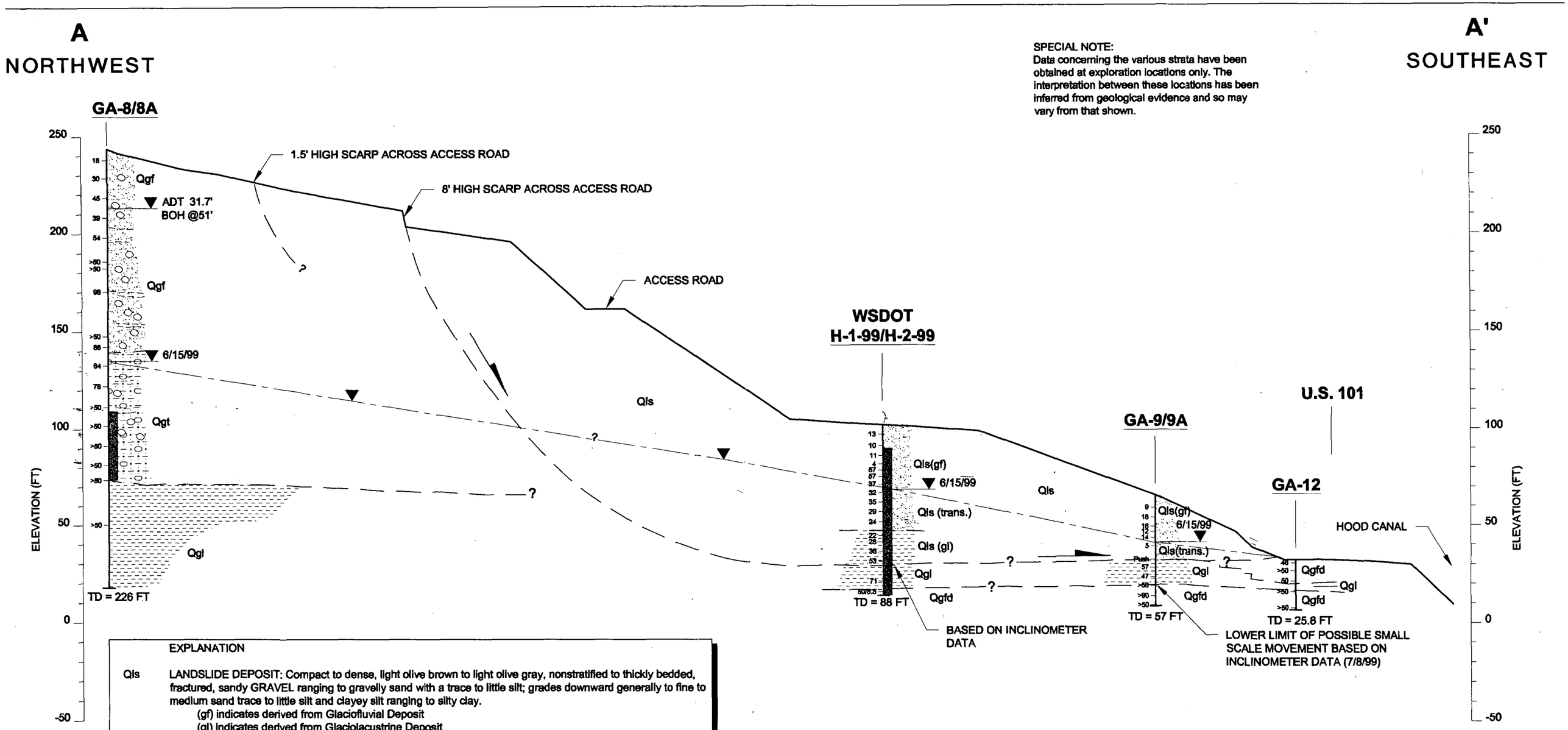
FIGURE **5**

SITE PHOTOGRAPH SHOWING AERIAL VIEW OF MP326 LANDSLIDE

WSDOT/MP326/WA

PROJECT NO. 993 1467.500 DRAWING NO. 85090 DATE 8/24/99 DRAWN BY EA

Golder Associates



EXPLANATION

Qls LANDSLIDE DEPOSIT: Compact to dense, light olive brown to light olive gray, nonstratified to thickly bedded, fractured, sandy GRAVEL ranging to gravelly sand with a trace to little silt; grades downward generally to fine to medium sand trace to little silt and clayey silt ranging to silty clay.
(gf) indicates derived from Glaciofluvial Deposit
(gl) indicates derived from Glaciolacustrine Deposit
(trans.) indicates derived from Transitional Beds

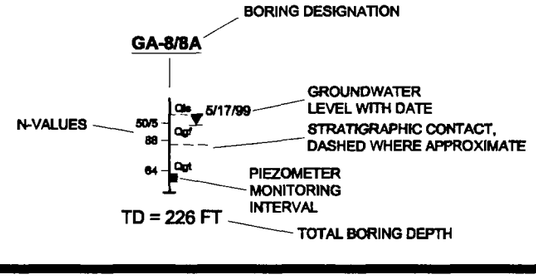
Qgf GLACIOFLUVIAL DEPOSIT: Compact to very dense, light olive brown to light olive gray, thickly interbedded fine to coarse subrounded to rounded GRAVEL little to some fine to coarse sand, trace to little silt; and fine to coarse SAND trace to some silt, little to some subrounded to rounded fine to coarse gravel; occasional interbeds of fine to medium SAND ranging to sandy SILT; minor interbeds of SILTY CLAY ranging to CLAYEY SILT; some interbeds containing till-like fabric observed in GA-4; FeOx staining common.

Qgt TRANSITIONAL BEDS: Compact to very dense, light olive gray to light olive brown, interbedded to laminated, fine to medium sand, trace to some silt ranging to silt, some sand, FeOx staining common.

Qgl GLACIOLACUSTRINE DEPOSIT: Hard, light olive gray to light olive brown, laminated to massive, jointed, SILTY CLAY ranging to CLAYEY SILT, trace sand, trace rounded gravel to cobble sized dropstones.

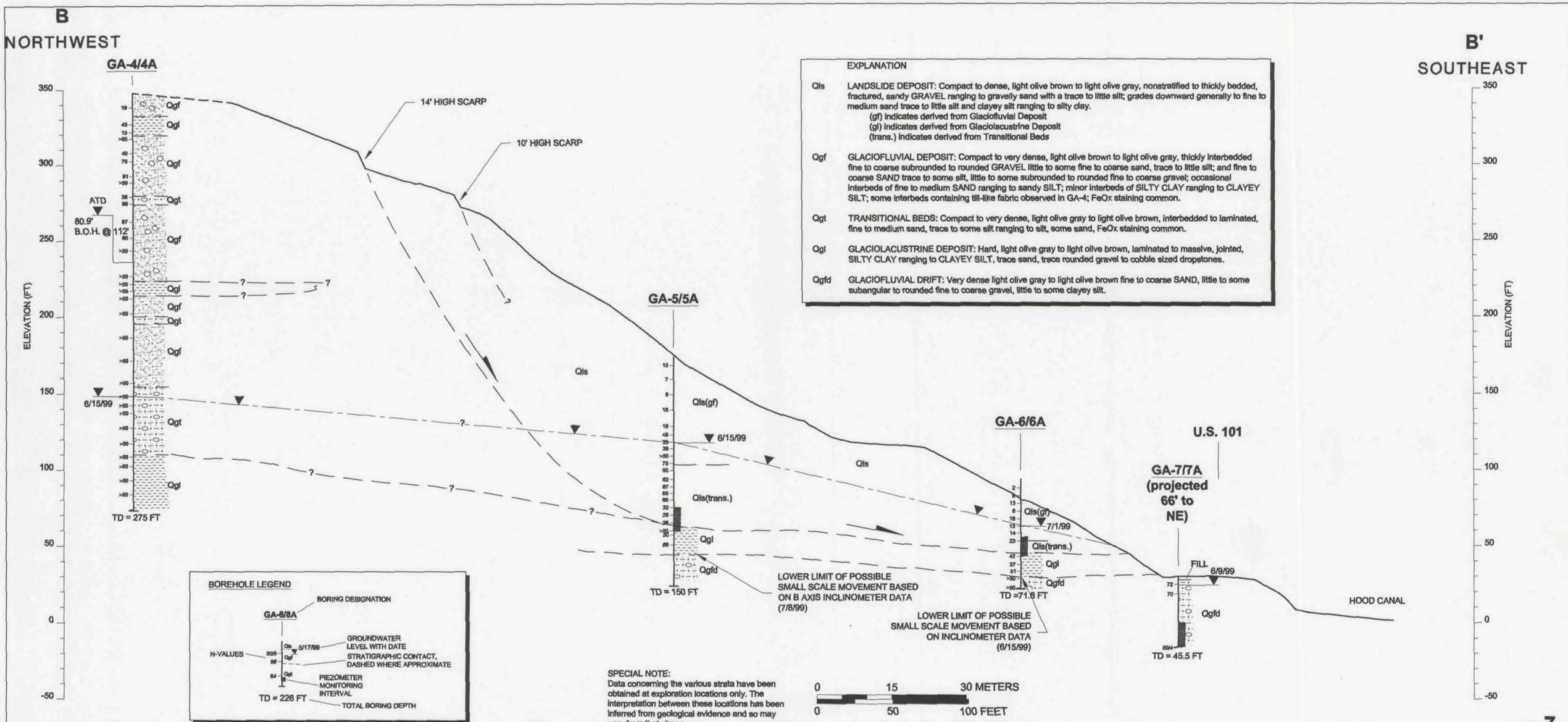
Qgfd GLACIOFLUVIAL DRIFT: Very dense light olive gray to light olive brown fine to coarse SAND, little to some subangular to rounded fine to coarse gravel, little to some clayey silt.

BOREHOLE LEGEND



0 15 30 METERS
0 50 100 FEET

FIGURE 6
GEOLOGIC CROSS-SECTION A-A'
WSDOT/MP 326/WA



EXPLANATION

Qls — LANDSLIDE DEPOSIT: Compact to dense, light olive brown to light olive gray, nonstratified to thickly bedded, fractured, sandy GRAVEL ranging to gravelly sand with a trace to little silt; grades downward generally to fine to medium sand trace to little silt and clayey silt ranging to silty clay.
(gf) indicates derived from Glaciofluvial Deposit
(gl) indicates derived from Glaciolacustrine Deposit
(trans.) indicates derived from Transitional Beds

Qgf — GLACIOFLUVIAL DEPOSIT: Compact to very dense, light olive brown to light olive gray, thickly interbedded fine to coarse subrounded to rounded GRAVEL little to some fine to coarse sand, trace to little silt; and fine to coarse SAND trace to some silt, little to some subrounded to rounded fine to coarse gravel; occasional interbeds of fine to medium SAND ranging to sandy SILT; minor interbeds of SILTY CLAY ranging to CLAYEY SILT; some interbeds containing till-like fabric observed in GA-4; FeOx staining common.

Qgt — TRANSITIONAL BEDS: Compact to very dense, light olive gray to light olive brown, interbedded to laminated, fine to medium sand, trace to some silt ranging to silt, some sand, FeOx staining common.

Qgl — GLACIOLACUSTRINE DEPOSIT: Hard, light olive gray to light olive brown, laminated to massive, jointed, SILTY CLAY ranging to CLAYEY SILT, trace sand, trace rounded gravel to cobble sized dropstones.

Qgfd — GLACIOFLUVIAL DRIFT: Very dense light olive gray to light olive brown fine to coarse SAND, little to some subangular to rounded fine to coarse gravel, little to some clayey silt.

FIGURE 7
GEOLOGIC CROSS-SECTION B-B'
WSDOT/MP 326/WA

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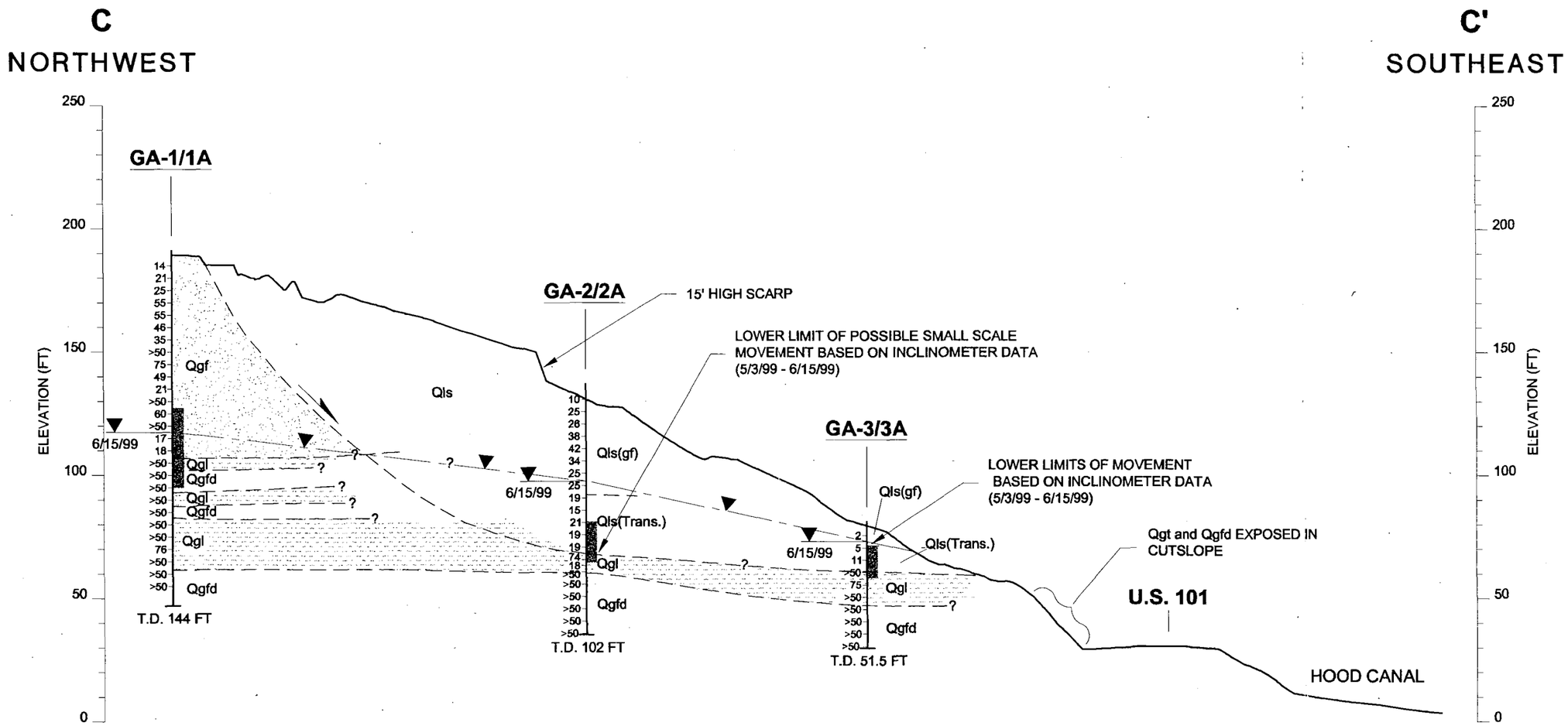
Golder Associates



EXPLANATION

Qls LANDSLIDE DEPOSIT: Compact to dense, light olive brown to light olive gray, nonstratified to thickly bedded, fractured, sandy GRAVEL ranging to gravelly sand with a trace to little silt; grades downward generally to fine to medium sand trace to little silt and clayey silt ranging to silty clay.
(gf) indicates derived from Glaciofluvial Deposit
(gl) indicates derived from Glaciolacustrine Deposit
(trans.) indicates derived from Transitional Beds

Qgf GLACIOFLUVIAL DEPOSIT: Compact to very dense, light olive brown to light olive gray, thickly interbedded fine to coarse subrounded to rounded GRAVEL little to some fine to coarse sand, trace to little silt; and fine to coarse SAND trace to some silt, little to some subrounded to rounded fine to coarse gravel; occasional interbeds of fine to medium SAND ranging to sandy SILT; minor interbeds of SILTY CLAY ranging to CLAYEY SILT; some interbeds containing till-like fabric observed in GA-4; FeOx staining common.

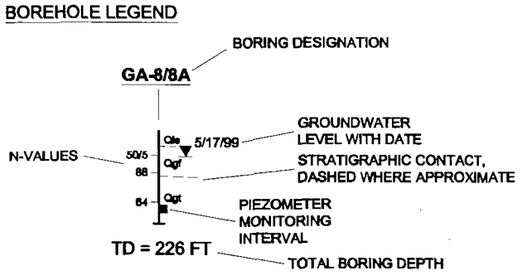
Qgt TRANSITIONAL BEDS: Compact to very dense, light olive gray to light olive brown, interbedded to laminated, fine to medium sand, trace to some silt ranging to silt, some sand, FeOx staining common.

Qgl GLACIOLACUSTRINE DEPOSIT: Hard, light olive gray to light olive brown, laminated to massive, jointed, SILTY CLAY ranging to CLAYEY SILT, trace sand, trace rounded gravel to cobble sized dropstones.

Qgfd GLACIOFLUVIAL DRIFT: Very dense light olive gray to light olive brown fine to coarse SAND, little to some subangular to rounded fine to coarse gravel, little to some clayey silt.

SPECIAL NOTE:
Data concerning the various strata have been obtained at exploration locations only. The interpretation between these locations has been inferred from geological evidence and so may vary from that shown.

BOREHOLE LEGEND



0 15 30 METERS
0 50 100 FEET

FIGURE 8
GEOLOGIC CROSS-SECTION C-C'
US 101 MP 326
WSDOT/MP 326/WA

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Golder Associates

D NORTHWEST

D' SOUTHEAST

EXPLANATION

Qls — LANDSLIDE DEPOSIT: Compact to dense, light olive brown to light olive gray, nonstratified to thickly bedded, fractured, sandy GRAVEL ranging to gravelly sand with a trace to little silt; grades downward generally to fine to medium sand trace to little silt and clayey silt ranging to silty clay.
(gf) indicates derived from Glaciofluvial Deposit
(gl) indicates derived from Glaciolacustrine Deposit
(trans.) indicates derived from Transitional Beds

Qgf — GLACIOFLUVIAL DEPOSIT: Compact to very dense, light olive brown to light olive gray, thickly interbedded fine to coarse subrounded to rounded GRAVEL little to some fine to coarse sand, trace to little silt; and fine to coarse SAND trace to some silt, little to some subrounded to rounded fine to coarse gravel; occasional interbeds of fine to medium SAND ranging to sandy SILT; minor interbeds of SILTY CLAY ranging to CLAYEY SILT; some interbeds containing till-like fabric observed in GA-4; FeOx staining common.

Qgt — TRANSITIONAL BEDS: Compact to very dense, light olive gray to light olive brown, interbedded to laminated, fine to medium sand, trace to some silt ranging to silt, some sand, FeOx staining common.

Qgl — GLACIOLACUSTRINE DEPOSIT: Hard, light olive gray to light olive brown, laminated to massive, jointed, SILTY CLAY ranging to CLAYEY SILT, trace sand, trace rounded gravel to cobble sized dropstones.

Qgfd — GLACIOFLUVIAL DRIFT: Very dense light olive gray to light olive brown fine to coarse SAND, little to some subangular to rounded fine to coarse gravel, little to some clayey silt.

ELEVATION (FT): 350, 300, 250, 200, 150, 100, 50, 0

Qols?

Qols EXPOSED IN 5' HIGH SCARP

GA-10/10A

GA-11/11A

Qgf

Qgt

Qls(gf)

Qls(Trans.)

Qgt

Qgl

Qgfd

6/15/99

T.D.= 96 FT

Qls(gf)

6/15/99

Qgt

Qgl

Qgfd

T.D.= 74.4 FT

LOWER LIMIT OF POSSIBLE SMALL SCALE MOVEMENT BASED ON INCLINOMETER DATA (6/15/99 - 7/8/99)

SLASH PILE

BASED ON INCLINOMETER DATA (6/18/99 - 7/8/99)

EXISTING RESIDENCIAL STRUCTURES

U.S. 101

HOOD CANAL

LOWER LIMIT OF POSSIBLE SMALL SCALE MOVEMENT BASED ON B-AXIS INCLINOMETER DATA (6/15/99 - 7/8/99)

CONTACT PROJECTED FROM GA-8/8A ON SECTION E-E'

BOREHOLE LEGEND

GA-8/8A — BORING DESIGNATION

N-VALUES: 50/5, 66, 64

5/17/99 — GROUNDWATER LEVEL WITH DATE

STRATIGRAPHIC CONTACT, DASHED WHERE APPROXIMATE

PIEZOMETER MONITORING INTERVAL

TD = 226 FT — TOTAL BORING DEPTH

SPECIAL NOTE:
Data concerning the various strata have been obtained at exploration locations only. The interpretation between these locations has been inferred from geological evidence and so may vary from that shown.

0 15 30 METERS
0 50 100 FEET

FIGURE

GEOLOGIC CROSS-SECTION D-

US 101 MP 3

WSDOT/MP 326/

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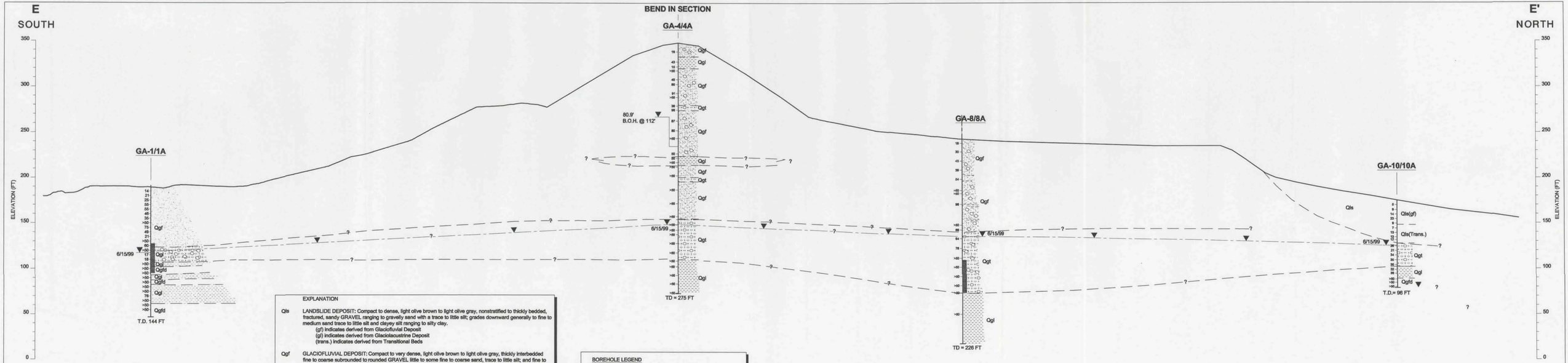

EXPLANATION

Qls — LANDSLIDE DEPOSIT: Compact to dense, light olive brown to light olive gray, nonstratified to thickly bedded, fractured, sandy GRAVEL ranging to gravelly sand with a trace to little silt; grades downward generally to fine to medium sand trace to little silt and clayey silt ranging to silty clay.
(gf) indicates derived from Glaciofluvial Deposit
(gl) indicates derived from Glaciolacustrine Deposit
(trans.) indicates derived from Transitional Beds

Qgf — GLACIOFLUVIAL DEPOSIT: Compact to very dense, light olive brown to light olive gray, thickly interbedded fine to coarse subrounded to rounded GRAVEL, little to some fine to coarse sand, trace to little silt; and fine to coarse SAND trace to some silt, little to some subrounded to rounded fine to coarse gravel; occasional interbeds of fine to medium SAND ranging to sandy SILT; minor interbeds of SILTY CLAY ranging to CLAYEY SILT; some interbeds containing till-like fabric observed in GA-4; FeOx staining common.

Qgt — TRANSITIONAL BEDS: Compact to very dense, light olive gray to light olive brown, interbedded to laminated, fine to medium sand, trace to some silt ranging to silt, some sand, FeOx staining common.

Qgl — GLACIOLACUSTRINE DEPOSIT: Hard, light olive gray to light olive brown, laminated to massive, jointed, SILTY CLAY ranging to CLAYEY SILT, trace sand, trace rounded gravel to cobble sized dropstones.

Qgfd — GLACIOFLUVIAL DRIFT: Very dense light olive gray to light olive brown fine to coarse SAND, little to some subangular to rounded fine to coarse gravel, little to some clayey silt.

BOREHOLE LEGEND

GA-8/8A — BORING DESIGNATION
N-VALUES — 50/6, 86, 54
Gw 5/17/99 — GROUNDWATER LEVEL WITH DATE
Qgf — STRATIGRAPHIC CONTACT, DASHED WHERE APPROXIMATE
Qgf — PIEZOMETER MONITORING INTERVAL
TD = 226 FT — TOTAL BORING DEPTH

SPECIAL NOTE:
Data concerning the various strata have been obtained at exploration locations only. The interpretation between these locations has been inferred from geological evidence and so may vary from that shown.

0 15 30 METERS
0 50 100 FEET

FIGURE 10
GEOLOGIC CROSS-SECTION E-E'
US 101 MP 326
WSDOT/MP 326/WA

Golder Associates

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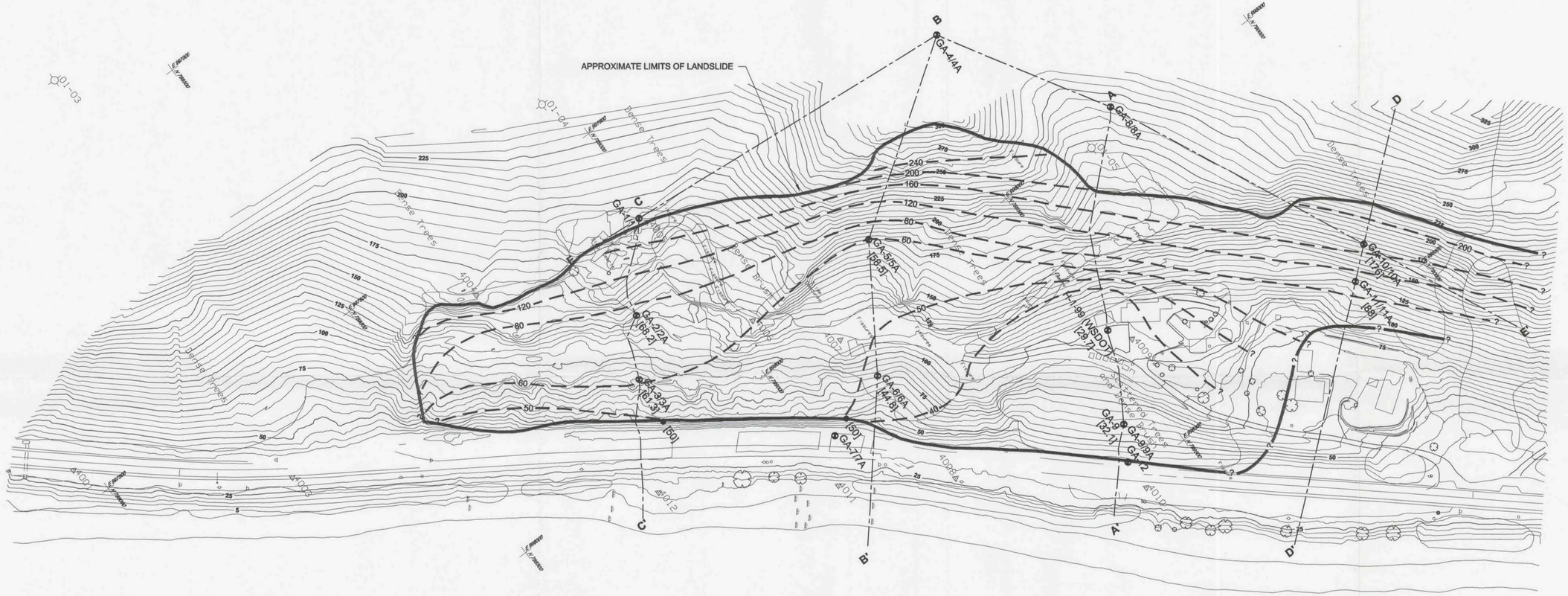
APPROXIMATE LIMITS OF LANDSLIDE
B
GA-4/4A
A
GA-8/8A
C
GA-1/1A
GA-5/5A
[59.3]
GA-2/2A
[58.2]
GA-3/3A
[61.3]
[50]
GA-6/6A
[44.9]
[50]
GA-7/7A
H-198 (WSDOT)
[28.7]
GA-9
[32.1]
GA-9/9A
GA-2
GA-10/10A
[77.9]
GA-11/11A
[88]
D
B'
A'
C'
D'
Dense Trees
Dense Brush
400A
400B
400C
400D
400E
400F
400G
400H
400I
400J
400K
400L
400M
400N
400O
400P
400Q
400R
400S
400T
400U
400V
400W
400X
400Y
400Z
400AA
400AB
400AC
400AD
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400AI
400AJ
400AK
400AL
400AM
400AN
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400AQ
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400AZ
400BA
400BB
400BC
400BD
400BE
400BF
400BG
400BH
400BI
400BJ
400BK
400BL
400BM
400BN
400BO
400BP
400BQ
400BR
400BS
400BT
400BU
400BV
400BW
400BX
400BY
400BZ
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400CC
400CD
400CE
400CF
400CG
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400CI
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400CK
400CL
400CM
400CN
400CO
400CP
400CQ
400CR
400CS
400CT
400CU
400CV
400CW
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400CY
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400DW
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400ED
400EE
400EF
400EG
400EH
400EI
400EJ
400EK
400EL
400EM
400EN
400EO
400EP
400EQ
400ER
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400EW
400EX
400EY
400EZ
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400FC
400FD
400FE
400FF
400FG
400FH
400FI
400FJ
400FK
400FL
400FM
400FN
400FO
400FP
400FQ
400FR
400FS
400FT
400FU
400FV
400FW
400FX
400FY
400FZ
400GA
400GB
400GC
400GD
400GE
400GF
400GG
400GH
400GI
400GJ
400GK
400GL
400GM
400GN
400GO
400GP
400GQ
400GR
400GS
400GT
400GU
400GV
400GW
400GX
400GY
400GZ
400HA
400HB
400HC
400HD
400HE
400HF
400HG
400HH
400HI
400HJ
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400HV
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400IG
400IH
400II
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400IN
400IO
400IP
400IQ
400IR
400IS
400IT
400IU
400IV
400IW
400IX
400IY
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400JD
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400JF
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400JI
400JJ
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400JR
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400JV
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400KR
400KS
400KT
400KU
400KV
400KW
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400LB
400LC
400LD
400LE
400LF
400LG
400LH
400LI
400LJ
400LK
400LL
400LM
400LN
400LO
400LP
400LQ
400LR
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400LT
400LU
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400LW
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400MN
400MO
400MP
400MQ
400MR
400MS
400MT
400MU
400MV
400MW
400MX
400MY
400MZ
400NA
400NB
400NC
400ND
400NE
400NF
400NG
400NH
400NI
400NJ
400NK
400NL
400NM
400NN
400NO
400NP
400NQ
400NR
400NS
400NT
400NU
400NV
400NW
400NX
400NY
400NZ
400OA
400OB
400OC
400OD
400OE
400OF
400OG
400OH
400OI
400OJ
400OK
400OL
400OM
400ON
400OO
400OP
400OQ
400OR
400OS
400OT
400OU
400OV
400OW
400OX
400OY
400OZ
400PA
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400PC
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SPECIAL NOTE:
Data concerning the location of the elevation of the various stratigraphic horizons have been obtained at exploration locations only. The interpretation between these locations has been inferred from geologic evidence and so may vary from that shown.

N

0 30 60 METERS
0 100 200 FEET

EXPLANATION

B — · — B' LOCATION OF GEOLOGIC CROSS SECTION

— 50 — ELEVATION CONTOUR AT BASE OF GLACIOFLUVIAL DEPOSITS (FEET MSL)

GA-6/6A EXPLORATORY BORING LOCATION ("A" DENOTES PIEZOMETER INSTALLED IN ADDITION TO INCLINOMETER)

[50] ELEVATION OF STRATIGRAPHIC HORIZON AT LOCATION SHOWN

FIGURE 12
ELEVATION OF BASE OF GLACIOFLUVIAL DEPOSITS (TOP OF TRANSITIONAL BEDS)
WSDOT/MP 326/WA

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Golder Associates

SPECIAL NOTE:
Data concerning the location of the elevation of the various stratigraphic horizons have been obtained at exploration locations only. The interpretation between these locations has been inferred from geologic evidence and so may vary from that shown.

N

0 30 60 METERS
0 100 200 FEET

EXPLANATION

Symbol	Description
B ——·—— B'	LOCATION OF GEOLOGIC CROSS SECTION
— —50— —	ELEVATION CONTOUR AT TOP OF GLACIOLACUSTRINE DEPOSITS (FEET MSL)
GA-6/6A	EXPLORATORY BORING LOCATION ("A" DENOTES PIEZOMETER INSTALLED IN ADDITION TO INCLINOMETER)
[50]	ELEVATION OF STRATIGRAPHIC HORIZON AT LOCATION SHOWN

FIGURE 13
ELEVATION OF TOP OF GLACIOLACUSTRINE DEPOSITS (BOTTOM OF TRANSITIONAL BEDS)
WSDOT/MP 326/WA

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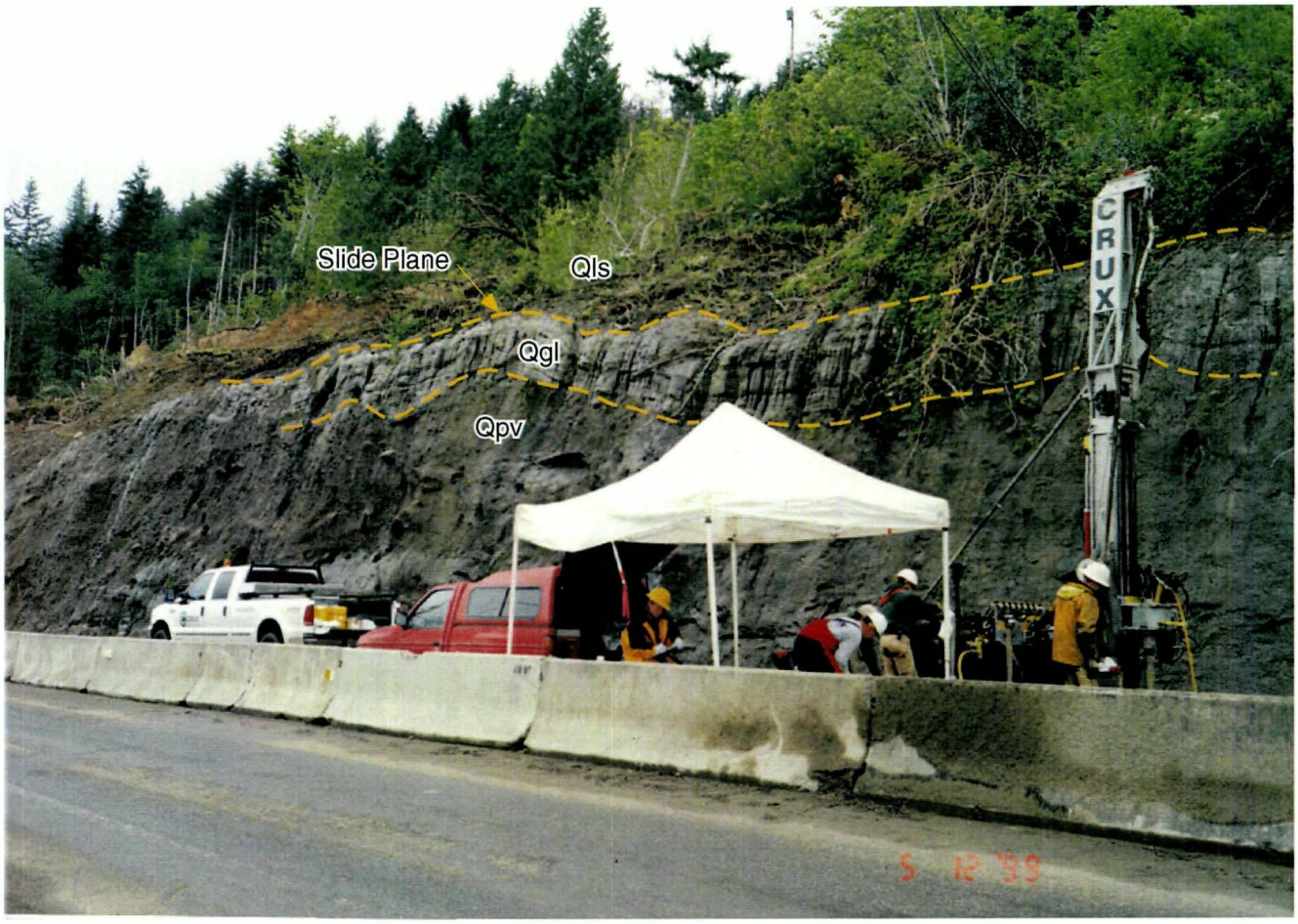

Drill on Boring GA-7. Cut face exposes glaciolacustrine deposits (Qgl) overlying older Pre-Vashon drift (Qpv). Note the undulatory nature of the glaciolacustrine deposits where slide plane daylights along the top of the road cut.

FIGURE **14**

SITE PHOTOGRAPH SHOWING CUT FACE ADJACENT TO BORING GA-7 AND US 101

WSDOT/MP326/WA

PROJECT NO. 993 1467.500 DRAWING NO. 85091 DATE 8/24/99 DRAWN BY EA

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View to the north of pavement bulging and deformation along shoulder of US 101, where slide plane is at or slightly below the road grade.

FIGURE **15**

SITE PHOTOGRAPH SHOWING DEFORMED PAVEMENT ALONG SHOULDER OF US 101

WSDOT/MP326/WA

PROJECT NO. 993 1467.500 DRAWING NO. 85092 DATE 8/24/99 DRAWN BY EA

Golder Associates

Figure 16

missing as of

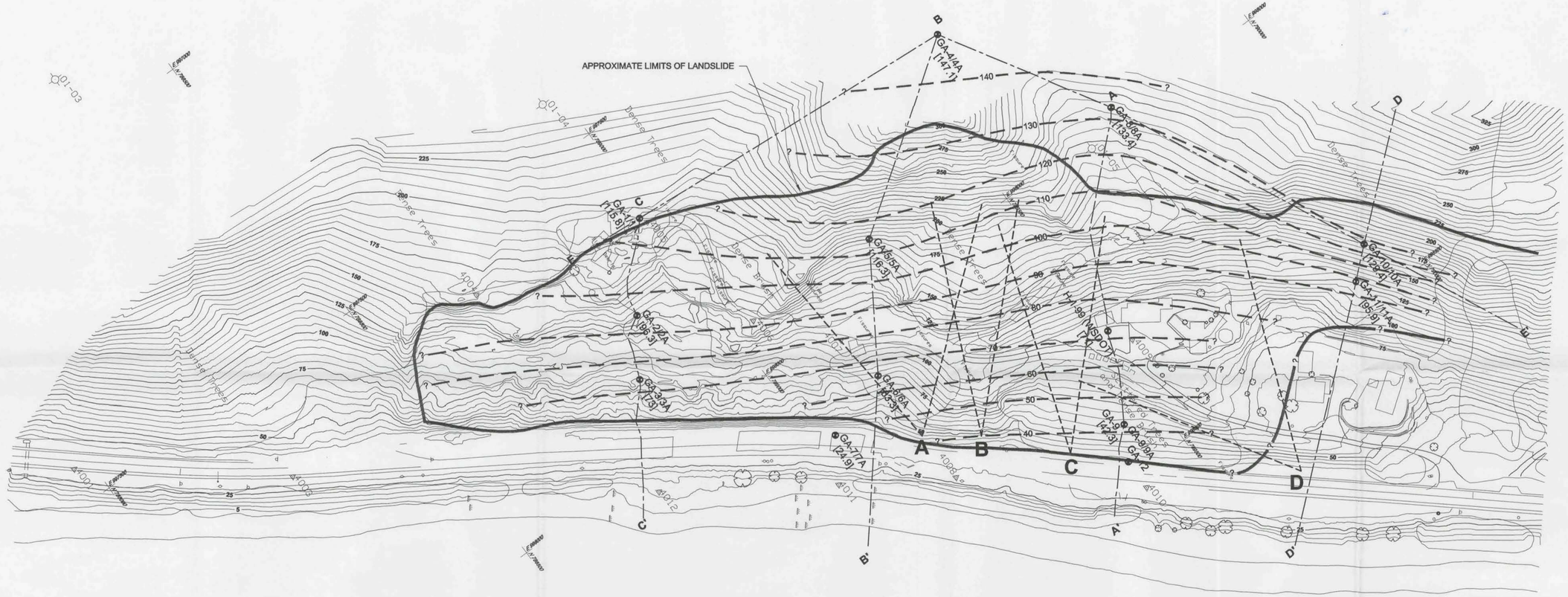
8/3/07

Groundwater flow along contact between glaciolacustrine deposits and granular landslide debris in toe area of MP326 Landslide.

FIGURE **17**

SITE PHOTOGRAPH SHOWING GROUNDWATER FLOW AT TOP OF GLACIOLACUSTRINE DEPOSITS (BASE OF LANDSLIDE DEBRIS) IN TOE AREA OF MP326 LANDSLIDE

WSDOT/MP326/WA



SPECIAL NOTE:
Data concerning the location of the elevation of the various stratigraphic horizons have been obtained at exploration locations only. The interpretation between these locations has been inferred from geologic evidence and so may vary from that shown.

NOTE:
Water levels used to create contour map were collected on July 1, 1999.

N

0 30 60 METERS
0 100 200 FEET

EXPLANATION

B — — B' LOCATION OF GEOLOGIC CROSS SECTION

— 50 — WATER LEVEL ELEVATION CONTOUR (FEET MSL)

GA-6/6A EXPLORATORY BORING LOCATION ("A" DENOTES PIEZOMETER INSTALLED IN ADDITION TO INCLINOMETER)

A APPROXIMATE LOCATION OF HORIZONTAL DRAIN ARRAYS

FIGURE 18
WATER ELEVATION CONTOUR MAP
WSDOT/MP 326/WA

Golder Associates

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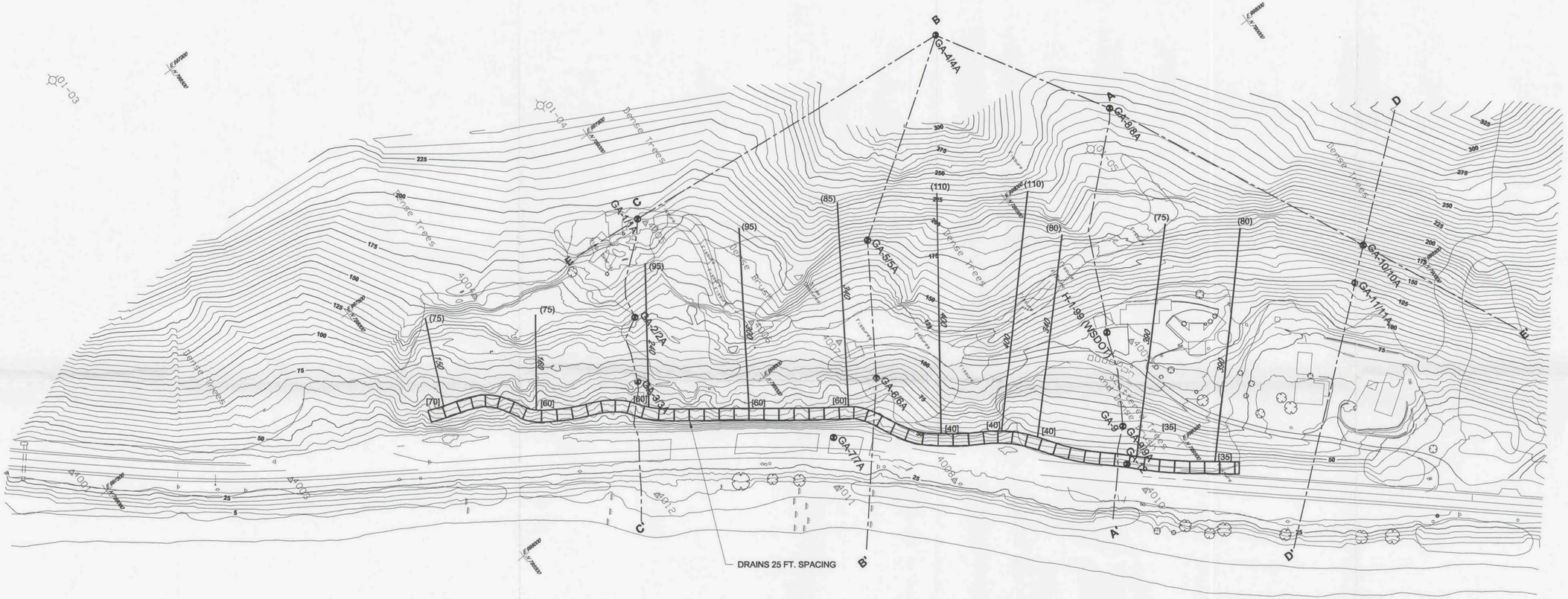

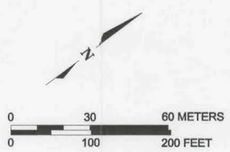

	EXPLANATION
B ——— B'	LOCATION OF GEOLOGIC CROSS SECTION
GA-6/6A	EXPLORATORY BORING LOCATION ("A" DENOTES PIEZOMETER INSTALLED IN ADDITION TO INCLINOMETER)
[60]	COLLAR ELEVATION (FEET)
(95)	DRAIN TIP ELEVATION (FEET)
300	DRAIN LENGTH (FEET)

FIGURE **19**

LOWER DRAIN COLLAR ZONE

WSDOT/MP 326/WA

Golder Associates

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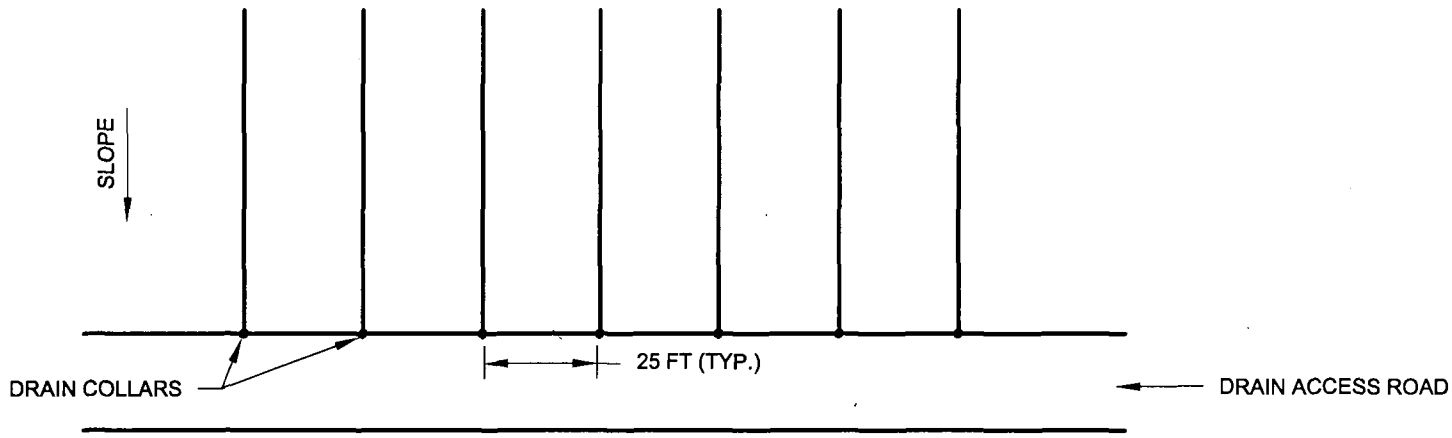
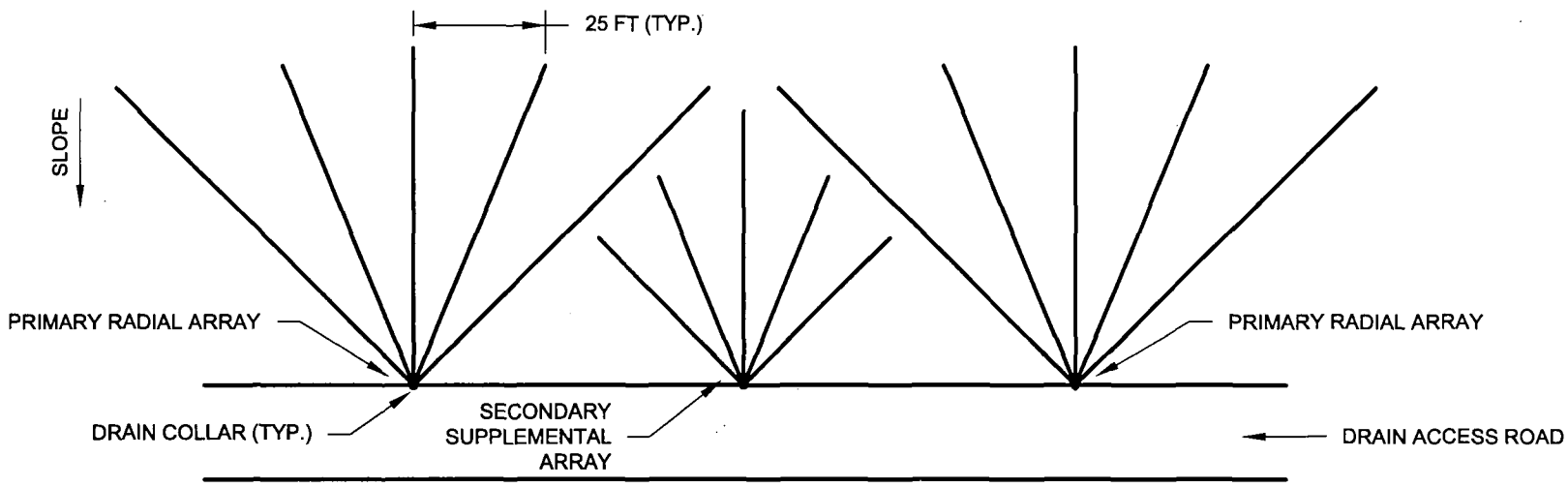


A. LINEAR DRAIN LAYOUT



B. RADIAL DRAIN ARRAY LAYOUT

FIGURE **20**

CONCEPTUAL DRAIN LAYOUTS

WSDOT/MP 326/WA

EXPLANATION

B ——·—— B'	LOCATION OF GEOLOGIC CROSS SECTION
GA-6/6A	EXPLORATORY BORING LOCATION ("A" DENOTES PIEZOMETER INSTALLED IN ADDITION TO INCLINOMETER)
[60]	COLLAR ELEVATION (FEET)
(95)	DRAIN TIP ELEVATION (FEET)
300	DRAIN LENGTH (FEET)
(shaded area)	AREA TO BE GRADED AND STABILIZED

FIGURE **21**

UPPER DRAIN COLLAR ZONE AND AREA TO BE GRADED AND STABILIZED

WSDOT/MP 326/WA

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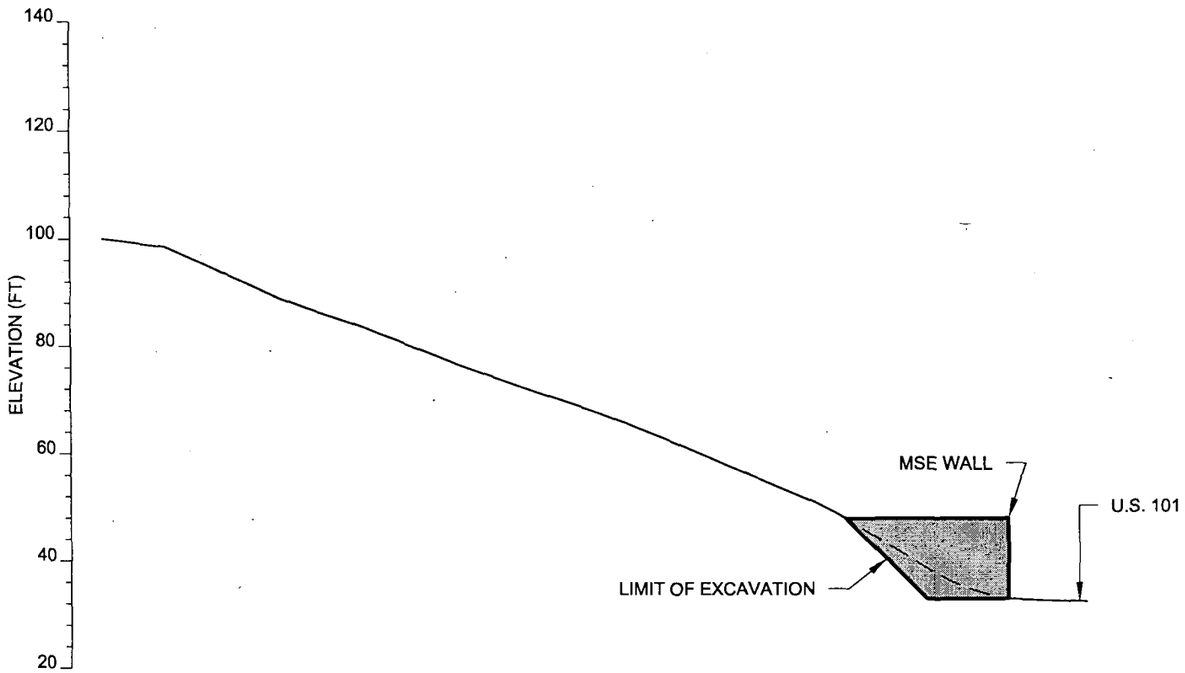
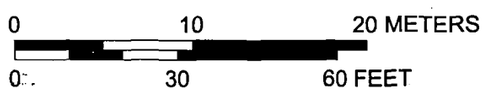
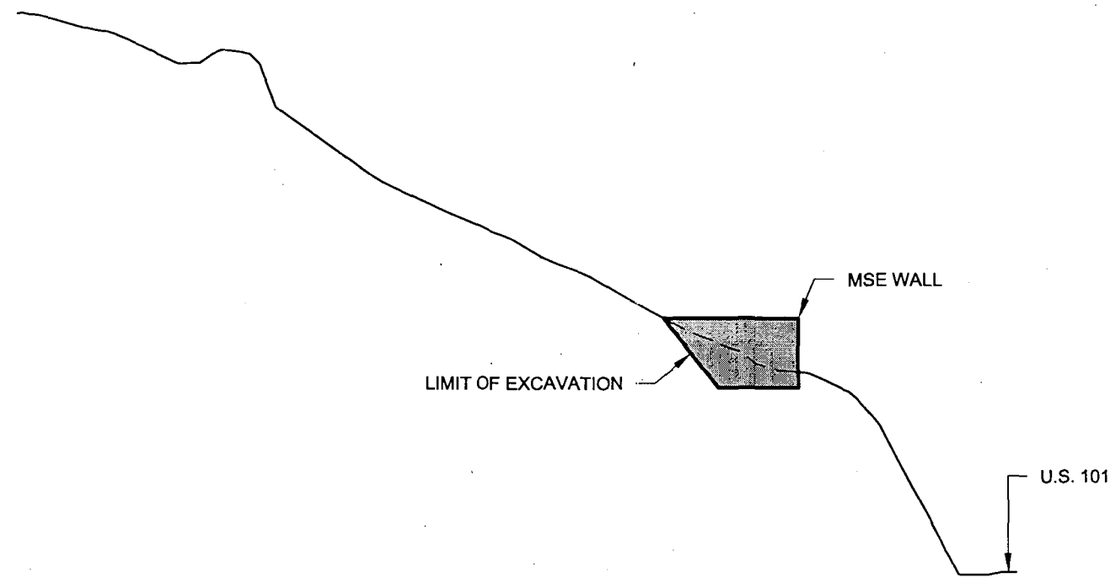
Golder Associates



A) TOE OF SLIDE AT ROAD - TYPICAL MSE BUTTRESS





B) TOE OF SLIDE ABOVE ROAD

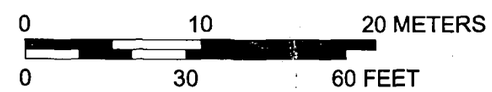


FIGURE **22**

TYPICAL MSE WALL BUTTRESS

WSDOT/MP 326/WA

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Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-1

BORING LOCATION: South line, upper hole

SHEET 1 **OF** 5

DATUM: MSL

BORING DATE: 4/30-5/4/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp ⊢ W ⊣ Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
					191.0							
0	HWT Casing Advancer with Spade Bit	Compact, pinkish orange, nonstratified, fine to coarse SAND and fine to coarse subangular to rounded GRAVEL, trace silt, moist (FILL)			0.0						PVC Stickup 0.0 feet A+A - slots @ N71°W	2.25 inch Inclinometer Casing
5						1	SS	8-7-7	14	0.6/1.5	■	
					184.0							Lime/ Cement Grout
		Compact, pinkish orange to light olive brown, nonstratified to crudely bedded, fine to coarse SAND and fine to coarse subrounded to rounded GRAVEL, trace silty clay, varies to sandy fine to coarse subrounded GRAVEL, little clayey silt, moist to wet (GLACIOFLUVIAL DEPOSIT)	SW-GM		7.0							
10						2	SS	6-10-11	21	1.0/1.5	■	
15						3	SS	11-14-11	25	1.0/1.5	■	
					173.0							
		Dense to very dense, light olive brown, stratified, fine to coarse SAND, little to some silt to clayey silt, little to some fine to coarse subrounded to rounded gravel, contains interbeds of fine SAND, little silt ranging to fine sandy SILT, occasional open frameworks fine to coarse GRAVEL interbeds observed in samples, moist to wet (may be minor perched water or drill fluids) (GLACIOFLUVIAL DEPOSIT)	SM		18.0							
20						4	SS	12-25-30	55	0.7/1.5		■→
25						5	SS	10-24-31	55	0.7/1.5		■→
30												

Log continued on next page

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: FSM/JDC

CHECKED:

DATE: 7/1/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-1

BORING LOCATION: South line, upper hole

DATUM: MSL

BORING DATE: 4/30-5/4/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT
30	HWT Casing Advancer with Spade Bit	Dense to very dense, light olive brown, stratified, fine to coarse SAND, little to some silt to clayey silt, little to some fine to coarse subrounded to rounded gravel, contains interbeds of fine SAND, little silt ranging to fine sandy SILT, occasional open frameworks fine to coarse GRAVEL *interbeds observed in samples, moist to wet (may be minor perched water or drill fluids)* (GLACIOFLUVIAL DEPOSIT)	SM-SW			6	SS	8-18-28	46	1.0/1.5
35		@37.0': No groundwater in boring after ~4 hours				7	SS	5-13-22	35	0.5/1.5
40			SP/ML			8	SS	22-35-50/5"	>50	1.3/1.5
45						9	SS	25-28-47	75	1.1/1.5
50						10	SS	25-27-22	49	1.1/1.5
55	HQ Casing Advancer	Compact, olive brown, nonstratified, subrounded to rounded fine to coarse GRAVEL, some fine to coarse sand, little clayey silt, moist (GLACIOFLUVIAL DEPOSIT)	GW-GM		138.0 / 53.0	11	SS	8-6-15	21	0.7/1.5
60		Very dense, light olive brown to grayish brown, nonstratified, fine to coarse SAND, little fine to coarse, subangular to rounded gravel, trace silt, damp to moist (GLACIOFLUVIAL DEPOSIT)	SW		132.5 / 58.5					

Log continued on next page

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT (Wp — W — Wl)

PIEZOMETER GRAPHIC / WATER LEVEL

2.25 inch Inclinometer Casing

Lime/ Cement Grout

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: FSM/JDC

CHECKED:

DATE: 7/1/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-1

BORING LOCATION: South line, upper hole

DATUM: MSL

BORING DATE: 4/30-5/4/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp 20 W 40 60 Wl 80 100)	PIEZOMETER GRAPHIC / WATER LEVEL
60	HQ Casing Advancer with Spade Bit	Very dense, light olive brown to grayish brown, nonstratified, fine to coarse SAND, little fine to coarse, subangular to rounded gravel, trace silt, damp tp moist (GLACIOFLUVIAL DEPOSIT)	SW			12	SS	33-50/5	>50	0.6/0.9		2.25 inch Inclinometer Casing
65						13	SS	25-30-30	60	0.5/1.5		Lime/ Cement Grout
		Compact to very dense, light olive gray to light olive brown or brownish orange, interbedded to laminated, fine SAND, trace to little silt, and SILT, some fine sand, varies to silty fine SAND, iron oxide staining observed, wet (GLACIOFLUVIAL/GLACIOLACUSTRINE TRANSITIONAL DEPOSIT)	SM/ ML		123.0 / 68.0							5/3/99 ATD 70.1' bgs BOH@113.6
70						14	SS	18-30-50/4"	>50	1.1/1.5		
75						15	SS	8-8-9	17	1.1/1.5	■	5/4/99 ATD 75.2' bgs BOH@126.5
80		80.0': 1 to 2 inch thick fractures observed infilled with silt				16	SS	4-7-11	18	1.5/1.5	■	
		Hard, light olive gray, nonstratified, SILT, moist to wet (GLACIOLACUSTRINE DEPOSIT)	ML		108.0 / 83.0							
85		86.0-86.2': Very soft (Slide plane?)				17	SS	15-27-50/5"	>50	1.5/1.5	29.7 (28 39)	
		Very dense, light gray to light olive brown, nonstratified, silty fine to coarse SAND, some fine subrounded gravel, varies to fine to coarse subrounded GRAVEL, trace medium to coarse sand, moist to wet (GLACIOFLUVIAL DRIFT)	SM-GW		103.0 / 88.0							
90		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: FSM/JDC

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-1

BORING LOCATION: South line, upper hole

SHEET 4 **OF** 5

DATUM: MSL

BORING DATE: 4/30-5/4/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — w — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
90	HQ Casing Advancer with Spade Bit	Very dense, light gray to light olive brown, nonstratified, silty fine to coarse SAND, some fine subrounded gravel, varies to fine to coarse subrounded GRAVEL, trace medium to coarse sand, moist to wet (GLACIOFLUVIAL DRIFT)	SM-GW			18	SS	50/4	>50	0.1/0.3		2.25 inch Inclinometer Casing
95						19	SS	50/2	>50	0.1/0.2		Lime/ Cement Grout
		Hard, light gray, nonstratified, SILTY CLAY, trace coarse subrounded sand, trace fine rounded gravel (dropstones), moist (GLACIOLACUSTRINE DEPOSIT)	CL		93.0 / 98.0							
100						20	SS	50/3	>50	0.2/0.25		
		Very dense, light gray, nonstratified, silty fine to corse SAND, little fine subrounded gravel, moist (GLACIOFLUVIAL DRIFT)	SM		88..0 / 103.0							
105		105.5-106.5': Boulder				21	SS	50/5	>50	0.3/0.4		
						21A	C	NA				
		Hard, light olive to olive gray, nonstratified, CLAYEY SILT, moist (GLACIOLACUSTRINE DEPOSIT)	CL		83.0 / 108.0							
110						22	SS	29-48-50/2	>50	1.2/1.2		
115	HQ Core	Hard, massive to laminated, jointed, SILTY CLAY to CLAY, contains thin (<1 cm) zones of hard angular CLAY fragments (due to sampling) and very thin (1-2 mm) polished, planar, faintly slickensided surfaces oriented perpendicular to axis of sampler (GLACIOLACUSTRINE DEPOSIT)	CL		77.5 / 113.5							
		ppen >4.5 tsf				23	SS	14-31-50/5"	>50	1.5/1.5		
						23A	C	NA		4/5		
120		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: FSM/JDC

CHECKED:

DATE: 7/1/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-1

BORING LOCATION: South line, upper hole

SHEET 5 **OF** 5

DATUM: MSL

BORING DATE: 4/30-5/4/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
120	HQ Core	Hard, massive to laminated, jointed, SILTY CLAY to CLAY, contains thin (<1 cm) zones of hard angular CLAY fragments (due to sampling) and very thin (1-2 mm) polished, planar, faintly slickensided surfaces oriented perpendicular to axis of sampler (GLACIOLACUSTRINE DEPOSIT)	CL			23A	C	NA		4/5		
						24	SS	16-26-50	76	1.5/1.5	25 (24–44)	
						24A	C	NA		4/5		2.25 inch Inclinometer Casing
125						25	SS	22-50/6	>50	0.7/1.0		
						25A	C	NA		4/5		Lime/ Cement Grout
130		Very dense, olive gray to light grayish green, nonstratified, SILTY CLAY, some subangular to rounded fine to coarse gravel, trace sand, varies to fine to coarse SAND, little to some subangular to rounded fine to coarse gravel, little to some clayey silt, trace boulders and cobbles throughout, damp to moist (GLACIOFLUVIAL DRIFT)	CL		61.0 / 130.0							
						26	SS	36-50/5	>50	0.9/0.9		
						26A	C	NA		3.5/5		
135						27	SS	50/5	>50	0.4/0.4		
						28	C	NA		4.5/5		
140		Very dense, light olive brown, interbedded, fine to medium SAND, little silt, trace fine subrounded gravel and fine SAND, trace to little silt, moist to wet (GLACIOFLUVIAL DRIFT)			50.0 / 141.0							
						29	C	NA		2.0/2.4		
		Very dense, olive gray to light grayish green, nonstratified, SILTY CLAY, some subangular to rounded fine to coarse gravel, trace sand, varies to fine to coarse SAND, little to some subangular to rounded fine to coarse gravel, little to some clayey silt, trace boulders and cobbles throughout, damp to moist (GLACIOFLUVIAL DRIFT)	CL		47.5 / 143.5							
145					144.0							
150												

Total depth 144 ft bgs

Note: Inclinometer casing installed to ~144.0.' Top of casing at ground surface

A-axis bearing N71°W

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: FSM/JDC

CHECKED:

DATE: 7/1/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-1A

BORING LOCATION: South line, upper hole

DATUM: MSL

BORING DATE: 5/4-5/5/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
					191.0 / 0.0							
0	HWT Casing Advancer/Tri-Cone Bit	Boring was speed drilled to install piezometer. See log for GA-1 for detailed soil description									PVC casing stickup 1.4'	
5												Bentonite
10												
15												
20	HQ Casing Advancer											
25												1.5-inch I.D. PVC Riser.
30		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: JDC/FSM

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-1A

BORING LOCATION: South line, upper hole

DATUM: MSL

BORING DATE: 5/4-5/5/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ 0 10 20 30 40 50 / WATER CONTENT, PERCENT Wp W Wl	PIEZOMETER GRAPHIC / WATER LEVEL
30	HQ Casing Advancer											1.5-inch I.D. PVC Riser; Bentonite
35												
40												
45												
50												
55												
60		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: JDC/FSM

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-1A

BORING LOCATION: South line, upper hole

DATUM: MSL

BORING DATE: 5/4-5/5/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
60	HQ Casing Advancer											1.5-inch I.D. PVC Riser; Bentonite
65												10/20 Silica Sand
70		71.0': Drill action suggests iner grained soils										6/15/99 73.69' bgs
75												1.5-inch I.D. PVC Screen
80		82.5': Color change in drill fluid from light brown to gray										
85						1	SS	50/5		.4/.4		
90		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: JDC/FSM

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-1A

BORING LOCATION: South line, upper hole

SHEET 4 **OF** 4

DATUM: MSL

BORING DATE: 5/4-5/5/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp ⊙W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
90	HQ Casing Advancer											10/20 Silica Sand; 1.5-inch I.D. PVC Screen
95		95.0-96.0': Very hard drilling (cobble?)			95.0							1.5-inch I.D. PVC Riser
		Total depth 96.0 ft bgs			96.0							
100												
105												
110												
115												
120												

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: JDC/FSM

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

RECORD OF BOREHOLE GA-2

SHEET 1 **OF** 4

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** South Line, Middle Hole

BORING DATE: 4/28-4/29/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0–50) / WATER CONTENT, PERCENT (Wp–W–Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
					137.2							
0	HWT Casing Advancer - Spade Bit	Loose to compact, light olive brown, stratified, fine to coarse, subrounded to rounded GRAVEL, trace sand, trace silt, ranging to fine to coarse SAND, little rounded fine gravel, trace silt and fine to medium SAND, trace to little silt, upward fining and coarsening sequences common, moist (GLACIOFLUVIAL LANDSLIDE DEBRIS)			0.0						Casing S.U. 2.0' A + A — slots @ N78W; PVC Stickup 2.0 feet	2.25 inch Inclinometer Casing
5						1	SS	5-5-5	10	0.2/1.5		Lime/ Cement Grout
10		10.0': Becomes wet; Note: Diminished drill fluid returns suggests open fractures present				2	SS	7-11-14	25	1.1/1.5		
15		17.0': Gravelly drilling				3	SS	8-9-17	26	1.0/1.5		
					118.2							
20		Dense, reddish brown to light olive brown, thickly interbedded, fine to coarse GRAVEL, trace to some fine to coarse sand, trace silt, varies to fine to coarse SAND, little to some subangular to *rounded fine to coarse gravel, trace silt*, occasional interbeds of laminated fine SAND, trace silt, contacts commonly gradational, moist to wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	GW/ SM		19.0	4	SS	8-17-21	38	1.0/1.5		
25						5	SS	13-20-22	42	0.2/1.5		
30		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: FSM/JDC

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

RECORD OF BOREHOLE GA-2

SHEET 2 **OF** 4

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** South Line, Middle Hole

BORING DATE: 4/28-4/29/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — w — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HWT Casing Advancer - Spade Bit	Dense, reddish brown to light olive brown, thickly interbedded, fine to coarse GRAVEL, trace to some fine to coarse sand, trace silt, varies to fine to coarse SAND, little to some subangular to rounded fine to coarse gravel, trace silt, occasional interbeds of laminated fine SAND, trace silt, contacts commonly gradational, moist to wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	GW-SP			6	SS	11-19-15	34	1.1/1.5	■	2.25 inch Inclinometer Casing
					104.7 / 33.0							
35		Compact, light olive brown to brownish black, interbedded, fine to coarse subrounded to rounded GRAVEL, some fine to coarse sand, trace silt and laminated fine to medium SAND, trace to little silt, contacts are gradational, coarsening upward sequences common, occasional hard (ppen >4.5 tsf) thin (~1 cm) interbeds of laminated CLAYEY SILT, mosit to wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	GW-SP			7	SS	12-10-15	25	1.1/1.5	■	Lime/ Cement Grout
40						8	SS	13-12-13	25	1.2/1.5	■	
					93.7 / 43.5							
45		Compact, light olive gray to light olive brown, interbedded, laminated fine to medium SAND, trace to little silt, trace subrounded faceted gravel, *varies to fine SAND and SILT, occasional* interbeds of CLAYEY SILT to 1 cm thick, wet, bedding orientation is ~90° wrt sampler axis, some FeOx staining observed along laminae @ ~45', well defined fining upward sequences, sand *infilled fracture observed at 55', oriented <20° wrt* sampler axis (TRANSITIONAL LANDSLIDE DEBRIS)	SP-ML			9	SS	7-10-9	19	1.0/1.5	■	
50						10	SS	7-8-7	15	0.8/1.5	■	
55						11	SS	6-9-12	21	1.1/1.5	■	
60		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: FSM/JDC

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

RECORD OF BOREHOLE GA-2

SHEET 3 **OF** 4

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** South line, Middle Hole

BORING DATE: 4/28-4/29/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0–50) / WATER CONTENT, PERCENT (Wp, W, Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
60	HWT Casing Advancer - Spade Bit	*Compact, light olive gray to light olive brown,* interbedded, laminated fine to medium SAND, trace to little silt, trace subrounded faceted gravel, varies to fine SAND and SILT, occasional interbeds of CLAYEY SILT to 1 cm thick, wet, *bedding orientation is ~90° wrt sampler axis,* some FeOx staining observed along laminae @ ~45', well defined fining upward sequences, sand infilled fracture observed at 55', oriented <20° wrt sampler axis (TRANSITIONAL LANDSLIDE DEBRIS)	SP-SM/ ML			12	SS	5-8-11	19	1.0/1.5	■	2.25 inch Inclinometer Casing
65		65.0': Some mottling and fractures observed in SS#13				13	SS	6-8-11	19	1.1/1.5	■	Lime/ Cement Grout
					68.2 / 69.0							
70	HQ Casing Advancer - Spade Bit	Very stiff to hard, light olive brown, laminated SILTY CLAY, wet, ~3" thick zone of soft SILTY CLAY with hard angular, polished SILTY CLAY, clasts observed at ~75.0' (GLACIOLACUSTRINE DEPOSIT)	CL-CH			14	SS	16-25-49	74	1.5/1.5		
		@ 72.5: Varies to SILT (ML)										
		ppen: 1.5-2.5 tsf				15	SS	4-7-11	18	1.5/1.5	■ 33.4 (27–37)	
75						15A	C	NA				
					61.2 / 76.0							
	HQ Core	Very dense, light olive gray to dark olive, nonstratified to crudely/thickly bedded, fine to coarse, subangular to subrounded GRAVEL, little to some silt, trace to little fine to coarse sand, cobbles and small boulders observed in core runs between split spoon samples, varies to silty fine to coarse SAND, little fine subrounded gravel, moist to wet (GLACIOFLUVIAL DRIFT)	GW-GM			16	SS	50/3	>50	0/0.25		
						16A	C	NA				
80						17	SS	50/3	>50	0.2/0.25		
85						17A	C	NA				
						18	SS	50/4	>50	0.3/0.3		
						18A	C	NA				
90		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: FSM/JDC

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

RECORD OF BOREHOLE GA-2

SHEET 4 **OF** 4

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** South Line, Mimddle Hole

BORING DATE: 4/28-4/29/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
90	HQ Core	Very dense, light olive gray to dark olive, nonstratified to crudely/thickly bedded, fine to coarse, subangular to subrounded GRAVEL, little to some silt, trace to little fine to coarse sand, cobbles and small boulders observed in core runs between split spoon samples, varies to silty fine to coarse SAND, little fine subrounded gravel, moist to wet (GLACIOFLUVIAL DRIFT)	GW-GM									
						19	SS	35-50/2	>50	0.3/0.7		2.25 inch Inclinometer Casing
						19A	C	NA				
95						20	SS	50/2	>50	0.0/0.2		
						20A	C	NA				Lime/ Cement Grout
					37.7 / 99.5							
100		Hard, dark olive, laminated to nonstratified, CLAYEY SILT, little fine subrounded to rounded gravel with interbeds of laminated SILTY CLAY, trace fine sand, trace organic laminae, moist to wet, well developed gravel sockets (GLACIOFLUVIAL DRIFT/GLACIOLACUSTRINE DEPOSIT)	CL-ML		35.4 / 101.8	21	SS	50/4	>50	0.3/0.3		
		Total depth sampled 101.8 ft bgs										
		A-axis bearing 78°E										
105												
110												
115												
120												

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: FSM/JDC

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

RECORD OF BOREHOLE GA-2A

SHEET 1 **OF** 3

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** South line, middle hole

BORING DATE: 4/29-4/30/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
					~137.0							
0	HWT Casing Advancer - Spade Bit	Boring was speed dilled to 62 ft. See log for GA-2 for detailed soil description			0.0						P.V.C. S.U. 3.0'	1.5-inch Sch.40 I.D. PVC Riser; Bentonite
5												
10												
15												
20												
25												
30		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury

LOGGED: JDC

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

RECORD OF BOREHOLE GA-2A

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** South line, middle hole

BORING DATE: 4/29-4/30/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HWT Casing Advancer - Spade Bit											1.5-inch I.D. Sch.40 PVC Riser
35												Bentonite
40												▼ 39.74 bgs 6/15/99
45												
50												
55												10-20 Silica Sand
60		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury

LOGGED: JDC

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

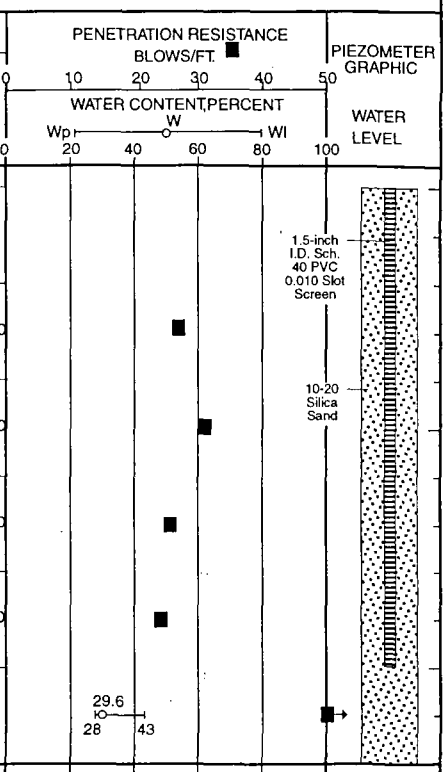
RECORD OF BOREHOLE GA-2A

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** South line, middle hole

BORING DATE: 4/29-4/30/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer, 30 inch drop)	N	REC/ATT
60	HWT Casing Advancer - Spade Bit									
		Compact to dense, light olive brown, tan and light olive gray, laminated, mottled, fine SAND, little to some silt, trace hard CLAYEY SILT laminae and coarse sand sized clasts observed between 64' and 69.5', wet, laminae commonly subhorizontal (LANDSLIDE DEBRIS)	SM		75.0 / 62.0	1	SS	8-13-14-22	27	2.0/2.0
65						2	SS	10-14-17-27	31	2.0/2.0
						3	SS	6-11-16-21	27	2.0/2.0
						4	SS	6-11-13-22	24	2.0/2.0
70		Hard, light olive gray, subhorizontally laminated, SILTY CLAY, trace coarse subrounded gravel (dropstones), varies to silt, moist (GLACIOLACUSTRINE DEPOSIT)	CL-ML		67.5 / 69.5	5	SS	5-25-35-50/6	60	
		Boring terminated 72.0 ft bgs			65.0 / 72.0					
75										
80										
85										
90										



DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury

LOGGED: JDC

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

RECORD OF BOREHOLE GA-3

SHEET 1 **OF** 2

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** South line, lower hole

BORING DATE: 4/27-4/28/99

DEPTH FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT
					81.3					
0	HWT Casing Advancer	*Loose, brown, nonstratified to weakly stratified,* silty fine to coarse SAND, some fine to coarse gravel and cobbles, damp (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SM		0.0					
5						1	SS	1-1-1	2	0.0/1.5
		Loose, mottled light olive brown and dark brown, weakly stratified, fine to medium SAND, trace fine subrounded gravel, trace organics in thin laminae, wet (TRANSITIONAL LANDSLIDE DEBRIS)	SM		72.3 / 9.0					
10						2	SS	5-3-2	5	0.4/1.5
15		Compact, light to olive brown, stratified, fine to medium SAND, little silt grading to silty fine SAND, wet (TRANSITIONAL LANDSLIDE DEBRIS)	SM		66.6 / 14.7					
						3	SS	5-5-6	11	1.0/1.5
20		Hard, gray, stratified, SILT, moist to wet, contains thin interbeds of fine sand (GLACIOLACUSTRINE DEPOSIT)	ML		61.3 / 20.0					
		Hard, gray, massive, SILTY CLAY, to CLAYEY SILT, moist to wet (GLACIOLACUSTRINE DEPOSIT)	CL		59.3 / 22.0	4	SS	12-26-50/4	>50	1.3/1.3
25						5	SS	50-25-50/6	75	1.5/1.5
		Hard, gray, massive, SILTY CLAY, trace fine subrounded gravel, moist (GLACIOLACUSTRINE DEPOSIT)	CL		52.3 / 29.0					
30		*Log continued on next page*								

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT: Wp ⊢—o W—⊣ Wl

PIEZOMETER GRAPHIC / WATER LEVEL

PVC Stickup 2.65 feet
A+A - slots @ N70°W

2.25 inch Inclinometer Casing

Lime/ Cement Grout

Wp 19, W 30, Wl 39

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

RECORD OF BOREHOLE GA-3

SHEET 2 **OF** 2

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** South line, lower hole

BORING DATE: 4/27-4/28/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp W Wl; 0 20 40 60 80 100)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HWT Casing Advancer	Hard, gray, massive, CLAY, trace fine subrounded gravel, moist (GLACIOLACUSTRINE DEPOSIT)	CL									
						6	SS	22-50-50/2	>50	1.2/1.2	22.7 (26–44)	
					47.3 / 34.0							2.25 inch Inclinometer Casing
35		Very dense, grayish brown, nonstratified, silty fine to coarse SAND, some fine to coarse subrounded gravel, moist to wet (GLACIOFLUVIAL DRIFT)	SM									
						7	SS	50/2	>50	0.1/0.2		
												Lime/ Cement Grout
					42.3 / 39.0							
40		Very dense, light olive gray, nonstratified, silty fine to coarse SAND, some fine to coarse subrounded and subangular gravel, wet (GLACIOFLUVIAL DRIFT)	SM									
						8	SS	50/4	>50	0.3/0.3		
45					36.3 / 45.0							
		Very dense, olive gray, nonstratified, silty, fine to coarse GRAVEL, some fine to coarse sand, wet (GLACIOFLUVIAL DRIFT)	ML									
						9	SS	40-50/2	>50	0.7/0.7		
50		49.5': Increase in gravel, decrease in silty and sand										
					29.8	10	SS	50/5	>50	0.4/0.4		
		Total depth 51.5 ft bgs Groundwater encountered <11 ft Inclinometer (2.25" ID at 51.5 ft) A-axis bearing N70°W			51.5							
55												
60												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: M.S.

CHECKED: R. Luark

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

RECORD OF BOREHOLE GA-3A

SHEET 1 **OF** 1

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** South line, lower hole

BORING DATE: 4/28/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp ⊢—○W—⊣ Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
					81.3							
0	HWT Casing Advancer	Boring was speed drilled to install piezometer. See log for GA-3 for detailed soil description			0.0						P.V.C. S.U. 3.3'	Bentonite; 1.5" I.D. Sch. 40 PVC Riser; 8.18' bgs 6/15/99; 10-20 Silica Sand; 1.5" I.D. Sch. 40 PVC 0.010 slot screen
5												
10												
15												
20						1	SH	Push	N/A	1.2/1.2		
		Total Depth 23.0										
25												
30												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole

BORING DATE: 5/18-5/27/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer, 30 inch drop)	N	REC/ATT
					347.9 / 0.0					
0	HWT Casing Advancer	Compact, light reddish brown, nonstratified to thickly bedded, subrounded to rounded GRAVEL, *some fine to coarse sand, little clayey silt, moist,* drill action suggests presence of cobbles and occasional boulders (GLACIOFLUVIAL DEPOSIT)	GM							
5						G	1	N/A		N/A
10						1	SS	5-10-9	19	0.7/1.5
		13 to 15.5' SAND interbed based on drill action								
15		Stiff to hard, olive brown, faintly laminated to massive slightly iron oxide stained CLAY to SILTY CLAY, trace sand, trace to little angular gravel, damp to moist, contains randomly oriented, discontinuous, planar, iron oxide stained surfaces (joints) with very faint lineations (slickensides?) creating a blocky texture, ppen 2.5 tsf to >4.5 tsf (GLACIOLACUSTRINE DEPOSIT)	CH		332.4 / 15.5					
20						2	SS	12-22-21	43	1.3/1.5
25						3	SS	10-7-8	15	0.7/1.5
		Dense to very dense, olive brown, nonstratified, fine to coarse, subrounded to rounded GRAVEL, some sand, trace silt, ranging to silty SAND, some rounded gravel, wet (GLACIOFLUVIAL DEPOSIT)	GW/SM		319.4 / 28.5					
30		Log continued on next page								

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT: Wp ⊢—o W—⊣ Wl

PIEZOMETER GRAPHIC / WATER LEVEL

PVC Stickup 1.56 feet
A+A- Slots @ N54°W

2.25 inch Inclinometer Casing

Lime/ Cement Grout

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/CAV

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole

BORING DATE: 5/18-5/27/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HWT Casing Advancer	Dense to very dense, olive brown, nonstratified, fine to coarse, subrounded to rounded GRAVEL, some sand, trace silt, ranging to silty SAND, some rounded gravel, wet (GLACIOFLUVIAL DEPOSIT)	GW/ SM			4	SS	30-50/2"	>50	0.5/0.7		2.25 inch Inclinometer Casing
35												Lime/ Cement Grout
40						5	SS	7-14-26	40	0.7/1.5	■	
45						6	SS	18-41-29	70	1.0/1.5		
50												
55						7	SS	37-50-41	91	1.2/1.5	○ 13	
		@~57.0': Increase in sand content in drill fluid, smooth drill action, decrease in SILT/CLAY content to trace										
60		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: Mocker/Valentine

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole **BORING DATE:** 5/18-5/27/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp ○ W ○ Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
60	HWT Casing Advancer	61.0-65.0': Drill action suggests presence of coarse gravel and cobbles with an occasional boulder	GW/ SM			8	SS	29-50/2"	>50	0.5/0.7		2.25 inch Inclinometer Casing
65		@66.0': Possible SAND heave										Lime/ Cement Grout
	HQ Casing Advancer	Hard, reddish brown, nonstratified, subangular to rounded, fine to coarse GRAVEL, little sand, little clay, damp, some gravel clasts are faceted, some are completely weathered or FeOx stained, well developed clay sockets (TILL)	CH		278.9 / 69.0							
70						9	SS	12-15-23	38	1.2/1.5	○ 11 ■	
		Dense to very dense, reddish brown to light olive brown, nonstratified to thickly bedded, fine coarse subrounded to rounded GRAVEL and fine to coarse SAND, trace to little silt/clay, trace to little cobble, trace boulder, ranges to sandy GRAVEL, *FeOx staining observed, some gravel clasts* (granitic) are completely weathered, moist to wet (GLACIOFLUVIAL DEPOSIT)	GW-GM		274.4 / 73.5							
75						10	SS	30-46-50	96	0.8/1.3		■→
	HQ Core (Diamond Core Bit)					11	C	N/A	N/A	1.5/2.7		5/27/99 ATD 80.5' bgs BOH@ 268.0'
80												▼ ▼ 5/1/99 ATD 80.9' bgs BOH@ 112.0'
85						12	C	N/A	N/A	1.7/4.5		
						13	SS	20-37-50	87	0.8/1.3		■→
						14	C	N/A	N/A	2.9/4.2		▼ 5/26/99 ATD 88.5' bgs BOH@ 210.0'
90		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/CAV

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4

DATUM: MSL

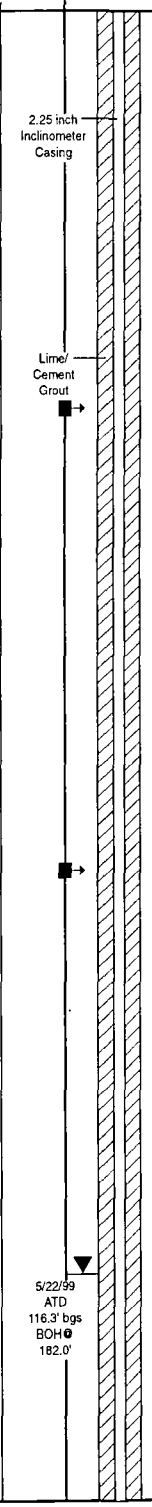
PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole **BORING DATE:** 5/18-5/27/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT
90	HQ Core (Diamond Core Bit)	Dense to very dense, reddish brown to light olive brown, nonstratified to thickly bedded, fine coarse subrounded to rounded GRAVEL and fine to coarse SAND, trace to little silt/clay, trace to little cobble, trace boulder, ranges to sandy GRAVEL, FeOx staining observed, some gravel clasts (granitic) are completely weathered, moist to wet (GLACIOFLUVIAL DEPOSIT)	GW-GM			14	C	N/A	N/A	2.9/4.2
						15	C	N/A	N/A	1.5/1.5
95						16	C	N/A	N/A	2.0/3.5
		@98.0': Increased SILT/CLAY content				17	SS	23-34-46	80	0.7/1.5
100						18	C	N/A	N/A	1.5/3.5
						19	C	N/A	N/A	0.5/2.0
105						20	C	N/A	N/A	1.0/3.0
						21	SS	29-50/6"	>50	0.2/1.0
110						22	C	N/A	N/A	1.4/3.0
						23	C	N/A	N/A	0.0/1.0
115						24	C	N/A	N/A	2.6/5.0
						25	C	N/A	N/A	0.0/5.0
120		Log continued on next page								

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT: Wp ⊢—o W—⊣ Wl

PIEZOMETER GRAPHIC / WATER LEVEL



DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/CAV

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole

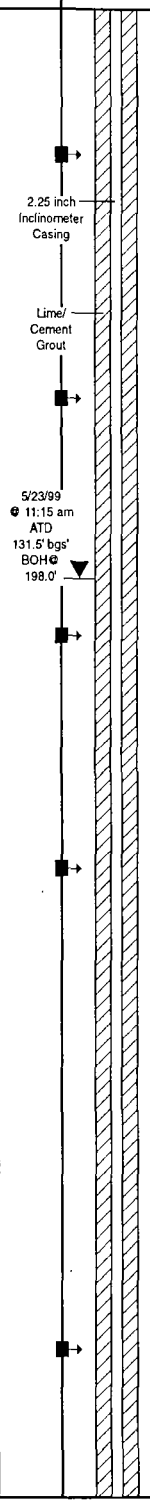
BORING DATE: 5/18-5/27/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT
120	HQ Core (Diamond Core Bit)	Dense to very dense, reddish brown to light olive brown, nonstratified to thickly bedded, fine coarse subrounded to rounded GRAVEL and fine to coarse SAND, trace to little silt/clay, trace to little cobble, trace boulder, ranges to sandy GRAVEL, FeOx staining observed, some gravel clasts (granitic) are completely weathered, moist to wet (GLACIOFLUVIAL DEPOSIT)	GW-GM			25	C	N/A	N/A	0.0/5.0
						26	SS	26-50/2"	>50	0.5/0.8
125		Very dense and hard, olive brown to ligh tolive brown, sometimes with dark gray mottling, *interbedded, SILTY CLAY ranging to CLAYEY* SILT, fine SAND, little to some silt, and SILT, moist to wet, contacts are sharp to gradational, joints observed in clay interbeds (PPEN > 4.5 tsf) (GLACIOLACUSTRINE DEPOSIT?)	CL/SP		222.9 / 125.0	27	C	N/A	N/A	3.5/4.2
						28	SS	26-50	50	0.3/0.7
		Note: By 4:30 pm, water level in boring had dropped to 195' bgs with bottom of hole @ 198'								
130						29	C	N/A	N/A	3.6/4.3
						30	C	42-50/4"	>50	0.8/0.8
135		Very dense, light olive brown to dark olive, fne to coarse, subrounded to rounded GRAVEL and fine to coarse SAND, trace silt/clay, trace cobble, ranges to gravelly, fine to coarse SAND, moist to wet (GLACIOFLUVIAL DEPOSIT)	GW-SW			31	C	N/A	N/A	0.9/4.2
						32	SS	50/5"	>50	0.0/0.4
140						33	C	N/A	N/A	1.7/4.6
145						34	C	N/A	N/A	2.0/5.0
						35	SS	50/4"	>50	0.1/0.3
		Very dense?, olive gray, nonstratified, fine to coarse, subangular to rounded GRAVEL, some clayey silt, trace to little sand, moist (TILL?)			199.4 / 148.5	36	C	N/A	N/A	0.4/5.0
150		Log continued on next page								

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT PERCENT: Wp ⊢—o W—⊣ Wl

PIEZOMETER GRAPHIC / WATER LEVEL



DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/CAV

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole **BORING DATE:** 5/18-5/27/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT
150	HQ Core (Diamond Core Bit)	Very dense?, olive gray, nonstratified, fine to coarse, subangular to rounded GRAVEL, some clayey silt, trace to little sand, moist (TILL?)	GM		196.9 / 151.0	36	C	N/A	N/A	0.4/5.0
		Very dense, light olive brown, nonstratified to thickly bedded, fine to coarse, subrounded to rounded GRAVEL, little to some fine to coarse sand, trace silt/clay. trace cobble, moist to wet, clasts are monolithologic (Shale?) (GLACIOFLUVIAL DEPOSIT)	GW			37	C	N/A	N/A	0.3/5.0
155										
160						38	C	N/A	N/A	0.0/5.0
						39	SS	50/5"	>50	0.3/0.4
165						40	C	N/A	N/A	2.5/5.0
170						41	C	N/A	N/A	2.2/5.0
175						42	C	N/A	N/A	2.0/5.0
						43	SS	50/3"	>50	0.0/0.25
						44	C	N/A	N/A	2.0/5.0
180		Log continued on next page								

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT: Wp ⊢—o W—⊣ Wl

PIEZOMETER GRAPHIC / WATER LEVEL

2.25 inch Inclinometer Casing

Lime/ Cement Grout

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/CAV

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole **BORING DATE:** 5/18-27/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer, 30 inch drop)	N	REC/ATT
180	HQ Core (Diamond Core Bit)	Very dense, light olive brown, nonstratified to thickly bedded, fine to coarse, subrounded to *rounded GRAVEL, little to some fine to coarse* sand, trace silt/clay. trace cobble, moist to wet, clasts are monolithologic (Shale?) (GLACIOFLUVIAL DEPOSIT)	GW/ SW			44	C	N/A	N/A	2.0/5.0
185		Note: Diminished fluid returns while drilling from approximately 187.0-200.0'. had to grout boring while at ~198.0' to stabilize hole and prevent loss of circulation				45	C	N/A	N/A	0.0/5.0
190						46	C	N/A	N/A	0.0/5.0
						47	SS	50/5"	>50	0.3/0.4
195		Hard and very dense, dark olive to light olive brown, interbedded, fine SAND, trace to some silt; SILT, trace to some fine sand, and CLAYEY SILT ranging to SILTY CLAY, wet, joints and laminae common in SILT and CLAY units, minor gravel dropstones suggested by drill action (GLACIOFLUVIAL/GLACIOLACUSTRINE TRANSITIONAL DEPOSIT)	ML/ SP		153.4 / 194.5	48	C	N/A	N/A	4.5/5.0
200	HQ Casing Advancer					49	SS	50/4"	>50	0.2/0.3
205			SM			50	SS	41-50/3"	>50	0.8/0.8
			ML-SP							
210		Log continued on next page								

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT: Wp ⊢—— w ——⊣ Wl

PIEZOMETER GRAPHIC / WATER LEVEL

2.25 inch Inclinometer Casing

Lime/ Cement Grout

5/23/99 @4:30pm

ATD 195' bgs Bottom @ 198.0'

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/CAV

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4

SHEET 8 **OF** 10

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole

BORING DATE: 5/18-5/27/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0–50) / WATER CONTENT, PERCENT (Wp–W–Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
210	HQ Casing Advancer	Hard and very dense, dark olive to light olive brown, interbedded, fine SAND, trace to some silt; SILT, trace to some fine sand, and CLAYEY SILT ranging to SILTY CLAY, wet, joints and laminae common in SILT and CLAY units, minor gravel dropstones suggested by drill action (GLACIOFLUVIAL/GLACIOLACUSTRINE TRANSITIONAL DEPOSIT)	ML/ SP			51	SS	41-50/2"	>50	0.7/0.7	o 25	
215												2.25 inch Inclinometer Casing; Lime/ Cement Grout
220						52	SS	38-50/3"	>50	0.2/0.75		
225												
230						53	SS	41-50/2"	>50	0.2/0.7		
235												
		Hard, gray, massive to laminated CLAY to SILTY CLAY, moist to wet (GLACIOLACUSTRINE DEPOSIT)	CH		109.4 / 238.5							
240		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/CAV

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole

BORING DATE: 5/18-5/27/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp W Wl (0 20 40 60 80 100)	PIEZOMETER GRAPHIC / WATER LEVEL
240	HQ Casing Advancer	Hard, gray, massive to laminated CLAY to SILTY CLAY, contains interbeds of fine, sandy SILT, moist to wet (GLACIOLACUSTRINE DEPOSIT)	CH/ ML			54	SS	32-50/3"	>50	0.7/0.7	24.6 23 28	
												2.25 inch Inclinometer Casing
245						55	SS	50/6"	>50	0.5/0.5		Lime/ Cement Grout
250												
255						56	SS	50/3"	>50	0.0/0.2		
260												
265						57	SS	50/4"	>50	0.3/0.3		
270		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/CAV

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole **BORING DATE:** 5/18-5/27/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp w Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
270	HQ Casing Advancer	Hard, gray, massive to laminated CLAY to SILTY CLAY, contains interbeds of fine, sandy SILT, moist to wet (GLACIOLACUSTRINE DEPOSIT)	CH/ ML									2.25 inch Inclinometer Casing; Lime/ Cement Grout
275					72.2	58	SS	37-50/2"	>50	0.7/0.7	■→	
		Total Depth 275.7' BGS Note: Inclinometer casing installed to ~271.0' BGS A-axis bearing N 83° feet			275.7							
280												
285												
290												
295												
300												

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/CAV

CHECKED:

DATE: 7/2/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4A

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole

BORING DATE: 6/1-6/4/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
0	HWT Casing Advancer	Boring was speed drilled to install piezometer. For detailed geologic log see GA-4 drilled approximately 5 ft west of boring.									P.V.C. S.U. 2.0'	1.5-inch Sch.40 PVC Riser; Bentonite
5												
10												
15												
20												
25												
30		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/CAV

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4A

SHEET 2 **OF** 8

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole

BORING DATE: 6/1-6/4/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HWT Casing Advancer											1.5-inch Sch.40 PVC Riser
35												Bentonite
40												
45												
50												
55												
60		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/CAV

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4A

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole

BORING DATE: 6/1-6/4/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — w — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
60	HWT Casing Advancer											
65												1.5-inch Sch.40 PVC Riser; Bentonite
70												
75												
80												
85												
90		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/CAV

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4A

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole

BORING DATE: 6/1-6/4/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
90	HWT Casing Advancer											1.5-inch Sch.40 PVC Riser
95												Bentonite
100												
105												
110												
115												
120		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/CAV

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4A

SHEET 5 **OF** 8

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole

BORING DATE: 6/1-6/4/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
120	HWT Casing Advancer											1.5-inch Sch.40 PVC Riser
125												Bentonite
130												
135												
140												
145												
150		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/ J. Salisbury

LOGGED: FSM/CAV

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4A

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole

BORING DATE: 6/1-6/4/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp ⊢—o W—⊣ Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
150	HWT Casing Advancer											
155												1.5-inch Sch.40 PVC Riser; Bentonite
160												
165												ATD 68.0 ft bgs BOH @ 165 CSG @ 162
170												
175												
180		*Log continued on next page*										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/CAV

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4A

SHEET 7 **OF** 8

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole

BORING DATE: 6/1-6/4/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — w — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
180	HWT Casing Advancer											Bentonite; 1.5-inch I.D. Sch. 40 PVC Riser
185												10/20 Silica Sand
190												108-208' 1.5-inch Sch.40 PVC Hand Slotted Screen
195												
200												ATD 199.77' bgs 6/15/99
205												
210		Log continued on next page										208-238' 1.5-inch I.D. Sch. 40 PVC 0.010" Slot Screen

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/CAV

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-4A

SHEET 8 **OF** 8

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** Middle Line, Upper Hole

BORING DATE: 6/1-6/4/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
210	HWT Casing Advancer											1.5-inch I.D. Sch. 40 PVC 0.010 Screen; 10/20 Silica Sand
215												
220												
225												
230												
235												1.5-inch Sch. 40 PVC Riser
240		Total depth 240 ft bgs										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: FSM/CAV

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-5

BORING LOCATION: Middle line, middle hole

SHEET 1 **OF** 5

DATUM: MSL

BORING DATE: 5/5-5/8/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer, 30 inch drop)	N	REC/ATT
0	HWT Casing Advancer/Tri-Cone bit	Loose, brown, nonstratified, silty fine to coarse SAND, with some fine to coarse gravel, damp, trace organics to 6-inches (LANDSLIDE DEBRIS)	SM		175.0 / 0.0					
		Compact, dark brownish gray, nonstratified, fine to coarse GRAVEL, some fine to coarse sand, trace silt, wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	GW		172.0 / 3.0					
5						1	SS	16-10-5	15	0.3/1.5
10										
		Loose, light olive brown and reddish brown, nonstratified, silty fine to coarse SAND, little fine subrounded gravel, wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SM		161.0 / 14.0					
15						2	SS	3-4-3	7	0.3/1.5
20		Loose, light olive brown, nonstratified, fine to coarse SAND, little to some clayey silt, trace fine subrounded gravel, wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SM		155.0 / 20.0					
25						3	SS	5-4-5	9	0.25/1.0
30										

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT: Wp — W — Wl

PIEZOMETER GRAPHIC / WATER LEVEL

PVC Stickup 2.5 feet
A+A- Slots @ N50°W

2.25-inch Inclinometer Casing

ATD 5/6/99

Lime/ Cement Grout

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/S. Walker

LOGGED: JDC/MS

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-5

BORING LOCATION: Middle line, middle hole

DATUM: MSL

BORING DATE: 5/5-5/8/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HWT Casing Advancer / Tri-Cone bit	Loose, light olive brown, nonstratified, fine to coarse SAND, little to some clayey silt, trace fine subrounded gravel, wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SM									2.25-inch Inclinometer Casing
35		36.0': Becomes compact with decrease in clayey silt (to little), increase in size and content of gravel (to little, fine to coarse), trace organics				4	SS	10-9-7	16	0.3/1.0	■	Lime/ Cement Grout
40		Compact, light olive brown, nonstratified, fine to coarse SAND, trace fine subrounded gravel, little to some silt, wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SW-SM		135.0 / 40.0							
45						5	SS	8-9-10	19	1.0/1.5	■	
50		51.0': Becomes dense with decrease in sand size (fine to medium) and increase in gravel size (fine to coarse)				6	SS	18-24-25	49	1.0/1.5		■
55		56.0': Becomes compact and weakly stratified. Gravel is absent. 57.0': *One inch of medium to coarse sand*				7	SS	13-10-10	20	1.2/1.5	■	
60												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/S. Walker

LOGGED: JDC/MS

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-5

BORING LOCATION: Middle line, middle hole

SHEET 3 **OF** 5

DATUM: MSL

BORING DATE: 5/5-5/8/99

DEPTH FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — w — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
60	HWT Casing Advancer / Tri-Cone bit	Compact, light olive brown, nonstratified, fine to coarse SAND, trace fine subrounded gravel, little to some silt, wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SW-SM									
						8	SS	26-21-18	39	1.2/1.5	■	2.25-inch Inclinometer Casing
65						9	SS	48-50/3	>50	0.3/0.75		
												Lime/ Cement Grout
70		Very dense, olive brown, stratified, silty fine SAND, wet (TRANSITIONAL LANDSLIDE DEBRIS)	SM		64.5 / 70.0							
						10	SS	26-35-40	75	1.3/1.5		
75						11	SS	13-21-29	50	0.25/1.5		
80						12	SS	19-29-33	62	0.9/1.5		
85						13	SS	29-32-35	67	1.2/1.5		
90												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/S. Walker

LOGGED: JDC/MS

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-5

BORING LOCATION: Middle line, middle hole

DATUM: MSL

BORING DATE: 5/5-5/8/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT Wp W Wl (0 20 40 60 80 100)	PIEZOMETER GRAPHIC / WATER LEVEL
90	HWT Casing Advancer / Tri-Cone bit	Very dense, olive brown, stratified, silty fine SAND, wet (TRANSITIONAL LANDSLIDE DEBRIS)	SM			14	SS	25-30-35	65	0.9/1.5		2.25 inch Inclinometer Casing
95						15	SS	26-36-32	68	1.0/1.5		Lime/ Cement Grout
100						16	SS	7-14-18	32	1.5/1.5		
105		105.0': Becomes compact and weakly stratified, with increase in silt				17	SS	11-12-16	28	0.2/1.5		
110						18	SS	9-12-14	26	1.3/1.5		
		Stiff to soft, gray, blocky (stiff to firm) within softer material, very deformed, SILTY CLAY, , trace gravel, wet (GLACIOLACUSTRINE LANDSLIDE DEBRIS)	CH		62.0 / 113.0							
115						19	SS	21-36-50/5	>50	0.2/1.4		
		Hard, gray, weakly stratified CLAY, trace fine to coarse, subrounded gravel, moist (GLACIOLACUSTRINE DEPOSIT)	CH		58.5 / 116.5	20	SS	11-20-30	50	1.5/1.5	Wp 23.1, Wl 27, W 49	
120												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/S. Walker

LOGGED: JDC/MS

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-5

BORING LOCATION: Middle line, middle hole

DATUM: MSL

BORING DATE: 5/5-5/8/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp ⊢ w ⊣ Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
120	HWT Casing Advancer / Tri-Cone bit	Hard, gray, weakly stratified CLAY, trace fine to coarse subrounded gravel, moist (GLACIOLACUSTRINE DEPOSIT)	CL									2.25-inch Inclinometer Casing
125						21	SS	11-23-43	66	1.5/1.5	■→	
					48.5 / 126.5							
		Hard, gray, massive, SILTY CLAY, little gravel, moist (GLACIOLACUSTRINE DEPOSIT)	CL		47.5 / 127.5							
		Hard, gray, stratified, SILTY CLAY and CLAYEY SILT, trace fine gravel, moist (GLACIOLACUSTRINE DEPOSIT)	CL/ ML		46.5 / 128.5	22	C	Core Run 1	N/A	3.2/3.5		
		Hard, gray, massive, SILTY CLAY, some gravel, moist (GLACIOFLUVIAL DRIFT)	CL		45.0 / 130.0							
130		Dense to very dense, gray, nonstratified, fine to coarse GRAVEL with some coarse sand and silt, wet (GLACIOFLUVIAL DRIFT)	GW			23	C	Core Run 2	N/A	1/4		Lime/ Cement Grout
		134.0': Trace silty clay				24A	C	Core Run 3	N/A	2/5		
135					38.0 / 137.0	24B						
		Hard, dark greenish gray, massive, SILTY CLAY, some sand, little fine to coarse gravel, damp to moist (GLACIOFLUVIAL DRIFT)	CL		36.0 / 139.0							
140		Dense to very dense, gray, nonstratified, fine to coarse GRAVEL, with some coarse sand and trace silty clay, wet (GLACIOFLUVIAL DRIFT)	GW		34.0 / 141.0	25A	C	Core Run 4	N/A	2.5/5		
		Very dense, orange brown, fine to coarse sandy fine to coarse GRAVEL, some clayey silt, moist (GLACIOFLUVIAL DRIFT)	GM			25B						
		143.0-150.0': Drill action suggests gravelly soils										
145							C	Core Run 5	N/A	0/5		Soil Cave
							C	Core Run 6	N/A	0/2		
150		Total depth 150 ft bgs			25.0 / 150.0							
		A-axis bearing N 41°W										

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/S. Walker

LOGGED: JDC/MS

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-5A

BORING LOCATION: North line, upper hole

SHEET 1 **OF** 4

DATUM: MSL

BORING DATE: 5/9-5/11/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
0	HWT Casing Advancer	Boring was speed drilled to install piezometer. For detailed geologic log see GA-5			~175.0 / 0.0						P.V.C. S.U. 2.7'	1.5-inch I.D. PVC Riser; Bentonite
5												
10												
15												
20												
25												5/10/99 30.0' BOH @115.0'
30		Log continued on next page										

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/S. Walker

LOGGED: FSM/MS

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-5A

BORING LOCATION: North line, upper hole

DATUM: MSL

BORING DATE: 5/9-5/11/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HWT Casing Advancer	Boring was speed drilled to install piezometer. For detailed geologic log see GA-5										1.5-inch I.D. PVC Riser; Bentonite
35												
40												
45												
50												
55												6/15/99 57.4'
60		Log continued on next page										

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/S. Walker

LOGGED: FSM/MS

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-5A

BORING LOCATION: North line, upper hole

DATUM: MSL

BORING DATE: 5/9-5/11/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
60	HWT Casing Advancer											1.5-inch I.D. PVC Riser; Bentonite
65												
70												
75												
80												
85												
90		Log continued on next page										

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/S. Walker

LOGGED: FSM/MS

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-5A

BORING LOCATION: North line, upper hole

SHEET 4 **OF** 4

DATUM: MSL

BORING DATE: 5/9-5/11/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
90	HWT Casing Advancer											1.5-inch I.D. PVC Riser; Bentonite
95												
100												10-20 Silica Sand; 1.5-inch I.D. Sch. 40 PVC 0.0010 Slot Screen
105												
110						1	SH	Push for 5"		0		
						2	SH	Push 9" from 112.5'		0		1.5-inch I.D. PVC Riser
115					60.0							
		Total depth 115 ft bgs			115.0							
120												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/S. Walker

LOGGED: FSM/MS

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-6

BORING LOCATION: Middle line, lower hole

SHEET 1 **OF** 3

DATUM: MSL

BORING DATE: 4/29-4/30/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT
					93.8					
0	HWT Casing Advancer with Spade Bit	Loose, brown, nonstratified, silty fine to coarse SAND, some fine to coarse gravel and cobbles, damp (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SM		0.0					
5		Loose, brown, nonstratified, fine to coarse GRAVEL, some medium to coarse sand, trace to little silt, moist (GLACIOFLUVIAL LANDSLIDE DEBRIS)	GM		88.8 / 5.0	1	SS	2-1-1	2	0/1.5
10		11.0': Contains trace cobbles				2	SS	5-3-3	6	0/1.5
15		Compact, brown, nonstratified, fine to coarse GRAVEL, some fine to coarse sand, wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	GM		79.8 / 14.0	3	SS	7-7-6	13	0.3/1.5
20		Loose to compact, grayish brown, nonstratified, silty, fine to coarse GRAVEL, some fine to coarse sand, wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	GM-GW		73.8 / 20.0	4	SS	5-3-5	8	0.25/1.5
25		@26.0': Becomes compact				5	SS	7-11-7	18	0.2/1.5
		See description on next page	SP-SM		64.8 / 29.0					
30		Log continued on next page								

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT (Wp — W — Wl)

PIEZOMETER GRAPHIC / WATER LEVEL

PVC Stickup 2.5 feet
A+A- Slots @ N40°W

2.25-inch Inclinometer Casing

Lime/ Cement Grout

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-6

BORING LOCATION: Middle line, lower hole

SHEET 2 **OF** 3

DATUM: MSL

BORING DATE: 4/29-4/30/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp ○ W Wl, 0 20 40 60 80 100)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HWT Casing Advancer with Spade Bit	Compact, grayish brown, nonstratified, silty, fine to coarse SAND, some fine gravel, wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SP-SM									
						6	SS	10-7-6	13	0.1/1.5	■	
												2.25-inch Inclinometer Casing
35		36.0': Sand is predominantly fine to medium *and gravel is fine to coarse, trace silt*										Lime/ Cement Grout
						7	SS	8-7-7	14	0.6/1.5	■	
40		Compact, grayish brown, nonstratified, silty fine SAND, trace fine to coarse gravel, trace cobbles, wet *(TRANSITIONAL LANDSLIDE DEBRIS)*	SM		53.8 / 40.0							
						8	SS	14-10-13	23	0.5/1.5	■	
45		NOTE: 42.0-52.0': Lithology obtained from sampling piezometer hole – see piezo log for detailed soil descriptions				9						
		Very stiff, gray, primarily massive, SILT, with trace very faint laminations of very plastic, shiny, SILTY CLAY, moist (GLACIOLACUSTRINE DEPOSIT)	ML		44.8 / 49.0							
50						10	SS	11-18-24	42	1.5/1.5	27.5 ○ 26 39 ■	
		Hard, gray, massive, SILTY CLAY, wet (GLACIOLACUSTRINE DEPOSIT)	CL-CH		41.8 / 52.0							
55		56.0': 1 inch thick interbed of brown, silty fine sand				11	SS	9-16-21	37	1.5/1.5	27 ○ 24 40 W ■	
		58.0-60.0': drill action suggests sand interbed, brown, fine to medium SAND										
60		Log continued on next page										

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-6

BORING LOCATION: Middle line, lower hole

SHEET 3 **OF** 3

DATUM: MSL

BORING DATE: 4/29-4/30/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp ⊢—o W—⊣ Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
60	HWT Casing Advancer with Spade Bit	Hard, gray, massive SILTY CLAY, wet (GLACIOLACUSTRINE DEPOSIT)	CL-CH									
						12	SS	12-19-32	>50	1.5/1.5	■→	
					29.8 / 64.0							2.25-inch Inclinometer Casing
65		Very dense, dark gray, mottled, nonstratified, fine to coarse GRAVEL, some fine to coarse sand, some clayey silt, moist (GLACIOFLUVIAL DRIFT)	GW									
						13	SS	30-50/3	>50	0.4/1.5	■→	
												Lime/ Cement Grout
70		70.0': Becomes more brown										
		71.0': Becomes mottled gray			22.0	14	SS	37-50/2.5	>50	0.6/1.5	■→	
		Total depth 71.8 ft bgs			71.8							
		Inclinometer installed at 71.5 ft										
		Groundwater at 13 ft fairly constantly throughout drilling and at time of installation										
		A-axis bearing N50°W										
75												
80												
85												
90												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-6A

BORING LOCATION: Middle line, lower hole

SHEET 1 **OF** 2

DATUM: MSL

BORING DATE: 5/1/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — w — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
					~94.0							
0	HWT Casing Advancer with Spade Bit	See log GA-6 for description. Boring was speed drilled to 4.2' bgs. Continuous sampling was performed from 42.0 to 52.' bgs			0.0						P.V.C. S.U. 3.4'	1.5" I.D. Sch. 40 PVC Riser
5												Bentonite Seal
10												
15												
20												
25												29.46' bgs 6/11/99
30		Log continued on next page										

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-6A

BORING LOCATION: Middle line, lower hole

SHEET 2 **OF** 2

DATUM: MSL

BORING DATE: 5/1/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0–50) / WATER CONTENT, PERCENT (Wp–W–Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HWT Casing Advancer with Spade Bit											1.5" I.D. Sch. 40 PVC Riser
35												Bentonite Seal
												10-20 Silica Sand
40												1.5" I.D. Sch. 40 PVC 0.010 slot screen
		Compact, brown, nonstratified, silty fine SAND, trace gravel ranges to SILT, some fine sand, moist (LANDSLIDE DEBRIS)	SM			1	SS	5-4-5	9	0.75/1.5		
						2	SS	6-8-10	18	0.6/1.5		
45		45.0-46.5': Increase in silt and sand becomes very fine with lenses (little) of silty fine sand				3	SS	6-9-14	23	0.9/1.5		
						4	SS	6-11-16	27	0.6/1.5		
						5	SS	6-11-12	23	1.5/1.5		
		Very stiff, gray, massive, SILTY CLAY, with trace very faint laminations of very plastic, shiny, SILTY CLAY; also contains traces of hard medium sand sized fragments of SILTY CLAY, moist (BASAL FAILURE ZONE)	CL-CH									
50			SM		44.0	6	SH	Push	N/A	6-6		
			CL-CH		50.0	7	SS	13-17-24-28	52	2/2	27 (24–42)	
		Compact, brown, nonstratified, silty fine SAND, moist			42.0							
		Hard, gray, laminated, SILTY CLAY, moist (GLACIOLACUSTRINE DEPOSIT)			52.0							
		Total depth 52.0 ft										
55												
60												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/7/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-7

BORING LOCATION: West side of Highway 101, MP 326, between GA-6 and GA-9

DATUM: MSL

BORING DATE: 5/12/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer, 30 inch drop)	N	REC/ATT
0	HWT Casing Advancer / Tri-Cone				31.0					
		Asphalt			0.0					
		Fill								
					28.0					
		Firm to stiff, gray, SILTY CLAY with some fine to coarse sand and fine to coarse gravel, moist (GLACIOFLUVIAL DRIFT)	CL		3.0					
5					25.5					
		Very dense, dark gray to bluish black, silty sandy GRAVEL, moist (GLACIOFLUVIAL DRIFT)	GM		5.5					
					24.0	1	SS	17-31-41	72	1.5/1.5
		Very dense, grayish brown, silty sandy, fine to coarse GRAVEL to gravelly SAND, moist (GLACIOFLUVIAL DRIFT)	GM		7.0					
						2	C	NA	NA	0
10		10.0': WEATHERED TILL, reddish brown with increase in clay content				3	C	NA	NA	0
						4	SS	8-18-52	72	1.2/1.5
						5	C	NA	NA	1.5/1.5
15						6	C	NA	NA	4.3/5
20						7	C	NA	NA	5/5
25						8	C	NA	NA	0
						9	C	NA	NA	5/5
30										

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT: Wp ⊢—o W—⊣ Wl

PIEZOMETER GRAPHIC / WATER LEVEL

PVC stickup 0.0 feet

1.5-inch I.D Sch 40 PVC Casing

6.13' bgs 6/15/99

Bentonite

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-7

BORING LOCATION: West side of Highway 101, MP 326, between GA-6 and GA-9

DATUM: MSL

BORING DATE: 5/12/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HWT Casing Advancer / Tri-Cone	Very dense, grayish brown, clayey silty sandy, fine to coarse GRAVEL to gravelly SAND, moist (GLACIOFLUVIAL DRIFT)	GM			9	C	NA	NA	5/5		Bentonite Chips
						10	C	NA	NA	4.2/4.5		1.5-inch I.D. Sch 40 PVC; 10/20 Silica Sand
35						11	C	NA	NA	2.5/4		1.5-inch I.D. Sch 40 PVC 0.010 Slotted Screen
						12	C	NA	NA	0.7/1.0		
40						13	C	NA	NA	2.2/5		Bentonite Chips that got down into PVC top-cap came off as we were drilling casing
45					-14.5	14	SS	32-50/4	>50	0.8/0.8		
		Total depth 45.5 ft bgs			45.5							
50												
55												
60												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-7A

BORING LOCATION: West side of Highway 101, MP 326, between GA-6 and GA-9

SHEET 1 **OF** 2

DATUM: MSL

BORING DATE: 5/12-13/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
					31.0							
0	HWT Casing Advancer	Boring speed drilled to install inclinometer. See Log for GA-7 for detailed soils description.			0.0						PVC Stickup 0.0 feet A+A- Slots @N88°E	2.25-inch Inclinometer Casing
5												Lime Cement Grout
10	HQ Casing Advancer											
15												
20												
25												
30												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl

LOGGED: FSM

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-7A

BORING LOCATION: West side of Highway 101, MP 326, between GA-6 and GA-9

DATUM: MSL

BORING DATE: 5/12-13/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HQ Casing Advancer											2.25-inch Inclinometer Casing; Lime Cement Grout
35												
40												
45		Total depth drilled 45 ft bgs A-axis bearing N86°W			-14.0 45.0							
50												
55												
60												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl

LOGGED: FSM

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-8

BORING LOCATION: North line, upper hole

SHEET 1 **OF** 8

DATUM: MSL

BORING DATE: 5/6-11/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
					243.7							
0	HWT Casing Advancer with Tri-Cone Bit (Carbide Shoe)	Compact, brownish orange to light olive brown, nonstratified to crudely bedded, fine to coarse SAND, some fine to coarse subangular to rounded gravel, trace to little silt, ranging to silty fine to coarse subrounded to subangular SAND and GRAVEL, moist (GLACIOFLUVIAL DEPOSIT)	SW-SM		0.0						A-axis bearing N80°W	2.25-inch Inclinometer Casing
		Drill action suggests cobbles present as well as interbeds of sand and/or silt with a trace of gravel									PVC Stickup 2.6 feet	Lime Cement Grout
5						1	SS	1-10-8	18	0.7/1.5	■	
10												
15						2	SS	19-17-13	30	0.2/1.5	■	
20												
25		25.0': Becomes wet				3	SS	17-31-14	45	0.5/1.5	■	
30												

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: JDC/FSM

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-8

BORING LOCATION: North line, upper hole

DATUM: MSL

BORING DATE: 5/6-11/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HQ Casing Advancer/Spade Bit	Compact, brownish orange to light olive brown, nonstratified to crudely bedded, fine to coarse SAND, some fine to coarse subangular to rounded gravel, trace to little silt, ranging to silty fine to coarse subrounded to subangular SAND and GRAVEL, moist (GLACIOFLUVIAL DEPOSIT)	SW-SM									Lime Cement Grout; 31.7' bgs; BOH@51.0'
35						4	SS	11-23-16	39	0.4/1.5	■	2.25-inch Inclinometer Casing
40		Very dense, light olive brown, silty fine to coarse SAND, little fine to coarse subrounded to subangular gravel, moist to wet (GLACIOFLUVIAL DEPOSIT)	SM		203.7 / 40.0							
		42.0-43.5': Boulder										
45						5	SS	18-26-28	54	0.5/1.5	■	
		Very dense, olive brown, light olive brown, olive gray and light olive, crudely stratified, subangular to rounded fine to coarse GRAVEL, some fine to coarse sand, trace to little silt to clayey silt, varies to fine to coarse SAND and fine rounded GRAVEL, contains thin interbeds of SILT to CLAYEY SILT, trace cobbles observed, iron oxide stained in places, moist to wet (GLACIOFLUVIAL DEPOSIT)	SP-SM/GW		196.2 / 47.5							
50	HQ Core					5A	C	NA	NA	1.5/5.5		
55		25.0': Becomes wet				6	SS	32-50/3	>50	0.5/.75		
						6A	C	NA	NA	0.5/2		
						6B	C	NA	NA	1.5/3.0		
60												

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: JDC/FSM

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-8

BORING LOCATION: North line, upper hole

DATUM: MSL

BORING DATE: 5/6-11/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
60	HQ Core	Very dense, olive brown, light olive brown, olive gray and light olive, crudely stratified, subangular to rounded fine to coarse GRAVEL, some fine to coarse sand, trace to little silt to clayey silt, varies to fine to coarse SAND and fine rounded GRAVEL, contains thin interbeds of SILT to CLAYEY SILT, trace cobbles observed, iron oxide stained in places, moist to wet (GLACIOFLUVIAL DEPOSIT)	SP-SM/GW			6B	C	NA	NA	1.5/3.0		Lime Cement Grout
						7	SS	40-50/4	>50	0.8/0.8		
						7A	C	NA	NA	0.7/0.7		
		63.0': Varies to GRAVEL with a trace of sand						No Recovery				
65												2.25-inch Inclinometer Casing
						7B	C	NA	NA	0.3/5		
70												
						8	SS	5-48-50	98	0.6/1.5		
		73.0-76.0': Contains some silt										
						9	C	NA	NA	3/5		
75												
						10	C	NA	NA	0/4		
80												
85	HQ Casing Advancer	NOTE: Sampling was not performed from ~80 to 93 ft due to drilling problems (heave/slough in casing, loss of drill fluids)										
90		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: JDC/FSM

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-8

BORING LOCATION: North line, upper hole

DATUM: MSL

BORING DATE: 5/6-11/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
90	HQ Casing Advancer	Very dense, olive brown, light olive brown, olive gray and light olive, crudely stratified, subangular to rounded fine to coarse GRAVEL, little to some fine to coarse sand, trace silt to clayey silt, varies to fine to coarse SAND and fine rounded GRAVEL, contains thin interbeds of SILT to CLAYEY SILT, trace cobbles observed, iron oxide stained in places, moist to wet (GLACIOFLUVIAL DEPOSIT)	SW/ GW									Lime Cement Grout; 2.25-inch Inclinometer Casing
95						11	SS	45-50/5	>50	0/0.9	■	
100						12	SS	27-38-50	88	1.0/1.5	■	
		Very dense, light olive to olive brown, intebedded, laminated, fine SAND, trace to little silt, fine to medium SAND, some subangular to rounded fine to coarse gravel, trace silt, and fine sandy SILT, with laminae of SILTY CLAY, contacts are sharp to gradational, wet (GLACIOFLUVIAL/GLACIOLACUSTRINE TRANSITIONAL DEPOSIT)	SP/ ML		140.2 / 103.5							
105												
110						13	SS	22-29-35	64	0.8/1.5	■	
115												
120		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: JDC/FSM

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-8

BORING LOCATION: North line, upper hole

DATUM: MSL

BORING DATE: 5/6-11/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — w — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
120	HQ Casing Advancer	Very dense, light olive to olive brown, intebedded, laminated, fine SAND, trace to little silt, fine to medium SAND, some subangular to rounded fine to coarse gravel, trace silt, and fine sandy SILT, with laminae of SILTY CLAY, contacts are sharp to gradational, wet (GLACIOFLUVIAL/GLACIOLACUSTRINE TRANSITIONAL DEPOSIT)	SP/ ML			14	SS	19-28-50	78	0.9/1.5		Lime Cement Grout
		120.0-125.0': Drill action suggests drilling through SAND with some gravelly interbeds, cont. good fluid returns with SILT and fine to medium SAND, olive brown color										
125		125.0-130.0': As at 120-125, with some clay on bit										2.25-inch Inclinometer Casing
					118.5 / 125.5							
		Very dense, light olive, laminated to faintly interbedded, fine SAND, trace to little silt, ranging to fine sandy SILT, contains very thin (< 1mm), laminae of silty CLAY to CLAY, wet (GLACIOFLUVIAL/GLACIOLACUSTRINE TRANSITIONAL DEPOSIT)	SP/ ML									
130						15	SS	29-50/4	>50	0.6/0.8		
135												
140						16	SS	34-50/5	>50	0.2/0.9		
145												
					96.7 / 149.0							
		See description on next page	SM/ ML									
150		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: JDC/FSM

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-8

BORING LOCATION: North line, upper hole

DATUM: MSL

BORING DATE: 5/6-11/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT
150	HQ Casing Advancer	Very dense, light olive gray to dark greenish gray, laminated, silty, fine SAND and sandy SILT, wet (GLACIOFLUVIAL/GLACIOLACUSTRINE TRANSITIONAL DEPOSIT)	SM-ML			17	SS	32-50/5	>50	0.5/0.9
155										
160						18	SS	42-50/4	>50	0/10
165						19	SS	38-50/4	>50	0.5/0.8
	HQ Core				76.7 / 169.0	20	C	NA	NA	1.8/5.0
170		Hard, light olive gray to olive gray, laminated to massive and jointed, SILTY CLAY to CLAY, trace scattered sand, gravel, and cobbles (dropstones) from approximately 169 ft to 171 ft, trace medium to coarse sand in 1-inch to 2-inch interbeds between 216 ft and 221 ft, moist to damp (GLACIOLACUSTRINE DEPOSIT)	ML-CL							
		ppen data from Sample 20 – Sample 31 all >4.5 tsf				21	C	NA	NA	5/5
175						22	C	NA	NA	4/5
180		Log continued on next page								

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT: Wp ⊢—o W—⊣ Wl

PIEZOMETER GRAPHIC / WATER LEVEL

Lime Cement Grout

2.25-inch Inclinometer Casing

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: JDC/FSM

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-8

BORING LOCATION: North line, upper hole

DATUM: MSL

BORING DATE: 5/6-11/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
180	HQ Core	Hard, light olive gray to olive gray, laminated to massive and jointed, SILTY CLAY to CLAY, trace scattered sand, gravel, and cobbles (dropstones) from approximately 169 ft to 171 ft, trace medium to coarse sand in 1-inch to 2-inch interbeds between 216 ft and 221 ft, moist to damp (GLACIOLACUSTRINE DEPOSIT)	ML-CL			22	C	NA	NA	4/5		Lime Cement Grout
						23	C	NA	NA	4/5		
185												2.25-inch Inclinometer Casing
						24	C	NA	NA	5/5		
190						24A	SS	20-50/6	>50	1/1		
						25	C	NA	NA	4/4		
195						26	C	NA	NA	5/5		
200						27	C	NA	NA	5/5		
205						28	C	NA	NA	5/5		
210		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: JDC/FSM

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-8

BORING LOCATION: North line, upper hole

SHEET 8 **OF** 8

DATUM: MSL

BORING DATE: 5/6-11/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
210	HQ Core	Hard, light olive gray to olive gray, laminated to massive and jointed, SILTY CLAY to CLAY, trace scattered sand, gravel, and cobbles (dropstones) from approximately 169 ft to 171 ft, trace medium to coarse sand in 1-inch to 2-inch interbeds between 216 ft and 221 ft, moist to damp (GLACIOLACUSTRINE DEPOSIT)	ML-CL			28	C	NA	NA	5/5		Lime Cement Grout
						29	C	NA	NA	3/5		
215												2.25-inch Inclinometer Casing
						30	C	NA	NA	5/5		
220												
						31	C	NA	NA	5/5		
225					17.7							
		Boring terminated 226 ft bgs			226.0							
230												
235												
240												

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Hundahl/J. Salisbury

LOGGED: JDC/FSM

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-8A

BORING LOCATION: North line, upper hole

SHEET 1 **OF** 6

DATUM: MSL

BORING DATE: 5/11-12/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — w — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
					~224.0							
0	HWT Casing Advancer	Boring speed drilled to install piezometer. See log for GA-8 for detailed soil descriptions.			0.0						PVC stickup 2.3 feet	1.5-inch I.D. PVC Riser; Bentonite
5												
10												
15												
20												
25												
30		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: JDC/FSM

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-8A

BORING LOCATION: North line, upper hole

DATUM: MSL

BORING DATE: 5/11-12/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HWT Casing Advancer											1.5-inch I.D. PVC Riser; Bentonite
35												
40												
45	HQ Casing Advancer											
50												
55												
60		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: JDC/FSM

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-8A

BORING LOCATION: North line, upper hole

SHEET 3 **OF** 6

DATUM: MSL

BORING DATE: 5/11-12/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — w — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
60	HQ Casing Advancer											1.5-inch I.D. PVC Riser; Bentonite
65												
70												
75												ATD 75' bgs BOH @ 105'
80												
85												
90		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: JDC/FSM

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-8A

BORING LOCATION: North line, upper hole

SHEET 4 **OF** 6

DATUM: MSL

BORING DATE: 5/11-12/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — w — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
90	HQ Casing Advancer											1.5-inch I.D. PVC Riser; Bentonite
95												
100												
105												
110												108.83' bgs 6/15/99
115												
120		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: JDC/FSM

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-8A

BORING LOCATION: North line, upper hole

SHEET 5 **OF** 6

DATUM: MSL

BORING DATE: 5/11-12/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
120	HQ Casing Advancer											1.5-inch I.D. PVC Riser; Bentonite
125												
130												
135												10/20 Silica Sand
140												
145												
150		Log continued on next page										1.5-inch I.D. PVC 0.010 Slot Screen

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: JDC/FSM

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-8A

BORING LOCATION: North line, upper hole

SHEET 6 **OF** 6

DATUM: MSL

BORING DATE: 5/11-12/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
150	HQ Casing Advancer											1.5-inch I.D. PVC 0.010 Slot Screen; 10/20 Silica Sand
155												
160												
165												
					75.0							
		Boring terminated 169 ft bgs			169.0							
170												
175												
180												

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: JDC/FSM

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-9

BORING LOCATION: North line, lower hole

SHEET 1 **OF** 2

DATUM: MSL

BORING DATE: 5/3-4/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT
					65.6					
0	HWT Casing Advancer/Tricone	Loose, brown, nonstratified, silty fine to coarse SAND with some fine to coarse gravel, damp (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SM		0.0					
5					60.1 / 5.5					
		Loose, grayish brown, nonstratified, fine to coarse GRAVEL, some medium to coarse sand, trace fine sand, trace silt, moist (GLACIOFLUVIAL LANDSLIDE DEBRIS)	GW			1	SS	6-5-4	9	0/1.5
10		11.0': Becomes compact				2	SS	5-8-10	18	0.4/1.5
					51.6 / 14.0					
15		Compact, grayish brown, nonstratified, fine to coarse GRAVEL, some fine to coarse sand, some silt, wet (GLACIOFLUVIAL LANDSLIDE DEBRIS)	GW			3	SS	5-5-11	16	0.25/1.5
		18.0': Increase in silt				4	SS	9-7-5	12	0.5/1.5
20					45.6 / 20.0					
		Compact, brown, nonstratified, silty fine SAND, trace fine gravel, wet (TRANSITIONAL LANDSLIDE DEBRIS)	SM			5	SS	6-8-6	14	0.25/1.5
25		26.0': Becomes loose								
		27.0-29.0': Possible void				6	SS	4-2-3	5	1.5/1.5
30		Log continued on next page								

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT: Wp — W — Wl

PIEZOMETER GRAPHIC / WATER LEVEL

PVC Stickup 2.3 feet
A+A- Slots @ N45°W

2.25-inch Inclinometer Casing

Lime Cement Grout

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-9

BORING LOCATION: North line, lower hole

SHEET 2 **OF** 2

DATUM: MSL

BORING DATE: 5/3-4/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ / WATER CONTENT, PERCENT (Wp, W, Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HWT Casing Advancer/Tricone	Compact, brown, nonstratified, silty fine SAND, trace fine gravel, wet (TRANSITIONAL LANDSLIDE DEBRIS)	SM		35.1							
		Stiff, gray with greenish brown mottling, stratified, SILTY CLAY, moist to wet within laminations, deformed material, hard clasts within softer matrix, trace gravel at 31.0 ft, trace fine sand from 30.5-31.0 ft, wet fractures between laminations from31.4-31.8 ft, material in fractures broken, blocky (GLACIOLACUSTRINE LANDSLIDE DEBRIS)	CH		30.5	7	SH	Push	NA	1.5/1.7		2.25-inch Inclinometer Casing
			CL		32.1 / 33.5							Lime Cement Grout
35		Hard, light gray, weakly stratified, SILTY CLAY, moist (GLACIOLACUSTRINE DEPOSIT)				8	SS	12-20-37	57	1.5/1.5	29 (23–37)	
40		Hard, light gray, nonstratified, SILT, moist (GLACIOLACUSTRINE DEPOSIT)	ML		25.6 / 40.0	9	SS	11-20-27	47	1.5/1.5	28.7 (26–44)	
45		Very dense, light olive gray, nonstratified, silty fine to coarse SAND, some fine to corse subrounded gravel, wet (GLACIOFLUVIAL DRIFT)	SM		20.1 / 45.5	10	SS	50/6	>50	0.5/0.5		
		Very dense, light gray, cobbley fine to coarse subrounded GRAVEL, wet (GLACIOFLUVIAL DRIFT)	FW		18.6 / 47.0							
50		Hard, light gray, weakly stratified, CLAYEY SILT, trace fine subrounded gravel (dropstones), moist (GLACIOLACUSTRINE DEPOSIT)	CL-ML		15.1 / 50.5							
		Very dense, light olive to reddish brown, nonstratified, silty fine to coarse SAND, little fine to coarse subrounded gravel, moist (GLACIOFLUVIAL DRIFT)	SM		14.1 / 51.5	11	SS	10-40-50/3	>50	1.25/ 1.25		
		55.5': Increase in gravel and becomes subrounded to subangular										
55					8.6	12	SS	9-23-50/3	>50	1.25/ 1.25		
		Boring terminated at 57.0 ft bgs			57.0							
		A-axis bearing N71°W										
60												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-9A

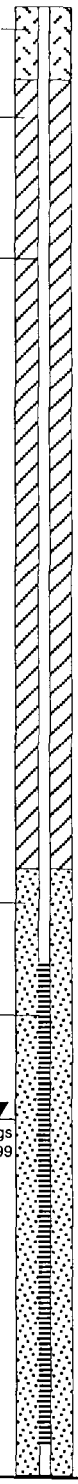
BORING LOCATION: North line, lower hole

SHEET 1 **OF** 2

DATUM: MSL

BORING DATE: 5/4-5/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
					~66.0							
0	HWT Casing Advancer/Tricone	Speed drilled boring to install piezometer. See log for GA-9 for detailed soil description.			0.0						PVC Stickup 2.6 feet	Concrete; Bentonite; 1.5-inch I.D. Sch 40 PVC Casing; 10/20 Silica Sand; 1.5-inch I.D. Sch 40 0.010 Slot PVC Screen; 23.26' bgs 6/15/99
5												
10												
15												
20												
25												
30		Log continued on next page										



DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-9A

BORING LOCATION: North line, lower hole

SHEET 2 **OF** 2

DATUM: MSL

BORING DATE: 5/4-5/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HWT Casing Advancer/Tricone					1	SS	2-4-5-7	12	1.5/2.0	■	10/20 Silica Sand
					34.0							
		Boring terminated at 32.0 ft bgs			32.0							
		Installed piezometer screen from 20.0-30.0 ft; sand from 18.0-32.0 ft; bentonite seal from2.0-18.0 ft; concrete with above ground monument										
		TOC is approximately at ground surface										
35												
40												
45												
50												
55												
60												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/9/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-10

BORING LOCATION: North plus line, upper hole

DATUM: MSL

BORING DATE: 5/13-14/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer, 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — w — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
					~180.0							
0	HWT Casing Advancer	Loose to compact, light olive brown to dark greenish gray, nonstratified to crudely bedded, fine to coarse SAND, little to some fine to coarse subrounded to rounded gravel, trace silt, varies to fine to medium SAND, trace silt, moist (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SW		0.0						PVC Stickup 1.7 feet A+A- Slots N52°W	2.25-inch Inclinometer Casing; Lime Cement Grout
5						1	SS	1-1-4	5	0.7/1.5	■	
10						2	SS	2-5-4	9	0.6/1.5	■	
15						3	SS	6-7-7	14	0.8/1.5	■	
20						4	SS	11-11-12	23	0.9/1.5	■	
25						5	SS	4-4-5	9	0.7/1.5	■	
		See description on next page	SP		~152.0 / 28.0							
30		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: JDC/FSM

CHECKED:

DATE: 7/23/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-10

BORING LOCATION: North plus line, upper hole

DATUM: MSL

BORING DATE: 5/13-14/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp ○ W Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HQ Casing Advancer	Loose to compact, light olive gray to light olive brown and dark olive brown, interbedded, fine to medium SAND, trace subangular to rounded fine gravel, trace silt, fine SAND, trace to little silt, trace rounded fine gravel, and fine SAND and fine to coarse GRAVEL, little silt, wet (TRANSITIONAL LANDSLIDE DEBRIS)	SP			6	SS	5-4-3	7	0.7/1.5	■	2.25-inch Inclinometer Casing; Lime Cement Grout
35						7	SS	8-7-6	13	0.5/1.5	■	
40		40.0': Faint mottling observed				8	SS	7-6-7	13	1.0/1.5	■	
						9	SS	5-5-7	12	0.9/1.5	■	
45		Compact to dense, light olive gray to light olive brown, faintly laminated and interbedded, fine SAND, trace to little silt and SILT, wet (GLACIOFLUVIAL/GLACIOLACUSTRINE TRANSITIONAL DEPOSIT)	SP/ ML		~133.0 / 47.0							
50						10	SS	9-14-12	26	1.1/1.5	26.5 ○ 27 43 ■	
55						11	SS	7-10-11	21	1.0/1.5	■	
60		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: JDC/FSM

CHECKED:

DATE: 7/23/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-10

BORING LOCATION: North plus line, upper hole

DATUM: MSL

BORING DATE: 5/13-14/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0–50) / WATER CONTENT, PERCENT (Wp–W–Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
60	HQ Casing Advancer	Compact to dense, light olive gray to light olive brown, faintly laminated and interbedded, fine SAND, trace to little silt and SILT, wet (GLACIOFLUVIAL/GLACIOLACUSTRINE TRANSITIONAL DEPOSIT)	SP/ ML			12	SS	13-15-19	34	1.2/1.5		2.25-inch Inclinometer Casing; Lime Cement Grout
65						13	SS	10-14-21	35	1.1/1.5		
70						14	SS	11-14-21	35	1.5/1.5		
		Hard and dense, light olive gray to light olive brown, laminated, SILTY CLAY to CLAYEY SILT and sandy SILT with thin (~1/32-inch) SILTY CLAY laminae, moist to wet (GLACIOLACUSTRINE DEPOSIT)	CL-ML		~107.0 / 73.0							
75		ppen: >4.5 tsf				15	SS	8-13-19	32	1.5/1.5		
80						16	SS	10-15-23	38	1.5/1.5		
85					~94.0 / 86.0	17	SS	21-50/2	>50	0.7/0.7		
		Very dense, reddish brown to light olive brown, nonstratified, silty fine to coarse SAND, little to some fine to coarse gravel, moist (GLACIOFLUVIAL DRIFT)	SM									
90		*Log continued on next page*										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: JDC/FSM

CHECKED:

DATE: 7/23/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-10

BORING LOCATION: Highway 101, MP 326, North plus line, upper hole

DATUM: MSL

BORING DATE: 5/13/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
90	HQ Casing Advancer	Very dense, reddish brown to light olive brown, nonstratified, silty fine to coarse SAND, little to some fine to coarse gravel, moist (GLACIOFLUVIAL DRIFT)	SM			18	SS	50/3	>50	2/3		2.25-inch Inclinometer Casing; Lime Cement Grout
95					~84.0	19	SS	15-50/6	>50	1/12		
		Boring terminated at 96 ft bgs A-axis bearing N85°E			96.0							
100												
105												
110												
115												
120												

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: J. Salisbury/Hundahl

LOGGED: JDC/FSM

CHECKED:

DATE: 7/23/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-10A

SHEET 1 **OF** 3

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** North plus line, upper hole

BORING DATE: 5/15-16/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — w — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
0		Boring speed drilled to install piezometer. For detailed geologic log see GA-10.									PVC Stickup 2.2 feet	Bentonite
5												1.5-inch I.D. Sch. 40 PVC Riser
10												
15	HWT Casing Advancer											
20												
25												ATD -24.0 ft BOH@26 ft
30	HQ Casing Advancer	Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Buck/Hundahl

LOGGED: JDC/FSM

CHECKED:

DATE: 7/12/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-10A

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** North plus line, upper hole **BORING DATE:** 5/15-16/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp ⊢ w ⊣ Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HQ Casing Advancer											Bentonite
35												1.5-inch I.D. Sch. 40 PVC Riser
40												
45												
50												49.67 ft 6/15/99; 10/20 Silica Sand
55												1.5-inch I.D. PVC 0.010 Slot Screen
60		Log continued on next page										

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Buck/Hundahl

LOGGED: JDC/FSM

CHECKED:

DATE: 7/12/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

RECORD OF BOREHOLE GA-10A

SHEET 3 **OF** 3

DATUM: MSL

PROJECT NUMBER: 993 1467.300 **BORING LOCATION:** North plus line, upper hole

BORING DATE: 5/15-16/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp ⊢—○W—⊣ Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
60	HQ Casing Advancer											10/20 Silica Sand
65												1.5-inch I.D. PVC 0.010 Slot Screen
70												
75		Total depth 75 ft bgs										1.5-inch I.D. Sch. 40 PVC Riser with Flush Screw Joints and O-rings
80												
85												
90												

DRILL RIG: Burley 4500

DRILLING CONTRACTOR: Crux

DRILLER: Buck/Hundahl

LOGGED: JDC/FSM

CHECKED:

DATE: 7/12/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-11

BORING LOCATION: North plus line, lower hole

SHEET 1 **OF** 3

DATUM: MSL

BORING DATE: 5/13-14/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT
0	HWT Casing Advancer	Loose, brown, silty fine to medium SAND, little to some gravel and cobbles, little coarse sand, organics to 6-inches (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SM		~127.0 / 0.0					
5		6.0': Becomes compact (nonstratified) with little coarse sand and fine to medium gravel				1	SS	2-7-5	12	0.2/1.5
10		11.0': Increase in size and content of gravel to some fine to coarse				2	SS	10-8-9	17	0.2/1.5
15		16.0': Decrease in coarse sand to trace				3	SS	8-7-8	15	0.4/1.5
20		Compact, mottled brown, nonstratified, silty fine to medium SAND, some gravel, moist (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SM		~107.0 / 20.0	4	SS	10-9-16	25	0.2/1.5
25						5	SS	9-8-9	17	0.4/1.5
30		Log continued on next page								

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT (Wp, W, Wl)

PIEZOMETER GRAPHIC / WATER LEVEL

PVC Stickup 2.0 feet
A+A- Slots @ N78°W

2.25-inch Inclinometer Casing

Lime Cement Grout

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/12/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-11

BORING LOCATION: North plus line, lower hole

DATUM: MSL

BORING DATE: 5/13-14/99

DEPTH FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp ⊢—o W —⊣ Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HQ Casing Advancer	Compact, mottled brown, nonstratified, silty fine to medium SAND, some gravel, moist (GLACIOFLUVIAL LANDSLIDE DEBRIS)	SM			6	SS	7-8-8	16	0.25/1.5	■	
		30.0': Increase in sand size, becomes fine to coarse										2.25-inch Inclinometer Casing
35						7	SS	7-8-6	14	0.4/1.5	■	Lime Cement Grout
		Dense, brown, nonstratified, silty fine SAND, moist	SM		~88.0 / 39.0							
40		Dense, gray, nonstratified, silty fine SAND to fine sandy SILT, moist to wet (GLACIOFLUVIAL/GLACIOLACUSTRINE TRANSITIONAL DEPOSIT)			~86.5 / 40.5	8	SS	12-14-22	36	0.7/1.5	■	
		44.0': Increase in silt	SM/ ML									
45		45.8': Weakly stratified				9	SS	14-21-25	46	1.0/1.5		■
		Dense, weakly stratified to massive, fine sandy SILT, moist to wet (GLACIOFLUVIAL/ GLACIOLACUSTRINE TRANSITIONAL DEPOSIT)	ML		~79.0 / 48.0							
50		51.0': 1/4-inch thick layer of SILTY CLAY (fine sandy silt below)				10	SS	13-18-25	43	1.2/1.5		■
		Very stiff, stratified, tan with layers of gray, predominantly SILTY CLAY with layers of silty fine SAND and CLAYEY SILT, some fine sand, moist (GLACIOLACUSTRINE DEPOSIT)	CL		~72.5 / 54.5	11	SS	13-17-12	29	1.4/1.5	■	
55												
		See description on next page			~67.5 / 59.5							
60		Log continued on next page										

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/12/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-11

BORING LOCATION: North plus line, lower hole

DATUM: MSL

BORING DATE: 5/13-14/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. (140 lb. hammer, 30 inch drop)	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. (0–50) / WATER CONTENT, PERCENT (Wp–W–Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
60	HQ Casing Advancer	Hard, grayish tan, weakly stratified, SILT, trace gravel at 61.0', moist (GLACIOLACUSTRINE DEPOSIT)	ML			12	SS	50-28-50/1	>50	0.8/1.5	30.5 (28–36)	
					~64.0 / 63.0							2.25-inch Inclinometer Casing
		Hard, grayish brown, nonstratified, SILTY CLAY with some coarse sand and fine to coarse gravel, moist (GLACIOFLUVIAL DRIFT)	CL									
65					~61.0 / 66.0	13	SS	37-50-43	93	0.8/1.5		
		Very dense, orange-brown, nonstratified, silty fine SAND, trace gravel, moist (GLACIOFLUVIAL DRIFT)	SM									Lime Cement Grout
					~58.0 / 69.0							
		Very dense, brown, nonstratified, gravelly fine to coarse SAND, some clayey silt, moist (GLACIOFLUVIAL DRIFT)	SM									
70						14	SS	50/3	>50	0.25/0.25		
75					~51.4 / 74.4	15	SS	50/3	>50	0.25/0.25		
		Total depth 74.4 ft bgs										
80												
85												
90												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/12/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-11A

BORING LOCATION: North plus line, lower hole

SHEET 1 **OF** 2

DATUM: MSL

BORING DATE: 5/14/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
					~127.0							
0	HWT Casing Advancer	*Boring speed* drilled to install piezometer. For detailed geologic log see GA-11.			0.0						PVC Stickup 1.6 feet	
5												Granular Bentonite Seal
10												1.5-inch I.D. Sch 40 PVC Casing
												Caved Material
15												
20	HQ Casing Advancer											
25												
30		Log continued on next page										

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/12/99

Golder Associates

PROJECT: WSDOT/MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-11A

BORING LOCATION: North plus line, lower hole

SHEET 2 **OF** 2

DATUM: MSL

BORING DATE: 5/14/99

DEPTH FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT. ■ (0 10 20 30 40 50) / WATER CONTENT, PERCENT (Wp — W — Wl)	PIEZOMETER GRAPHIC / WATER LEVEL
30	HQ Casing Advancer											Caved Material; 30.87' bgs 6/15/99; 10/20 Silica Sand; 1.5-inch I.D. Sch. 40 PVC Riser
35												
40												1.5-inch I.D. Sch. 40 PVC 0.010 Slot Screen
45												
50					~75.0							Threaded End Cap with O-Ring
		Total depth 52.0 ft bgs			52.0							
55												
60												

DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: MS

CHECKED:

DATE: 7/12/99

Golder Associates

PROJECT: WSDOT/ MP 326 Landslide/WA

PROJECT NUMBER: 993 1467.300

RECORD OF BOREHOLE GA-12

BORING LOCATION: North line, west edge of pagement

SHEET 1 **OF** 1

DATUM: MSL

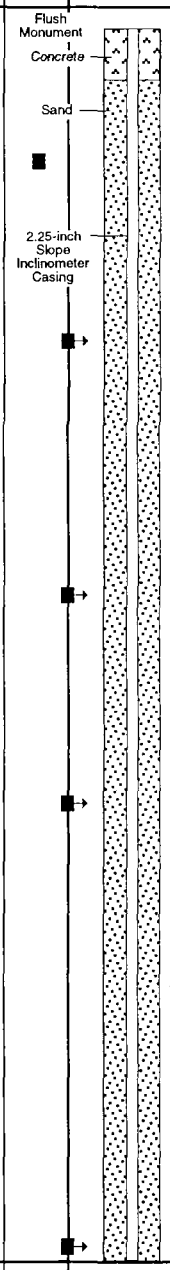
BORING DATE: 6/16/99

DEPTH FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT
					~33.0					
0	HWT Casing Advancer	Dense to very dense, light olive gray, nonstratified, silty, gravelly fine to coarse SAND, moist (GLACIOFLUVIAL DRIFT)	SM		0.0					
						1	SS	18-18-28	46	1.5/1.5
5						2	SS	30-50/5	50/5	11/11
10						3	SS	21-42-21	63	6/18
	HQ Casing Advancer	Hard, light olive gray, weakly stratified, SILTY CLAY, trace coarse rounded sand as dropstones, moist (GLACIOLACUSTRINE DEPOSIT)	CL		~21.0 12.0					
15		Very dense, light brown, nonstratified, silty fine to coarse SAND, some fine to coarse subrounded and subangular gravel, moist (GLACIOFLUVIAL DRIFT)	GM-ML		~18.0 15.0	4	SS	50/0		0/0
	HQ Core					5	C			3/3
20						6	C			2/2
						7	C			2/2
25					~7.2	8	SS	35-50/4	50/4	0.8/0.8
		Boring terminated at 25.8 ft bgs			25.8					
30										

PENETRATION RESISTANCE BLOWS/FT. ■ (0, 10, 20, 30, 40, 50)

WATER CONTENT, PERCENT: Wp — W — Wl

PIEZOMETER GRAPHIC / WATER LEVEL



DRILL RIG: 2500

DRILLING CONTRACTOR: Crux

DRILLER: S. Walker

LOGGED: J. Coleman

CHECKED:

DATE: 6/29/99

Golder Associates

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-1-99

PROJECT Lilliwaup Vacinity Slide — Job No. DMC-013

Near MP 326 approximately 72 feet above SR 101. — S.R. 101

Station — Offset — C.S. 2303

Equipment CME 45 w/ cathead — Casing HW, HQ — Ground El 0.0 (0.00 m)

Method of Boring Wet Rotary

Start Date April 7, 1999 — Completion Date April 10, 1999 — Sheet 1 of 4

Master Copy for MP326 Final Rpt. App. A

102.7

DRAFT

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30)	Blows	Sample	Description of Material	Groundwater	Instrument
5	1, 2			7 7 6 (13)	D-1	Silty SAND with gravel, subrounded, medium dense, brown, wet, Homogeneous, no HCl reaction, light oxidation - light orangish tint Length Recovered 0.5 ft, Length Retained 0.5 ft		
10	3, 4			3 4 6 (10)	D-2	Silty GRAVEL with sand, subrounded, loose, brown, wet, Stratified, no HCl reaction, stratified with partially elastic SILT with sand(1.5") Length Recovered 0.7 ft, Length Retained 0.7 ft	04/08/1999	
15	5, 6			8 4 7 (11)	D-3	Silty GRAVEL with sand, subrounded, medium dense, brown, wet, Homogeneous, no HCl reaction Length Recovered 0.7 ft, Length Retained 0.7 ft	04/09/1999	
20								

SOIL DMC013-1.GPJ SOIL.GDT 4/14/99 07:46:25 A4

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-1-99

PROJECT Lilliwaup Vacinity Slide

Sheet 2 of 4

Job No. DMC-013

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				7 7 7 (14)		D-4		Silty GRAVEL with sand, subangular, medium dense, brown, wet, Homogeneous, no HCl reaction, Interpreted from drill cuttings, rest of sample was lost Length Recovered 0.2 ft, Length Retained 0.2 ft		
	7									
25			>>	13 27 30 (57)		D-5		Silty GRAVEL with sand, subangular, very dense, brown, wet, Homogeneous, no HCl reaction Length Recovered 0.3 ft, Length Retained 0.3 ft		
	8									
30	9		>>	10 28 29 (57)		D-6		Sandy SILT, very dense, grayish brown, moist, Blocky, Homogeneous, no HCl reaction Length Recovered 1.3 ft, Length Retained 1.0 ft		
	10									
35	11			11 16 21 (37)		D-7		Silty SAND, dense, grayish brown, moist, Stratified, Laminated, Fissured, Blocky, Disrupted, weak HCl reaction, stratified with Sandy SILT, interbedded and coarsening downwards, soft and disrupted at 35.5 feet with voids, dark sandy 3mm laminations in upper part of sample(25 degrees), Length Recovered 1.3 ft, Length Retained 1.0 ft		
	12									
40	13			13 12 20 (32)		D-8		Silty SAND, dense, grayish brown, moist, Homogeneous, weak HCl reaction Length Recovered 1.3 ft, Length Retained 1.0 ft		
45				12		D-9		Silty SAND, dense, grayish brown, wet, Homogeneous,		

DRAFT

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-1-99

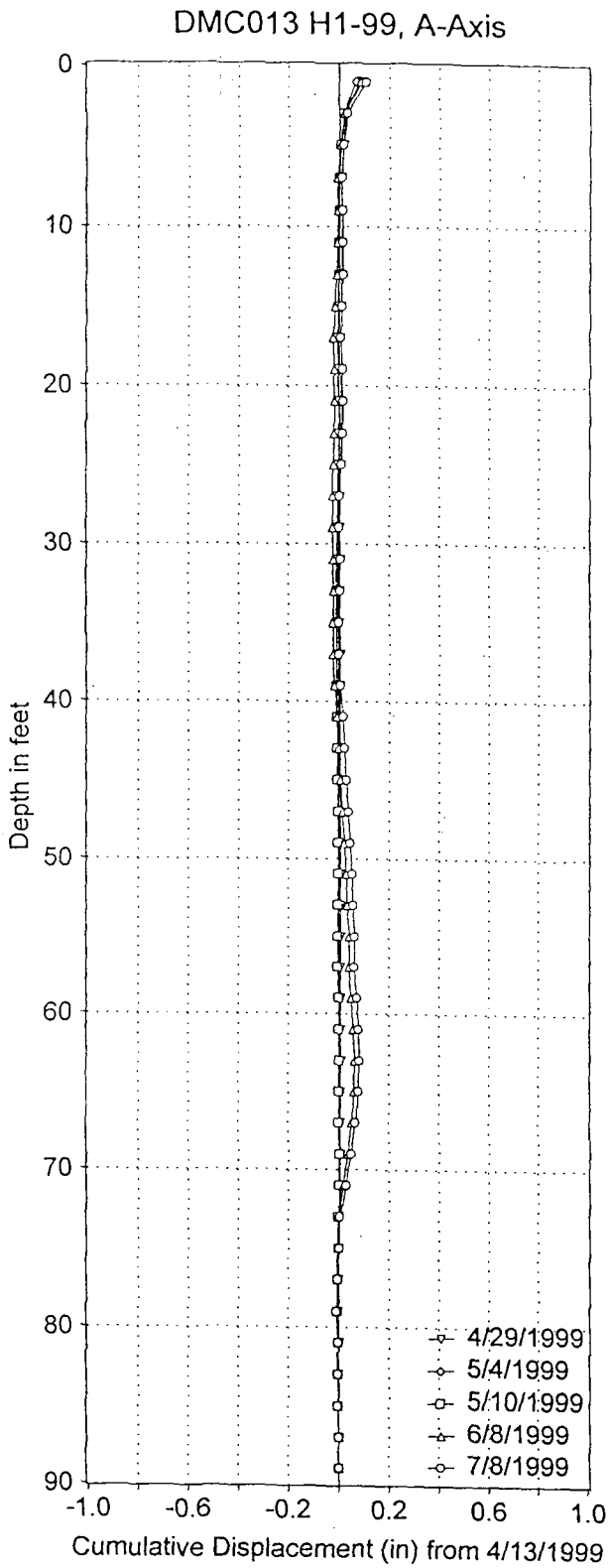
PROJECT Lilliwaup Vacinity Slide

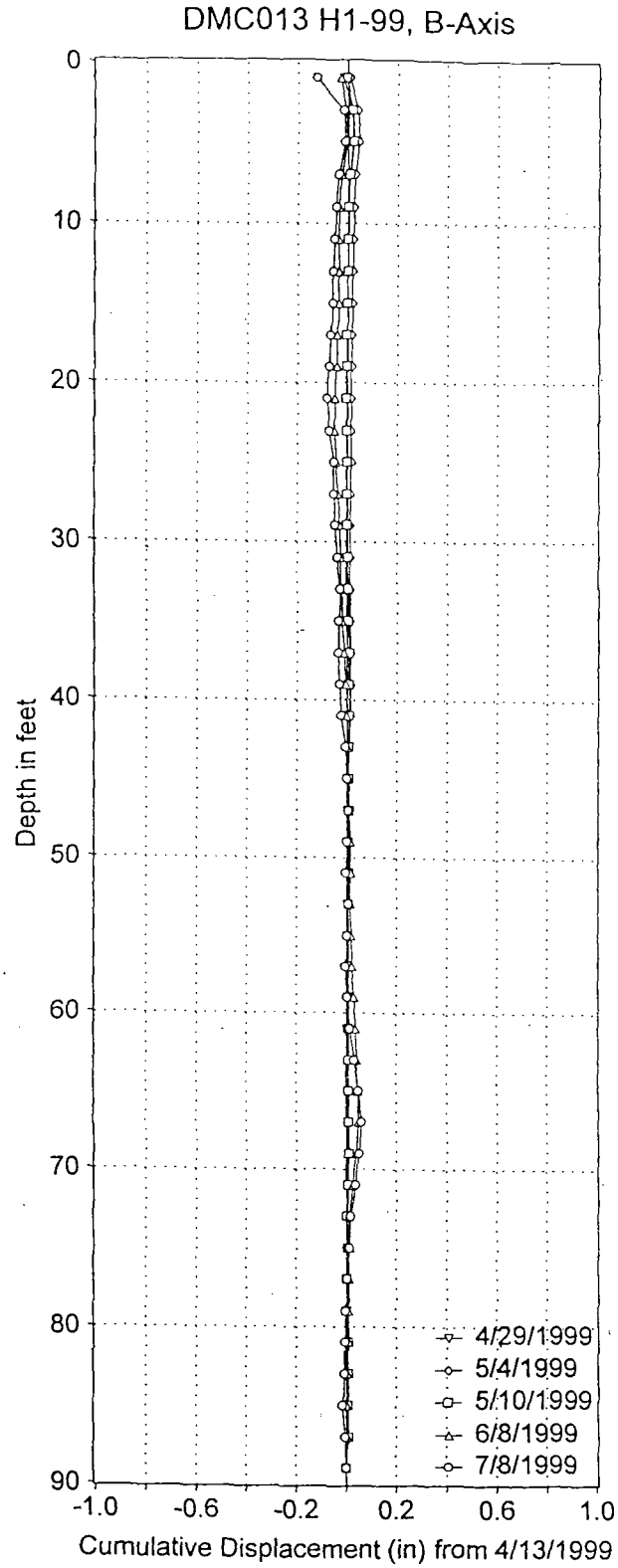
Sheet 4 of 4

Job No. DMC-013

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				15 21 (36)				Blocky,Homogeneous, no HCl reaction, glacial lacustrine deposit Length Recovered 1.5 ft, Length Retained 1.0 ft		
	22									
75	23			11 18 35 (53)		D-15		Lean CLAY with sand, hard, dark bluish gray, moist, Blocky,Homogeneous, no HCl reaction, glacial lacustrine deposit Length Recovered 1.5 ft, Length Retained 1.0 ft		
	24									
80				16 21 50/6" (71)		D-16		Lean CLAY, very hard, dark blush gray, moist, Blocky,Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.0 ft		
	25									
85	26			16 50/5.5" (50)		D-17		Sandy Lean CLAY with gravel, subrounded to angular, very hard, dark bluish gray, moist, Blocky,Homogeneous, no HCl reaction, contact between glacial lacustrine deposits and till Length Recovered 1.0 ft, Length Retained 1.0 ft		
	27									
90	28							End of test hole boring at 88 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
95										

DRAFT





WSDOT
MATERIALS LAB
GEOTECH SECTION
OLYMPIA, WA

DMC-013 SR 101
MP 326 SLIDE
H-1-99 A+ = N105 deg.

OPE INDICATOR DATA REDUCTION

inted by DMM on July 8,1999
E: DMC013 HOLE NUMBER H1-99
description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
TA SET #	1	10
ENSOR #	26087	26087
ATE	04/13/99 09:19	07/08/99 10:14
EADINGS PER DIRECTION	44	44

ENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	-250	248	-498	-186	183	-369	129	0.0714
4.000	-245	237	-482	-229	228	-457	25	-0.0060
6.000	-124	114	-238	-111	105	-216	22	-0.0210
8.000	53	-62	115	55	-57	112	-3	-0.0342
10.000	185	-194	379	186	-190	376	-3	-0.0324
12.000	139	-148	287	145	-147	292	5	-0.0306
14.000	73	-83	156	81	-85	166	10	-0.0336
16.000	67	-77	144	75	-78	153	9	-0.0396
18.000	98	-107	205	98	-101	199	-6	-0.0450
20.000	59	-65	124	58	-60	118	-6	-0.0414
22.000	-34	26	-60	-33	30	-63	-3	-0.0378
24.000	-91	82	-173	-84	80	-164	9	-0.0360
26.000	-114	103	-217	-107	104	-211	6	-0.0414
28.000	-135	126	-261	-133	130	-263	-2	-0.0450
30.000	-172	165	-337	-170	171	-341	-4	-0.0438
1.000	-197	186	-383	-196	191	-387	-4	-0.0414
34.000	-105	95	-200	-100	98	-198	2	-0.0390
36.000	-66	57	-123	-61	59	-120	3	-0.0402
38.000	-55	45	-100	-58	55	-113	-13	-0.0420
40.000	-93	87	-180	-101	101	-202	-22	-0.0342
42.000	-159	147	-306	-161	157	-318	-12	-0.0210
44.000	-169	160	-329	-173	171	-344	-15	-0.0138
46.000	-184	177	-361	-190	188	-378	-17	-0.0048
48.000	-172	162	-334	-178	172	-350	-16	0.0054
50.000	-168	160	-328	-173	171	-344	-16	0.0150
52.000	-170	162	-332	-170	169	-339	-7	0.0246
54.000	-184	176	-360	-189	187	-376	-16	0.0288
56.000	-210	200	-410	-206	202	-408	2	0.0384
58.000	-226	220	-446	-233	231	-464	-18	0.0372
60.000	-263	257	-520	-269	266	-535	-15	0.0480
62.000	-295	285	-580	-296	293	-589	-9	0.0570
64.000	-269	262	-531	-265	263	-528	3	0.0624
66.000	-242	234	-476	-232	230	-462	14	0.0606
68.000	-203	192	-395	-184	182	-366	29	0.0522
70.000	-216	210	-426	-200	199	-399	27	0.0348
72.000	-270	261	-531	-248	246	-494	37	0.0186
74.000	-259	253	-512	-253	253	-506	6	-0.0036
76.000	-235	227	-462	-230	227	-457	5	-0.0072
78.000	-215	207	-422	-211	209	-420	2	-0.0102
80.000	-290	283	-573	-291	290	-581	-8	-0.0114
2.000	-398	387	-785	-396	393	-789	-4	-0.0066
4.000	-447	440	-887	-446	443	-889	-2	-0.0042
86.000	-485	477	-962	-485	480	-965	-3	-0.0030

LOPE INDICATOR DATA REDUCTION

rinted by DMM on July 8,1999
TE: DMC013 HOLE NUMBER H1-99
e description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
ATA SET #	1	10
ENSOR #	26087	26087
DATE	04/13/99 09:19	07/08/99 10:14
EADINGS PER DIRECTION	44	44

ENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
88.000	-536	526	-1062	-535	529	-1064	-2	-0.0012

END OF RECORDS

SLOPE INDICATOR DATA REDUCTION

Printed by DMM on July 8,1999
SITE: DMC013 HOLE NUMBER H1-99
Site description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
DATA SET #	1	10
SENSOR #	26087	26087
DATE	04/13/99 09:19	07/08/99 10:14
READINGS PER DIRECTION	44	44

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	197	-244	441	118	-142	260	-181	-0.1488
4.000	137	-155	292	129	-153	282	-10	-0.0402
6.000	207	-233	440	223	-258	481	41	-0.0342
8.000	118	-142	260	118	-151	269	9	-0.0588
10.000	71	-81	152	64	-87	151	-1	-0.0642
12.000	85	-106	191	81	-113	194	3	-0.0636
14.000	121	-147	268	114	-148	262	-6	-0.0654
16.000	55	-82	137	52	-90	142	5	-0.0618
18.000	10	-30	40	7	-38	45	5	-0.0648
20.000	-68	69	-137	-70	59	-129	8	-0.0678
22.000	-187	145	-332	-196	159	-355	-23	-0.0726
24.000	-210	168	-378	-221	186	-407	-29	-0.0588
26.000	-267	226	-493	-267	231	-498	-5	-0.0414
28.000	-182	163	-345	-191	166	-357	-12	-0.0384
30.000	-93	83	-176	-106	84	-190	-14	-0.0312
[illegible].000	-188	163	-351	-202	171	-373	-22	-0.0228
34.000	-218	180	-398	-213	177	-390	8	-0.0096
36.000	-179	139	-318	-176	143	-319	-1	-0.0144
38.000	-159	121	-280	-163	129	-292	-12	-0.0138
40.000	-155	138	-293	-170	137	-307	-14	-0.0066
42.000	-197	165	-362	-211	180	-391	-29	0.0018
44.000	-232	195	-427	-230	209	-439	-12	0.0192
46.000	-244	204	-448	-242	213	-455	-7	0.0264
48.000	-249	213	-462	-243	214	-457	5	0.0306
50.000	-204	169	-373	-198	167	-365	8	0.0276
52.000	-197	155	-352	-203	166	-369	-17	0.0228
54.000	-210	171	-381	-205	170	-375	6	0.0330
56.000	-189	152	-341	-181	148	-329	12	0.0294
58.000	-152	114	-266	-153	121	-274	-8	0.0222
60.000	-159	142	-301	-177	145	-322	-21	0.0270
62.000	-228	192	-420	-238	206	-444	-24	0.0396
64.000	-243	203	-446	-251	221	-472	-26	0.0540
66.000	-266	225	-491	-272	239	-511	-20	0.0696
68.000	-288	251	-539	-275	245	-520	19	0.0816
70.000	-268	250	-518	-264	233	-497	21	0.0702
72.000	-255	222	-477	-239	207	-446	31	0.0576
74.000	-240	202	-442	-230	198	-428	14	0.0390
76.000	-235	197	-432	-226	192	-418	14	0.0306
78.000	-235	199	-434	-228	196	-424	10	0.0222
80.000	-211	191	-402	-211	183	-394	8	0.0162
[illegible]2.000	-151	137	-288	-154	127	-281	7	0.0114
[illegible]4.000	-67	38	-105	-59	28	-87	18	0.0072
86.000	-26	-12	-14	-30	-11	-19	-5	-0.0036

OPE INDICATOR DATA REDUCTION

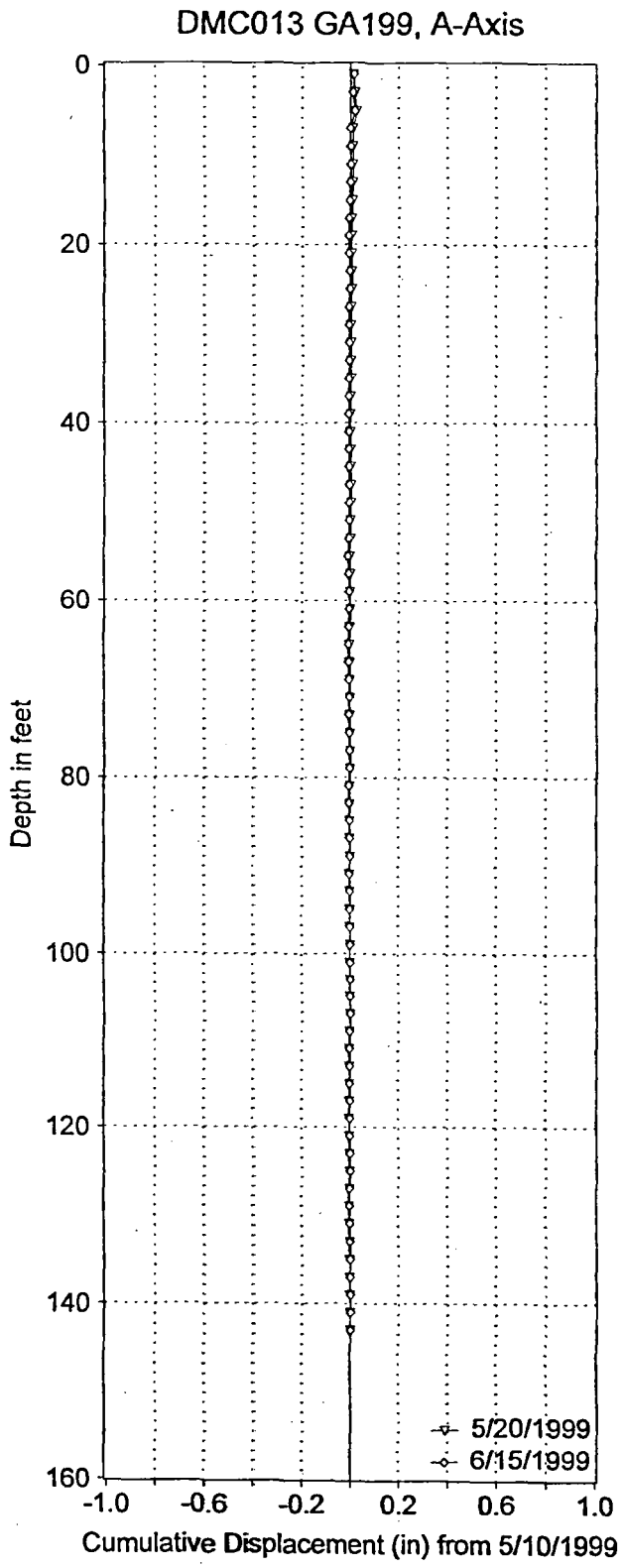
inted by DMM on July 8,1999
TE: DMC013 HOLE NUMBER H1-99
description SR 101 MP 326 SLIDE

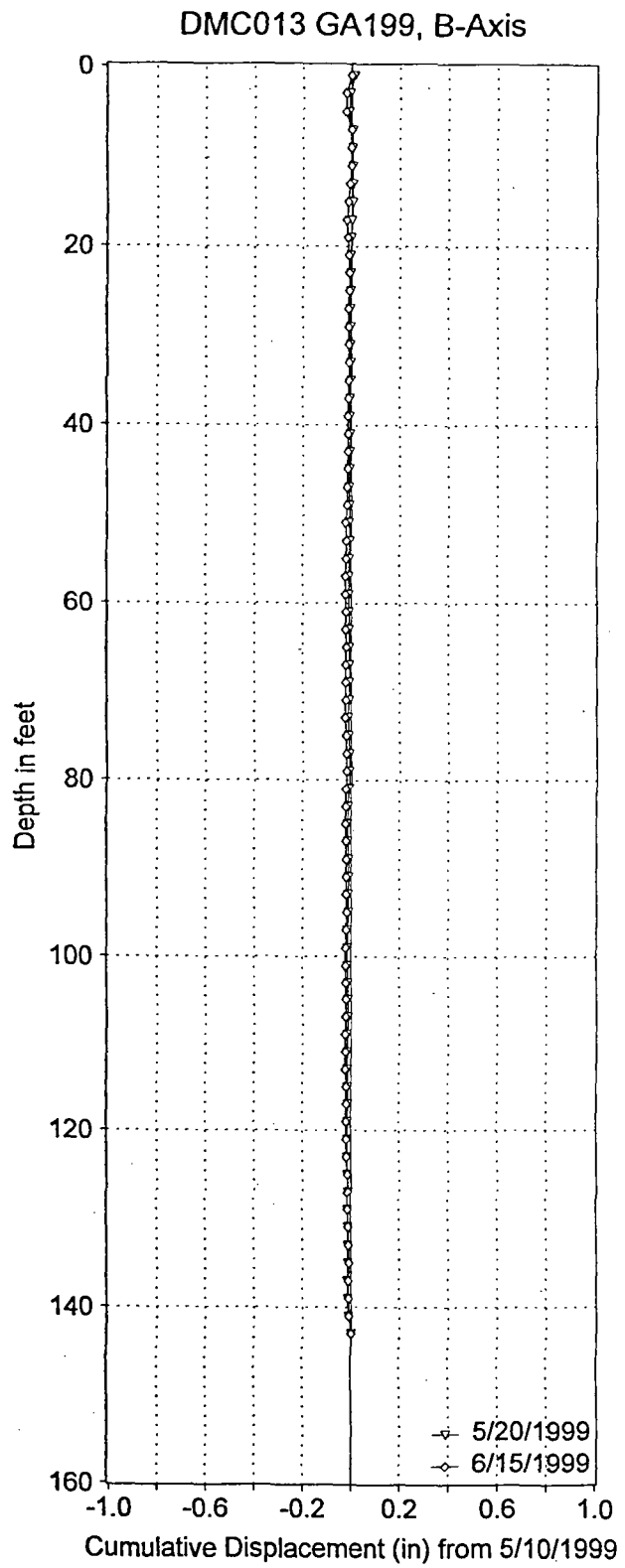
	PREVIOUS	CURRENT
ATA SET #	1	10
ENSOR #	26087	26087
DATE	04/13/99 09:19	07/08/99 10:14
EADINGS PER DIRECTION	44	44

ENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
88.000	-39	29	-68	-50	19	-69	-1	-0.0006

END OF RECORDS





WSDOT
MATERIALS LAB
GEOTECH SECTION
OLYMPIA, WA

DMC-013 SR 101
MP 326 SLIDE
A+ = N114 deg.
GA1-99

SLOPE INDICATOR DATA REDUCTION

Printed by DigiPro on June 17,1999
JOB: DMC013 HOLE NUMBER GA199
Job description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
DATA SET #	1	3
SENSOR #	26087	26087
DATE	05/10/99 07:19	06/15/99 10:19
READINGS PER DIRECTION	71	71

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	-321	311	-632	-316	307	-623	9	0.0156
4.000	-241	231	-472	-249	237	-486	-14	0.0102
6.000	-210	199	-409	-194	183	-377	32	0.0186
8.000	-247	237	-484	-249	239	-488	-4	-0.0006
10.000	-237	229	-466	-236	227	-463	3	0.0018
12.000	-198	187	-385	-195	186	-381	4	0.0000
14.000	-105	95	-200	-102	93	-195	5	-0.0024
16.000	93	-103	196	95	-105	200	4	-0.0054
18.000	159	-169	328	159	-169	328	0	-0.0078
20.000	242	-249	491	241	-249	490	-1	-0.0078
22.000	46	-55	101	42	-54	96	-5	-0.0072
24.000	-116	109	-225	-120	109	-229	-4	-0.0042
26.000	-258	249	-507	-257	246	-503	4	-0.0018
28.000	-159	150	-309	-157	148	-305	4	-0.0042
30.000	-119	111	-230	-119	111	-230	0	-0.0066
[illegible].000	-101	90	-191	-100	90	-190	1	-0.0066
34.000	-99	91	-190	-102	92	-194	-4	-0.0072
36.000	-127	118	-245	-127	116	-243	2	-0.0048
38.000	-62	52	-114	-61	50	-111	3	-0.0060
40.000	-41	35	-76	-42	34	-76	0	-0.0078
42.000	-75	66	-141	-75	65	-140	1	-0.0078
44.000	-102	94	-196	-105	95	-200	-4	-0.0084
46.000	-145	137	-282	-146	137	-283	-1	-0.0060
48.000	-132	123	-255	-133	121	-254	1	-0.0054
50.000	-65	58	-123	-65	57	-122	1	-0.0060
52.000	-69	61	-130	-68	60	-128	2	-0.0066
54.000	-17	7	-24	-16	7	-23	1	-0.0078
56.000	-44	35	-79	-47	37	-84	-5	-0.0084
58.000	-98	89	-187	-99	89	-188	-1	-0.0054
60.000	-111	104	-215	-111	103	-214	1	-0.0048
62.000	-122	114	-236	-123	112	-235	1	-0.0054
64.000	-107	99	-206	-107	98	-205	1	-0.0060
66.000	-92	83	-175	-92	83	-175	0	-0.0066
68.000	-91	83	-174	-93	83	-176	-2	-0.0066
70.000	-108	101	-209	-109	101	-210	-1	-0.0054
72.000	-127	118	-245	-127	117	-244	1	-0.0048
74.000	-158	151	-309	-159	151	-310	-1	-0.0054
76.000	-137	129	-266	-137	129	-266	0	-0.0048
78.000	-156	149	-305	-157	149	-306	-1	-0.0048
80.000	-159	152	-311	-159	152	-311	0	-0.0042
[illegible].000	-182	174	-356	-182	174	-356	0	-0.0042
[illegible].000	-229	221	-450	-231	222	-453	-3	-0.0042
86.000	-250	242	-492	-250	242	-492	0	-0.0024
88.000	-278	271	-549	-278	271	-549	0	-0.0024
90.000	-290	284	-574	-290	283	-573	1	-0.0024

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
92.000	-290	283	-573	-291	283	-574	-1	-0.0030
94.000	-271	263	-534	-273	262	-535	-1	-0.0024
96.000	-309	301	-610	-310	301	-611	-1	-0.0018
98.000	-349	341	-690	-350	342	-692	-2	-0.0012
100.000	-369	364	-733	-370	365	-735	-2	0.0000
102.000	-366	358	-724	-366	358	-724	0	0.0012
104.000	-366	360	-726	-365	358	-723	3	0.0012
106.000	-304	297	-601	-304	296	-600	1	-0.0006
108.000	-270	264	-534	-269	263	-532	2	-0.0012
110.000	-246	240	-486	-246	241	-487	-1	-0.0024
112.000	-277	271	-548	-277	270	-547	1	-0.0018
114.000	-239	231	-470	-241	232	-473	-3	-0.0024
116.000	-318	311	-629	-319	311	-630	-1	-0.0006
118.000	-345	339	-684	-346	339	-685	-1	0.0000
120.000	-353	347	-700	-351	346	-697	3	0.0006
122.000	-321	314	-635	-321	314	-635	0	-0.0012
124.000	-301	295	-596	-302	295	-597	-1	-0.0012
126.000	-299	292	-591	-299	293	-592	-1	-0.0006
128.000	-288	283	-571	-288	282	-570	1	0.0000
130.000	-285	279	-564	-285	279	-564	0	-0.0006
132.000	-282	276	-558	-282	275	-557	1	-0.0006
134.000	-254	245	-499	-254	246	-500	-1	-0.0012
136.000	-257	251	-508	-258	251	-509	-1	-0.0006
138.000	-249	242	-491	-249	243	-492	-1	0.0000
[illegible].000	-227	221	-448	-227	221	-448	0	0.0006
142.000	-238	230	-468	-238	229	-467	1	0.0006

END OF RECORDS

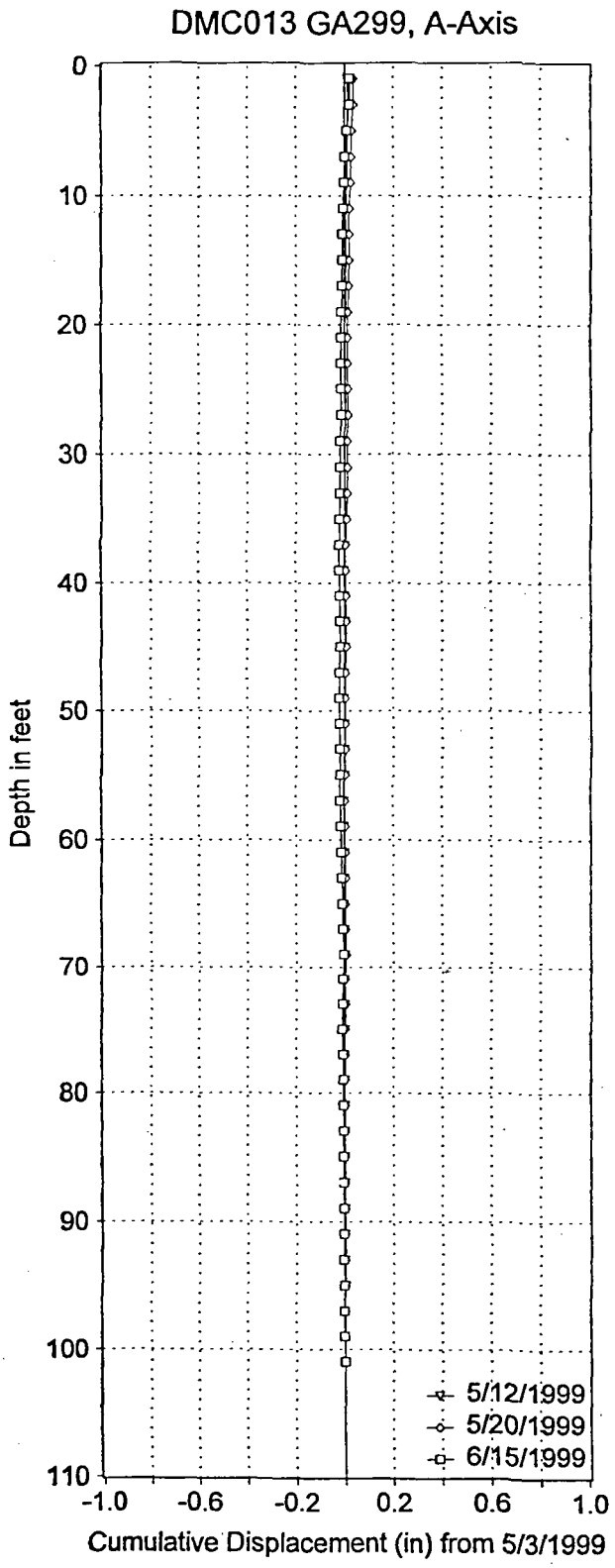
SENSOR: 26087

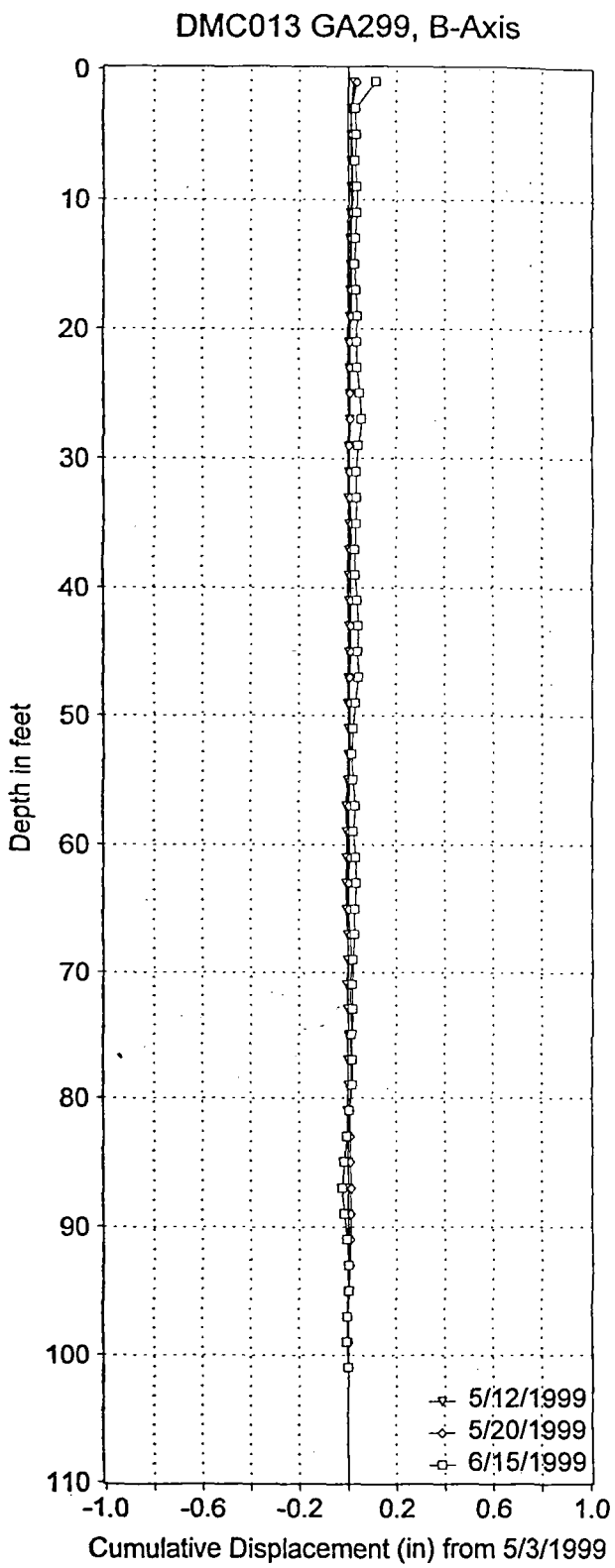
	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	32	-56	88	45	-81	126	38	-0.0426
4.000	-49	42	-91	-52	41	-93	-2	-0.0654
6.000	-213	174	-387	-233	191	-424	-37	-0.0642
8.000	-189	145	-334	-191	144	-335	-1	-0.0420
10.000	-182	143	-325	-186	141	-327	-2	-0.0414
12.000	-169	129	-298	-159	126	-285	13	-0.0402
14.000	-122	81	-203	-115	78	-193	10	-0.0480
16.000	-51	25	-76	-50	18	-68	8	-0.0540
18.000	1	-41	42	-2	-35	33	-9	-0.0588
20.000	-38	2	-40	-41	9	-50	-10	-0.0534
22.000	-110	72	-182	-114	71	-185	-3	-0.0474
24.000	-138	97	-235	-142	96	-238	-3	-0.0456
26.000	-106	91	-197	-108	86	-194	3	-0.0438
28.000	-38	-3	-35	-42	-7	-35	0	-0.0456
30.000	-65	25	-90	-69	22	-91	-1	-0.0456
32.000	-82	41	-123	-86	39	-125	-2	-0.0450
34.000	-116	80	-196	-119	79	-198	-2	-0.0438
36.000	-163	122	-285	-166	119	-285	0	-0.0426
38.000	-183	155	-338	-181	153	-334	4	-0.0426
40.000	-117	77	-194	-121	73	-194	0	-0.0450
42.000	-134	95	-229	-137	91	-228	1	-0.0450
44.000	-149	129	-278	-154	127	-281	-3	-0.0456
46.000	-226	210	-436	-225	206	-431	5	-0.0438
48.000	-135	91	-226	-137	88	-225	1	-0.0468
[illegible].000	-78	59	-137	-77	53	-130	7	-0.0474
[illegible]2.000	-158	126	-284	-164	127	-291	-7	-0.0516
54.000	-202	171	-373	-206	169	-375	-2	-0.0474
56.000	-198	161	-359	-198	157	-355	4	-0.0462
58.000	-173	133	-306	-175	130	-305	1	-0.0486
60.000	-195	157	-352	-199	155	-354	-2	-0.0492
62.000	-190	146	-336	-193	144	-337	-1	-0.0480
64.000	-137	103	-240	-141	104	-245	-5	-0.0474
66.000	-194	154	-348	-197	150	-347	1	-0.0444
68.000	-190	156	-346	-194	152	-346	0	-0.0450
70.000	-187	150	-337	-190	148	-338	-1	-0.0450
72.000	-202	158	-360	-203	155	-358	2	-0.0444
74.000	-231	195	-426	-235	198	-433	-7	-0.0456
76.000	-268	227	-495	-273	224	-497	-2	-0.0414
78.000	-273	231	-504	-277	227	-504	0	-0.0402
80.000	-259	217	-476	-263	214	-477	-1	-0.0402
82.000	-253	214	-467	-256	211	-467	0	-0.0396
84.000	-225	189	-414	-229	186	-415	-1	-0.0396
86.000	-220	180	-400	-225	177	-402	-2	-0.0390
88.000	-187	146	-333	-192	143	-335	-2	-0.0378
90.000	-173	132	-305	-177	130	-307	-2	-0.0366
92.000	-169	129	-298	-172	125	-297	1	-0.0354
94.000	-183	161	-344	-188	160	-348	-4	-0.0360
96.000	-257	218	-475	-258	215	-473	2	-0.0336
98.000	-253	213	-466	-255	211	-466	0	-0.0348
[illegible]0.000	-251	213	-464	-255	209	-464	0	-0.0348
[illegible].000	-229	190	-419	-233	187	-420	-1	-0.0348
104.000	-187	153	-340	-193	149	-342	-2	-0.0342
106.000	-204	163	-367	-207	159	-366	1	-0.0330
108.000	-179	138	-317	-182	134	-316	1	-0.0336

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
110.000	-146	104	-250	-149	102	-251	-1	-0.0342
112.000	-116	77	-193	-119	75	-194	-1	-0.0336
114.000	-118	96	-214	-123	101	-224	-10	-0.0330
116.000	-182	143	-325	-185	139	-324	1	-0.0270
118.000	-204	167	-371	-209	165	-374	-3	-0.0276
120.000	-241	201	-442	-243	198	-441	1	-0.0258
122.000	-240	201	-441	-243	199	-442	-1	-0.0264
124.000	-235	213	-448	-240	217	-457	-9	-0.0258
126.000	-293	253	-546	-298	251	-549	-3	-0.0204
128.000	-306	266	-572	-310	265	-575	-3	-0.0186
130.000	-314	273	-587	-318	272	-590	-3	-0.0168
132.000	-328	289	-617	-333	287	-620	-3	-0.0150
134.000	-327	293	-620	-331	293	-624	-4	-0.0132
136.000	-347	309	-656	-347	307	-654	2	-0.0108
138.000	-311	271	-582	-315	269	-584	-2	-0.0120
140.000	-302	265	-567	-305	262	-567	0	-0.0108
142.000	-249	256	-505	-269	254	-523	-18	-0.0108

END OF RECORDS





WSDOT
MATERIALS LAB
GEOTECH SECTION
OLYMPIA, WA

DMC-013 SR 101
MP 326 SLIDE
GA2-99 A+ = N112 deg.

SLOPE INDICATOR DATA REDUCTION

Printed by DigiPro on June 17,1999
[illegible]: DMC013 HOLE NUMBER GA299
s[illegible] description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
DATA SET #	1	4
SENSOR #	26087	26087
DATE	05/03/99 12:19	06/15/99 11:04
READINGS PER DIRECTION	50	50

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	55	-63	118	62	-58	120	2	0.0222
4.000	112	-119	231	128	-122	250	19	0.0210
6.000	163	-171	334	178	-171	349	15	0.0096
8.000	274	-282	556	283	-279	562	6	0.0006
10.000	291	-298	589	300	-294	594	5	-0.0030
12.000	231	-242	473	240	-237	477	4	-0.0060
14.000	255	-263	518	263	-257	520	2	-0.0084
16.000	230	-238	468	237	-232	469	1	-0.0096
18.000	159	-166	325	167	-161	328	3	-0.0102
20.000	152	-161	313	160	-155	315	2	-0.0120
22.000	144	-151	295	152	-147	299	4	-0.0132
24.000	173	-180	353	179	-174	353	0	-0.0156
26.000	213	-221	434	220	-214	434	0	-0.0156
28.000	256	-265	521	263	-259	522	1	-0.0156
[illegible].000	325	-332	657	333	-326	659	2	-0.0162
[illegible].000	353	-362	715	362	-358	720	5	-0.0174
34.000	327	-335	662	336	-330	666	4	-0.0204
36.000	239	-247	486	245	-238	483	-3	-0.0228
38.000	175	-183	358	181	-177	358	0	-0.0210
40.000	113	-119	232	119	-111	230	-2	-0.0210
42.000	63	-71	134	69	-63	132	-2	-0.0198
44.000	118	-125	243	125	-118	243	0	-0.0186
46.000	132	-138	270	138	-134	272	2	-0.0186
48.000	151	-159	310	159	-155	314	4	-0.0198
50.000	107	-113	220	114	-106	220	0	-0.0222
52.000	107	-114	221	113	-107	220	-1	-0.0222
54.000	145	-150	295	150	-142	292	-3	-0.0216
56.000	141	-147	288	146	-139	285	-3	-0.0198
58.000	145	-151	296	149	-145	294	-2	-0.0180
60.000	157	-162	319	161	-155	316	-3	-0.0168
62.000	245	-254	499	250	-244	494	-5	-0.0150
64.000	361	-366	727	365	-357	722	-5	-0.0120
66.000	346	-352	698	351	-344	695	-3	-0.0090
68.000	221	-226	447	225	-218	443	-4	-0.0072
70.000	196	-201	397	205	-197	402	5	-0.0048
72.000	195	-202	397	204	-197	401	4	-0.0078
74.000	237	-242	479	243	-235	478	-1	-0.0102
76.000	155	-159	314	159	-151	310	-4	-0.0096
78.000	145	-152	297	151	-145	296	-1	-0.0072
80.000	102	-106	208	109	-98	207	-1	-0.0066
[illegible].000	94	-101	195	102	-94	196	1	-0.0060
[illegible]4.000	107	-112	219	114	-105	219	0	-0.0066
86.000	103	-109	212	109	-103	212	0	-0.0066
88.000	125	-132	257	129	-123	252	-5	-0.0066
90.000	213	-219	432	221	-212	433	1	-0.0036

SENSOR: 26087

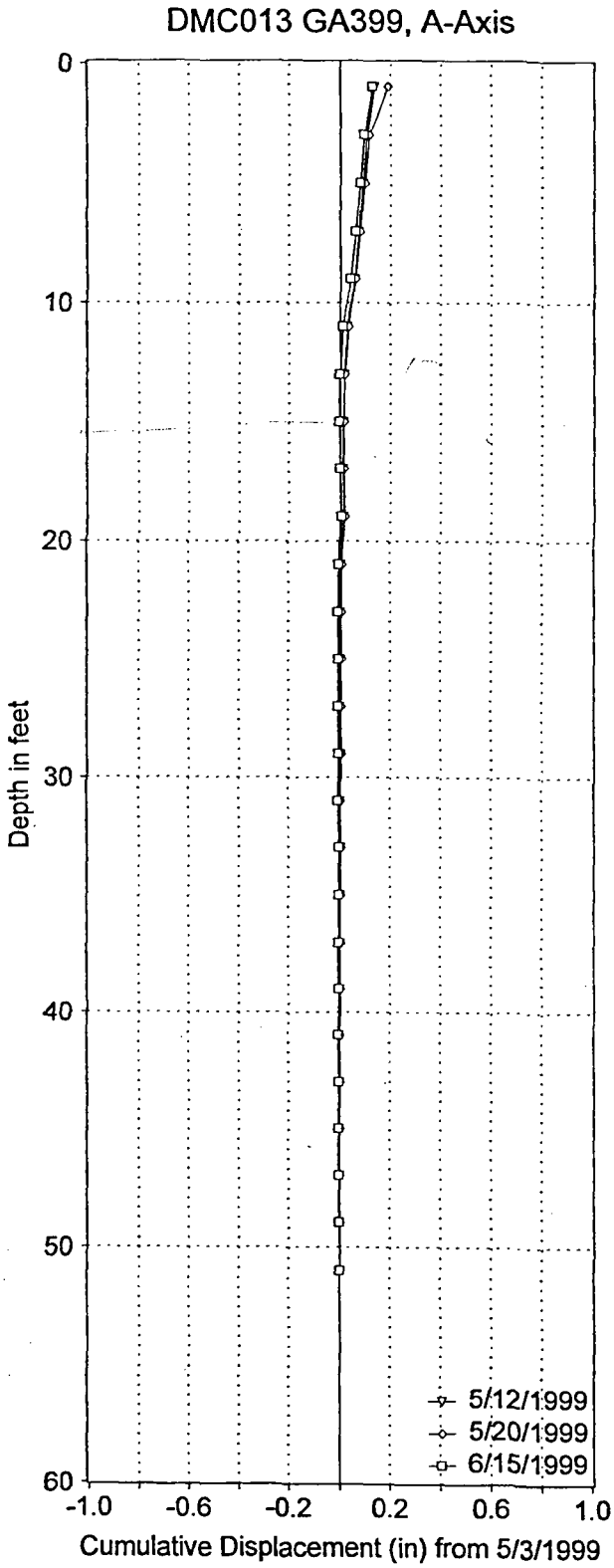
	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
92.000	301	-306	607	308	-299	607	0	-0.0042
94.000	241	-242	483	245	-235	480	-3	-0.0042
96.000	159	-164	323	164	-157	321	-2	-0.0024
98.000	74	-79	153	79	-73	152	-1	-0.0012
100.000	166	-168	334	171	-162	333	-1	-0.0006

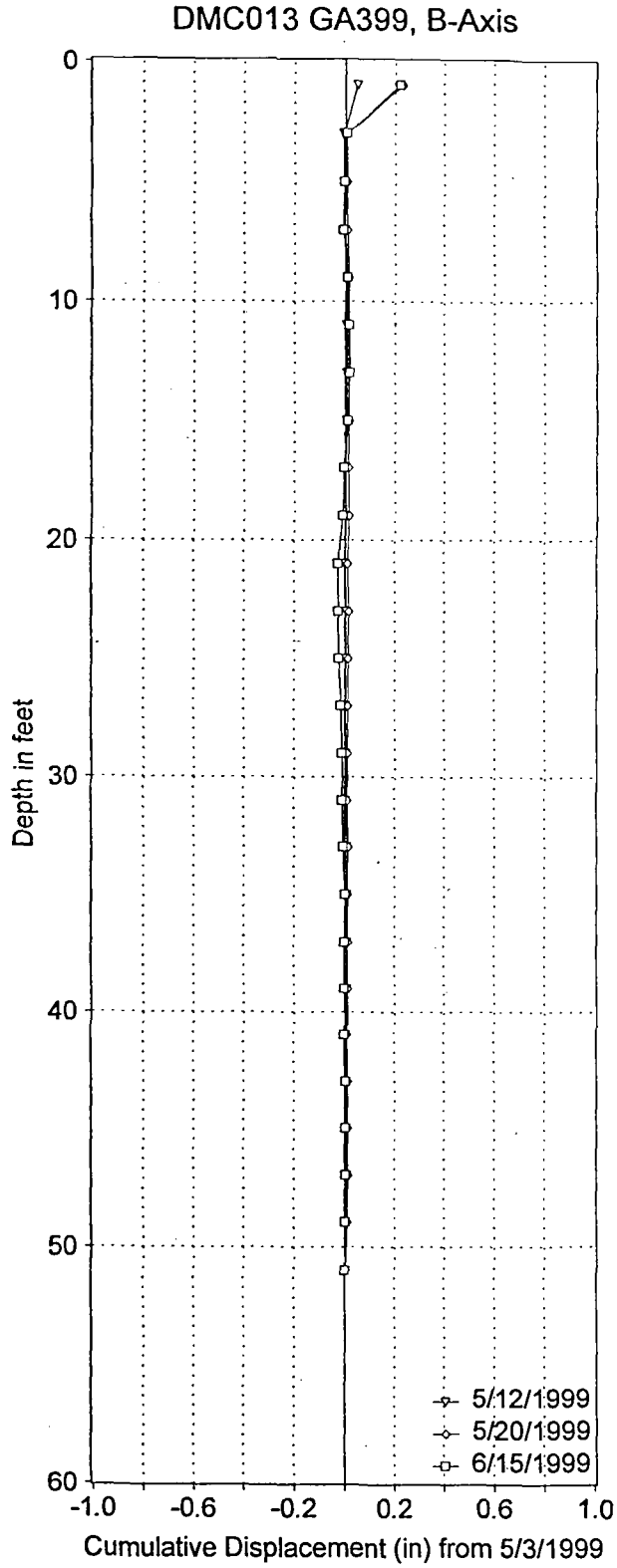
END OF RECORDS

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	-51	17	-68	11	-61	72	140	0.1440
4.000	-127	82	-209	-142	74	-216	-7	0.0600
6.000	-132	92	-224	-134	77	-211	13	0.0642
8.000	-108	62	-170	-122	58	-180	-10	0.0564
10.000	-148	125	-273	-167	107	-274	-1	0.0624
12.000	-197	185	-382	-210	165	-375	7	0.0630
14.000	-111	78	-189	-118	61	-179	10	0.0588
16.000	-79	37	-116	-96	30	-126	-10	0.0528
18.000	-63	35	-98	-81	22	-103	-5	0.0588
20.000	-129	102	-231	-147	87	-234	-3	0.0618
22.000	-157	135	-292	-175	115	-290	2	0.0636
24.000	-167	120	-287	-183	119	-302	-15	0.0624
26.000	-198	152	-350	-214	145	-359	-9	0.0714
28.000	-226	179	-405	-224	163	-387	18	0.0768
30.000	-233	190	-423	-230	176	-406	17	0.0660
32.000	-174	166	-340	-190	149	-339	1	0.0558
34.000	-84	43	-127	-93	29	-122	5	0.0552
36.000	-63	18	-81	-74	1	-75	6	0.0522
38.000	-49	2	-51	-62	-6	-56	-5	0.0486
40.000	-42	5	-47	-57	0	-57	-10	0.0516
42.000	-106	84	-190	-122	71	-193	-3	0.0576
44.000	-95	55	-150	-104	41	-145	5	0.0594
46.000	-142	117	-259	-161	105	-266	-7	0.0564
48.000	-229	185	-414	-225	166	-391	23	0.0606
[illegible].000	-170	130	-300	-169	113	-282	18	0.0468
[illegible]2.000	-139	114	-253	-142	95	-237	16	0.0360
54.000	-121	75	-196	-135	75	-210	-14	0.0264
56.000	-195	156	-351	-213	155	-368	-17	0.0348
58.000	-219	177	-396	-220	160	-380	16	0.0450
60.000	-193	158	-351	-211	153	-364	-13	0.0354
62.000	-288	267	-555	-309	251	-560	-5	0.0432
64.000	-378	331	-709	-379	318	-697	12	0.0462
66.000	-349	323	-672	-364	308	-672	0	0.0390
68.000	-281	242	-523	-284	225	-509	14	0.0390
70.000	-257	212	-469	-269	197	-466	3	0.0306
72.000	-253	230	-483	-267	213	-480	3	0.0288
74.000	-234	199	-433	-246	182	-428	5	0.0270
76.000	-162	117	-279	-171	111	-282	-3	0.0240
78.000	-213	170	-383	-222	162	-384	-1	0.0258
80.000	-219	171	-390	-213	154	-367	23	0.0264
82.000	-221	181	-402	-215	164	-379	23	0.0126
84.000	-169	133	-302	-171	115	-286	16	-0.0012
86.000	-122	82	-204	-124	65	-189	15	-0.0108
88.000	-77	35	-112	-94	32	-126	-14	-0.0198
90.000	-82	37	-119	-98	38	-136	-17	-0.0114
92.000	-121	82	-203	-135	78	-213	-10	-0.0012
94.000	-123	91	-214	-137	80	-217	-3	0.0048
96.000	-212	175	-387	-219	158	-377	10	0.0066
98.000	-78	61	-139	-90	42	-132	7	0.0006
[illegible].000	-98	91	-189	-119	76	-195	-6	-0.0036

END OF RECORDS





WSDOT
MATERIALS LAB
GEOTECH SECTION
OLYMPIA, WA

DMC-013 SR 101
MP 326 SLIDE
GA3-99 A+ = N112 deg.

LOPE INDICATOR DATA REDUCTION

rinted by DigiPro on June 17,1999
: DMC013 HOLE NUMBER GA399
s description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
ATA SET #	1	4
ENSOR #	26087	26087
DATE	05/03/99 12:54	06/15/99 11:35
EADINGS PER DIRECTION	25	25

ENSOR: 26087

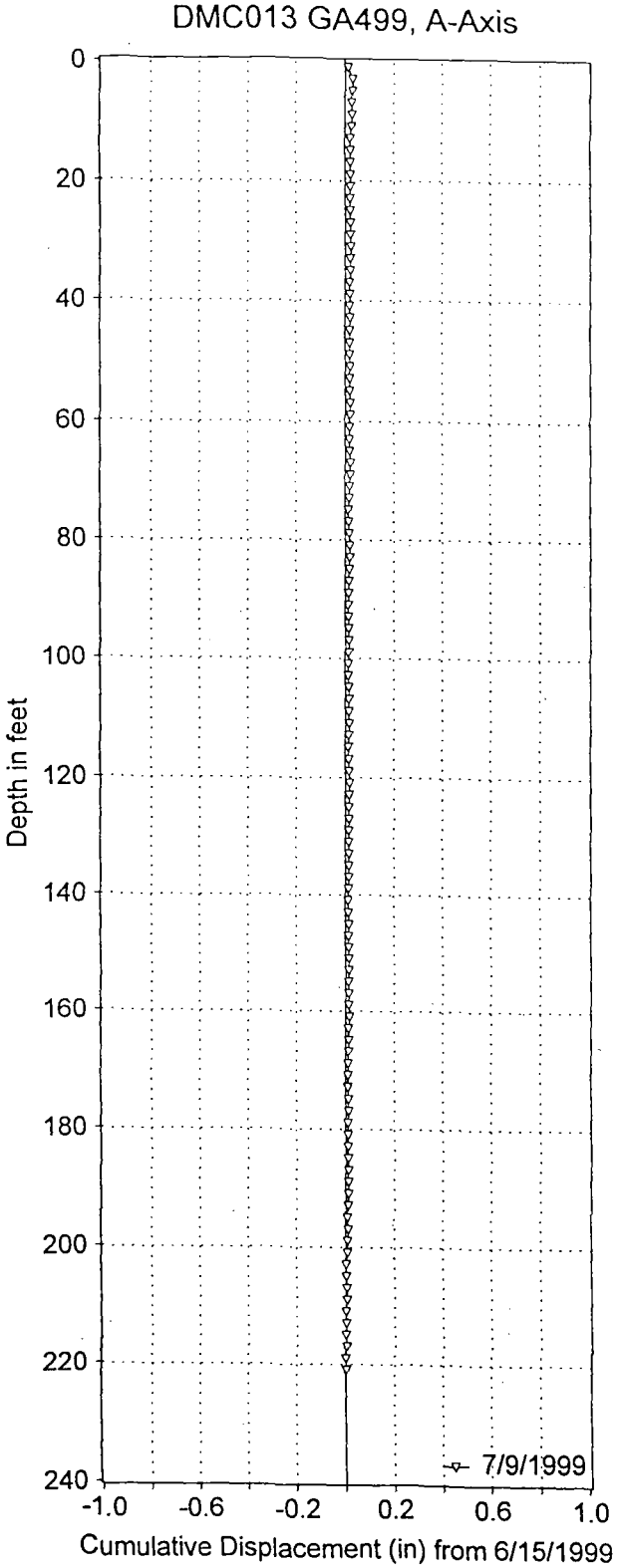
	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	-687	647	-1334	-633	646	-1279	55	0.1284
4.000	-741	727	-1468	-717	723	-1440	28	0.0954
6.000	-741	730	-1471	-719	724	-1443	28	0.0786
8.000	-743	734	-1477	-718	722	-1440	37	0.0618
10.000	-858	848	-1706	-828	833	-1661	45	0.0396
12.000	-863	854	-1717	-843	850	-1693	24	0.0126
14.000	-825	811	-1636	-815	817	-1632	4	-0.0018
16.000	-829	818	-1647	-824	830	-1654	-7	-0.0042
18.000	-814	803	-1617	-810	815	-1625	-8	0.0000
20.000	-783	771	-1554	-769	772	-1541	13	0.0048
22.000	-748	735	-1483	-736	738	-1474	9	-0.0030
24.000	-713	701	-1414	-707	711	-1418	-4	-0.0084
26.000	-702	692	-1394	-695	700	-1395	-1	-0.0060
28.000	-725	714	-1439	-716	722	-1438	1	-0.0054
30.000	-773	763	-1536	-766	771	-1537	-1	-0.0060
.000	-817	810	-1627	-811	819	-1630	-3	-0.0054
.000	-850	841	-1691	-842	849	-1691	0	-0.0036
36.000	-780	768	-1548	-771	775	-1546	2	-0.0036
38.000	-690	679	-1369	-682	688	-1370	-1	-0.0048
40.000	-692	681	-1373	-685	689	-1374	-1	-0.0042
42.000	-709	699	-1408	-702	706	-1408	0	-0.0036
44.000	-681	669	-1350	-673	675	-1348	2	-0.0036
46.000	-675	665	-1340	-669	673	-1342	-2	-0.0048
48.000	-695	686	-1381	-689	694	-1383	-2	-0.0036
50.000	-727	715	-1442	-721	725	-1446	-4	-0.0024

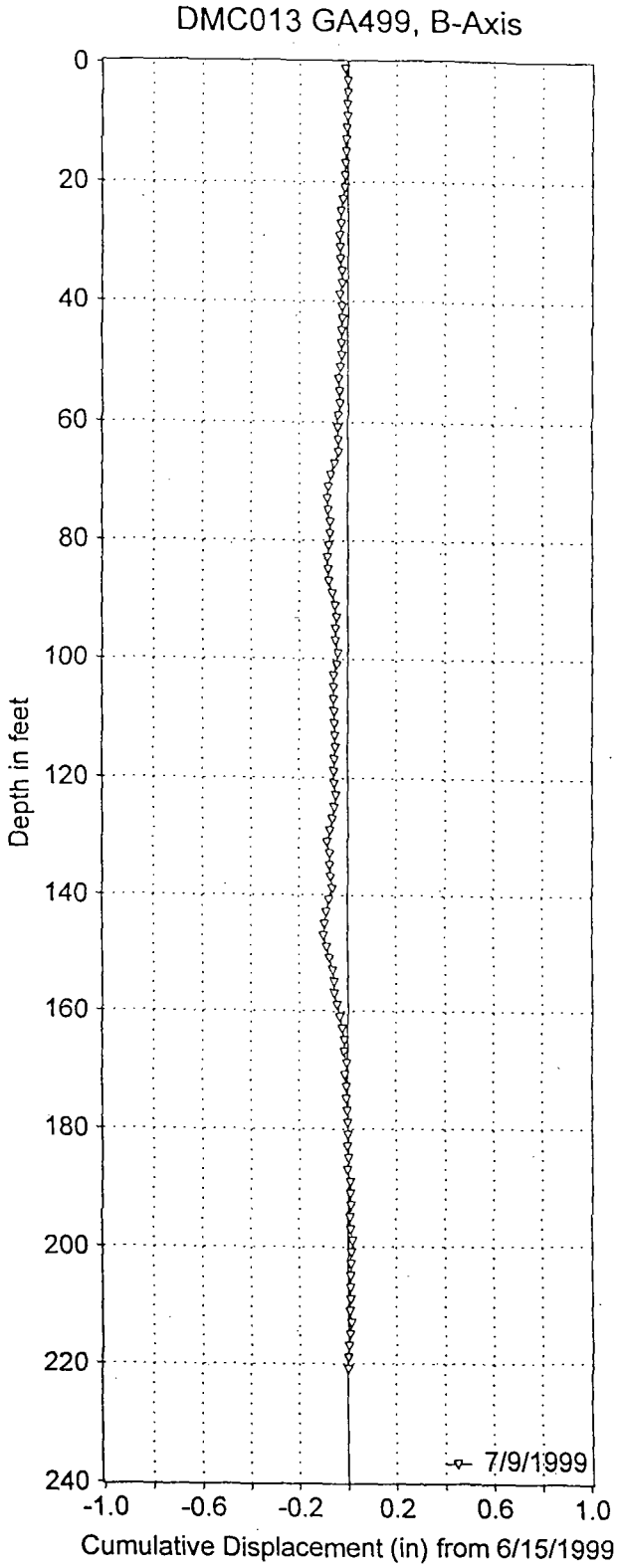
END OF RECORDS

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	-833	790	-1623	-655	609	-1264	359	0.2520
4.000	-807	768	-1575	-805	747	-1552	23	0.0366
6.000	-757	715	-1472	-768	701	-1469	3	0.0228
8.000	-713	672	-1385	-734	671	-1405	-20	0.0210
10.000	-694	651	-1345	-711	647	-1358	-13	0.0330
12.000	-695	672	-1367	-709	658	-1367	0	0.0408
14.000	-713	687	-1400	-718	666	-1384	16	0.0408
16.000	-640	599	-1239	-636	579	-1215	24	0.0312
18.000	-625	589	-1214	-625	574	-1199	15	0.0168
20.000	-588	547	-1135	-581	528	-1109	26	0.0078
22.000	-524	494	-1018	-533	480	-1013	5	-0.0078
24.000	-499	459	-958	-512	448	-960	-2	-0.0108
26.000	-477	434	-911	-493	433	-926	-15	-0.0096
28.000	-471	439	-910	-486	427	-913	-3	-0.0006
30.000	-498	473	-971	-515	457	-972	-1	0.0012
32.000	-567	544	-1111	-585	530	-1115	-4	0.0018
34.000	-691	654	-1345	-706	650	-1356	-11	0.0042
36.000	-659	636	-1295	-670	619	-1289	6	0.0108
38.000	-597	555	-1152	-611	537	-1148	4	0.0072
40.000	-589	544	-1133	-604	532	-1136	-3	0.0048
42.000	-582	538	-1120	-589	535	-1124	-4	0.0066
44.000	-564	523	-1087	-561	522	-1083	4	0.0090
46.000	-526	483	-1009	-522	485	-1007	2	0.0066
48.000	-468	441	-909	-466	440	-906	3	0.0054
[illegible].000	-399	382	-781	-395	380	-775	6	0.0036

END OF RECORDS





WSDOT
MATERIALS LAB
GEOTECH SECTION
OLYMPIA, WA

DMC013 SR 101
MP 326 SLIDE
A+ = N126 deg.
GA4-99

SLOPE INDICATOR DATA REDUCTION

rinted by DMM on July 9,1999
: DMC013 HOLE NUMBER GA499
site description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
ATA SET #	1	2
SENSOR #	26087	26087
ATE	06/15/99 07:57	07/09/99 08:46
EADINGS PER DIRECTION	110	110

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	-64	57	-121	-79	69	-148	-27	0.0132
4.000	-42	35	-77	-42	34	-76	1	0.0294
6.000	-40	26	-66	-40	25	-65	1	0.0288
8.000	-98	91	-189	-99	91	-190	-1	0.0282
10.000	-89	81	-170	-86	78	-164	6	0.0288
12.000	165	-178	343	167	-181	348	5	0.0252
14.000	234	-242	476	233	-242	475	-1	0.0222
16.000	223	-234	457	223	-235	458	1	0.0228
18.000	228	-237	465	227	-238	465	0	0.0222
20.000	233	-242	475	232	-243	475	0	0.0222
22.000	204	-213	417	204	-215	419	2	0.0222
24.000	183	-190	373	183	-190	373	0	0.0210
26.000	236	-248	484	235	-249	484	0	0.0210
28.000	261	-269	530	259	-269	528	-2	0.0210
0.000	149	-158	307	148	-158	306	-1	0.0222
2.000	145	-154	299	144	-157	301	2	0.0228
34.000	135	-142	277	135	-142	277	0	0.0216
36.000	110	-122	232	111	-124	235	3	0.0216
38.000	201	-210	411	202	-210	412	1	0.0198
40.000	164	-174	338	163	-174	337	-1	0.0192
42.000	137	-146	283	135	-146	281	-2	0.0198
44.000	138	-145	283	138	-146	284	1	0.0210
46.000	174	-186	360	174	-187	361	1	0.0204
48.000	207	-216	423	208	-218	426	3	0.0198
50.000	234	-243	477	234	-242	476	-1	0.0180
52.000	234	-243	477	233	-244	477	0	0.0186
54.000	211	-219	430	211	-220	431	1	0.0186
56.000	157	-166	323	155	-167	322	-1	0.0180
58.000	74	-82	156	73	-83	156	0	0.0186
60.000	-50	41	-91	-50	41	-91	0	0.0186
62.000	-31	19	-50	-31	18	-49	1	0.0186
64.000	79	-86	165	79	-86	165	0	0.0180
66.000	100	-116	216	99	-112	211	-5	0.0180
68.000	113	-126	239	114	-124	238	-1	0.0210
70.000	104	-118	222	106	-119	225	3	0.0216
72.000	69	-81	150	70	-85	155	5	0.0198
74.000	54	-66	120	55	-71	126	6	0.0168
76.000	62	-78	140	59	-78	137	-3	0.0132
78.000	96	-109	205	94	-109	203	-2	0.0150
80.000	85	-99	184	82	-99	181	-3	0.0162
2.000	63	-77	140	62	-78	140	0	0.0180
84.000	60	-69	129	61	-70	131	2	0.0180
86.000	41	-52	93	41	-53	94	1	0.0168

SLOPE INDICATOR DATA REDUCTION

rinted by DMM on July 9,1999
E: DMC013 HOLE NUMBER GA499
site description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
ATA SET #	1	2
SENSOR #	26087	26087
ATE	06/15/99 07:57	07/09/99 08:46
EADINGS PER DIRECTION	110	110

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
88.000	105	-115	220	107	-117	224	4	0.0162
90.000	111	-122	233	112	-122	234	1	0.0138
92.000	107	-117	224	107	-116	223	-1	0.0132
94.000	143	-153	296	143	-153	296	0	0.0138
96.000	176	-185	361	175	-185	360	-1	0.0138
98.000	185	-193	378	184	-193	377	-1	0.0144
100.000	161	-171	332	162	-172	334	2	0.0150
102.000	140	-150	290	141	-150	291	1	0.0138
104.000	146	-155	301	146	-154	300	-1	0.0132
106.000	108	-118	226	107	-117	224	-2	0.0138
108.000	95	-104	199	94	-104	198	-1	0.0150
110.000	34	-44	78	34	-45	79	1	0.0156
112.000	-17	7	-24	-17	6	-23	1	0.0150
114.000	-64	57	-121	-64	57	-121	0	0.0144
6.000	74	-90	164	74	-89	163	-1	0.0144
8.000	183	-191	374	183	-191	374	0	0.0150
120.000	179	-190	369	178	-189	367	-2	0.0150
122.000	142	-152	294	141	-153	294	0	0.0162
124.000	141	-149	290	142	-151	293	3	0.0162
126.000	137	-147	284	136	-148	284	0	0.0144
128.000	103	-113	216	104	-113	217	1	0.0144
130.000	145	-157	302	145	-155	300	-2	0.0138
132.000	192	-202	394	191	-203	394	0	0.0150
134.000	151	-158	309	151	-160	311	2	0.0150
136.000	96	-107	203	95	-109	204	1	0.0138
138.000	136	-146	282	135	-147	282	0	0.0132
140.000	197	-207	404	197	-207	404	0	0.0132
142.000	189	-198	387	189	-198	387	0	0.0132
144.000	173	-183	356	173	-182	355	-1	0.0132
146.000	77	-87	164	77	-86	163	-1	0.0138
148.000	37	-46	83	37	-46	83	0	0.0144
150.000	14	-23	37	14	-24	38	1	0.0144
152.000	16	-26	42	17	-26	43	1	0.0138
154.000	37	-47	84	38	-46	84	0	0.0132
156.000	33	-43	76	33	-43	76	0	0.0132
158.000	61	-71	132	61	-70	131	-1	0.0132
160.000	109	-119	228	107	-119	226	-2	0.0138
162.000	157	-168	325	158	-170	328	3	0.0150
164.000	259	-269	528	259	-270	529	1	0.0132
166.000	282	-292	574	283	-293	576	2	0.0126
8.000	259	-269	528	261	-269	530	2	0.0114
170.000	273	-281	554	273	-280	553	-1	0.0102
172.000	173	-181	354	173	-182	355	1	0.0108

SLOPE INDICATOR DATA REDUCTION

Printed by DMM on July 9,1999
[illegible]: DMC013 HOLE NUMBER GA499
Site description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
DATA SET #	1	2
SENSOR #	26087	26087
DATE	06/15/99 07:57	07/09/99 08:46
READINGS PER DIRECTION	110	110

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
174.000	118	-127	245	117	-127	244	-1	0.0102
176.000	68	-78	146	67	-79	146	0	0.0108
178.000	102	-111	213	103	-112	215	2	0.0108
180.000	93	-104	197	94	-103	197	0	0.0096
182.000	129	-141	270	130	-141	271	1	0.0096
184.000	162	-171	333	163	-170	333	0	0.0090
186.000	80	-88	168	78	-87	165	-3	0.0090
188.000	39	-48	87	38	-47	85	-2	0.0108
190.000	-8	3	-11	-7	3	-10	1	0.0120
192.000	-19	5	-24	-17	3	-20	4	0.0114
194.000	14	-23	37	15	-23	38	1	0.0090
196.000	-180	171	-351	-182	173	-355	-4	0.0084
198.000	-41	19	-60	-38	17	-55	5	0.0108
200.000	73	-76	149	74	-78	152	3	0.0078
[illegible]2.000	105	-118	223	107	-122	229	6	0.0060
[illegible]4.000	182	-187	369	182	-187	369	0	0.0024
206.000	-21	14	-35	-20	16	-36	-1	0.0024
208.000	-22	11	-33	-21	12	-33	0	0.0030
210.000	-17	2	-19	-13	1	-14	5	0.0030
212.000	55	-65	120	55	-65	120	0	0.0000
214.000	107	-116	223	109	-118	227	4	0.0000
216.000	-34	29	-63	-35	32	-67	-4	-0.0024
218.000	-65	55	-120	-63	55	-118	2	0.0000
220.000	-50	38	-88	-49	41	-90	-2	-0.0012

END OF RECORDS

LOPE INDICATOR DATA REDUCTION

rinted by DMM on July 9,1999
E: DMC013 HOLE NUMBER GA499
e description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
ATA SET #	1	2
ENSOR #	26087	26087
ATE	06/15/99 07:57	07/09/99 08:46
EADINGS PER DIRECTION	110	110

ENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	-43	10	-53	-54	14	-68	-15	-0.0120
4.000	-40	11	-51	-42	9	-51	0	-0.0030
6.000	-191	156	-347	-197	152	-349	-2	-0.0030
8.000	-121	98	-219	-127	92	-219	0	-0.0018
10.000	-18	-7	-11	-19	-14	-5	6	-0.0018
12.000	92	-131	223	95	-133	228	5	-0.0054
14.000	106	-148	254	108	-142	250	-4	-0.0084
16.000	82	-125	207	87	-126	213	6	-0.0060
18.000	104	-146	250	111	-144	255	5	-0.0096
20.000	101	-147	248	107	-142	249	1	-0.0126
22.000	86	-131	217	95	-134	229	12	-0.0132
24.000	110	-145	255	118	-153	271	16	-0.0204
26.000	113	-151	264	109	-154	263	-1	-0.0300
28.000	166	-210	376	179	-207	386	10	-0.0294
30.000	169	-214	383	177	-204	381	-2	-0.0354
2.000	157	-201	358	162	-191	353	-5	-0.0342
34.000	169	-208	377	167	-201	368	-9	-0.0312
36.000	69	-103	172	59	-109	168	-4	-0.0258
38.000	47	-91	138	59	-97	156	18	-0.0234
40.000	53	-97	150	48	-87	135	-15	-0.0342
42.000	26	-69	95	33	-61	94	-1	-0.0252
44.000	22	-63	85	30	-54	84	-1	-0.0246
46.000	3	-43	46	4	-45	49	3	-0.0240
48.000	54	-79	133	47	-85	132	-1	-0.0258
50.000	119	-157	276	126	-163	289	13	-0.0252
52.000	172	-215	387	183	-211	394	7	-0.0330
54.000	190	-219	409	188	-218	406	-3	-0.0372
56.000	103	-125	228	96	-130	226	-2	-0.0354
58.000	54	-102	156	68	-101	169	13	-0.0342
60.000	78	-124	202	85	-114	199	-3	-0.0420
62.000	164	-193	357	156	-200	356	-1	-0.0402
64.000	115	-144	259	109	-149	258	-1	-0.0396
66.000	52	-92	144	65	-108	173	29	-0.0390
68.000	35	-83	118	57	-84	141	23	-0.0564
70.000	23	-71	94	44	-69	113	19	-0.0702
72.000	28	-77	105	43	-65	108	3	-0.0816
74.000	28	-73	101	37	-61	98	-3	-0.0834
76.000	21	-67	88	19	-53	72	-16	-0.0816
78.000	27	-75	102	33	-71	104	2	-0.0720
80.000	46	-92	138	55	-94	149	11	-0.0732
2.000	77	-126	203	82	-131	213	10	-0.0798
4.000	95	-143	238	94	-137	231	-7	-0.0858
86.000	59	-100	159	54	-98	152	-7	-0.0816

SLOPE INDICATOR DATA REDUCTION

Printed by DMM on July 9,1999
SITE: DMC013 HOLE NUMBER GA499
Site description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
DATA SET #	1	2
SENSOR #	26087	26087
DATE	06/15/99 07:57	07/09/99 08:46
READINGS PER DIRECTION	110	110

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
88.000	21	-69	90	13	-55	68	-22	-0.0774
90.000	-4	-45	41	-11	-31	20	-21	-0.0642
92.000	-42	-6	-36	-40	6	-46	-10	-0.0516
94.000	-68	23	-91	-55	27	-82	9	-0.0456
96.000	-62	25	-87	-62	22	-84	3	-0.0510
98.000	-61	13	-74	-66	26	-92	-18	-0.0528
100.000	-85	34	-119	-75	37	-112	7	-0.0420
102.000	-97	49	-146	-85	43	-128	18	-0.0462
104.000	-79	46	-125	-82	41	-123	2	-0.0570
106.000	5	-37	42	-1	-45	44	2	-0.0582
108.000	85	-126	211	82	-123	205	-6	-0.0594
110.000	5	-31	36	-2	-38	36	0	-0.0558
112.000	-64	31	-95	-69	29	-98	-3	-0.0558
114.000	-101	78	-179	-109	78	-187	-8	-0.0540
116.000	-207	192	-399	-201	189	-390	9	-0.0492
[illegible].000	-29	2	-31	-32	-6	-26	5	-0.0546
[illegible].000	-19	-10	-9	-26	-17	-9	0	-0.0576
122.000	-95	50	-145	-101	60	-161	-16	-0.0576
124.000	-147	97	-244	-131	99	-230	14	-0.0480
126.000	-151	106	-257	-140	102	-242	15	-0.0564
128.000	-108	62	-170	-97	56	-153	17	-0.0654
130.000	-48	3	-51	-38	-1	-37	14	-0.0756
132.000	-20	-26	6	-27	-15	-12	-18	-0.0840
134.000	-64	26	-90	-62	26	-88	2	-0.0732
136.000	-91	50	-141	-93	53	-146	-5	-0.0744
138.000	-101	62	-163	-107	68	-175	-12	-0.0714
140.000	-124	77	-201	-111	71	-182	19	-0.0642
142.000	-89	42	-131	-77	34	-111	20	-0.0756
144.000	-62	23	-85	-57	15	-72	13	-0.0876
146.000	-14	-24	10	-14	-29	15	5	-0.0954
148.000	-27	-22	-5	-33	-8	-25	-20	-0.0984
150.000	-40	-9	-31	-45	4	-49	-18	-0.0864
152.000	-37	-13	-24	-41	3	-44	-20	-0.0756
154.000	-47	1	-48	-47	13	-60	-12	-0.0636
156.000	-45	3	-48	-46	3	-49	-1	-0.0564
158.000	-39	-9	-30	-45	3	-48	-18	-0.0558
160.000	-48	-2	-46	-54	11	-65	-19	-0.0450
162.000	-78	27	-105	-82	42	-124	-19	-0.0336
164.000	-110	67	-177	-114	77	-191	-14	-0.0222
166.000	-137	94	-231	-134	93	-227	4	-0.0138
[illegible]8.000	-104	57	-161	-111	70	-181	-20	-0.0162
[illegible].000	-131	86	-217	-122	83	-205	12	-0.0042
172.000	-84	39	-123	-85	46	-131	-8	-0.0114

SLOPE INDICATOR DATA REDUCTION

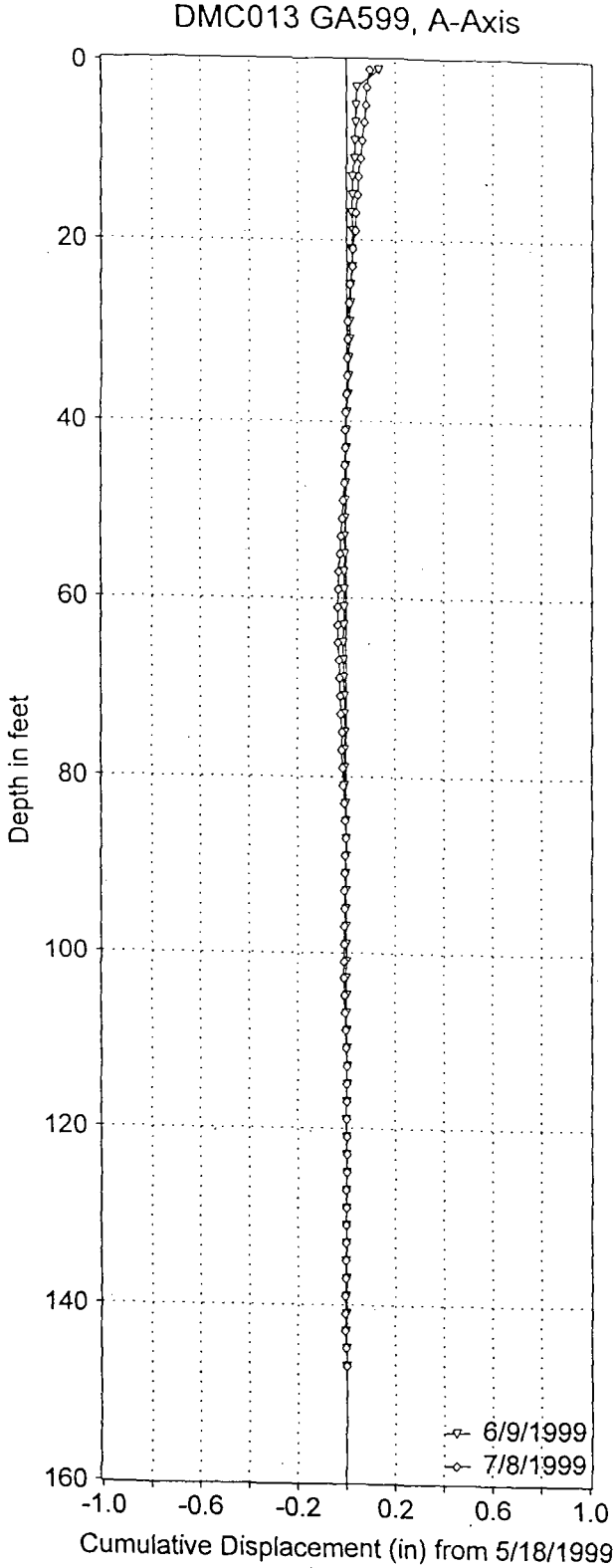
rinted by DMM on July 9,1999
E: DMC013 HOLE NUMBER GA499
e description SR 101 MP 326 SLIDE

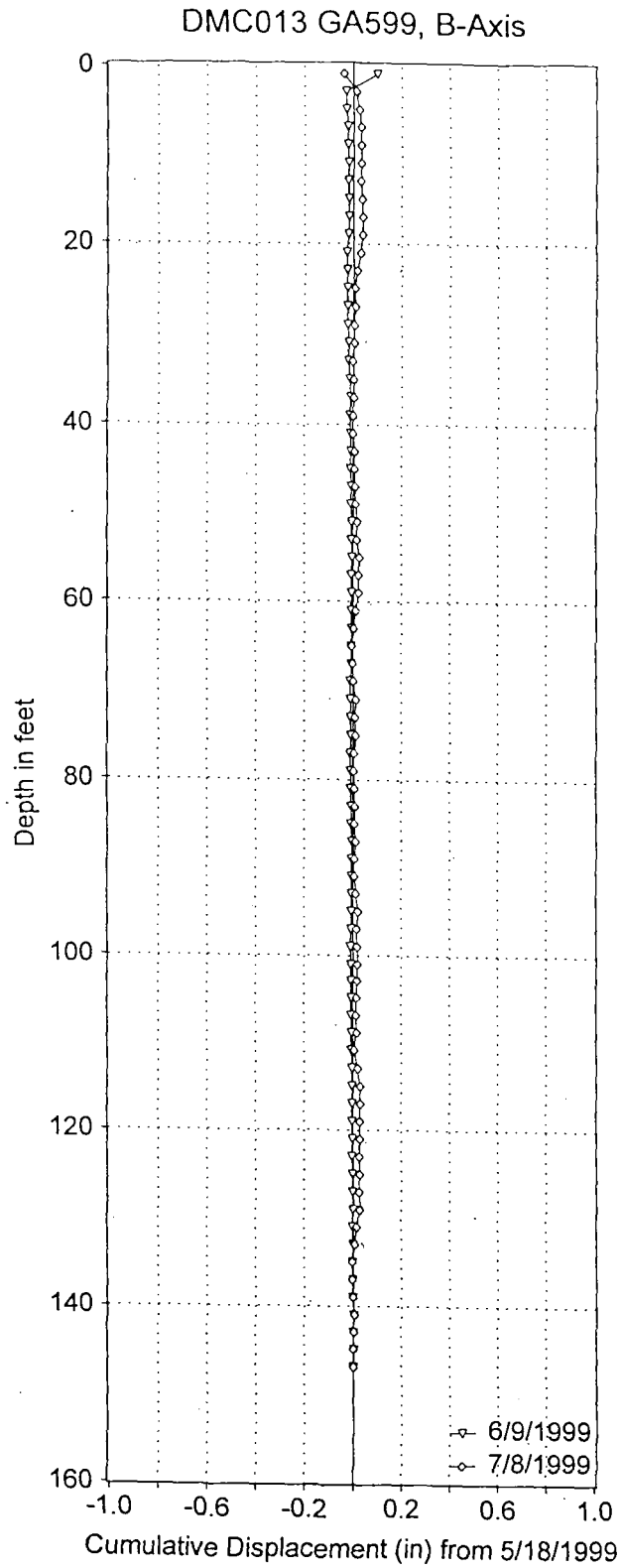
	PREVIOUS	CURRENT
ATA SET #	1	2
SENSOR #	26087	26087
ATE	06/15/99 07:57	07/09/99 08:46
EADINGS PER DIRECTION	110	110

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
174.000	-118	75	-193	-111	80	-191	2	-0.0066
176.000	-120	92	-212	-126	91	-217	-5	-0.0078
178.000	-156	113	-269	-155	121	-276	-7	-0.0048
180.000	-146	117	-263	-147	115	-262	1	-0.0006
182.000	22	-38	60	15	-50	65	5	-0.0012
184.000	34	-61	95	27	-63	90	-5	-0.0042
186.000	-5	-30	25	-9	-38	29	4	-0.0012
188.000	1	-50	51	-6	-39	33	-18	-0.0036
190.000	-1	-37	36	-1	-34	33	-3	0.0072
192.000	-73	53	-126	-78	49	-127	-1	0.0090
194.000	-83	49	-132	-88	45	-133	-1	0.0096
196.000	13	-38	51	5	-44	49	-2	0.0102
198.000	-159	139	-298	-168	140	-308	-10	0.0114
200.000	-172	144	-316	-170	139	-309	7	0.0174
202.000	-80	59	-139	-81	58	-139	0	0.0132
[illegible].000	-154	122	-276	-155	116	-271	5	0.0132
206.000	-134	117	-251	-133	116	-249	2	0.0102
208.000	190	-201	391	185	-206	391	0	0.0090
210.000	-60	22	-82	-62	17	-79	3	0.0090
212.000	-120	106	-226	-129	105	-234	-8	0.0072
214.000	-207	173	-380	-202	167	-369	11	0.0120
216.000	-175	160	-335	-174	152	-326	9	0.0054
218.000	-43	0	-43	-50	-8	-42	1	0.0000
220.000	-31	22	-53	-39	15	-54	-1	-0.0006

END OF RECORDS





WSDOT
MATERIALS LAB
GEOTECH SECTION
OLYMPIA, WA

DMC-013 SR 101
MP 326 SLIDE
GA5-99 A+ = N130 deg.

OPE INDICATOR DATA REDUCTION

inted by DMM on July 8,1999
: DMC013 HOLE NUMBER GA599
description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
TA SET #	1	3
ENSOR #	26087	26087
ATE	05/18/99 10:09	07/08/99 10:53
ADINGS PER DIRECTION	73	73

ENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	231	-246	477	242	-258	500	23	0.1860
4.000	167	-181	348	175	-182	357	9	0.1722
6.000	227	-241	468	238	-245	483	15	0.1668
8.000	288	-301	589	296	-305	601	12	0.1578
10.000	289	-301	590	298	-304	602	12	0.1506
12.000	214	-229	443	225	-231	456	13	0.1434
14.000	150	-163	313	156	-165	321	8	0.1356
16.000	90	-104	194	98	-105	203	9	0.1308
18.000	93	-107	200	98	-105	203	3	0.1254
20.000	191	-203	394	201	-207	408	14	0.1236
22.000	265	-277	542	271	-278	549	7	0.1152
24.000	298	-310	608	305	-311	616	8	0.1110
26.000	299	-312	611	307	-314	621	10	0.1062
28.000	275	-287	562	282	-289	571	9	0.1002
30.000	254	-267	521	261	-267	528	7	0.0948
.000	293	-306	599	301	-306	607	8	0.0906
34.000	323	-335	658	330	-336	666	8	0.0858
36.000	320	-334	654	327	-334	661	7	0.0810
38.000	311	-324	635	318	-324	642	7	0.0768
40.000	273	-285	558	281	-284	565	7	0.0726
42.000	227	-239	466	234	-238	472	6	0.0684
44.000	221	-233	454	227	-233	460	6	0.0648
46.000	229	-241	470	236	-241	477	7	0.0612
48.000	307	-320	627	314	-321	635	8	0.0570
50.000	233	-245	478	238	-244	482	4	0.0522
52.000	274	-286	560	279	-286	565	5	0.0498
54.000	272	-285	557	278	-285	563	6	0.0468
56.000	222	-235	457	228	-234	462	5	0.0432
58.000	90	-101	191	95	-100	195	4	0.0402
60.000	130	-141	271	134	-141	275	4	0.0378
62.000	145	-156	301	149	-154	303	2	0.0354
64.000	9	-19	28	11	-16	27	-1	0.0342
66.000	-81	70	-151	-79	73	-152	-1	0.0348
68.000	-114	102	-216	-112	106	-218	-2	0.0354
70.000	-86	77	-163	-85	79	-164	-1	0.0366
72.000	-43	34	-77	-41	37	-78	-1	0.0372
74.000	-51	42	-93	-50	45	-95	-2	0.0378
76.000	79	-89	168	82	-89	171	3	0.0390
78.000	118	-126	244	121	-125	246	2	0.0372
80.000	163	-174	337	167	-173	340	3	0.0360
).000	212	-221	433	214	-218	432	-1	0.0342
.4.000	287	-296	583	289	-294	583	0	0.0348
86.000	314	-325	639	317	-323	640	1	0.0348

ROPE INDICATOR DATA REDUCTION

inted by DMM on July 8,1999
: DMC013 HOLE NUMBER GA599
description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
TA SET #	1	3
ENSOR #	26087	26087
ATE	05/18/99 10:09	07/08/99 10:53
EADINGS PER DIRECTION	73	73

ENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
88.000	309	-318	627	312	-317	629	2	0.0342
90.000	289	-297	586	293	-297	590	4	0.0330
92.000	219	-229	448	222	-227	449	1	0.0306
94.000	180	-189	369	182	-186	368	-1	0.0300
96.000	63	-73	136	66	-70	136	0	0.0306
98.000	-53	43	-96	-50	47	-97	-1	0.0306
100.000	-79	66	-145	-75	69	-144	1	0.0312
102.000	-205	197	-402	-203	199	-402	0	0.0306
104.000	-178	169	-347	-175	170	-345	2	0.0306
106.000	-112	102	-214	-109	105	-214	0	0.0294
108.000	-59	54	-113	-56	54	-110	3	0.0294
110.000	22	-31	53	26	-30	56	3	0.0276
112.000	111	-117	228	116	-119	235	7	0.0258
114.000	200	-210	410	203	-209	412	2	0.0216
116.000	225	-233	458	230	-237	467	9	0.0204
[illegible].000	299	-306	605	303	-307	610	5	0.0150
120.000	303	-310	613	306	-309	615	2	0.0120
122.000	308	-317	625	311	-315	626	1	0.0108
124.000	298	-307	605	302	-307	609	4	0.0102
126.000	154	-164	318	157	-162	319	1	0.0078
128.000	12	-22	34	13	-17	30	-4	0.0072
130.000	-65	58	-123	-63	60	-123	0	0.0096
132.000	-118	109	-227	-113	110	-223	4	0.0096
134.000	-139	130	-269	-135	131	-266	3	0.0072
136.000	-118	108	-226	-113	108	-221	5	0.0054
138.000	-54	45	-99	-49	45	-94	5	0.0024
140.000	3	-11	14	7	-10	17	3	-0.0006
142.000	72	-80	152	74	-77	151	-1	-0.0024
144.000	132	-141	273	135	-138	273	0	-0.0018
146.000	150	-159	309	152	-154	306	-3	-0.0018

END OF RECORDS

LOPE INDICATOR DATA REDUCTION

inted by DMM on July 8,1999
: DMC013 HOLE NUMBER GA599
description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
TA SET #	1	3
ENSOR #	26087	26087
ATE	05/18/99 10:09	07/08/99 10:53
ADINGS PER DIRECTION	73	73

ENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	-81	57	-138	-129	95	-224	-86	-0.0312
4.000	-45	-3	-42	-55	10	-65	-23	0.0204
6.000	-65	51	-116	-78	49	-127	-11	0.0342
8.000	-248	224	-472	-260	219	-479	-7	0.0408
10.000	-241	235	-476	-247	229	-476	0	0.0450
12.000	-89	51	-140	-95	51	-146	-6	0.0450
14.000	-178	150	-328	-187	147	-334	-6	0.0486
16.000	-294	269	-563	-303	265	-568	-5	0.0522
18.000	-383	339	-722	-380	337	-717	5	0.0552
20.000	-341	294	-635	-334	290	-624	11	0.0522
22.000	-293	245	-538	-278	237	-515	23	0.0456
24.000	-278	238	-516	-272	234	-506	10	0.0318
26.000	-233	208	-441	-241	209	-450	-9	0.0258
28.000	-140	123	-263	-147	114	-261	2	0.0312
[illegible].000	-38	17	-55	-45	9	-54	1	0.0300
[illegible].000	67	-110	177	68	-115	183	6	0.0294
34.000	94	-134	228	88	-130	218	-10	0.0258
36.000	68	-97	165	62	-97	159	-6	0.0318
38.000	14	-47	61	7	-49	56	-5	0.0354
40.000	4	-54	58	-2	-58	56	-2	0.0384
42.000	10	-58	68	1	-56	57	-11	0.0396
44.000	-16	-2	-14	-25	-8	-17	-3	0.0462
46.000	-110	98	-208	-118	94	-212	-4	0.0480
48.000	-224	197	-421	-230	200	-430	-9	0.0504
50.000	-281	233	-514	-284	242	-526	-12	0.0558
52.000	-273	244	-517	-281	240	-521	-4	0.0630
54.000	-361	319	-680	-369	329	-698	-18	0.0654
56.000	-375	346	-721	-374	345	-719	2	0.0762
58.000	-265	259	-524	-271	249	-520	4	0.0750
60.000	-151	106	-257	-141	98	-239	18	0.0726
62.000	-119	72	-191	-105	70	-175	16	0.0618
64.000	-57	11	-68	-49	6	-55	13	0.0522
66.000	-27	-2	-25	-29	-5	-24	1	0.0444
68.000	-79	65	-144	-88	55	-143	1	0.0438
70.000	-119	86	-205	-126	87	-213	-8	0.0432
72.000	-75	52	-127	-77	42	-119	8	0.0480
74.000	8	-51	59	9	-54	63	4	0.0432
76.000	29	-67	96	34	-70	104	8	0.0408
78.000	106	-130	236	102	-138	240	4	0.0360
80.000	154	-184	338	146	-187	333	-5	0.0336
[illegible].000	105	-132	237	97	-137	234	-3	0.0366
[illegible]4.000	35	-64	99	29	-69	98	-1	0.0384
86.000	-37	5	-42	-43	9	-52	-10	0.0390

SLOPE INDICATOR DATA REDUCTION

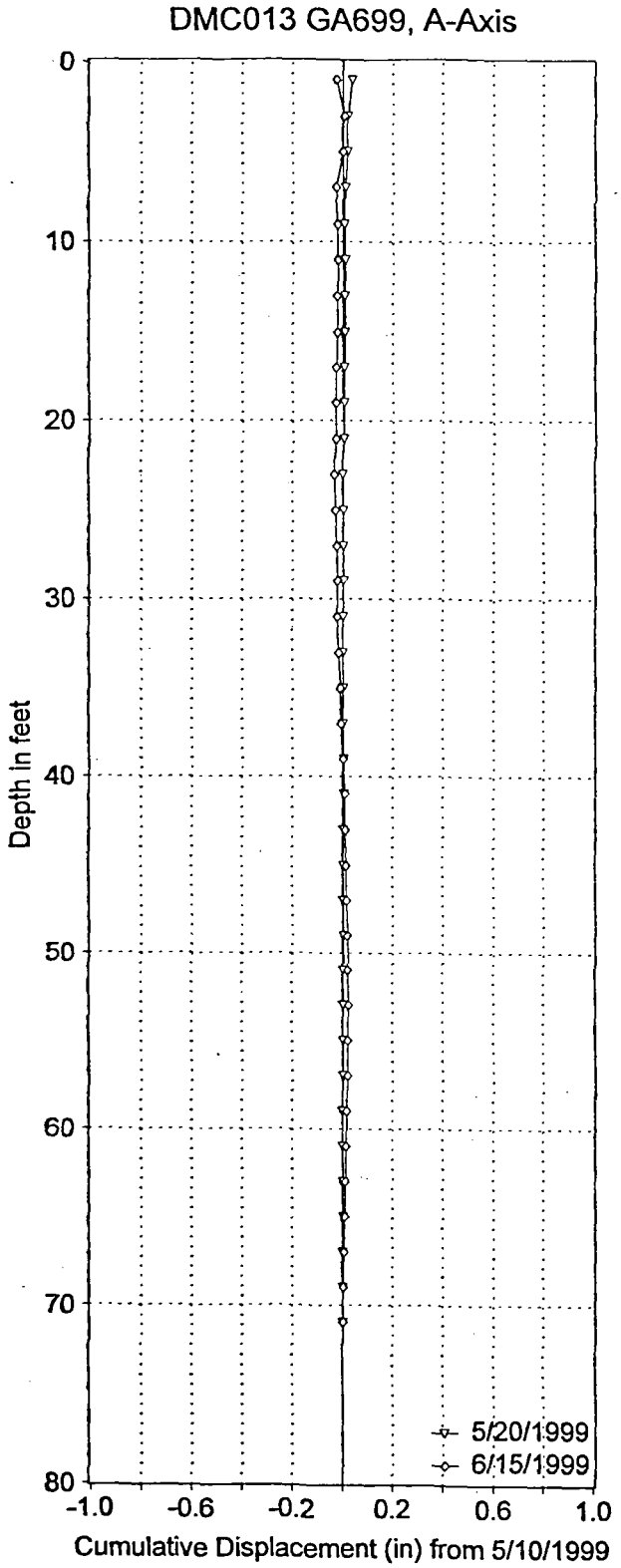
Printed by DMM on July 8,1999
[illegible]: DMC013 HOLE NUMBER GA599
Site description SR 101 MP 326 SLIDE

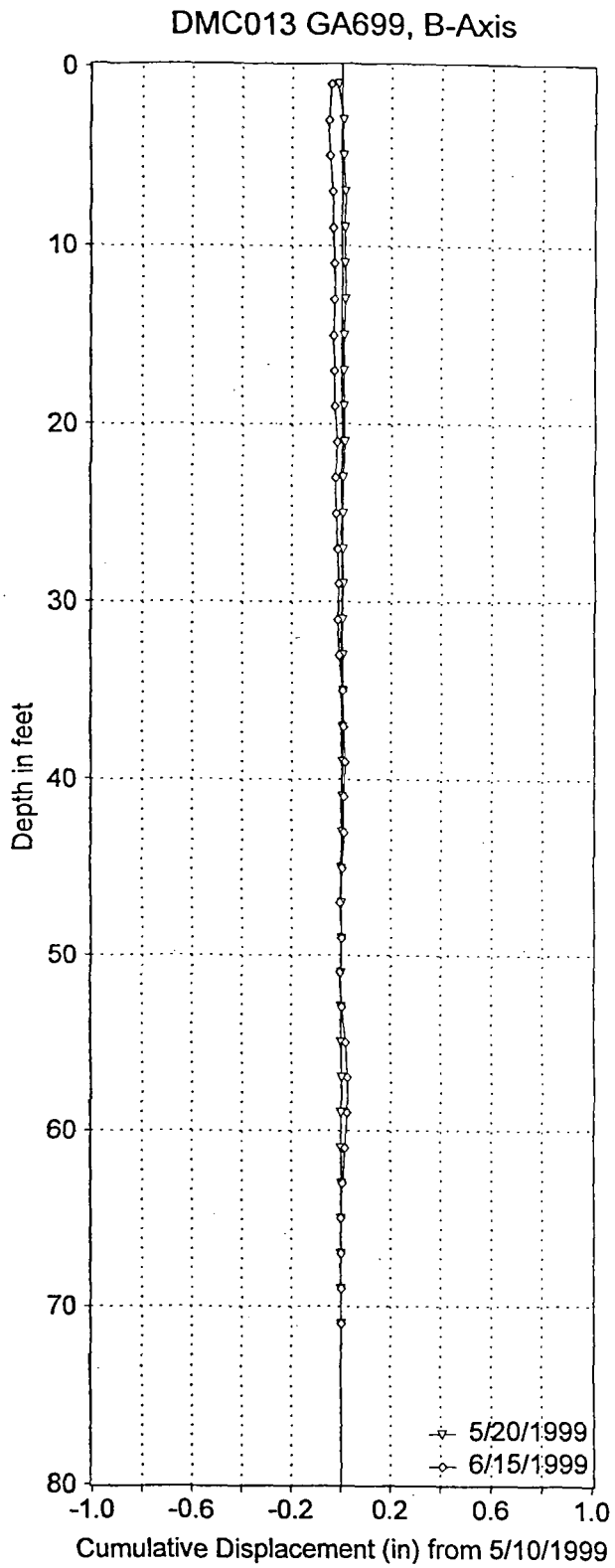
	PREVIOUS	CURRENT
DATA SET #	1	3
SENSOR #	26087	26087
DATE	05/18/99 10:09	07/08/99 10:53
READINGS PER DIRECTION	73	73

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
88.000	-110	74	-184	-114	69	-183	1	0.0450
90.000	-172	145	-317	-179	141	-320	-3	0.0444
92.000	-266	223	-489	-272	231	-503	-14	0.0462
94.000	-321	273	-594	-326	282	-608	-14	0.0546
96.000	-351	313	-664	-345	306	-651	13	0.0630
98.000	-324	295	-619	-327	289	-616	3	0.0552
100.000	-282	277	-559	-286	270	-556	3	0.0534
102.000	-107	77	-184	-105	69	-174	10	0.0516
104.000	-46	-1	-45	-34	-3	-31	14	0.0456
106.000	17	-58	75	19	-65	84	9	0.0372
108.000	41	-67	108	37	-74	111	3	0.0318
110.000	144	-182	326	153	-191	344	18	0.0300
112.000	180	-227	407	174	-213	387	-20	0.0192
114.000	153	-201	354	149	-187	336	-18	0.0312
[illegible].000	142	-173	315	137	-173	310	-5	0.0420
[illegible].000	14	-54	68	9	-57	66	-2	0.0450
120.000	-55	31	-86	-63	25	-88	-2	0.0462
122.000	-147	122	-269	-155	115	-270	-1	0.0474
124.000	-219	191	-410	-226	189	-415	-5	0.0480
126.000	-325	291	-616	-325	288	-613	3	0.0510
128.000	-252	219	-471	-257	215	-472	-1	0.0492
130.000	-223	177	-400	-206	169	-375	25	0.0498
132.000	-196	150	-346	-181	143	-324	22	0.0348
134.000	-157	110	-267	-142	102	-244	23	0.0216
136.000	-124	94	-218	-119	90	-209	9	0.0078
138.000	-119	85	-204	-124	82	-206	-2	0.0024
140.000	-103	57	-160	-109	52	-161	-1	0.0036
142.000	-99	50	-149	-102	46	-148	1	0.0042
144.000	-85	37	-122	-83	31	-114	8	0.0036
146.000	-23	34	-57	-31	28	-59	-2	-0.0012

END OF RECORDS





WSDOT
MATERIALS LAB
GEOTECH SECTION
OLYMPIA, WA

DMC-013 SR 101
MP 326 SLIDE
A+ = N 140 deg.
GA6-99

LOPE INDICATOR DATA REDUCTION

rinted by DigiPro on June 17,1999
E: DMC013 HOLE NUMBER GA699
s description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
ATA SET #	1	3
ENSOR #	26087	26087
DATE	05/10/99 08:02	06/15/99 12:04
EADINGS PER DIRECTION	35	35

ENSOR: 26087

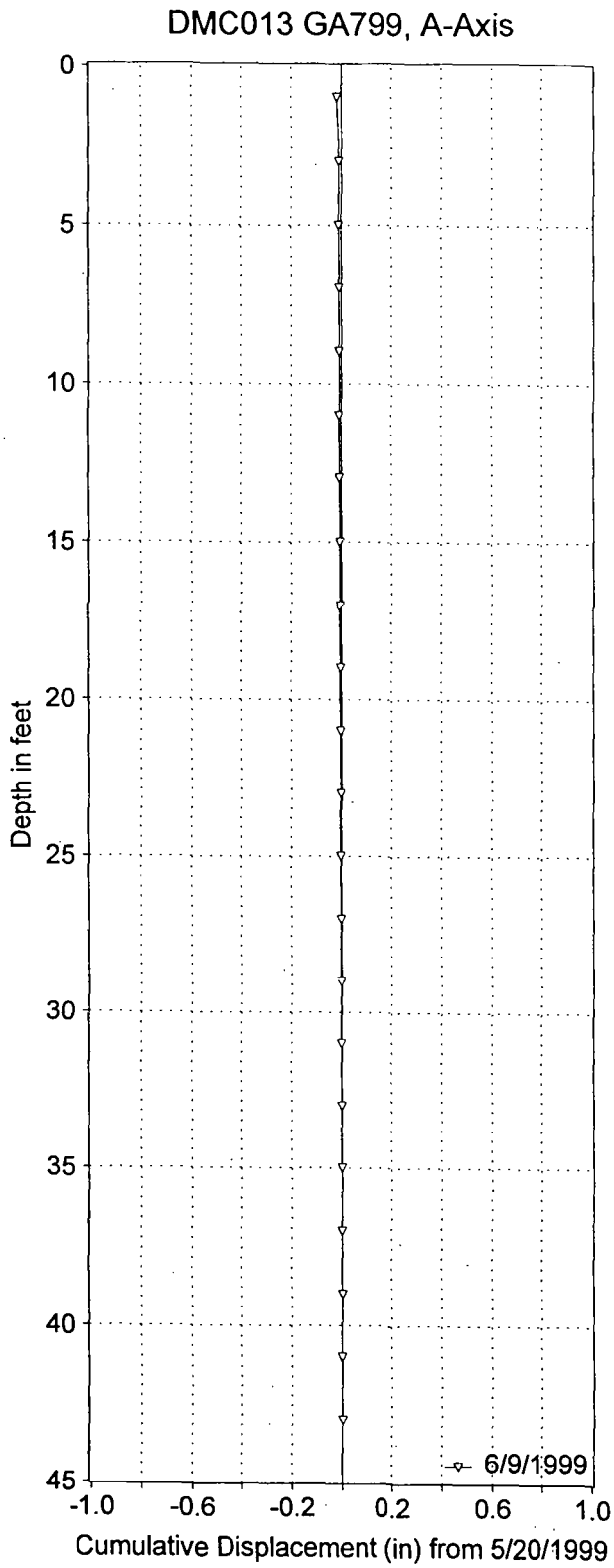
	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	350	-372	722	327	-340	667	-55	-0.1512
4.000	241	-253	494	249	-245	494	0	-0.1182
6.000	130	-142	272	159	-155	314	42	-0.1182
8.000	-225	214	-439	-226	231	-457	-18	-0.1434
10.000	-278	261	-539	-272	273	-545	-6	-0.1326
12.000	-234	223	-457	-228	233	-461	-4	-0.1290
14.000	-231	219	-450	-226	231	-457	-7	-0.1266
16.000	-256	245	-501	-247	253	-500	1	-0.1224
18.000	-352	340	-692	-345	349	-694	-2	-0.1230
20.000	-436	421	-857	-429	430	-859	-2	-0.1218
22.000	-326	319	-645	-319	329	-648	-3	-0.1206
24.000	-314	300	-614	-311	313	-624	-10	-0.1188
26.000	-230	218	-448	-229	233	-462	-14	-0.1128
28.000	-241	229	-470	-238	243	-481	-11	-0.1044
30.000	-284	271	-555	-278	283	-561	-6	-0.0978
.000	-347	337	-684	-346	354	-700	-16	-0.0942
.000	-210	198	-408	-209	214	-423	-15	-0.0846
36.000	-213	202	-415	-211	218	-429	-14	-0.0756
38.000	-225	213	-438	-225	230	-455	-17	-0.0672
40.000	-231	218	-449	-231	237	-468	-19	-0.0570
42.000	-297	285	-582	-291	299	-590	-8	-0.0456
44.000	-322	310	-632	-320	326	-646	-14	-0.0408
46.000	-261	250	-511	-256	262	-518	-7	-0.0324
48.000	-265	254	-519	-263	268	-531	-12	-0.0282
50.000	-239	227	-466	-237	242	-479	-13	-0.0210
52.000	-202	193	-395	-198	205	-403	-8	-0.0132
54.000	-196	186	-382	-189	195	-384	-2	-0.0084
56.000	-202	191	-393	-194	201	-395	-2	-0.0072
58.000	-215	203	-418	-207	213	-420	-2	-0.0060
60.000	-219	206	-425	-211	217	-428	-3	-0.0048
62.000	-210	199	-409	-201	207	-408	1	-0.0030
64.000	-242	230	-472	-234	239	-473	-1	-0.0036
66.000	-267	257	-524	-259	266	-525	-1	-0.0030
68.000	-286	275	-561	-279	283	-562	-1	-0.0024
70.000	-200	190	-390	-194	199	-393	-3	-0.0018

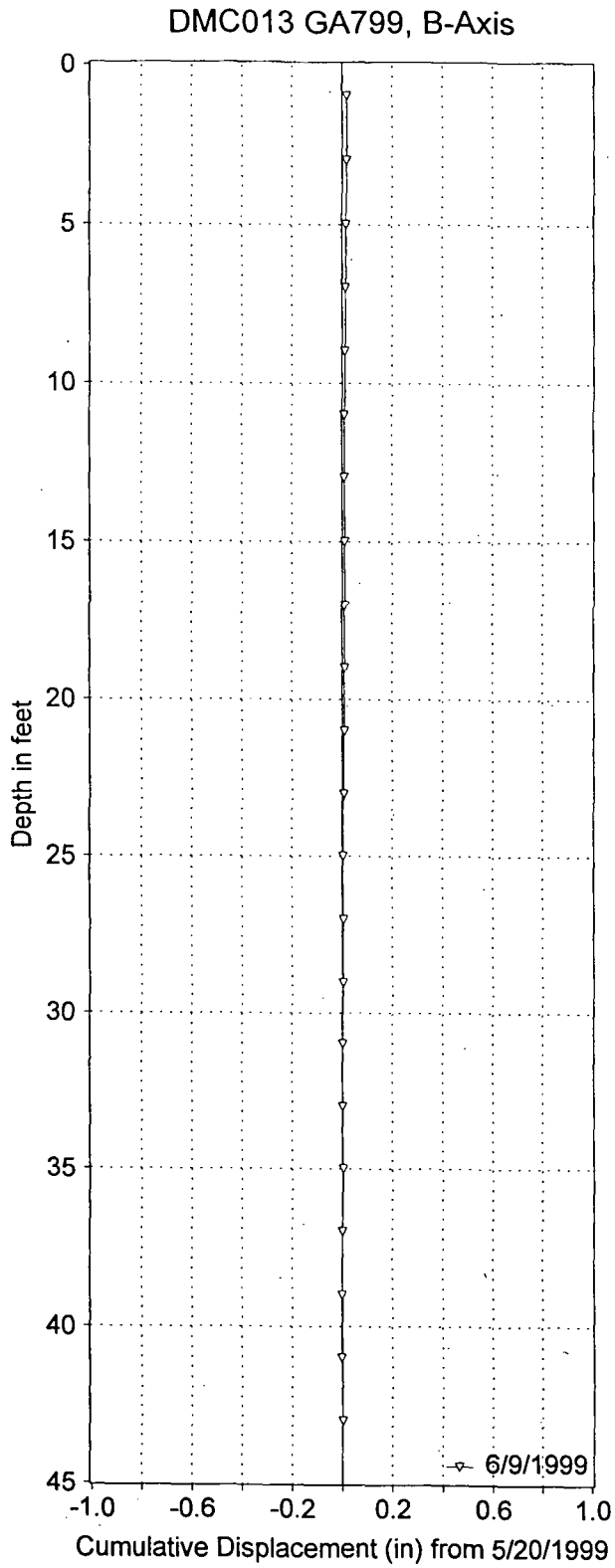
END OF RECORDS

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
EPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	-679	653	-1332	-681	634	-1315	17	-0.0444
4.000	-722	682	-1404	-737	678	-1415	-11	-0.0546
6.000	-682	659	-1341	-710	645	-1355	-14	-0.0480
8.000	-591	566	-1157	-614	553	-1167	-10	-0.0396
10.000	-495	471	-966	-515	455	-970	-4	-0.0336
12.000	-349	322	-671	-364	310	-674	-3	-0.0312
14.000	-183	168	-351	-202	141	-343	8	-0.0294
16.000	-58	35	-93	-80	21	-101	-8	-0.0342
18.000	87	-113	200	69	-130	199	-1	-0.0294
20.000	166	-204	370	146	-212	358	-12	-0.0288
22.000	3	-10	13	-16	-31	15	2	-0.0216
24.000	-303	297	-600	-318	282	-600	0	-0.0228
26.000	-407	377	-784	-425	370	-795	-11	-0.0228
28.000	-278	254	-532	-298	238	-536	-4	-0.0162
30.000	-164	134	-298	-179	117	-296	2	-0.0138
32.000	-102	71	-173	-120	61	-181	-8	-0.0150
34.000	-198	157	-355	-217	160	-377	-22	-0.0102
36.000	-213	166	-379	-226	165	-391	-12	0.0030
38.000	-247	203	-450	-261	194	-455	-5	0.0102
40.000	-216	190	-406	-229	171	-400	6	0.0132
42.000	-249	245	-494	-264	229	-493	1	0.0096
44.000	-341	317	-658	-357	295	-652	6	0.0090
46.000	-264	221	-485	-266	201	-467	18	0.0054
48.000	-262	218	-480	-278	215	-493	-13	-0.0054
.000	-283	236	-519	-288	219	-507	12	0.0024
2.000	-248	215	-463	-268	209	-477	-14	-0.0048
54.000	-250	206	-456	-270	210	-480	-24	0.0036
56.000	-279	237	-516	-299	226	-525	-9	0.0180
58.000	-310	265	-575	-327	251	-578	-3	0.0234
60.000	-322	277	-599	-322	262	-584	15	0.0252
62.000	-275	239	-514	-274	222	-496	18	0.0162
64.000	-199	158	-357	-203	141	-344	13	0.0054
66.000	-153	109	-262	-171	94	-265	-3	-0.0024
68.000	-185	143	-328	-205	126	-331	-3	-0.0006
70.000	-156	166	-322	-177	143	-320	2	0.0012

END OF RECORDS





WSDOT
MATERIALS LAB
GEOTECH SECTION
OLYMPIA, WA

DMC-013 SR 101
MP 326 SLIDE
GA7-99 A+ = N125 deg.

LOPE INDICATOR DATA REDUCTION

Printed by DMM on June 9,1999
ITE: DMC013 HOLE NUMBER GA799
e description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
ATA SET #	1	2
ENSOR #	26087	26087
DATE	05/20/99 08:38	06/09/99 09:51
EADINGS PER DIRECTION	21	21

ENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	-154	141	-295	-159	147	-306	-11	-0.0180
4.000	-226	215	-441	-225	216	-441	0	-0.0114
6.000	-234	225	-459	-235	226	-461	-2	-0.0114
8.000	-191	182	-373	-191	184	-375	-2	-0.0102
10.000	-209	200	-409	-209	201	-410	-1	-0.0090
12.000	-195	186	-381	-195	187	-382	-1	-0.0084
14.000	-135	123	-258	-134	125	-259	-1	-0.0078
16.000	-115	105	-220	-115	106	-221	-1	-0.0072
18.000	-135	125	-260	-135	126	-261	-1	-0.0066
20.000	-147	139	-286	-147	140	-287	-1	-0.0060
22.000	-159	149	-308	-160	150	-310	-2	-0.0054
24.000	-163	149	-312	-162	150	-312	0	-0.0042
26.000	-147	134	-281	-146	136	-282	-1	-0.0042
28.000	-142	131	-273	-141	133	-274	-1	-0.0036
30.000	-143	135	-278	-143	137	-280	-2	-0.0030
32.000	-126	117	-243	-126	118	-244	-1	-0.0018
34.000	-107	95	-202	-106	97	-203	-1	-0.0012
36.000	-125	115	-240	-126	117	-243	-3	-0.0006
38.000	-165	153	-318	-164	155	-319	-1	0.0012
40.000	-221	209	-430	-216	210	-426	4	0.0018
42.000	-288	275	-563	-287	277	-564	-1	-0.0006

END OF RECORDS

LOPE INDICATOR DATA REDUCTION

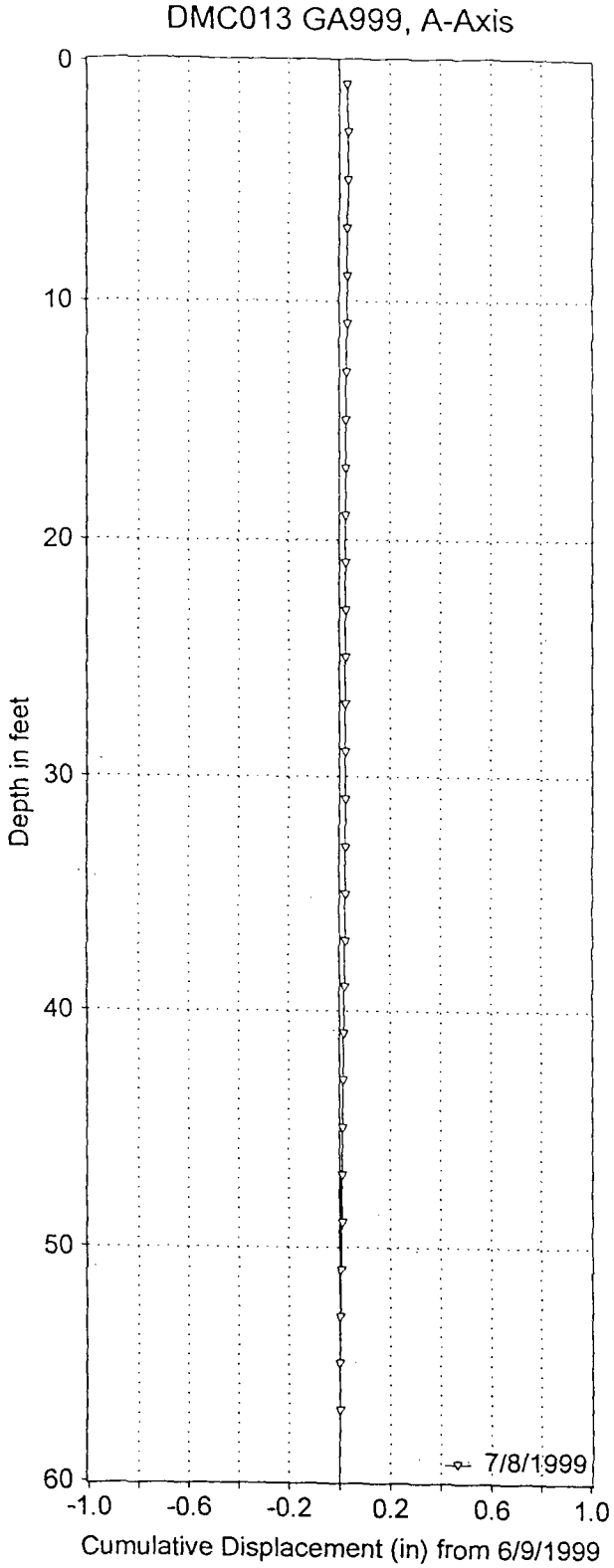
rinted by DMM on June 9,1999
TTE: DMC013 HOLE NUMBER GA799
te description SR 101 MP 326 SLIDE

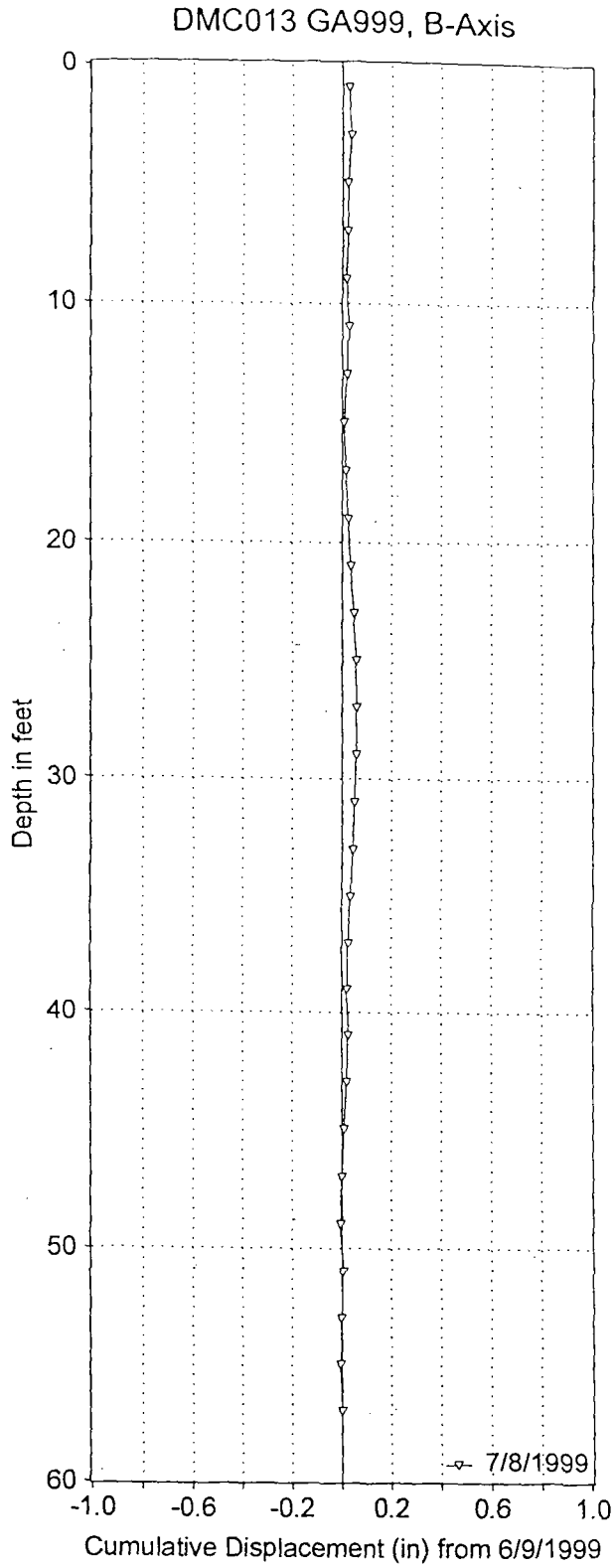
	PREVIOUS	CURRENT
ATA SET #	1	2
ENSOR #	26087	26087
DATE	05/20/99 08:38	06/09/99 09:51
EADINGS PER DIRECTION	21	21

ENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	400	-422	822	396	-424	820	-2	-0.0180
4.000	291	-300	591	289	-302	591	0	-0.0168
6.000	116	-155	271	115	-158	273	2	-0.0168
8.000	77	-121	198	76	-122	198	0	-0.0180
10.000	83	-126	209	81	-127	208	-1	-0.0180
12.000	83	-125	208	81	-126	207	-1	-0.0174
14.000	89	-127	216	85	-127	212	-4	-0.0168
16.000	81	-119	200	77	-120	197	-3	-0.0144
18.000	117	-158	275	115	-159	274	-1	-0.0126
20.000	130	-168	298	129	-169	298	0	-0.0120
22.000	141	-184	325	140	-186	326	1	-0.0120
24.000	169	-210	379	168	-211	379	0	-0.0126
26.000	143	-186	329	140	-185	325	-4	-0.0126
28.000	170	-214	384	169	-214	383	-1	-0.0102
30.000	186	-225	411	185	-225	410	-1	-0.0096
32.000	198	-239	437	197	-239	436	-1	-0.0090
34.000	208	-247	455	208	-240	448	-7	-0.0084
36.000	154	-195	349	154	-197	351	2	-0.0042
38.000	161	-205	366	160	-206	366	0	-0.0054
40.000	151	-193	344	150	-193	343	-1	-0.0054
42.000	122	-122	244	115	-121	236	-8	-0.0048

END OF RECORDS





WSDOT
MATERIALS LAB
GEOTECH SECTION
OLYMPIA, WA

DCM-013 SR 101
MP 326 SLIDE
GA9-99 A+ = N134 deg.

SLOPE INDICATOR DATA REDUCTION

Printed by DMM on July 8,1999
FILE: DMC013 HOLE NUMBER GA999
site description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
DATA SET #	2	3
SENSOR #	26087	26087
DATE	06/09/99 08:56	07/08/99 09:46
READINGS PER DIRECTION	28	28

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	202	-208	410	193	-203	396	-14	-0.0198
4.000	481	-485	966	481	-482	963	-3	-0.0114
6.000	374	-377	751	376	-375	751	0	-0.0096
8.000	282	-286	568	282	-283	565	-3	-0.0096
10.000	230	-234	464	232	-233	465	1	-0.0078
12.000	166	-171	337	169	-170	339	2	-0.0084
14.000	158	-163	321	161	-161	322	1	-0.0096
16.000	241	-244	485	243	-241	484	-1	-0.0102
18.000	214	-217	431	215	-214	429	-2	-0.0096
20.000	151	-155	306	153	-151	304	-2	-0.0084
22.000	89	-93	182	89	-90	179	-3	-0.0072
24.000	136	-140	276	137	-137	274	-2	-0.0054
26.000	138	-142	280	138	-138	276	-4	-0.0042
28.000	169	-173	342	169	-170	339	-3	-0.0018
30.000	184	-189	373	185	-185	370	-3	0.0000
32.000	172	-176	348	173	-171	344	-4	0.0018
34.000	170	-175	345	172	-171	343	-2	0.0042
36.000	215	-219	434	218	-217	435	1	0.0054
38.000	227	-231	458	229	-230	459	1	0.0048
40.000	213	-217	430	217	-215	432	2	0.0042
42.000	210	-214	424	213	-213	426	2	0.0030
44.000	230	-233	463	233	-230	463	0	0.0018
46.000	241	-243	484	243	-241	484	0	0.0018
48.000	209	-212	421	210	-210	420	-1	0.0018
50.000	183	-187	370	186	-187	373	3	0.0024
52.000	189	-193	382	192	-191	383	1	0.0006
54.000	161	-163	324	162	-162	324	0	0.0000
56.000	141	-145	286	144	-142	286	0	0.0000

END OF RECORDS

SLOPE INDICATOR DATA REDUCTION

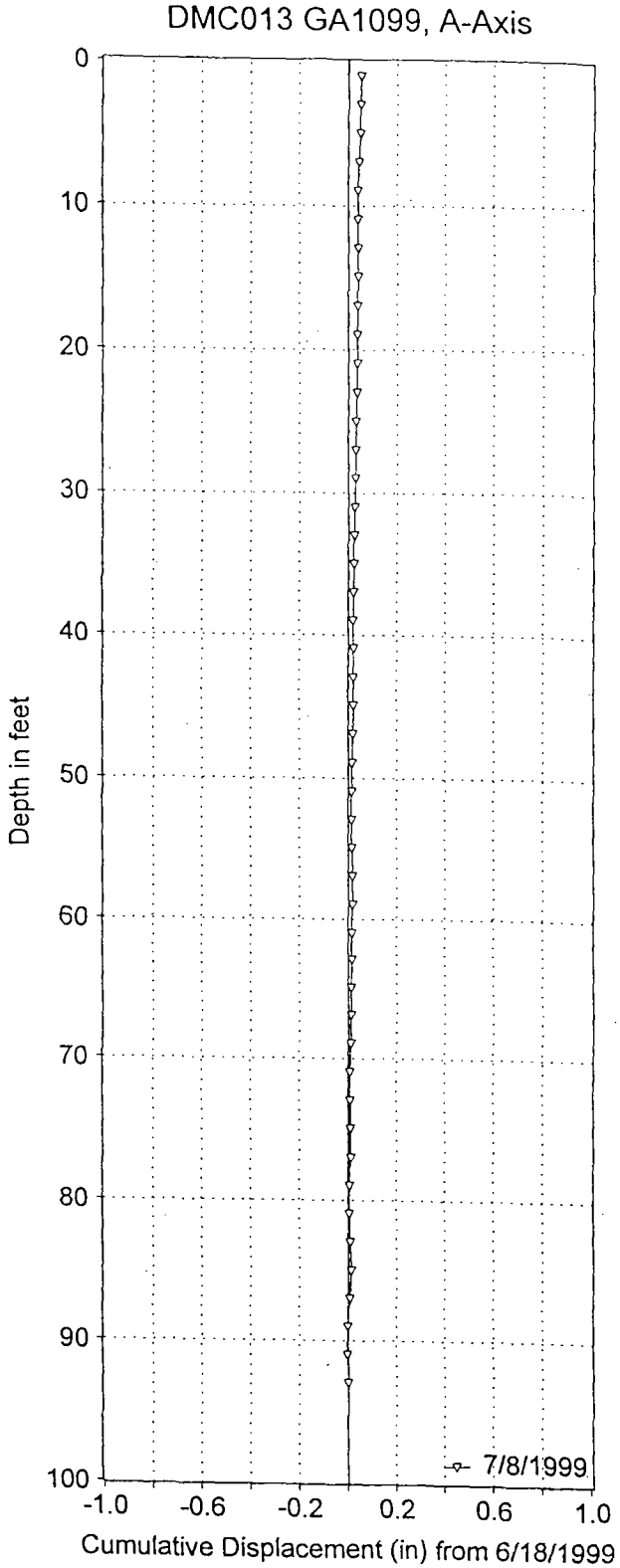
Printed by DMM on July 8,1999
SITE: DMC013 HOLE NUMBER GA999
Site description SR 101 MP 326 SLIDE

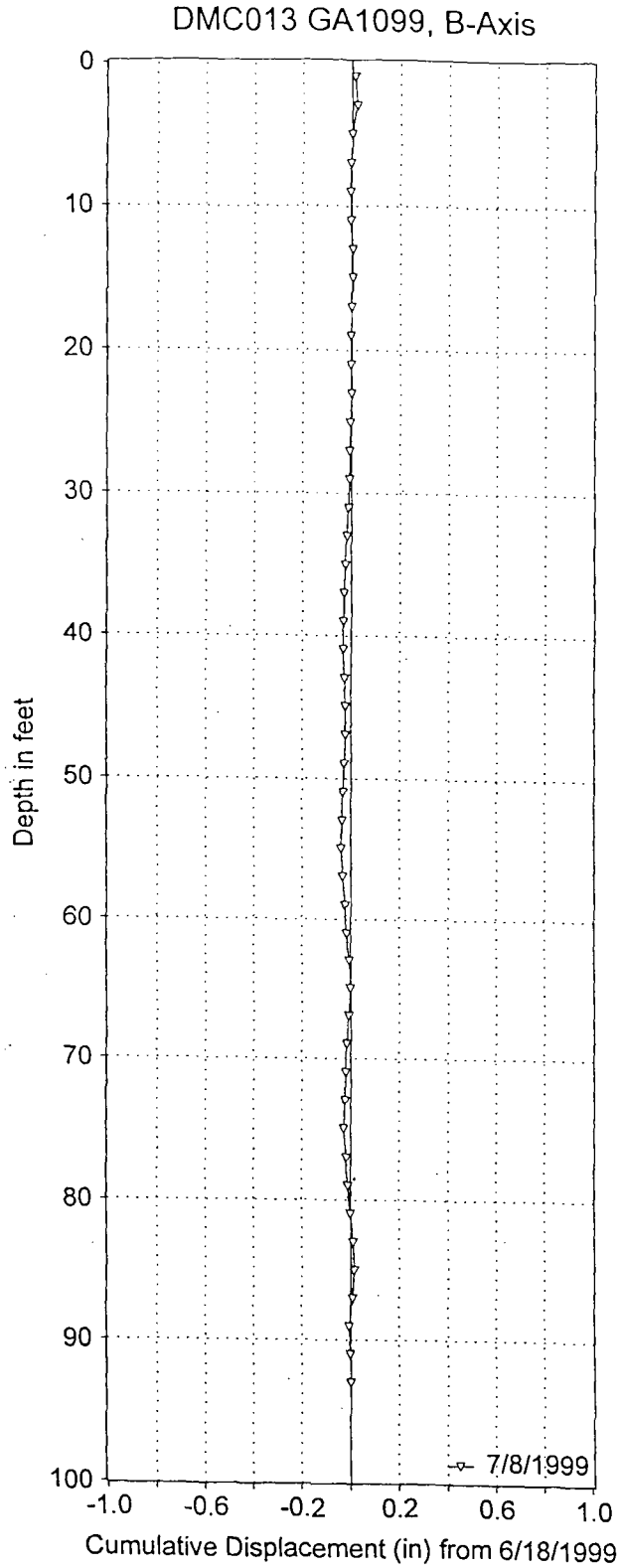
	PREVIOUS	CURRENT
DATA SET #	2	3
SENSOR #	26087	26087
DATE	06/09/99 08:56	07/08/99 09:46
READINGS PER DIRECTION	28	28

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	-294	259	-553	-302	267	-569	-16	-0.0138
4.000	-234	190	-424	-224	189	-413	11	-0.0042
6.000	-242	222	-464	-249	219	-468	-4	-0.0108
8.000	-201	181	-382	-207	173	-380	2	-0.0084
10.000	-175	131	-306	-183	143	-326	-20	-0.0096
12.000	-217	170	-387	-207	166	-373	14	0.0024
14.000	-198	151	-349	-185	146	-331	18	-0.0060
16.000	-150	106	-256	-154	120	-274	-18	-0.0168
18.000	-191	155	-346	-197	165	-362	-16	-0.0060
20.000	-212	168	-380	-217	181	-398	-18	0.0036
22.000	-238	198	-436	-247	211	-458	-22	0.0144
24.000	-257	213	-470	-257	227	-484	-14	0.0276
26.000	-266	227	-493	-263	235	-498	-5	0.0360
28.000	-212	191	-403	-217	186	-403	0	0.0390
30.000	-198	152	-350	-190	149	-339	11	0.0390
[illegible].000	-193	150	-343	-190	144	-334	9	0.0324
34.000	-211	170	-381	-203	164	-367	14	0.0270
36.000	-191	152	-343	-185	145	-330	13	0.0186
38.000	-178	141	-319	-176	139	-315	4	0.0108
40.000	-216	171	-387	-221	177	-398	-11	0.0084
42.000	-248	202	-450	-241	200	-441	9	0.0150
44.000	-261	220	-481	-251	214	-465	16	0.0096
46.000	-245	209	-454	-241	202	-443	11	0.0000
48.000	-192	167	-359	-193	159	-352	7	-0.0066
50.000	-199	156	-355	-206	171	-377	-22	-0.0108
52.000	-247	203	-450	-240	201	-441	9	0.0024
54.000	-207	178	-385	-205	174	-379	6	-0.0030
56.000	-147	147	-294	-163	142	-305	-11	-0.0066

END OF RECORDS





WSDOT
MATERIALS LAB
GEOTECH SECTION
OLYMPIA, WA

DMC013 SR 101
MP 326 SLIDE
A+ = N 128 deg.
GA10-99

LOPE INDICATOR DATA REDUCTION

inted by DMM on July 8,1999
: DMC013 HOLE NUMBER GA1099
description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
TA SET #	1	2
ENSOR #	26087	26087
ATE	06/18/99 12:54	07/08/99 08:29
ADINGS PER DIRECTION	46	46

ENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	352	-350	702	353	-355	708	6	0.0516
4.000	251	-242	493	247	-243	490	-3	0.0480
6.000	183	-174	357	183	-186	369	12	0.0498
8.000	150	-146	296	149	-150	299	3	0.0426
10.000	163	-158	321	161	-162	323	2	0.0408
12.000	147	-143	290	146	-146	292	2	0.0396
14.000	163	-164	327	162	-163	325	-2	0.0384
16.000	224	-219	443	222	-222	444	1	0.0396
18.000	203	-198	401	202	-202	404	3	0.0390
20.000	171	-167	338	170	-170	340	2	0.0372
22.000	173	-169	342	172	-173	345	3	0.0360
24.000	178	-173	351	177	-178	355	4	0.0342
26.000	189	-183	372	188	-186	374	2	0.0318
28.000	192	-187	379	190	-191	381	2	0.0306
[illegible].000	239	-233	472	239	-239	478	6	0.0294
[illegible].000	324	-321	645	325	-324	649	4	0.0258
34.000	354	-346	700	351	-350	701	1	0.0234
36.000	268	-263	531	265	-266	531	0	0.0228
38.000	211	-209	420	211	-212	423	3	0.0228
40.000	200	-197	397	198	-200	398	1	0.0210
42.000	214	-210	424	210	-211	421	-3	0.0204
44.000	222	-217	439	219	-221	440	1	0.0222
46.000	258	-256	514	257	-261	518	4	0.0216
48.000	276	-275	551	277	-280	557	6	0.0192
50.000	267	-264	531	266	-267	533	2	0.0156
52.000	219	-216	435	217	-218	435	0	0.0144
54.000	198	-190	388	193	-193	386	-2	0.0144
56.000	185	-181	366	181	-182	363	-3	0.0156
58.000	183	-182	365	182	-185	367	2	0.0174
60.000	165	-162	327	163	-166	329	2	0.0162
62.000	165	-159	324	162	-162	324	0	0.0150
64.000	174	-167	341	173	-171	344	3	0.0150
66.000	212	-210	422	212	-213	425	3	0.0132
68.000	279	-275	554	278	-279	557	3	0.0114
70.000	295	-291	586	293	-294	587	1	0.0096
72.000	229	-224	453	227	-226	453	0	0.0090
74.000	135	-130	265	132	-131	263	-2	0.0090
76.000	66	-60	126	63	-63	126	0	0.0102
78.000	74	-71	145	75	-76	151	6	0.0102
80.000	85	-82	167	84	-86	170	3	0.0066
[illegible].000	81	-76	157	75	-75	150	-7	0.0048
[illegible]4.000	50	-44	94	45	-44	89	-5	0.0090
86.000	25	-21	46	25	-29	54	8	0.0120

LOPE INDICATOR DATA REDUCTION

rinted by DMM on July 8,1999
E: DMC013 HOLE NUMBER GA1099
e description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
ATA SET #	1	2
ENSOR #	26087	26087
DATE	06/18/99 12:54	07/08/99 08:29
EADINGS PER DIRECTION	46	46

ENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
88.000	9	-6	15	16	-15	31	16	0.0072
90.000	125	-122	247	123	-126	249	2	-0.0024
92.000	179	-175	354	174	-174	348	-6	-0.0036

END OF RECORDS

LOPE INDICATOR DATA REDUCTION

inted by DMM on July 8,1999
: DMC013 HOLE NUMBER GA1099
e description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
TA SET #	1	2
SENSOR #	26087	26087
TE	06/18/99 12:54	07/08/99 08:29
EADINGS PER DIRECTION	46	46

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	-637	584	-1221	-632	611	-1243	-22	-0.1488
4.000	-380	311	-691	-347	315	-662	29	-0.1356
6.000	-278	206	-484	-263	222	-485	-1	-0.1530
8.000	-207	129	-336	-195	146	-341	-5	-0.1524
10.000	-173	83	-256	-157	104	-261	-5	-0.1494
12.000	-173	101	-274	-173	117	-290	-16	-0.1464
14.000	-145	72	-217	-134	90	-224	-7	-0.1368
16.000	-139	69	-208	-123	87	-210	-2	-0.1326
18.000	-215	147	-362	-199	165	-364	-2	-0.1314
20.000	-273	205	-478	-257	224	-481	-3	-0.1302
22.000	-346	266	-612	-330	289	-619	-7	-0.1284
24.000	-340	266	-606	-326	281	-607	-1	-0.1242
26.000	-353	269	-622	-336	287	-623	-1	-0.1236
28.000	-338	247	-585	-317	274	-591	-6	-0.1230
[illegible].000	-319	255	-574	-301	271	-572	2	-0.1194
[illegible].000	-362	287	-649	-344	303	-647	2	-0.1206
34.000	-285	209	-494	-269	227	-496	-2	-0.1218
36.000	-340	257	-597	-323	275	-598	-1	-0.1206
38.000	-343	257	-600	-329	272	-601	-1	-0.1200
40.000	-313	225	-538	-297	245	-542	-4	-0.1194
42.000	-284	193	-477	-267	229	-496	-19	-0.1170
44.000	-285	208	-493	-268	237	-505	-12	-0.1056
46.000	-319	232	-551	-303	255	-558	-7	-0.0984
48.000	-347	257	-604	-330	275	-605	-1	-0.0942
50.000	-359	272	-631	-343	287	-630	1	-0.0936
52.000	-341	266	-607	-328	281	-609	-2	-0.0942
54.000	-317	255	-572	-301	271	-572	0	-0.0930
56.000	-326	242	-568	-311	273	-584	-16	-0.0930
58.000	-349	262	-611	-332	297	-629	-18	-0.0834
60.000	-360	271	-631	-342	309	-651	-20	-0.0726
62.000	-379	292	-671	-363	329	-692	-21	-0.0606
64.000	-403	320	-723	-388	350	-738	-15	-0.0480
66.000	-373	302	-675	-353	315	-668	7	-0.0390
68.000	-329	243	-572	-309	258	-567	5	-0.0432
70.000	-296	224	-520	-279	244	-523	-3	-0.0462
72.000	-315	249	-564	-299	267	-566	-2	-0.0444
74.000	-321	257	-578	-306	270	-576	2	-0.0432
76.000	-355	271	-626	-339	302	-641	-15	-0.0444
78.000	-373	285	-658	-355	319	-674	-16	-0.0354
80.000	-366	277	-643	-350	315	-665	-22	-0.0258
[illegible]2.000	-362	285	-647	-351	318	-669	-22	-0.0126
84.000	-363	297	-660	-353	317	-670	-10	0.0006
86.000	-397	313	-710	-377	322	-699	11	0.0066

SLOPE INDICATOR DATA REDUCTION

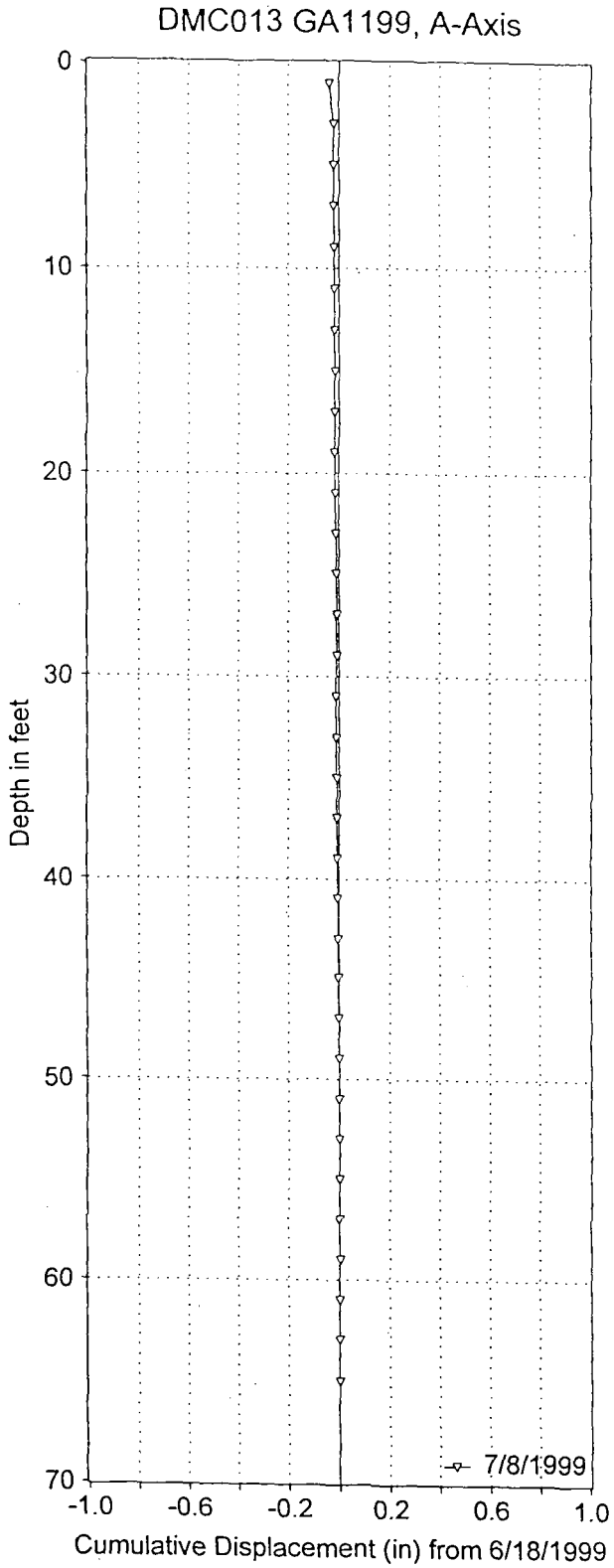
Printed by DMM on July 8,1999
[illegible]: DMC013 HOLE NUMBER GA1099
s. [illegible] description SR 101 MP 326 SLIDE

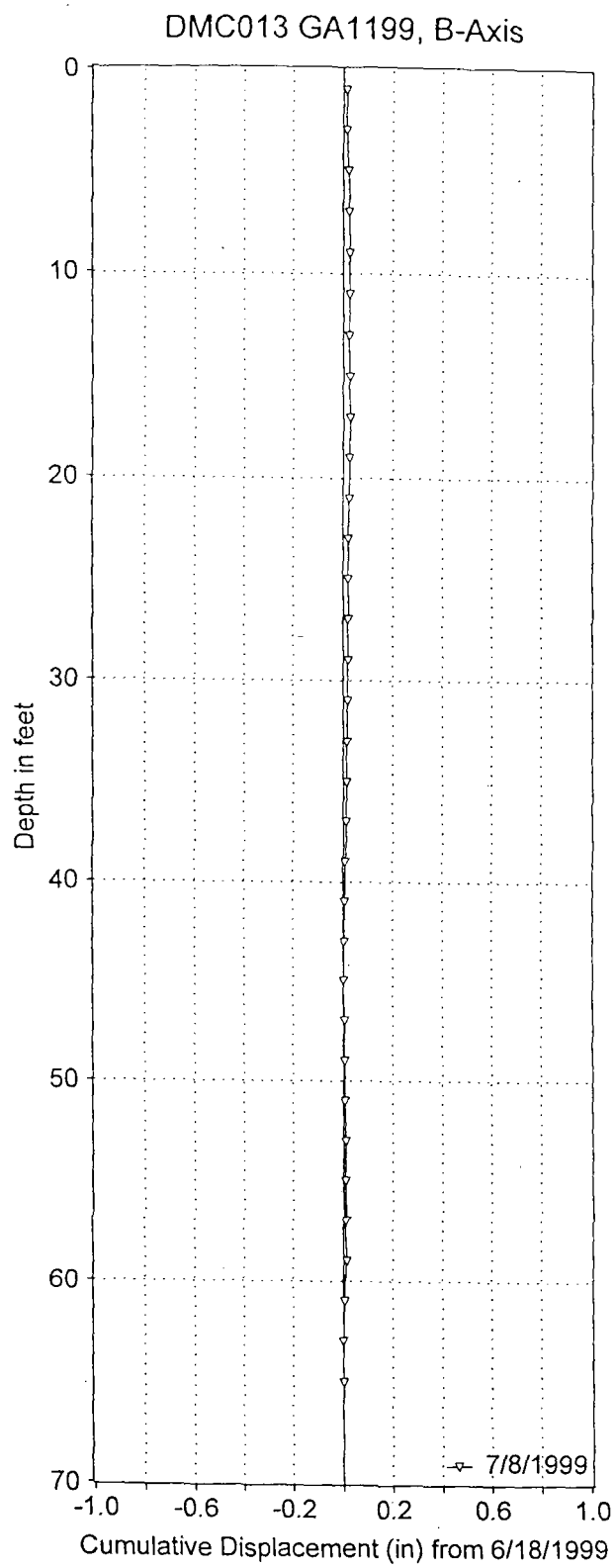
	PREVIOUS	CURRENT
DATA SET #	1	2
SENSOR #	26087	26087
DATE	06/18/99 12:54	07/08/99 08:29
READINGS PER DIRECTION	46	46

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
88.000	-382	295	-677	-358	298	-656	21	0.0000
90.000	-342	254	-596	-333	275	-608	-12	-0.0126
92.000	-321	265	-586	-311	284	-595	-9	-0.0054

END OF RECORDS





WSDOT
MATERIALS LAB
GEOTECH SECTION
OLYMPIA, WA

DMC013 SR 101
MP 326 SLIDE
A+ = N 102 deg.
GA11-99

SLOPE INDICATOR DATA REDUCTION

Printed by DMM on July 8,1999
[illegible]: DMC013 HOLE NUMBER GA1199
Site description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
DATA SET #	3	4
SENSOR #	26087	26087
DATE	06/18/99 12:21	07/08/99 09:07
READINGS PER DIRECTION	32	32

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	A0	A180	DIFF	A0	A180	DIFF		IN.
2.000	-39	30	-69	-55	46	-101	-32	-0.0330
4.000	-41	38	-79	-45	39	-84	-5	-0.0138
6.000	217	-214	431	215	-213	428	-3	-0.0108
8.000	277	-279	556	274	-281	555	-1	-0.0090
10.000	172	-173	345	170	-174	344	-1	-0.0084
12.000	267	-266	533	266	-269	535	2	-0.0078
14.000	327	-330	657	326	-331	657	0	-0.0090
16.000	373	-375	748	374	-378	752	4	-0.0090
18.000	418	-417	835	415	-418	833	-2	-0.0114
20.000	422	-421	843	419	-422	841	-2	-0.0102
22.000	367	-366	733	363	-367	730	-3	-0.0090
24.000	329	-323	652	326	-323	649	-3	-0.0072
26.000	289	-294	583	286	-295	581	-2	-0.0054
28.000	242	-243	485	241	-244	485	0	-0.0042
[illegible].000	331	-330	661	331	-334	665	4	-0.0042
[illegible].000	373	-372	745	371	-373	744	-1	-0.0066
34.000	334	-331	665	331	-333	664	-1	-0.0060
36.000	310	-309	619	307	-311	618	-1	-0.0054
38.000	290	-289	579	287	-291	578	-1	-0.0048
40.000	290	-293	583	289	-294	583	0	-0.0042
42.000	307	-305	612	305	-306	611	-1	-0.0042
44.000	291	-291	582	290	-292	582	0	-0.0036
46.000	292	-294	586	288	-295	583	-3	-0.0036
48.000	156	-151	307	152	-151	303	-4	-0.0018
50.000	166	-167	333	165	-168	333	0	0.0006
52.000	201	-199	400	199	-201	400	0	0.0006
54.000	181	-182	363	179	-183	362	-1	0.0006
56.000	211	-213	424	210	-214	424	0	0.0012
58.000	200	-198	398	198	-199	397	-1	0.0012
60.000	239	-239	478	238	-242	480	2	0.0018
62.000	323	-321	644	322	-323	645	1	0.0006
64.000	384	-384	768	382	-386	768	0	0.0000

END OF RECORDS

SLOPE INDICATOR DATA REDUCTION

Printed by DMM on July 8,1999
J : DMC013 HOLE NUMBER GA1199
Site description SR 101 MP 326 SLIDE

	PREVIOUS	CURRENT
DATA SET #	3	4
SENSOR #	26087	26087
DATE	06/18/99 12:21	07/08/99 09:07
READINGS PER DIRECTION	32	32

SENSOR: 26087

	PREVIOUS DATA			CURRENT DATA			CHANGE	CUM.DISP.
DEPTH	B0	B180	DIFF	B0	B180	DIFF		IN.
2.000	-141	77	-218	-124	86	-210	8	0.0348
4.000	-167	101	-268	-153	119	-272	-4	0.0300
6.000	-9	-43	34	4	-27	31	-3	0.0324
8.000	61	-117	178	73	-105	178	0	0.0342
10.000	129	-189	318	144	-177	321	3	0.0342
12.000	213	-283	496	231	-269	500	4	0.0324
14.000	162	-229	391	176	-214	390	-1	0.0300
16.000	132	-186	318	138	-173	311	-7	0.0306
18.000	177	-243	420	193	-228	421	1	0.0348
20.000	119	-198	317	142	-173	315	-2	0.0342
22.000	126	-193	319	145	-179	324	5	0.0354
24.000	88	-151	239	102	-137	239	0	0.0324
26.000	15	-79	94	33	-63	96	2	0.0324
28.000	10	-70	80	25	-59	84	4	0.0312
[illegible].000	-10	-55	45	3	-43	46	1	0.0288
[illegible].000	96	-158	254	110	-146	256	2	0.0282
34.000	158	-221	379	174	-207	381	2	0.0270
36.000	119	-185	304	134	-173	307	3	0.0258
38.000	184	-246	430	201	-234	435	5	0.0240
40.000	155	-218	373	171	-205	376	3	0.0210
42.000	119	-185	304	145	-164	309	5	0.0192
44.000	101	-169	270	125	-152	277	7	0.0162
46.000	101	-150	251	111	-135	246	-5	0.0120
48.000	19	-80	99	33	-67	100	1	0.0150
50.000	92	-169	261	114	-149	263	2	0.0144
52.000	90	-163	253	109	-143	252	-1	0.0132
54.000	83	-148	231	97	-137	234	3	0.0138
56.000	107	-175	282	129	-154	283	1	0.0120
58.000	105	-163	268	117	-150	267	-1	0.0114
60.000	38	-118	156	65	-106	171	15	0.0120
62.000	46	-124	170	66	-111	177	7	0.0030
64.000	63	-122	185	77	-106	183	-2	-0.0012

END OF RECORDS

Atterberg Limit Determination

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

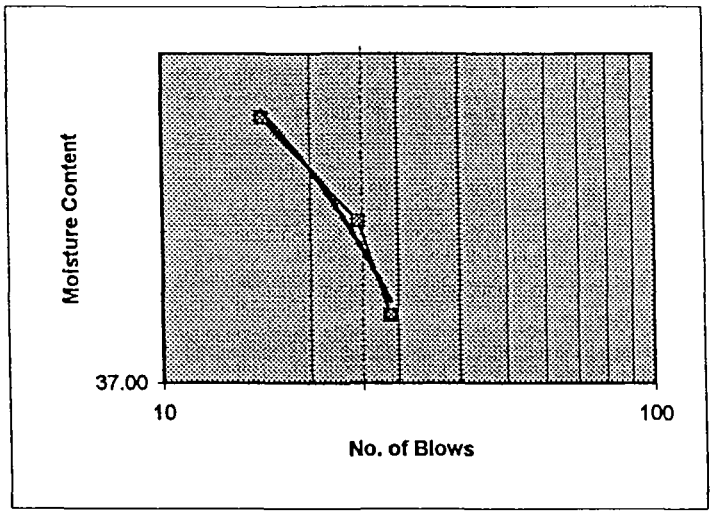
Boring No: GA 1 Sample No: SS 17 Depth: 0

Soil Description: Gray silt (ML)

Natural Moisture Content: 29.7%

Liquid Limit Determination

Can No.	K17	K9	D31		
No. of Blows	29	25	16		
Moisture Content	37.83	38.97	40.23		



Liquid Limit 39

Plastic Limit 28

Plasticity Index 11

Plastic Limit Determination

Can No.	D7	T10	K3		
Moisture Content	29.00	26.87	28.72		

Atterberg Limit Determination

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

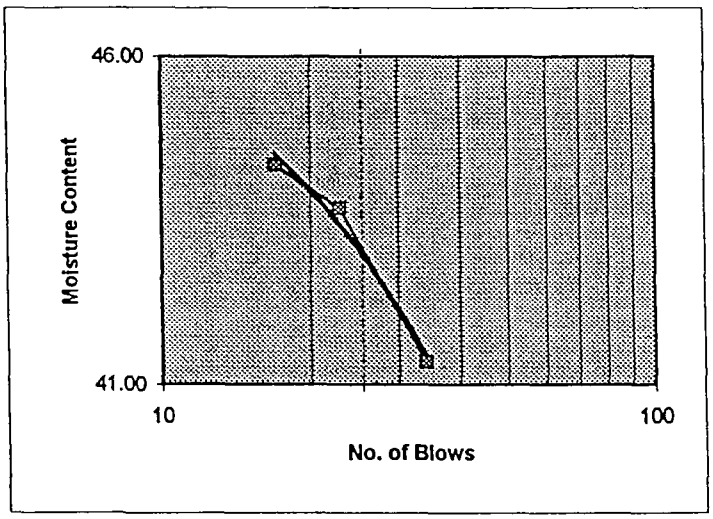
Boring No: GA 2A Sample No: SS 5 Depth: 0

Soil Description: Brown silt (ML)

Natural Moisture Content: 29.6%

Liquid Limit Determination

Can No.	D2	T8	D12		
No. of Blows	34	23	17		
Moisture Content	41.34	43.71	44.38		



Liquid Limit 43

Plastic Limit 28

Plasticity Index 15

Plastic Limit Determination

Can No.	D99	K22	D28		
Moisture Content	29.32	25.26	28.74		

Atterberg Limit Determination

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

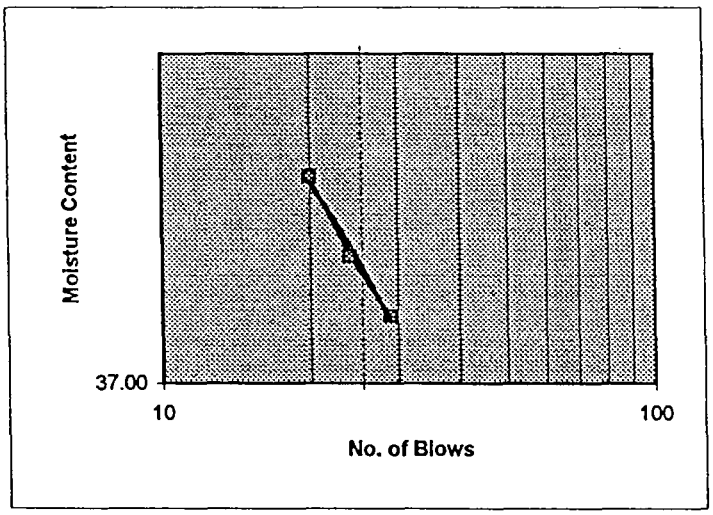
Boring No: GA 2 Sample No: SS 15 Depth: 0

Soil Description: Brown silt (ML)

Natural Moisture Content: 33.4%

Liquid Limit Determination

Can No.	T4	T7	T1		
No. of Blows	29	24	20		
Moisture Content	37.06	37.12	37.19		



Liquid Limit 37

Plastic Limit 27

Plasticity Index 10

Plastic Limit Determination

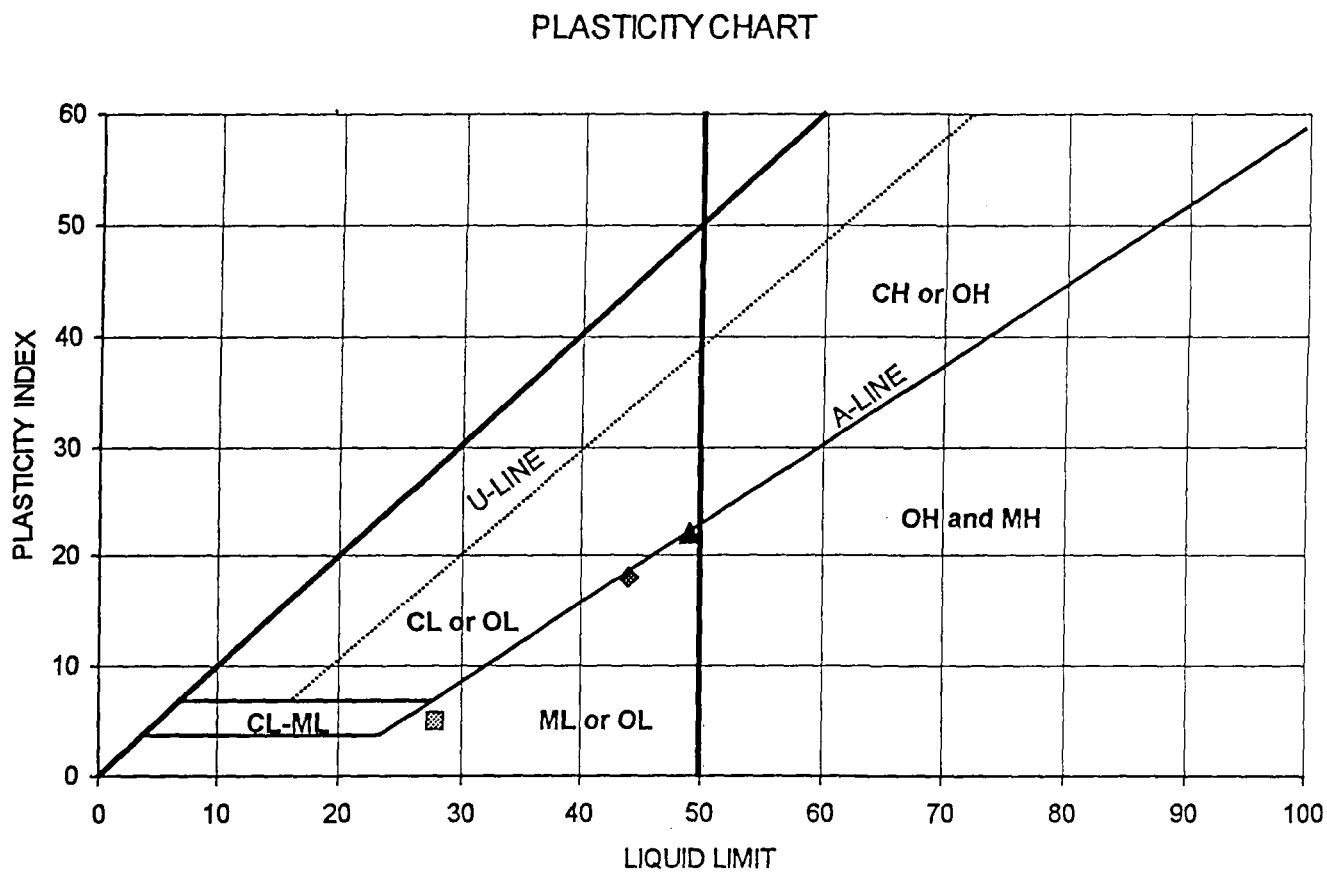
Can No.	K17	D10	K14		
Moisture Content	26.45	26.40	28.42		

0314-031-00 JRS:MBB:mbb 8/18/99 (Atterbergs.ppt)

Geo Engineers

FIGURE #

ATTERBERG LIMITS TEST RESULTS



SYMBOL	EXPLORATION NUMBER	SAMPLE NUMBER	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	SOIL DESCRIPTION
◆	GA 3	SS 6	22.7	44	18	Gray clay (CL)
▩	GA 4	SS 54	24.6	28	5	Gray fine sandy silt (ML)
▲	GA 5	SS 20	23.1	49	22	Gray clay (CL)

Atterberg Limit Determination

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

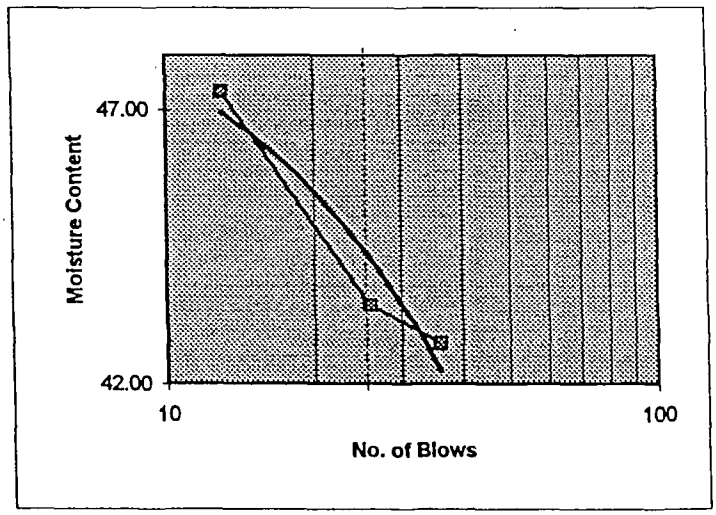
Boring No: GA 3 Sample No: SS 6 Depth: 0

Soil Description: Gray clay (CL)

Natural Moisture Content: 22.7%

Liquid Limit Determination

Can No.	D26	D27	D18		
No. of Blows	36	26	13		
Moisture Content	42.73	43.44	47.33		



Liquid Limit 44

Plastic Limit 26

Plasticity Index 18

Plastic Limit Determination

Can No.	D32	D19	D5		
Moisture Content	26.50	25.00	27.52		

Atterberg Limit Determination

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

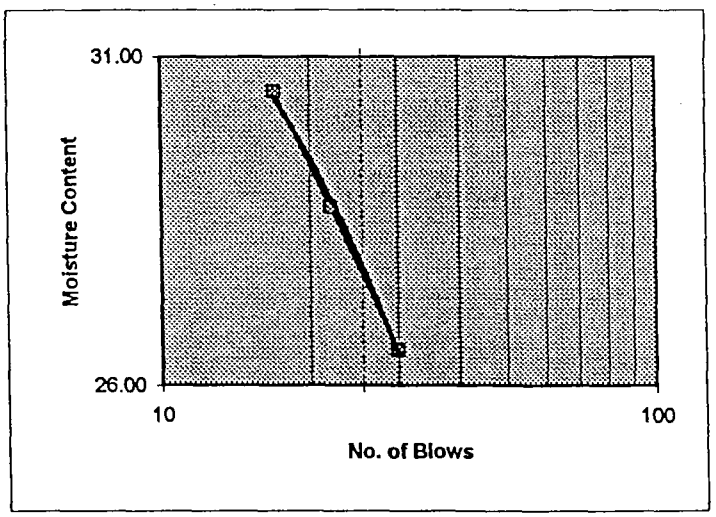
Boring No: GA 4 Sample No: SS 54 Depth: 0

Soil Description: Gray fine sandy silt (ML)

Natural Moisture Content: 24.6%

Liquid Limit Determination

Can No.	T3	K13	D24		
No. of Blows	30	22	17		
Moisture Content	26.54	28.71	30.47		



Liquid Limit 28

Plastic Limit 23

Plasticity Index 5

Plastic Limit Determination

Can No.	D30	K10	D98		
Moisture Content	24.11	22.45	22.78		

Atterberg Limit Determination

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

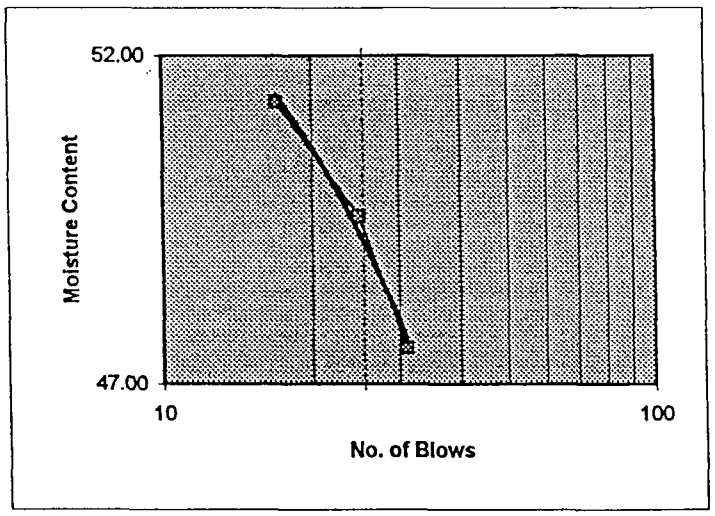
Boring No: GA 5 Sample No: SS 20 Depth: 0

Soil Description: Gray clay (CL)

Natural Moisture Content: 23.1%

Liquid Limit Determination

Can No.	T4	D22	K14		
No. of Blows	31	25	17		
Moisture Content	47.55	49.57	51.29		



Liquid Limit 49

Plastic Limit 28

Plasticity Index 22

Plastic Limit Determination

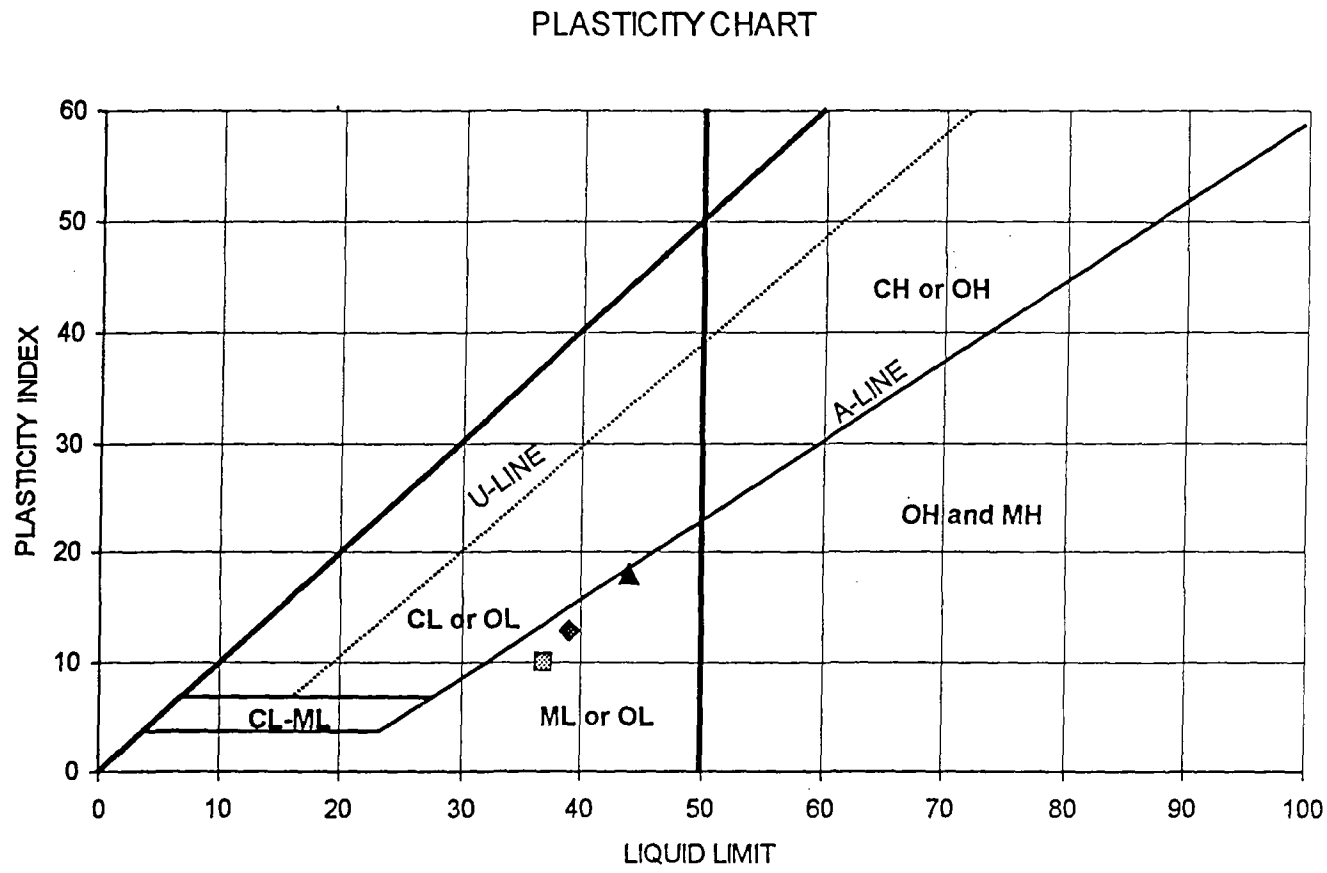
Can No.	D20	K16	T6		
Moisture Content	27.27	28.75	27.27		

0314-031-00 JRS:MBB:mbb 8/18/99 (Atterbergs.ppt)

Geo Engineers

FIGURE #

ATTERBERG LIMITS TEST RESULTS



SYMBOL	EXPLORATION NUMBER	SAMPLE NUMBER	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	SOIL DESCRIPTION
◆	GA 6	SS 10	27.5	39	13	Gray silt (ML)
▩	GA 8	C22	22.0	37	10	Gray silt (ML)
▲	GA 9	SS 9	28.7	44	18	Gray silt (ML)

Atterberg Limit Determination

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

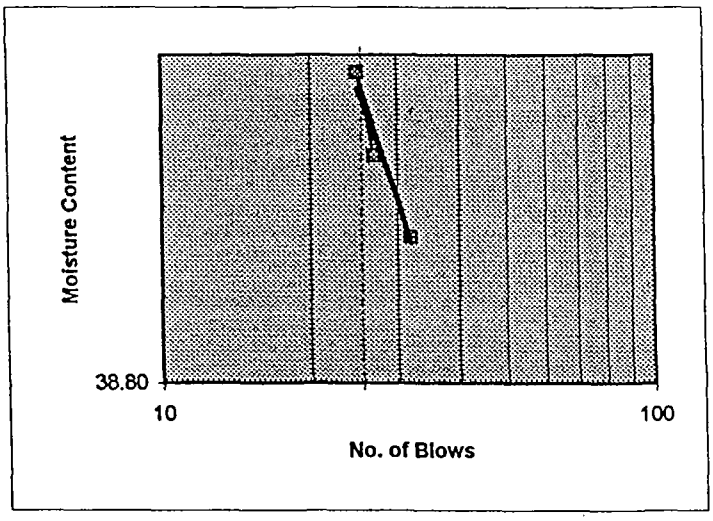
Boring No: GA 6 Sample No: SS 10 Depth: 0

Soil Description: Gray silt (ML)

Natural Moisture Content: 27.5%

Liquid Limit Determination

Can No.	T5	K9	D6		
No. of Blows	32	25	27		
Moisture Content	38.98	39.18	39.08		



Liquid Limit 39

Plastic Limit 26

Plasticity Index 13

Plastic Limit Determination

Can No.	K21	D8	K7		
Moisture Content	24.42	26.87	26.17		

Atterberg Limit Determination

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

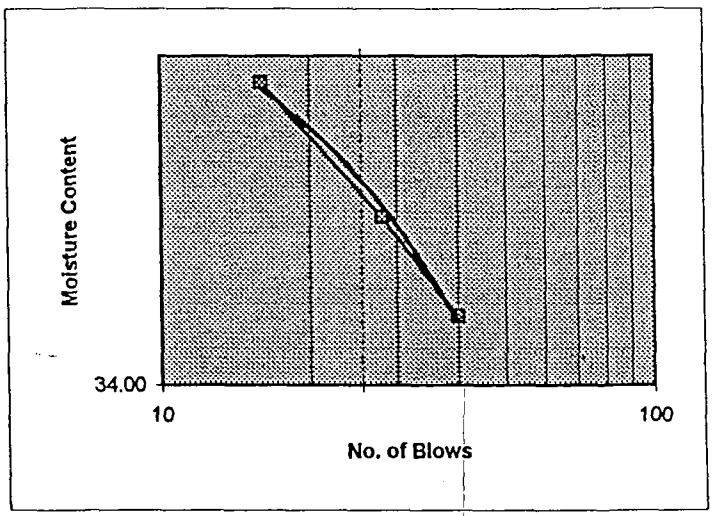
Boring No: GA 8 Sample No: C 22 Depth: 0

Soil Description: Gray silt (ML)

Natural Moisture Content: 22.0%

Liquid Limit Determination

Can No.	D98	K8	D14		
No. of Blows	40	28	16		
Moisture Content	34.85	36.06	37.68		



Liquid Limit 37

Plastic Limit 26

Plasticity Index 10

Plastic Limit Determination

Can No.	T11	K13	D22		
Moisture Content	24.69	24.21	29.89		

Atterberg Limit Determination

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

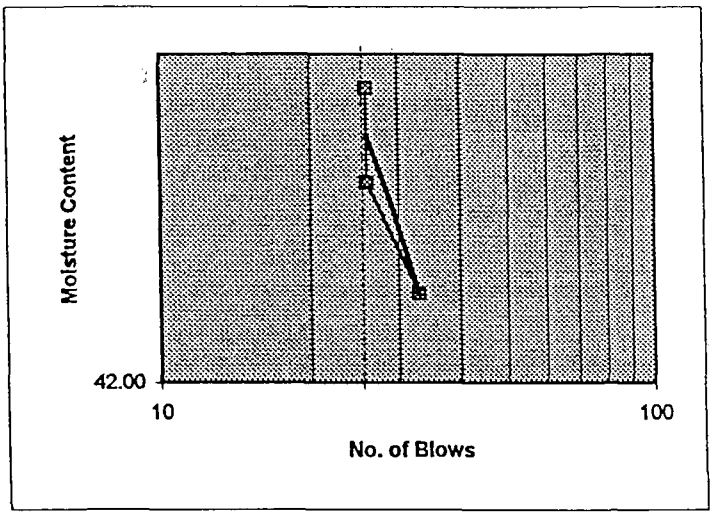
Boring No: GA 9 Sample No: SS 9 Depth: 0

Soil Description: Gray silt (ML)

Natural Moisture Content: 28.7%

Liquid Limit Determination

Can No.	D16	D4	D25		
No. of Blows	33	26	26		
Moisture Content	42.83	43.84	44.69		



Liquid Limit 44

Plastic Limit 26

Plasticity Index 18

Plastic Limit Determination

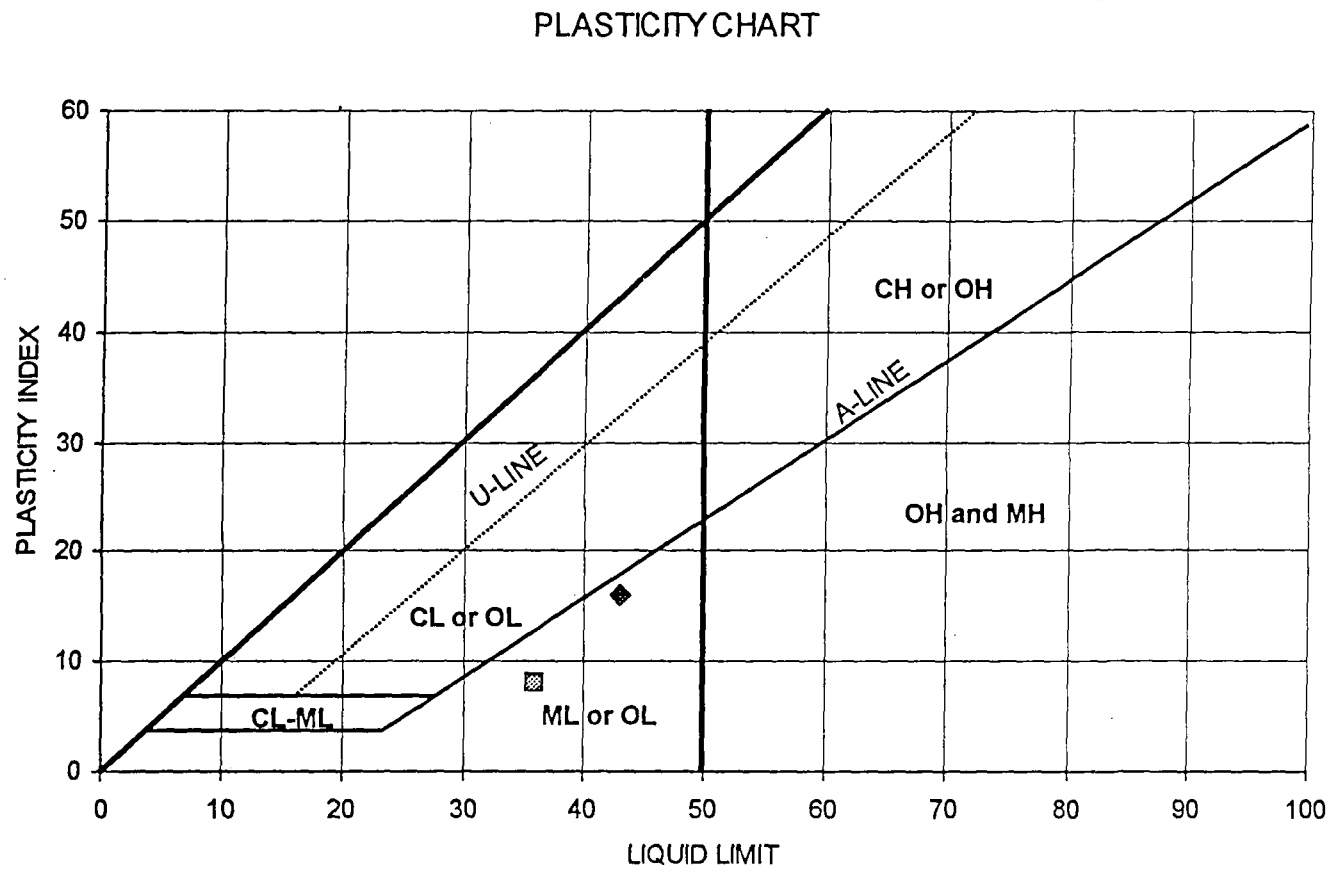
Can No.	D29	K18	K4		
Moisture Content	25.64	25.58	27.03		

0314-031-00 JRS:MBB:mbb 8/18/99 (Atterbergs.ppt)

Geo Engineers

FIGURE #

ATTERBERG LIMITS TEST RESULTS



SYMBOL	EXPLORATION NUMBER	SAMPLE NUMBER	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	SOIL DESCRIPTION
◆	GA 10	SS 15	26.5	43	16	Gray silt (ML)
▩	GA 11	SS 12	30.5	36	8	Brown silt (ML)

Atterberg Limit Determination

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

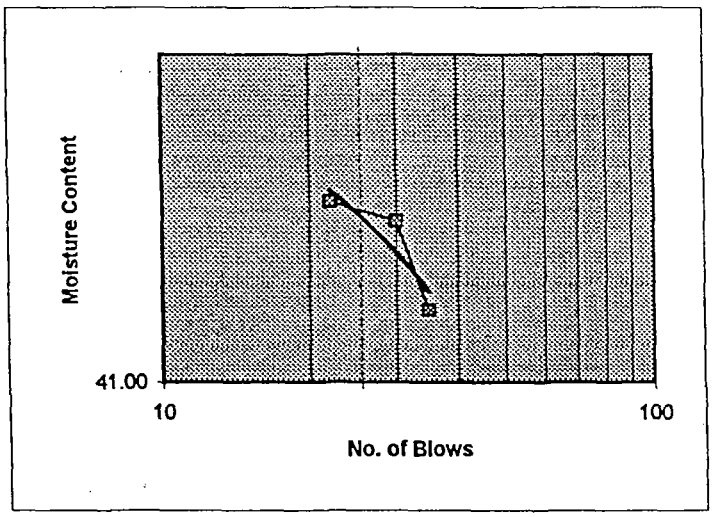
Boring No: GA 10 Sample No: SS 15 Depth: 0

Soil Description: Gray silt (ML)

Natural Moisture Content: 26.5%

Liquid Limit Determination

Can No.	D1	D17	K19		
No. of Blows	35	30	22		
Moisture Content	41.79	42.75	42.95		



Liquid Limit 43

Plastic Limit 27

Plasticity Index 16

Plastic Limit Determination

Can No.	K1	D23	K20		
Moisture Content	27.27	27.18	25.29		

Atterberg Limit Determination

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

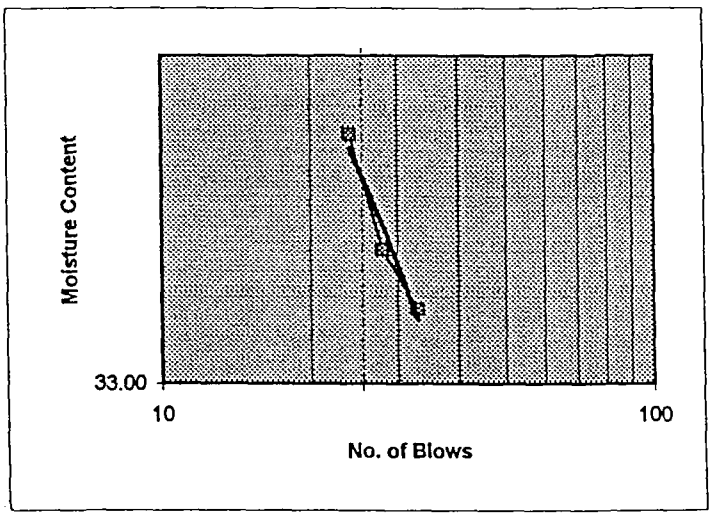
Boring No: GA 11 Sample No: SS 12 Depth: 0

Soil Description: Brown silt (ML)

Natural Moisture Content: 30.5%

Liquid Limit Determination

Can No.	D33	T2	D31		
No. of Blows	33	28	24		
Moisture Content	33.92	34.64	36.05		



Liquid Limit 36

Plastic Limit 27

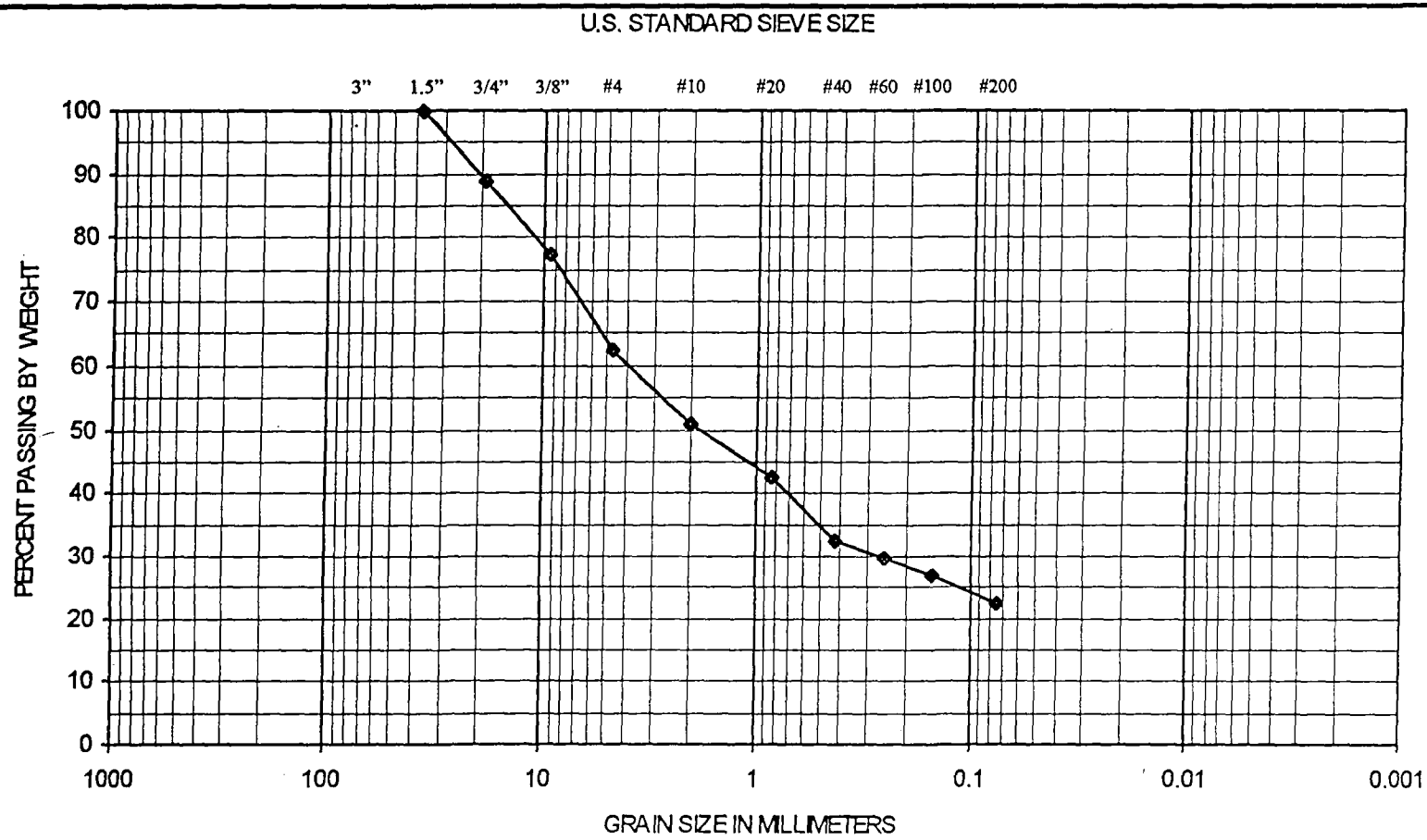
Plasticity Index 8

Plastic Limit Determination

Can No.	K15	D24	K2		
Moisture Content	27.73	28.87	25.27		

0314-031-00 JRS:MBM:jrs 7/18/99 (Sieves.ppt)

Geo Engineers



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	SAMPLE NUMBER	SOIL CLASSIFICATION
◆	GA-4	SS-6	Brown silty medium sand with fine gravel (SM)

SIEVE ANALYSIS RESULTS

FIGURE #

Particle Size Analysis Worksheet

Job Name: Golder #993-1467.500 Job No: 0314-031-00

Date: 8/19/99 Tested By: JRS

Boring No: GA-4 Sample No: SS6 Depth:

Soil Description: Brown silty fine to medium sand with fine gravel (SM) (moist)

Moisture Content		
Pan #	z1	*
Pan + Wet Soil	397.03	*
Pan + Dry Soil	366.84	*
Moisture Loss	30.19	
Pan Wt.	83.84	*
Dry Soil Wt.	283.00	
Moisture Content	10.7	

-200 Wash		
Pan #	z1	
Pan + Dry Soil (Before)	366.84	
Pan + Dry Soil (After)	307.03	*
-200 From Wash	59.81	
Pan Wt.	83.84	
Dry Soil Wt.	283.00	
% of -200	21.1	

Total Washed Soil Wt: 223.19

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	**********	0.00	0.0	100.0
1.5"	**********	0.00	0.0	100.0
3/4"	**********	31.51	11.1	88.9
3/8"	**********	63.71	22.5	77.5
#4	**********	106.13	37.5	62.5
#10	17.06	138.89	49.1	50.9
#20	29.62	163.01	57.6	42.4
#40	37.73	191.07	67.5	32.5
#60	43.60	199.18	70.4	29.6
#100	49.30	207.07	73.2	26.8
#200	58.72	220.09	77.8	22.2
Pan	60.96	223.19		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	88.9
3/8"	77.5
#4	62.5
#10	50.9
#20	42.4
#40	32.5
#60	29.6
#100	26.8
#200	22.2

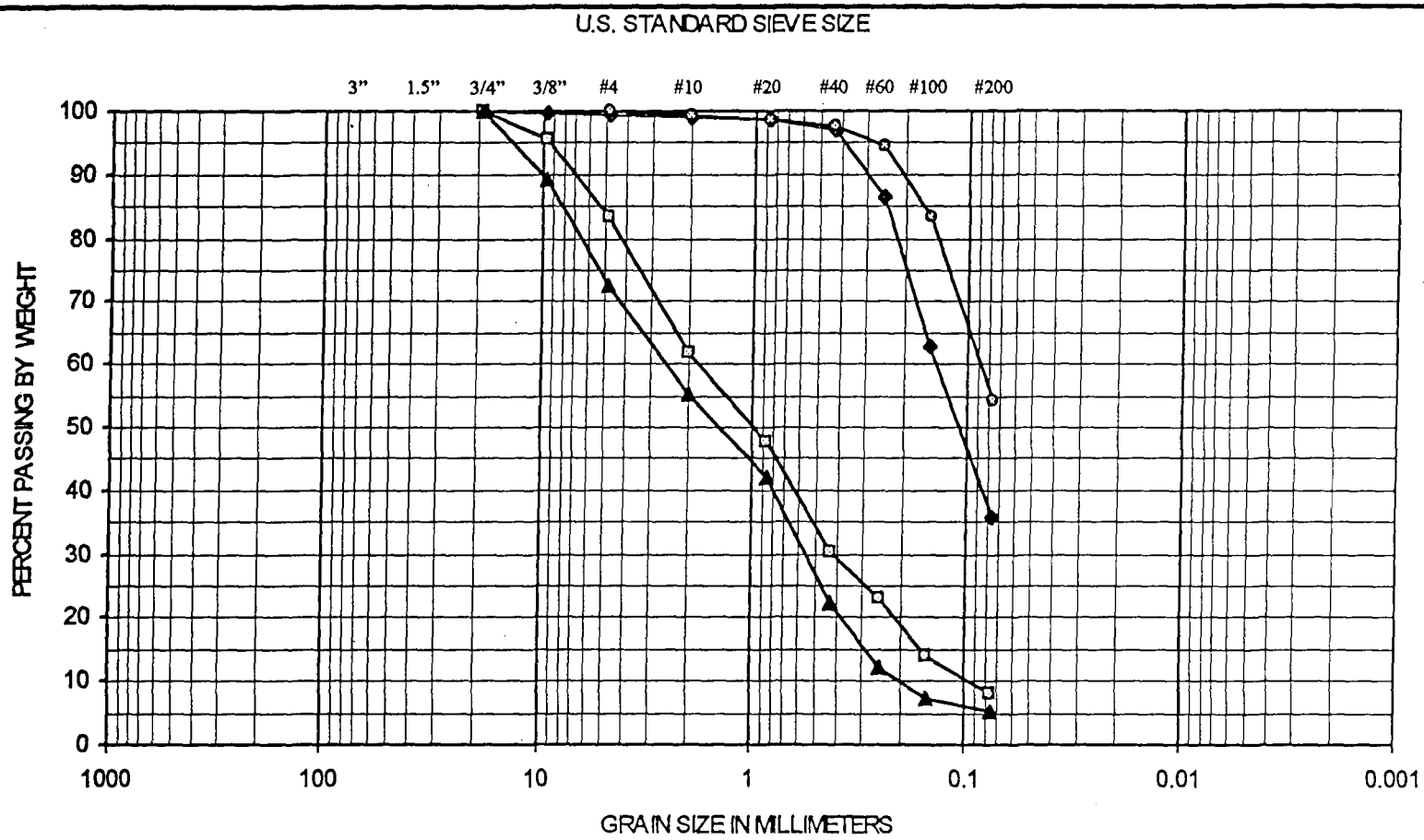
Classification Data

Description		% Total
Gravel	Coarse	11.1
	Fine	26.4
Sand	Coarse	11.6
	Medium	18.4
	Fine	10.3
-200		22.2

Soil Classification: Brown silty medium sand with fine gravel (SM)

0314-031-00 JRS:MBB:mbb 8/18/99 (Sieves.ppt)

Geo Engineers



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	SAMPLE NUMBER	SOIL CLASSIFICATION
◆	GA 1	SS 16	Brown silty fine sand (SM)
▩	GA 2	SS 8A	Brown fine to coarse sand with silt and fine gravel (SW-SM)
⊗	GA 2	SS 13	Brown fine sandy silt (ML)
▲	GA 5	SS 8	Brown fine to coarse sand with silt and fine gravel (SW-SM)

SIEVE ANALYSIS RESULTS

FIGURE #

Particle Size Analysis Worksheet

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

Boring No: GA 1 Sample No: SS 16 Depth:

Soil Description: Brown silty fine sand (SM)

Moisture Content		
Pan #	DP21	*
Pan + Wet Soil	777.80	*
Pan + Dry Soil	658.94	*
Moisture Loss	118.86	
Pan Wt.	197.44	*
Dry Soil Wt.	461.50	
Moisture Content	25.8	

-200 Wash		
Pan #	DP21	
Pan + Dry Soil (Before)	658.94	
Pan + Dry Soil (After)	515.60	*
-200 From Wash	143.34	
Pan Wt.	197.44	
Dry Soil Wt.	461.50	
% of -200	31.1	

Total Washed Soil Wt: 318.16

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	**********	0.00	0.0	100.0
1.5"	**********	0.00	0.0	100.0
3/4"	**********	0.00	0.0	100.0
3/8"	**********	1.66	0.4	99.6
#4	**********	2.58	0.6	99.4
#10	0.47	4.59	1.0	99.0
#20	1.00	6.85	1.5	98.5
#40	2.23	14.06	3.0	97.0
#60	13.68	62.67	13.6	86.4
#100	39.24	171.18	37.1	62.9
#200	68.91	297.14	64.4	35.6
Pan	73.86	318.16		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	99.6
#4	99.4
#10	99.0
#20	98.5
#40	97.0
#60	86.4
#100	62.9
#200	35.6

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	0.6
Sand	Coarse	0.4
	Medium	2.1
	Fine	61.3
-200		35.6

Soil Classification:	Brown silty fine sand (SM)

Particle Size Analysis Worksheet

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

Boring No: GA 2 Sample No: SS 8A Depth:

Soil Description: Brown silty fine to coarse sand (SM)

Moisture Content		
Pan #	DP10	*
Pan + Wet Soil	627.50	*
Pan + Dry Soil	563.93	*
Moisture Loss	63.57	
Pan Wt.	192.24	*
Dry Soil Wt.	371.69	
Moisture Content	17.1	

-200 Wash		
Pan #	DP10	
Pan + Dry Soil (Before)	563.93	
Pan + Dry Soil (After)	536.91	*
-200 From Wash	27.02	
Pan Wt.	192.24	
Dry Soil Wt.	371.69	
% of -200	7.3	

Total Washed Soil Wt: 344.67

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	**********	0.00	0.0	100.0
1.5"	**********	0.00	0.0	100.0
3/4"	**********	0.00	0.0	100.0
3/8"	**********	16.22	4.4	95.6
#4	**********	62.29	16.8	83.2
#10	19.05	142.44	38.3	61.7
#20	31.41	194.43	52.3	47.7
#40	38.87	259.55	69.8	30.2
#60	47.95	286.91	77.2	22.8
#100	58.79	319.57	86.0	14.0
#200	66.12	341.66	91.9	8.1
Pan	67.12	344.67		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	95.6
#4	83.2
#10	61.7
#20	47.7
#40	30.2
#60	22.8
#100	14.0
#200	8.1

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	16.8
Sand	Coarse	21.6
	Medium	31.5
	Fine	22.1
-200		8.1

Soil Classification:	Brown fine to coarse sand with silt and fine gravel (SW-SM)

Particle Size Analysis Worksheet

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

Boring No: GA 2 Sample No: SS 13 Depth:

Soil Description: Brown silty fine sand (SM)

Moisture Content		
Pan #	DP5	*
Pan + Wet Soil	647.60	*
Pan + Dry Soil	551.58	*
Moisture Loss	96.02	
Pan Wt.	192.29	*
Dry Soil Wt.	359.29	
Moisture Content	26.7	

-200 Wash		
Pan #	DP5	
Pan + Dry Soil (Before)	551.58	
Pan + Dry Soil (After)	383.34	*
-200 From Wash	168.24	
Pan Wt.	192.29	
Dry Soil Wt.	359.29	
% of -200	46.8	

Total Washed Soil Wt: 191.05

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	**********	0.00	0.0	100.0
1.5"	**********	0.00	0.0	100.0
3/4"	**********	0.00	0.0	100.0
3/8"	**********	0.00	0.0	100.0
#4	**********	0.00	0.0	100.0
#10	0.50	2.18	0.6	99.4
#20	1.14	4.98	1.4	98.6
#40	1.69	9.48	2.6	97.4
#60	4.10	19.89	5.5	94.5
#100	13.39	60.01	16.7	83.3
#200	37.71	165.05	45.9	54.1
Pan	43.73	191.05		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	100.0
#4	100.0
#10	99.4
#20	98.6
#40	97.4
#60	94.5
#100	83.3
#200	54.1

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	0.0
Sand	Coarse	0.6
	Medium	2.0
	Fine	43.3
-200		54.1

Soil Classification:	Brown fine sandy silt (ML)

Particle Size Analysis Worksheet

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

Boring No: GA 5 Sample No: SS 8 Depth:

Soil Description: Brown fine to coarse sand with silt and fine gravel (SW-SM)

Moisture Content		
Pan #	Z7	*
Pan + Wet Soil	690.80	*
Pan + Dry Soil	624.00	*
Moisture Loss	66.80	
Pan Wt.	87.59	*
Dry Soil Wt.	536.41	
Moisture Content	12.5	

-200 Wash		
Pan #	Z7	
Pan + Dry Soil (Before)	624.00	
Pan + Dry Soil (After)	598.07	*
-200 From Wash	25.93	
Pan Wt.	87.59	
Dry Soil Wt.	536.41	
% of -200	4.8	

Total Washed Soil Wt: 510.48

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	**********	0.00	0.0	100.0
1.5"	**********	0.00	0.0	100.0
3/4"	**********	0.00	0.0	100.0
3/8"	**********	56.71	10.6	89.4
#4	**********	146.84	27.4	72.6
#10	22.76	240.69	44.9	55.1
#20	39.89	311.32	58.0	42.0
#40	57.51	416.62	77.7	22.3
#60	75.37	471.26	87.9	12.1
#100	83.70	496.74	92.6	7.4
#200	87.44	508.19	94.7	5.3
Pan	88.19	510.48		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	89.4
#4	72.6
#10	55.1
#20	42.0
#40	22.3
#60	12.1
#100	7.4
#200	5.3

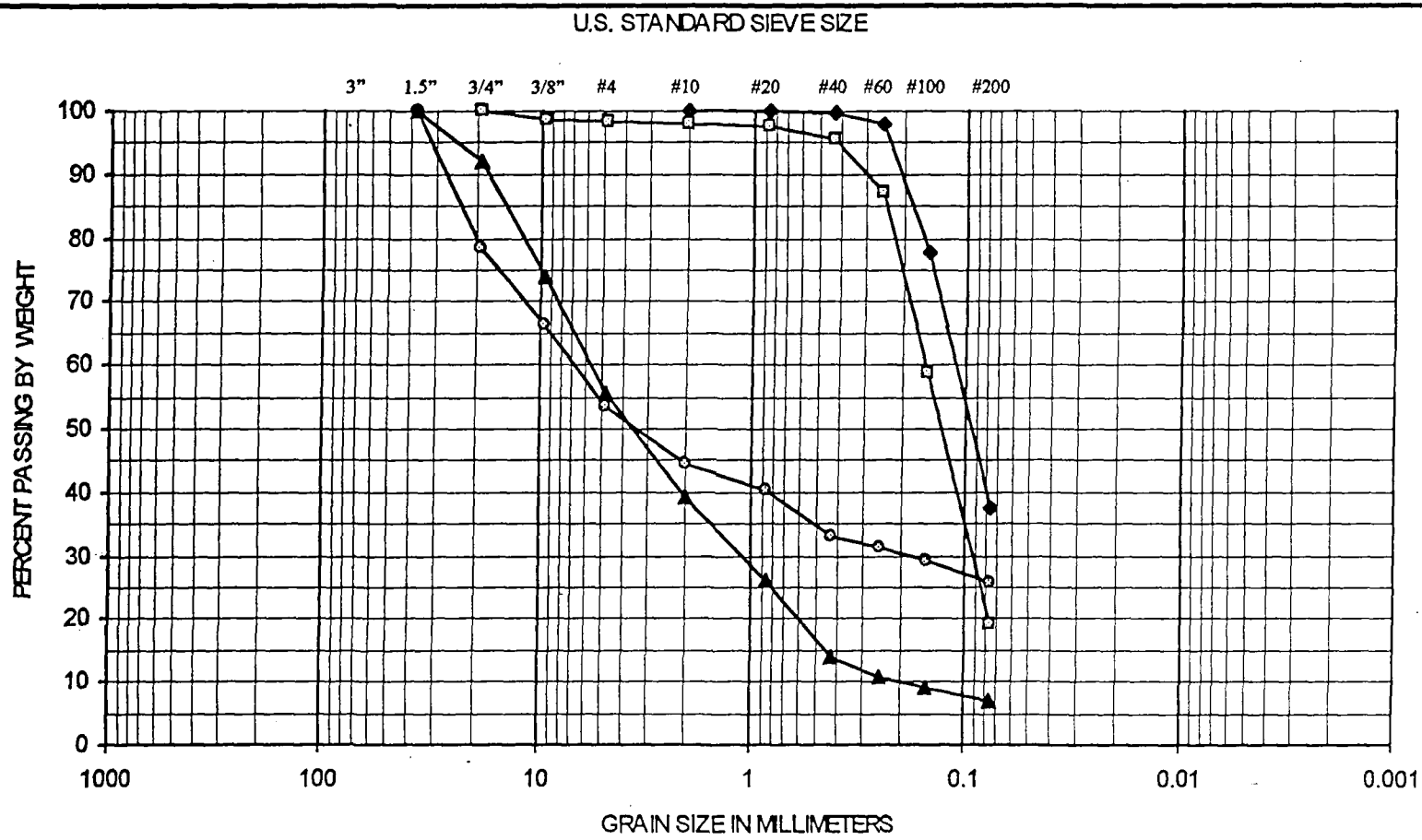
Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	27.4
Sand	Coarse	17.5
	Medium	32.8
	Fine	17.1
-200		5.3

Soil Classification:	Brown fine to coarse sand with silt and fine gravel (SW-SM)

0314-031-00 JRS:MBB:mbb 8/18/99 (Sieves.ppt)

Geo Engineers



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	SAMPLE NUMBER	SOIL CLASSIFICATION
◆	GA 5	SS 18	Brown silty fine sand (SM)
▩	GA 6A	SS 2	Brown silty fine sand (SM)
⊗	GA 7	SS 4	Orange-brown silty fine to coarse gravel with sand (GM)
▲	GA 8	SS 7	Brown medium to coarse sand with silt and fine gravel (SP-SM)

SIEVE ANALYSIS RESULTS

FIGURE #

Particle Size Analysis Worksheet

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

Boring No: GA 5 Sample No: SS 18 Depth:

Soil Description: Brown silty fine sand (SM)

Moisture Content		
Pan #	B6	*
Pan + Wet Soil	576.10	*
Pan + Dry Soil	474.76	*
Moisture Loss	101.34	
Pan Wt.	85.90	*
Dry Soil Wt.	388.86	
Moisture Content	26.1	

-200 Wash		
Pan #	B6	
Pan + Dry Soil (Before)	474.76	
Pan + Dry Soil (After)	356.88	*
-200 From Wash	117.88	
Pan Wt.	85.90	
Dry Soil Wt.	388.86	
% of -200	30.3	

Total Washed Soil Wt: 270.98

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	**********	0.00	0.0	100.0
1.5"	**********	0.00	0.0	100.0
3/4"	**********	0.00	0.0	100.0
3/8"	**********	0.00	0.0	100.0
#4	**********	0.00	0.0	100.0
#10	0.03	0.12	0.0	100.0
#20	0.09	0.37	0.1	99.9
#40	0.25	1.16	0.3	99.7
#60	2.03	8.56	2.2	97.8
#100	20.73	86.25	22.2	77.8
#200	58.57	243.47	62.6	37.4
Pan	65.19	270.98		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	100.0
#4	100.0
#10	100.0
#20	99.9
#40	99.7
#60	97.8
#100	77.8
#200	37.4

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	0.0
Sand	Coarse	0.0
	Medium	0.3
	Fine	62.3
-200		37.4

Soil Classification: Brown silty fine sand (SM)

Particle Size Analysis Worksheet

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

Boring No: GA 6A Sample No: SS 2 Depth:

Soil Description: Brown fine sand with silt (SP-SM)

Moisture Content		
Pan #	Z4	*
Pan + Wet Soil	459.90	*
Pan + Dry Soil	385.15	*
Moisture Loss	74.75	
Pan Wt.	85.37	*
Dry Soil Wt.	299.78	
Moisture Content	24.9	

-200 Wash		
Pan #	Z4	
Pan + Dry Soil (Before)	385.15	
Pan + Dry Soil (After)	343.48	*
-200 From Wash	41.67	
Pan Wt.	85.37	
Dry Soil Wt.	299.78	
% of -200	13.9	

Total Washed Soil Wt: 258.11

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	**********	0.00	0.0	100.0
1.5"	**********	0.00	0.0	100.0
3/4"	**********	0.00	0.0	100.0
3/8"	**********	4.30	1.4	98.6
#4	**********	4.75	1.6	98.4
#10	0.33	6.14	2.0	98.0
#20	0.61	7.32	2.4	97.6
#40	1.73	13.38	4.5	95.5
#60	7.86	39.04	13.0	87.0
#100	28.12	123.84	41.3	58.7
#200	56.40	242.20	80.8	19.2
Pan	60.20	258.11		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	98.6
#4	98.4
#10	98.0
#20	97.6
#40	95.5
#60	87.0
#100	58.7
#200	19.2

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	1.6
Sand	Coarse	0.5
	Medium	2.4
	Fine	76.3
-200		19.2

Soil Classification:	Brown silty fine sand (SM)

Particle Size Analysis Worksheet

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

Boring No: GA 7 Sample No: SS 4 Depth:

Soil Description: Orange-brown silty fine to coarse sand (SM)

Moisture Content		
Pan #	B9	*
Pan + Wet Soil	610.80	*
Pan + Dry Soil	513.83	*
Moisture Loss	96.97	
Pan Wt.	84.37	*
Dry Soil Wt.	429.46	
Moisture Content	22.6	

-200 Wash		
Pan #	B9	
Pan + Dry Soil (Before)	513.83	
Pan + Dry Soil (After)	406.99	*
-200 From Wash	106.84	
Pan Wt.	84.37	
Dry Soil Wt.	429.46	
% of -200	24.9	

Total Washed Soil Wt: 322.62

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	**********	0.00	0.0	100.0
1.5"	**********	0.00	0.0	100.0
3/4"	**********	92.55	21.6	78.4
3/8"	**********	145.28	33.8	66.2
#4	**********	200.34	46.6	53.4
#10	18.11	237.97	55.4	44.6
#20	27.14	256.73	59.8	40.2
#40	34.17	287.12	66.9	33.1
#60	40.25	295.87	68.9	31.1
#100	46.45	304.78	71.0	29.0
#200	56.80	319.67	74.4	25.6
Pan	58.85	322.62		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	78.4
3/8"	66.2
#4	53.4
#10	44.6
#20	40.2
#40	33.1
#60	31.1
#100	29.0
#200	25.6

Classification Data

Description		% Total
Gravel	Coarse	21.6
	Fine	25.1
Sand	Coarse	8.8
	Medium	11.4
	Fine	7.6
-200		25.6

Soil Classification: Orange-brown silty fine to coarse gravel with sand (GM)

Particle Size Analysis Worksheet

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

Boring No: GA 8 Sample No: SS 7 Depth:

Soil Description: Brown silty fine to coarse sand with fine gravel (SM)

Moisture Content		
Pan #	B5	*
Pan + Wet Soil	584.10	*
Pan + Dry Soil	528.06	*
Moisture Loss	56.04	
Pan Wt.	83.95	*
Dry Soil Wt.	444.11	
Moisture Content	12.6	

-200 Wash		
Pan #	B5	
Pan + Dry Soil (Before)	528.06	
Pan + Dry Soil (After)	499.26	*
-200 From Wash	28.80	
Pan Wt.	83.95	
Dry Soil Wt.	444.11	
% of -200	6.5	

Total Washed Soil Wt: 415.31

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	**********	0.00	0.0	100.0
1.5"	**********	0.00	0.0	100.0
3/4"	**********	35.26	7.9	92.1
3/8"	**********	115.19	25.9	74.1
#4	**********	197.32	44.4	55.6
#10	18.21	269.52	60.7	39.3
#20	32.86	327.61	73.8	26.2
#40	42.76	382.91	86.2	13.8
#60	47.92	396.59	89.3	10.7
#100	50.82	404.28	91.0	9.0
#200	54.09	412.95	93.0	7.0
Pan	54.98	415.31		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	92.1
3/8"	74.1
#4	55.6
#10	39.3
#20	26.2
#40	13.8
#60	10.7
#100	9.0
#200	7.0

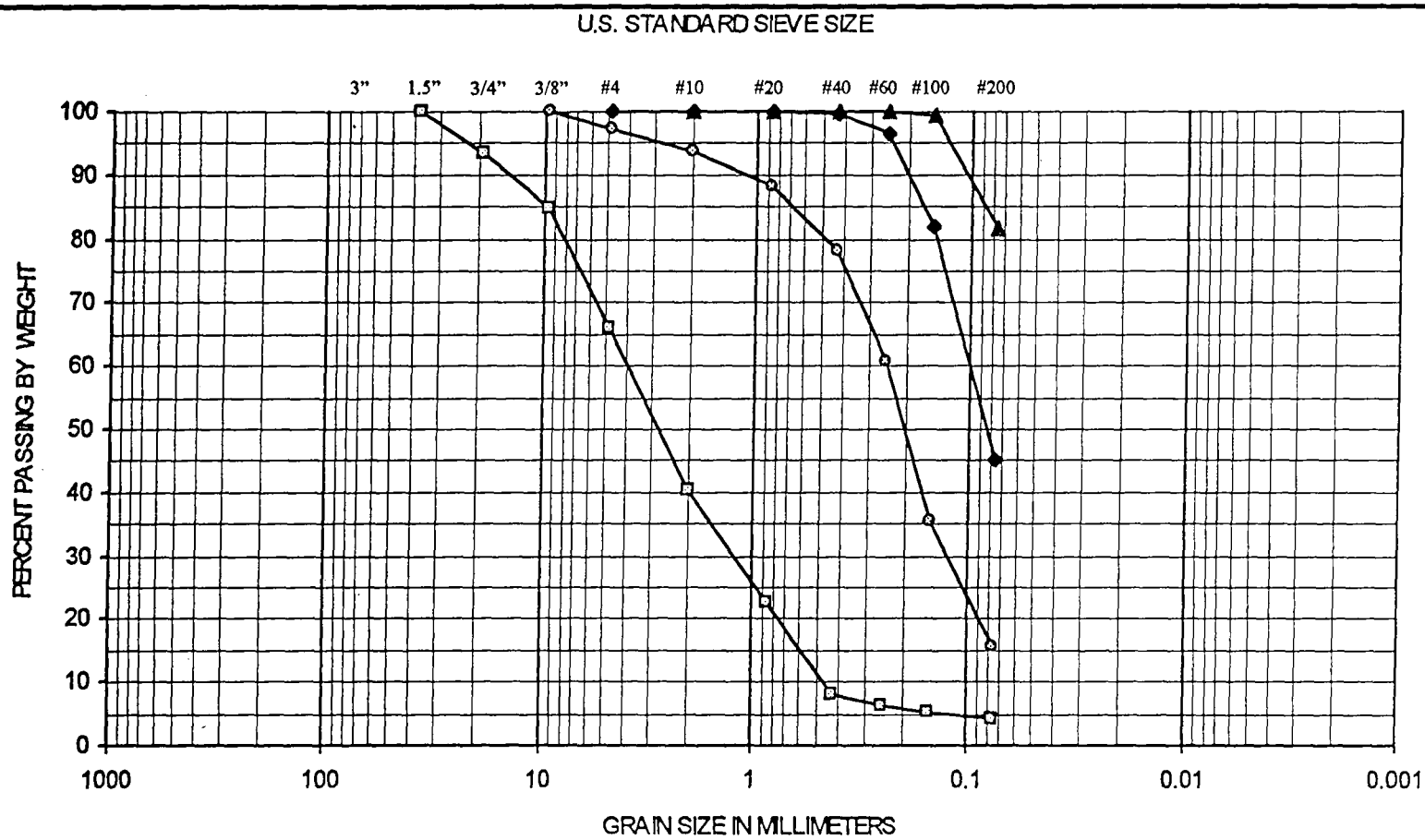
Classification Data

Description		% Total
Gravel	Coarse	7.9
	Fine	36.5
Sand	Coarse	16.3
	Medium	25.5
	Fine	6.8
-200		7.0

Soil Classification: **Brown medium to coarse sand with silt and fine gravel (SP-SM)**

0314-031-00 JRS:MBB:mbb 8/18/99 (Sieves.ppt)

Geo Engineers



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	SAMPLE NUMBER	SOIL CLASSIFICATION
◆	GA 8	SS 14A	Brown silty fine sand (SM)
▩	GA 10	SS 4	Brown medium to coarse sand with fine gravel (SP)
⊗	GA 10	SS 8	Brown silty fine to medium sand (SM)
▲	GA 11	SS 9	Dark gray silt with fine sand (ML)

FIGURE #

SIEVE ANALYSIS RESULTS

Particle Size Analysis Worksheet

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

Boring No: GA 8 Sample No: SS 14A Depth:

Soil Description: Brown silty fine sand (SM)

Moisture Content		
Pan #	Z2	*
Pan + Wet Soil	585.60	*
Pan + Dry Soil	479.79	*
Moisture Loss	105.81	
Pan Wt.	84.51	*
Dry Soil Wt.	395.28	
Moisture Content	26.8	

-200 Wash		
Pan #	Z2	
Pan + Dry Soil (Before)	479.79	
Pan + Dry Soil (After)	339.04	*
-200 From Wash	140.75	
Pan Wt.	84.51	
Dry Soil Wt.	395.28	
% of -200	35.6	

Total Washed Soil Wt: 254.53

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	**********	0.00	0.0	100.0
1.5"	**********	0.00	0.0	100.0
3/4"	**********	0.00	0.0	100.0
3/8"	**********	0.00	0.0	100.0
#4	**********	0.00	0.0	100.0
#10	0.07	0.30	0.1	99.9
#20	0.11	0.47	0.1	99.9
#40	0.29	1.55	0.4	99.6
#60	3.07	13.49	3.4	96.6
#100	16.42	70.84	17.9	82.1
#200	50.53	217.37	55.0	45.0
Pan	59.18	254.53		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	100.0
#4	100.0
#10	99.9
#20	99.9
#40	99.6
#60	96.6
#100	82.1
#200	45.0

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	0.0
Sand	Coarse	0.1
	Medium	0.3
	Fine	54.6
-200		45.0

Soil Classification: **Brown silty fine sand (SM)**

Particle Size Analysis Worksheet

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

Boring No: GA 10 Sample No: SS 4 Depth:

Soil Description: Brown fine to coarse sand with silt (SW-SM)

Moisture Content		
Pan #	B4	*
Pan + Wet Soil	701.10	*
Pan + Dry Soil	631.85	*
Moisture Loss	69.25	
Pan Wt.	84.25	*
Dry Soil Wt.	547.60	
Moisture Content	12.6	

-200 Wash		
Pan #	B4	
Pan + Dry Soil (Before)	631.85	
Pan + Dry Soil (After)	609.77	*
-200 From Wash	22.08	
Pan Wt.	84.25	
Dry Soil Wt.	547.60	
% of -200	4.0	

Total Washed Soil Wt: 525.52

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	**********	0.00	0.0	100.0
1.5"	**********	0.00	0.0	100.0
3/4"	**********	35.55	6.5	93.5
3/8"	**********	83.20	15.2	84.8
#4	**********	186.50	34.1	65.9
#10	33.71	326.43	59.6	40.4
#20	57.17	423.82	77.4	22.6
#40	73.06	504.53	92.1	7.9
#60	77.08	514.33	93.9	6.1
#100	78.91	518.79	94.7	5.3
#200	81.16	524.28	95.7	4.3
Pan	81.67	525.52		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	93.5
3/8"	84.8
#4	65.9
#10	40.4
#20	22.6
#40	7.9
#60	6.1
#100	5.3
#200	4.3

Classification Data

Description		% Total
Gravel	Coarse	6.5
	Fine	27.6
Sand	Coarse	25.6
	Medium	32.5
	Fine	3.6
-200		4.3

Soil Classification: Brown medium to coarse sand with fine gravel (SP)

Particle Size Analysis Worksheet

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

Boring No: GA 10 Sample No: SS 8 Depth:

Soil Description: Brown fine to medium sand with silt (SP-SM)

Moisture Content		
Pan #	B10	*
Pan + Wet Soil	638.60	*
Pan + Dry Soil	539.82	*
Moisture Loss	98.78	
Pan Wt.	85.22	*
Dry Soil Wt.	454.60	
Moisture Content	21.7	

-200 Wash		
Pan #	B10	
Pan + Dry Soil (Before)	539.82	
Pan + Dry Soil (After)	482.08	*
-200 From Wash	57.74	
Pan Wt.	85.22	
Dry Soil Wt.	454.60	
% of -200	12.7	

Total Washed Soil Wt: 396.86

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	**********	0.00	0.0	100.0
1.5"	**********	0.00	0.0	100.0
3/4"	**********	0.00	0.0	100.0
3/8"	**********	0.00	0.0	100.0
#4	**********	13.07	2.9	97.1
#10	1.71	29.30	6.4	93.6
#20	4.30	53.89	11.9	88.1
#40	7.75	99.76	21.9	78.1
#60	16.44	178.76	39.3	60.7
#100	29.12	294.04	64.7	35.3
#200	38.97	383.59	84.4	15.6
Pan	40.43	396.86		

Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	100.0
#4	97.1
#10	93.6
#20	88.1
#40	78.1
#60	60.7
#100	35.3
#200	15.6

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	2.9
Sand	Coarse	3.6
	Medium	15.5
	Fine	62.4
-200		15.6

Soil Classification: Brown silty fine to medium sand (SM)

Particle Size Analysis Worksheet

Job Name: Golder (993-1467.500) Job No: 0314-031-00

Date: 8/18/99 Tested By: MBB

Boring No: GA 11 Sample No: SS 9 Depth:

Soil Description: Dark gray sandy silt (ML)

Moisture Content		
Pan #	B7	*
Pan + Wet Soil	627.10	*
Pan + Dry Soil	513.17	*
Moisture Loss	113.93	
Pan Wt.	84.57	*
Dry Soil Wt.	428.60	
Moisture Content	26.6	

-200 Wash		
Pan #	B7	
Pan + Dry Soil (Before)	513.17	
Pan + Dry Soil (After)	199.76	*
-200 From Wash	313.41	
Pan Wt.	84.57	
Dry Soil Wt.	428.60	
% of -200	73.1	

Total Washed Soil Wt: 115.19

Sieve Analysis

Sieve Size	Fractional Sample Accum. Wt. Retained	Total Sample Accum. Wt. Retained	% Retained	% Passing
3.0"	**********	0.00	0.0	100.0
1.5"	**********	0.00	0.0	100.0
3/4"	**********	0.00	0.0	100.0
3/8"	**********	0.00	0.0	100.0
#4	**********	0.00	0.0	100.0
#10	0.03	0.06	0.0	100.0
#20	0.11	0.23	0.1	99.9
#40	0.20	0.47	0.1	99.9
#60	0.27	0.62	0.1	99.9
#100	1.27	2.67	0.6	99.4
#200	38.30	78.65	18.3	81.7
Pan	56.11	115.19		

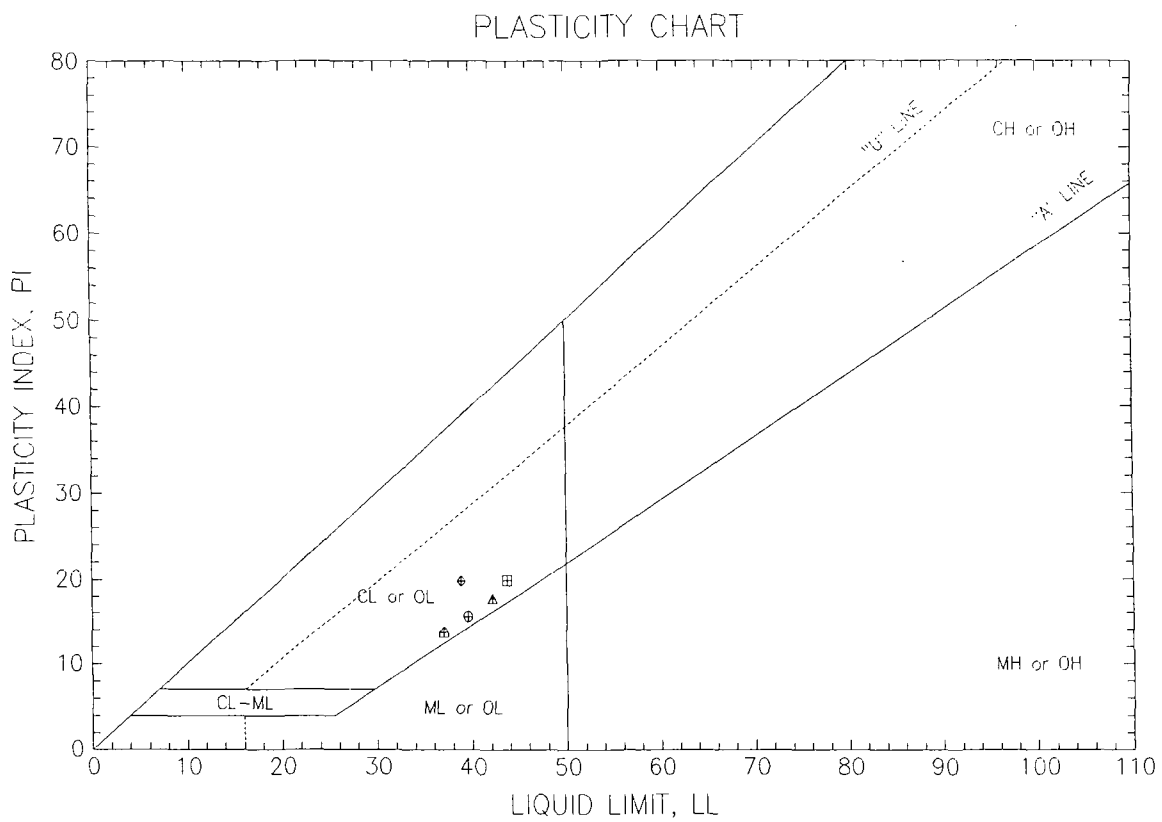
Summary	
Sieve Size	% Passing
3.0"	100.0
1.5"	100.0
3/4"	100.0
3/8"	100.0
#4	100.0
#10	100.0
#20	99.9
#40	99.9
#60	99.9
#100	99.4
#200	81.7

Classification Data

Description		% Total
Gravel	Coarse	0.0
	Fine	0.0
Sand	Coarse	0.0
	Medium	0.1
	Fine	18.2
-200		81.7

Soil Classification: Dark gray silt with fine sand (ML)

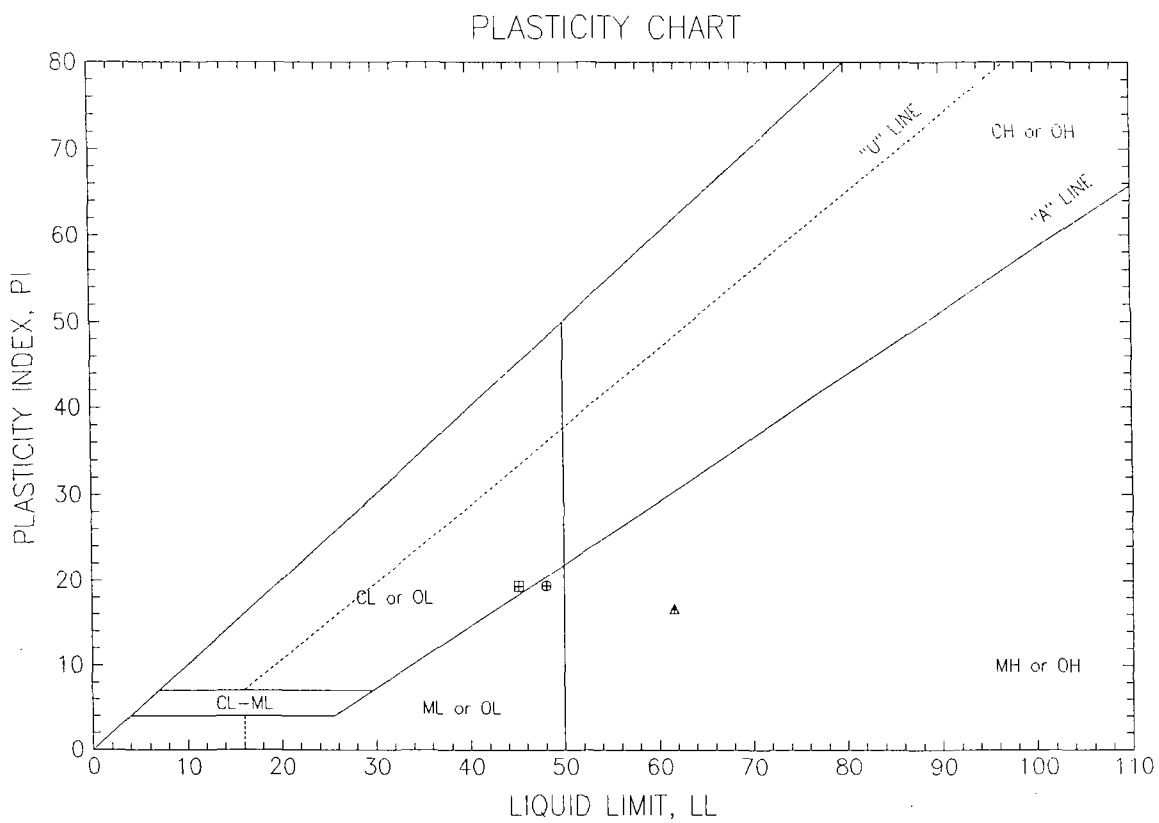
Soil Technology, Inc.	Project : Golder Associates WSDOT 101 MP-326 Project No. : J-1238 Location : Date : Thu May 13 1999



Symbol	Sample Number	Water Content	Liquid Limit	Plastic Limit	Plasticity Index	Soil Classification
○	GA6 S11	27	40	24	16	(CL) lean clay
△	GA6A S7	27	42	24	18	(CL) lean clay
□	GA1 S24	25	44	24	20	(CL) lean clay
◇	GA3 S4	30	39	19	20	(CL) lean clay
⌂	GA9 S8	29	37	23	14	(CL) lean clay

Figure 1

Soil Technology, Inc.	Project : Golder Associates 993-1467 Project No. : J-1239 Location : US 101 Date : Tue Jun 15 1999



Symbol	Sample Number	Water Content	Liquid Limit	Plastic Limit	Plasticity Index	Soil Classification
○	GA4 SS2	31	48	29	19	(ML) silt } MP 326
△	GA4 SS9	11	62	45	17	17 } MP 326
□	GA8 S29	31	45	26	19	(CL) lean clay - MP 322

GA4 SS-9 seived over # 40 seive for atterberg limits

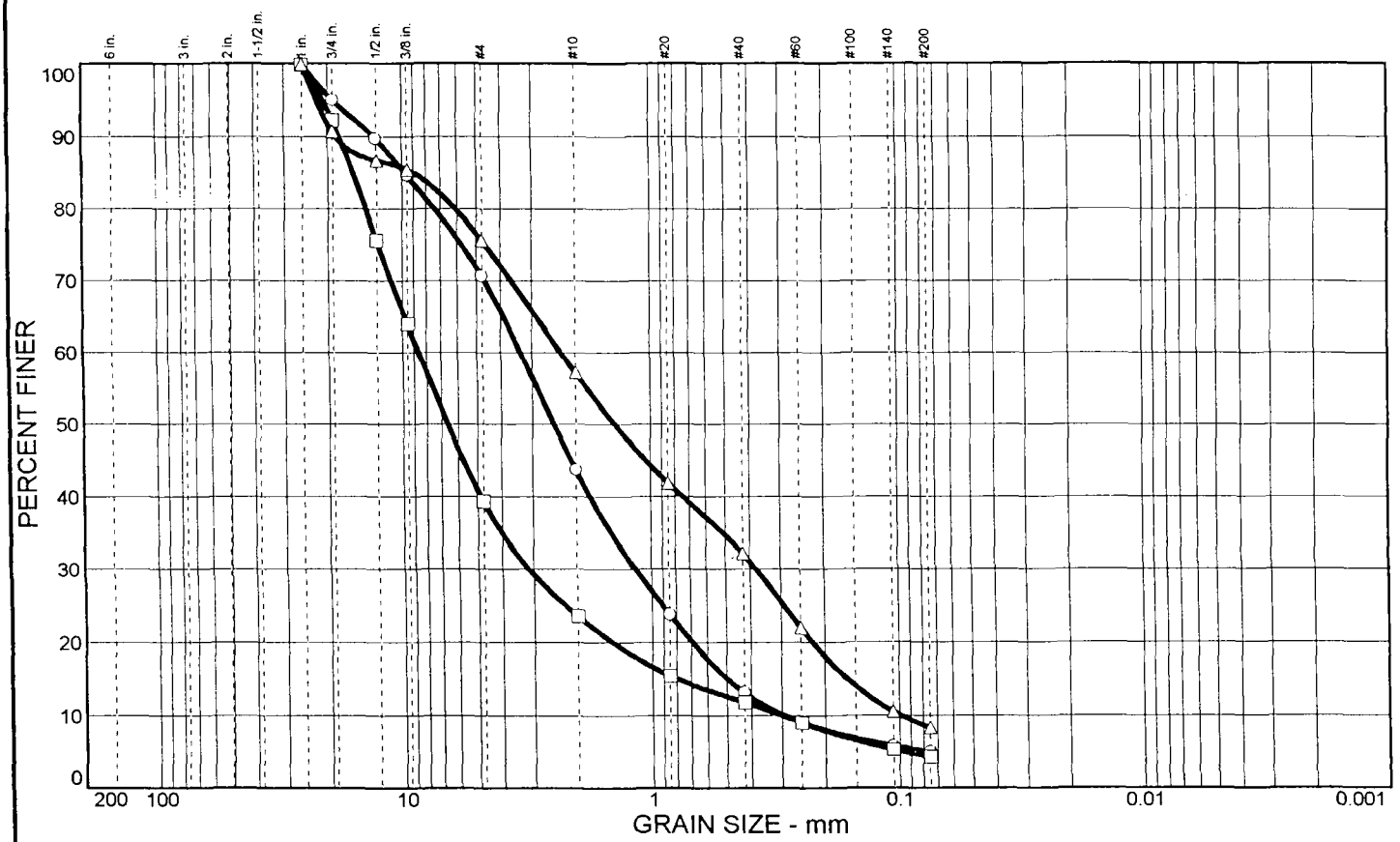
Figure 1

Moisture Contents and Percent Passing 75 micron
Table 1

Exploration Number	Sample Number	Sample Depth (ft)	Moisture Content %	Percent Passing U.S. Sieve No. 200	
GA-4	SS-2	20.0-21.5	31	NR	
GA-4	SS-7	55.0-56.5	13	14	MP
GA-4	SS-9	70.0-71.5	11	9	
GA-4	SS-17	97.0-98.5	NR	38	326
GA-4	SS-30	132.0-132.8	27	43	
GA-4	SS-51	210.0-210.7	25	69	
GA-6A	S-1	63.0-65.0	NR	82	
GA-8	S-6	71.0-72.5	19	4	
GA-8	S-10	91.0-92.5	24	5	MP
GA-8	S-23	156.0-157.5	29	62	322
GA-8	S-29	186.0-187.3	31	NR	

NR not requested.

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		29.4	65.7			SW			
□			35.2			GP			
△		24.4	67.3			SP-SM			

SIEVE inches size	PERCENT FINER ○	□	△
1	100.0	99.9	100.0
.75	95.0	92.2	90.7
.5	89.7	75.6	86.7
.375	84.6	64.0	85.4
	GRAIN SIZE		
D_{60}	3.32	8.60	2.28
D_{30}	1.16	3.12	0.376
D_{10}	0.292	0.301	0.0991
	COEFFICIENTS		
C_c	1.39	3.76	0.63
C_u	11.37	28.54	23.01

SIEVE number size	PERCENT FINER ○	□	△
#4	70.6	39.4	75.6
#10	43.7	23.6	57.2
#20	23.8	15.4	41.9
#40	13.1	11.8	32.2
#60	9.1	9.0	22.0
#140	5.7	5.2	10.5
#200	4.9	4.2	8.3

SOIL DESCRIPTION

○ Well-graded sand with gravel

□ Poorly graded gravel with sand

△ Poorly graded sand with silt and gravel

REMARKS:

○ Classification based on grainsize only.

□ Classification based on grainsize only.

△ Classification based on grainsize only.

○ Source: GA-1	Sample No.: S-10	Elev./Depth: 50.0-51.5
□ Source: GA-2	Sample No.: S-3	Elev./Depth: 15.0-16.5
△ Source: GA-2	Sample No.: S-4	Elev./Depth: 20.0-21.5

SOIL TECHNOLOGY, INC.

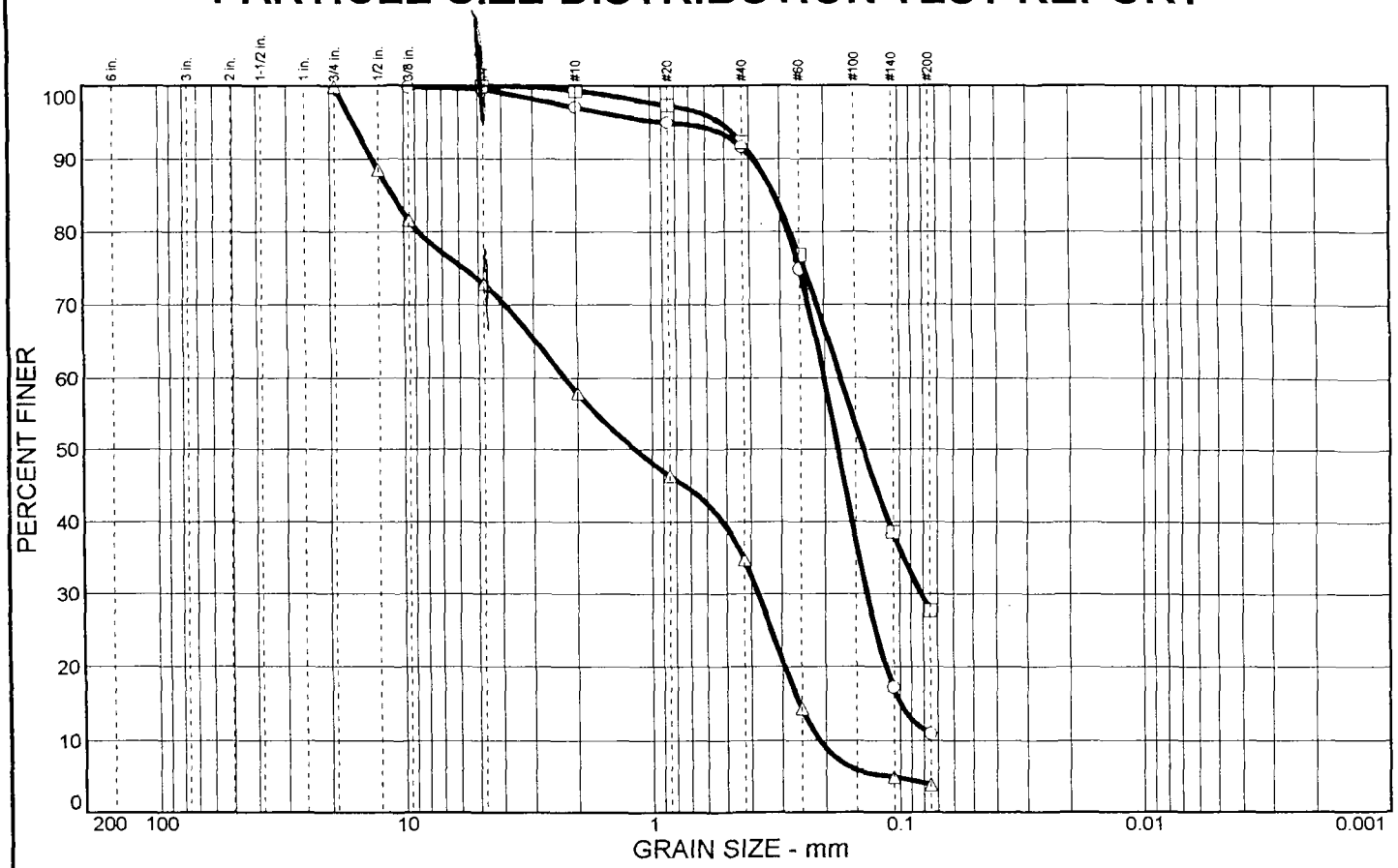
Client: Golder Associates

Project: WSDOT US101 MP326

Project No.: J-1238

Plate 1

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○			88.7			SP-SM			
□			72.3			SM			
△		27.1	69.0			SP			

SIEVE inches size	PERCENT FINER ○	□	△
.75			100.0
.5			88.5
.375	99.8		81.6
GRAIN SIZE			
D_{60}	0.201	0.172	2.25
D_{30}	0.135	0.0812	0.373
D_{10}			0.212
COEFFICIENTS			
C_c			0.29
C_u			10.63

SIEVE number size	PERCENT FINER ○	□	△
#4	99.6	100.0	72.9
#10	97.1	99.4	57.9
#20	95.0	97.4	46.4
#40	91.6	92.3	34.8
#60	74.8	76.8	14.3
#140	17.1	38.6	4.9
#200	10.9	27.7	3.9

SOIL DESCRIPTION

○ Poorly graded sand with silt

□ Silty sand

△ Poorly graded sand with gravel

REMARKS:

○ Classification based on grainsize only.

□ Classification based on grainsize only.

△ Classification based on grainsize only.

○ Source: GA-2 Sample No.: S-9 Elev./Depth: 45.0-46.5

□ Source: GA-3 Sample No.: S-3 Elev./Depth: 16.0-17.5

△ Source: GA-6 Sample No.: S-7 Elev./Depth: 36.0-37.5

SOIL TECHNOLOGY, INC.

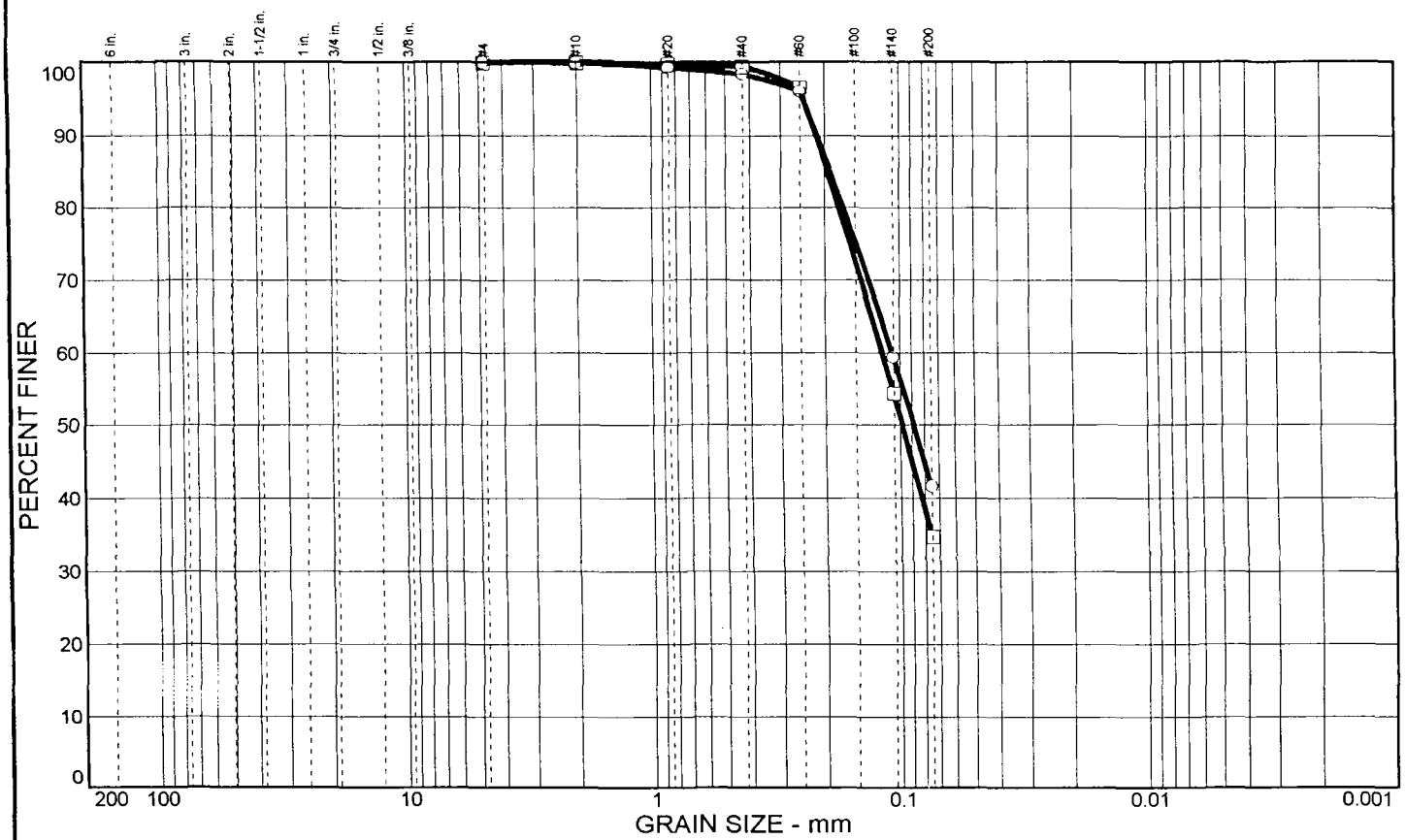
Client: Golder Associates

Project: WSDOT US101 MP326

Project No.: J-1238

Plate 2

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○			58.4			SM			
□			65.2			SM			

SIEVE inches size	PERCENT FINER ○	PERCENT FINER □	
	GRAIN SIZE		
D_{60}	0.107	0.118	
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	PERCENT FINER □	
#4	100.0	100.0	
#10	99.9	100.0	
#20	99.3	99.7	
#40	98.5	99.5	
#60	96.1	96.7	
#140	59.4	54.4	
#200	41.6	34.8	

SOIL DESCRIPTION

○ Silty sand

□ Silty sand

REMARKS:

○ Classification based on grainsize only.

□ Classification based on grainsize only.

○ Source: GA-6A Sample No.: S-3 Elev./Depth: 45.0-46.5

□ Source: GA-9 Sample No.: S-6 Elev./Depth: 26.0-27.5

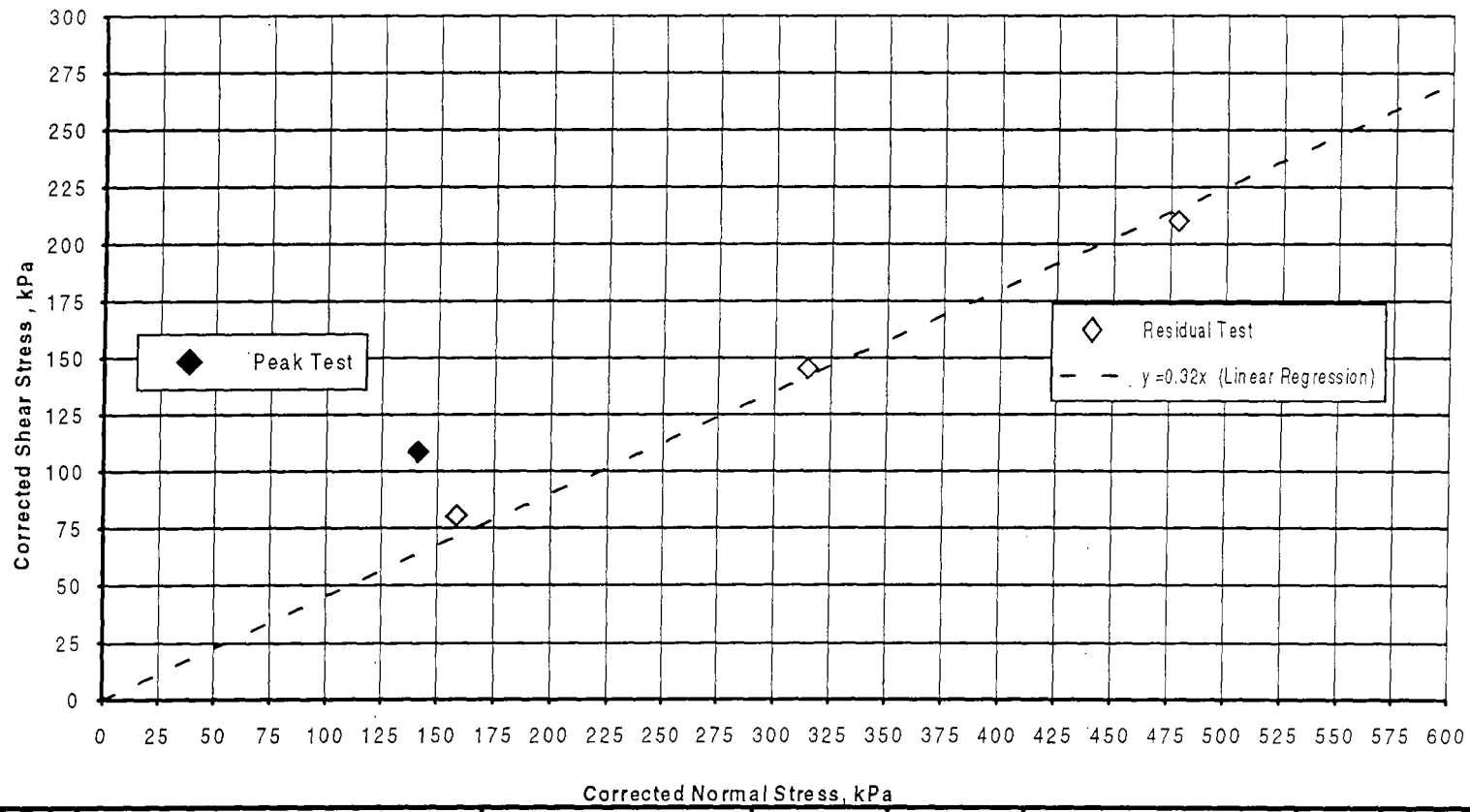
SOIL TECHNOLOGY, INC.

Client: Golder Associates

Project: WSDOT US101 MP326

Project No.: J-1238 Plate 3

Direct Shear Test of Soils Under Consolidated Drained Conditions
ASTM D3080-90



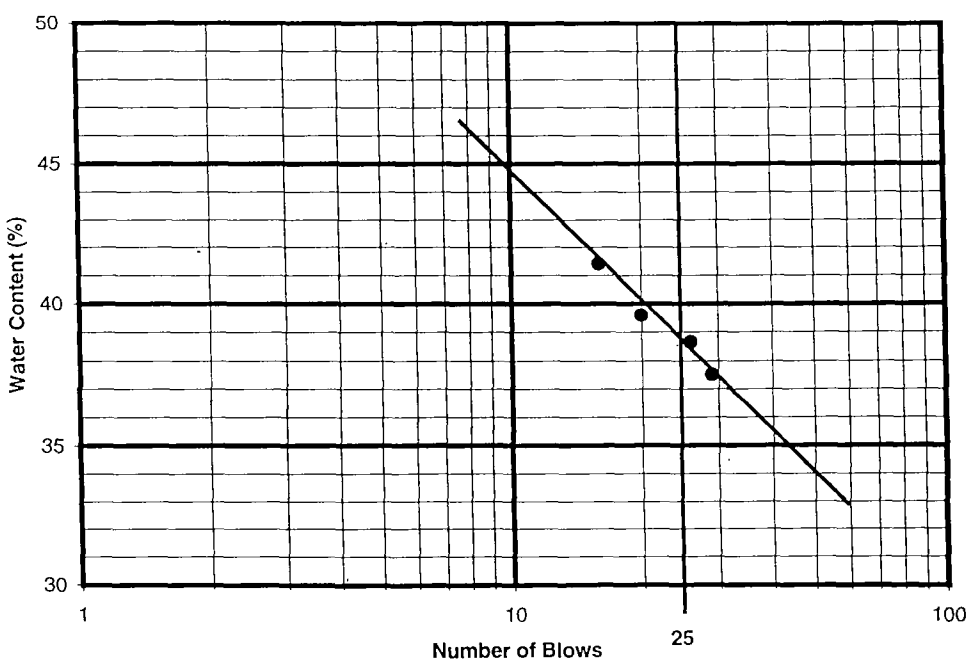
Test No.	Sample Identification			Water Content		γ_{dry}	Feed Rate	Peak Values		Residual Values	
	Borehole	Sample	Depth	$W_{initial}$	W_{final}	@ σ_n'		σ_n'	τ_{max}	σ_n'	τ_{max}
			m	%	%	Kg/M^3	mm/min	kPa	kPa	kPa	kPa
Dtest-1P	GA-9	S-7	31.0-32.7	30.1	n/a	1493	0.0049	141.2	108.6	n/a	n/a
Dtest-1R	GA-9	S-7	31.0-32.7	n/a	n/a	n/a	0.0049	n/a	n/a	158.6	80.4
Dtest-2R	GA-9	S-7	31.0-32.7	n/a	n/a	n/a	0.0049	n/a	n/a	314.7	145.2
Dtest-3R	GA-9	S-7	31.0-32.7	n/a	30.7	n/a	0.0049	n/a	n/a	478.4	210.1

Project # 9931467 Tech : SH

Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D 4318-93

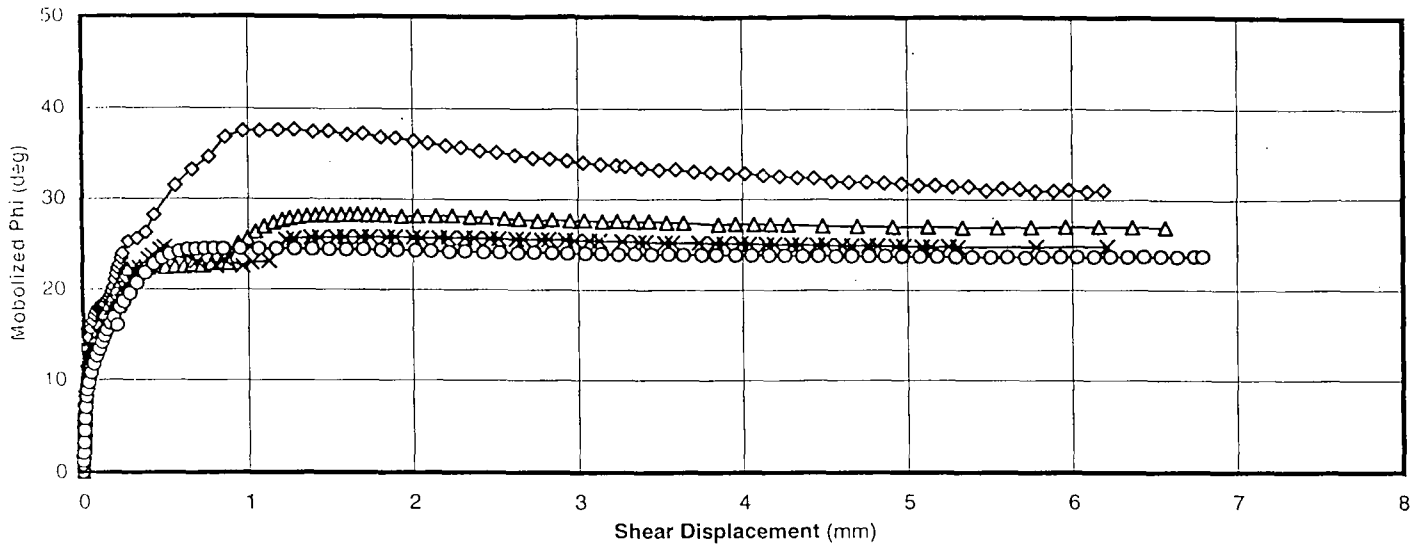
TYPE OF TEST	LL	LL	LL	LL		W% Nat.
CONTAINER NUMBER	106	98	111	180		
NUMBER OF BLOWS	29	26	20	16		
MASS WET SOIL + TARE	22.78	22.56	24.01	31.86		490.70
MASS DRY SOIL + TARE	16.95	16.68	17.62	22.95		426.30
MASS OF WATER	5.83	5.88	6.39	8.91		64.40
MASS OF CONTAINER	1.40	1.46	1.47	1.43		212.30
MASS OF DRY SOIL	15.55	15.22	16.15	21.52		214.0
WATER CONTENT W (%)	37.5	38.6	39.6	41.4		30.1

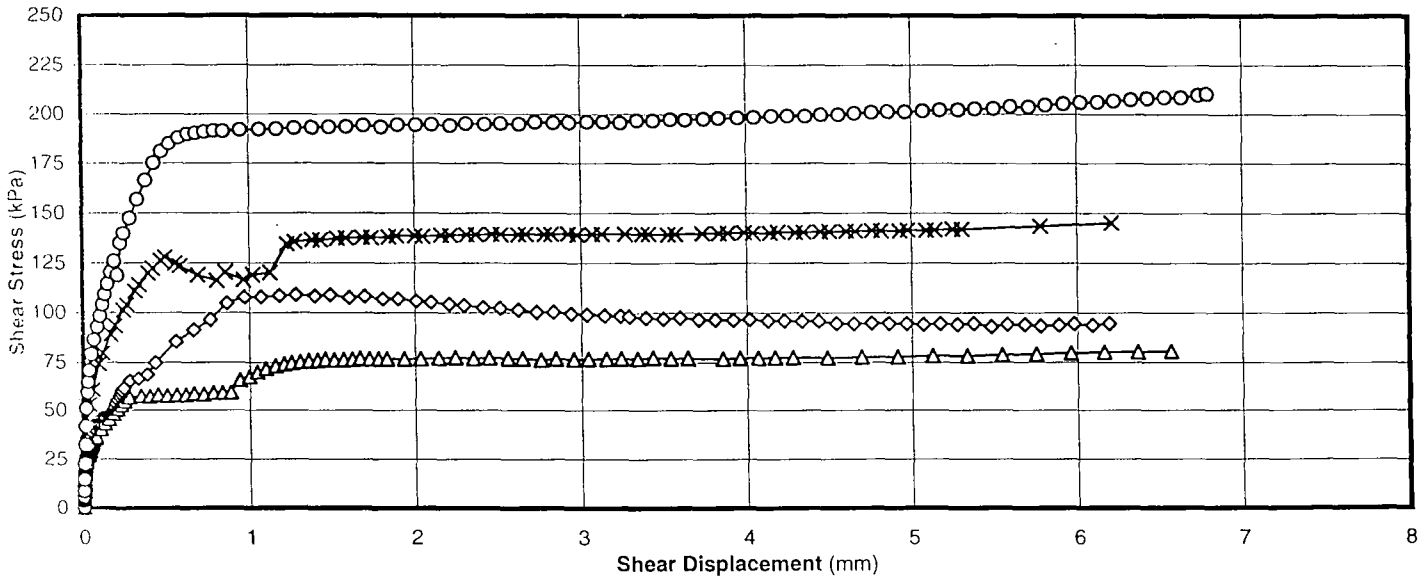
TYPE OF TEST	PL	PL	BOREHOLE NO.	6A-9
CONTAINER NUMBER	141	155	SAMPLE	7
MASS WET SOIL + TARE	11.89	11.08	DEPTH	9.45-9.97m
MASS DRY SOIL + TARE	10.16	9.43	LIQUID LIMIT (%)	38.8
MASS OF WATER	1.75	1.65	PLASTIC LIMIT (%)	20.4
MASS OF CONTAINER	1.46	1.43	PLASTICITY INDEX (%)	18.4
MASS OF DRY SOIL	8.70	8.00	W% Natural (%)	30.1
WATER CONTENT W (%)	20.1	20.6	LIQUIDITY INDEX	0.53

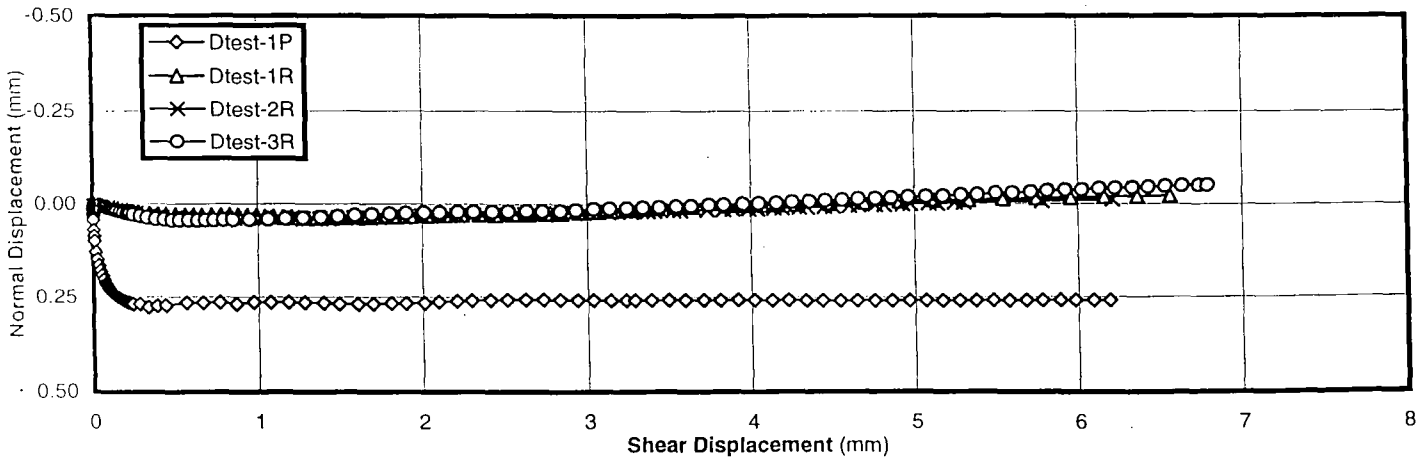


SAMPLE DESCRIPTION : CL

Direct Shear Test of Soils Under Consolidated Drained Condtions
ASTM D3080-90







Project#	993-1467	Sch#	171	Remarks :
Project	Washington Dept. of Transportation	Site-E	GA-9	Consolidated Drained Test
Client	MP 326	Sample	S-7	Undisturbed Sample - Multistage Test
Location	US101 - Hood Canal	Depth	31.0-32.7	

APPENDIX C

SEISMIC REFRACTION SURVEY
WSDOT U.S. 101 MP 326 LANDSLIDE INVESTIGATION, WA

Submitted by:

Golder Associates Inc.
Redmond, Washington

August 26, 1999

993-1467.400
Appendix C.doc

TABLE OF CONTENTS

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1.	INTRODUCTION	1
2.	INSTRUMENTATION AND FIELD PROCEDURES	1
3.	GEOPHYSICAL RESULTS	1
3.1	Data Processing and Interpretation	1
3.2	Results and Discussion	1
4.	LIMITATIONS	2

LIST OF FIGURES

Figure 1 Survey Site Map
Figure 2 Elevation contour map of the top surface of Glaciolacustrine Deposit

ATTACHMENT A

SL1 Interpreted depth section of line SL-1
SL2 Interpreted depth section of line SL-2
SL3 Interpreted depth section of line SL-3
SL4a-d Interpreted depth section of line SL-4 (spread 1-4)
SL4e Interpreted depth section of line SL-4 (spread 5)
SL5 Interpreted depth section of line SL-5
SL6 Interpreted depth section of line SL-7

1. INTRODUCTION

During the period of May 3 to May 12 of 1999, Golder Associates Inc. completed a seismic refraction survey at MP 326 of Highway 101, Washington. This seismic refraction survey was completed in support of Golder Associates' ongoing subsurface drilling investigation of the MP 326 landslide. The purpose of the geophysical survey was to map the top surface of the Glaciolacustrine Deposit (hard clay and silty clay), which is interpreted to correlate with the approximate base of the landslide. Six lines with thirteen spreads in total were completed. The survey line locations are shown in Figure 1.

2. INSTRUMENTATION AND FIELD PROCEDURES

The seismic refraction survey was carried out utilizing a Geometrics 24-channel Strataview, 24 16Hz geophones and two 5 or 20 meter spacing takeout cables. Single stick charges of Kine-Pak Explosives were used for the energy source.

Field procedure consisted of laying out the cables, planting the geophones, and setting up two middle shots, two near-end shots and two off-end shots. Data were collected and saved in digital format and also printed on paper.

WSDOT provided surveying support for horizontal and vertical control of the seismic survey lines the geophone locations.

3. GEOPHYSICAL RESULTS

3.1 Data Processing and Interpretation

The data processing was completed utilizing the generalized reciprocal method.

The first arrivals of the seismic signals were picked, then plotted versus geophone locations for all records for each spread. The parallelism of arrival times from different location shots and total times of reciprocal shots were carefully examined. Then the velocities of all layers and travel times to sub-surfaces of the layers under each geophone were analyzed, and in turn the depths to the sub-surfaces of the layers under each geophone were calculated.

3.2 Results and Discussion

The interpreted depth sections of SL-1 through SL-7 are presented in drawings SL1 through SL7, respectively in Appendix A. Four layers are interpreted. The interpreted velocity of the surficial layer varies from 250 m/s (819 ft/s) on SL-3 to 330 m/s (1082ft/s) on SL-1. The second layer exhibited velocities varying from 550 m/s (1803 ft/s) to 700 m/s (2525 ft/s) and is interpreted to correlate with dry Glaciofluvial Deposit (dense sand and gravel). The underlying layer with velocities ranging from 1250 m/s (4100 ft/s) to 1450

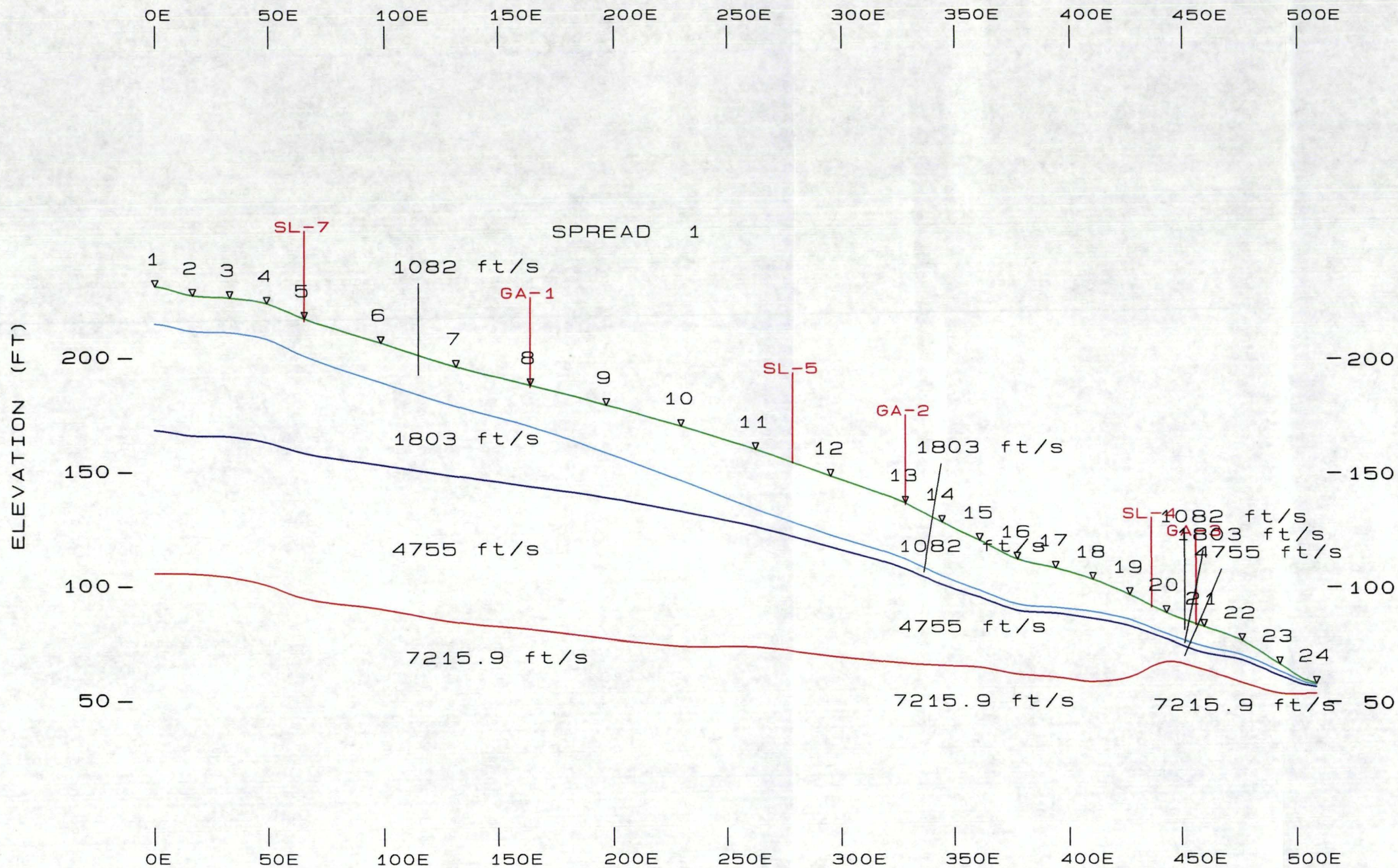
m/s (4756 ft/s) is interpreted to correlate with wet to saturated Glaciofluvial Deposit in this area. The basal layer with a velocity about 2200 m/s (7216 ft/s) is interpreted to correlate with Glaciolacustrine Deposit (hard clay to silty clay). The thickness of the total overburden varies from less than 1 m (3.28 ft) in the east to about 73 m (240 ft) in the west. The water table changed daily during the survey.

The elevation contour of the top surface of the basal layer is shown in Figure 2. In general, the surface dips eastward with two major depressions, one is located near SL-2 and one near SL-3.

4. LIMITATIONS

The geophysical information in this report is based on geophysical measurements obtained by generally accepted methods and procedures and our interpretation of the data. Individual values may in some instances, be erroneous due to noise occurring simultaneously with the measurements. Given the consistency of the data, however, the survey results are considered to be a reasonably accurate representation of the measured geophysical parameters at the site. In general, the errors in the interpreted depths related to the resolution of the technique is about ±15 % of the true depths.

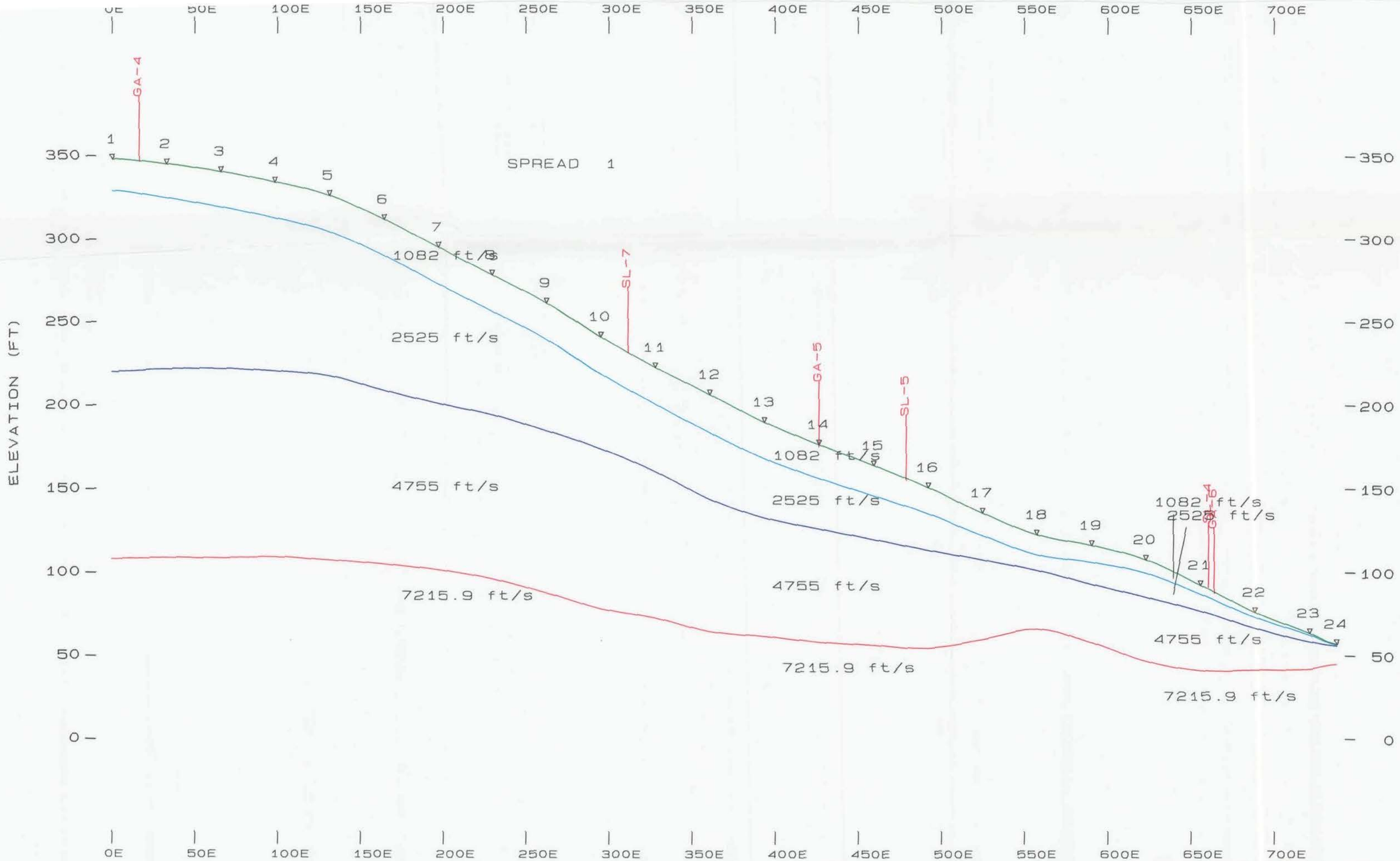
For Golder Associates Inc.



NOTES:
VERTICAL SCALE: 1 in = 50 ft
HORIZONTAL SCALE: 1 in = 50 ft
INSTRUMENT: GEOMETRICS STRATAVIEW

SEISMIC LINE WSDOT/MP326 SL1

LANDSLIDE GEOPHYSICAL INVESTIGATION WSDOT/MP326/WA: 993-1467
SEISMIC REFRACTION SURVEY
INTERPRETED DEPTH SECTION
GOLDER ASSOCIATES INC.
DATE: MAY 1999 | | SL1



NOTES:
VERTICAL SCALE: 1 in = 50 ft
HORIZONTAL SCALE: 1 in = 50 ft
INSTRUMENT: GEOMETRICS STRATAVIEW

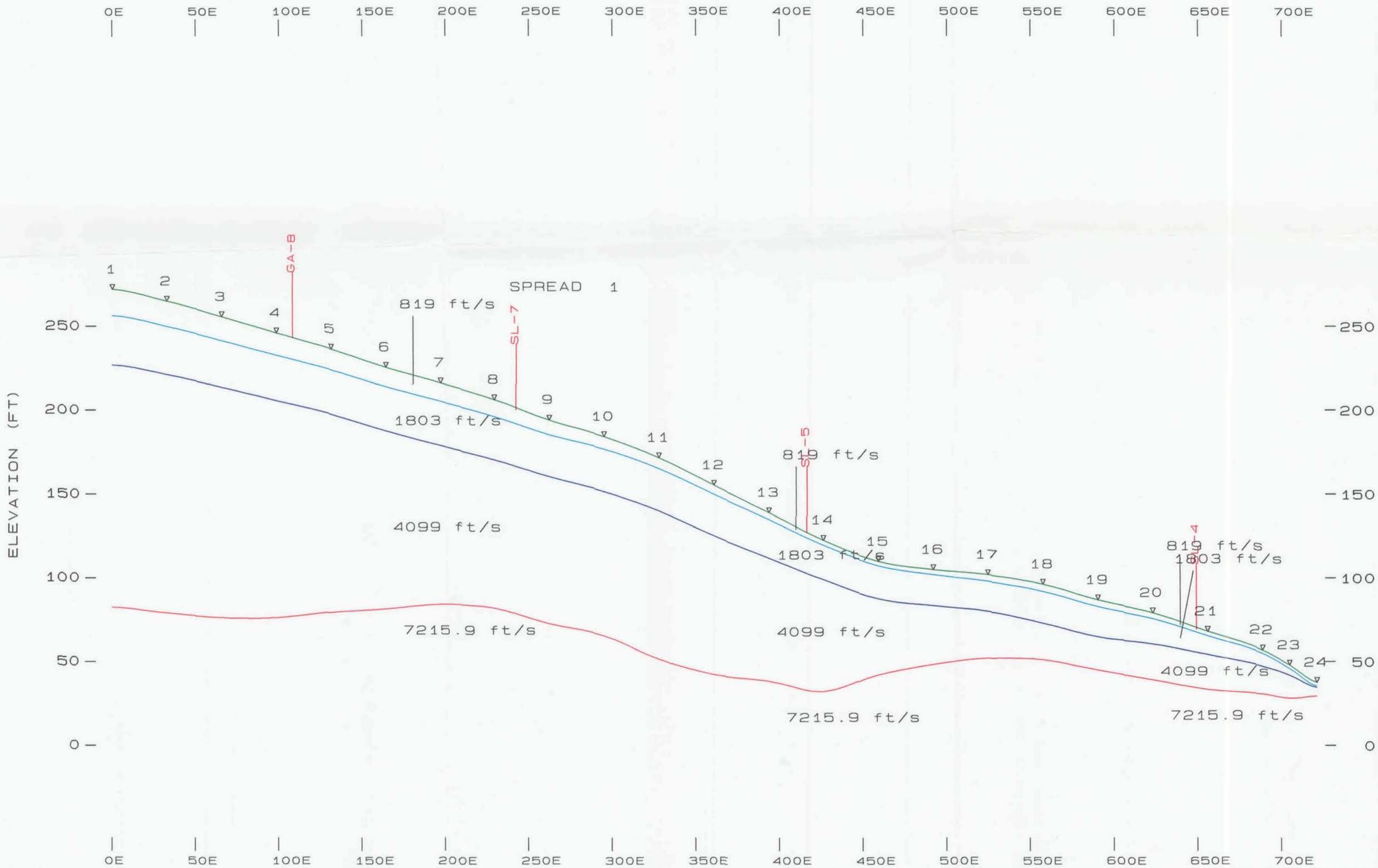
LANDSLIDE GEOPHYSICAL INVESTIGATION
WSDOT/MP326/WA: 993-1467

SEISMIC REFRACTION SURVEY

INTERPRETED DEPTH SECTION

GOLDER ASSOCIATES INC.

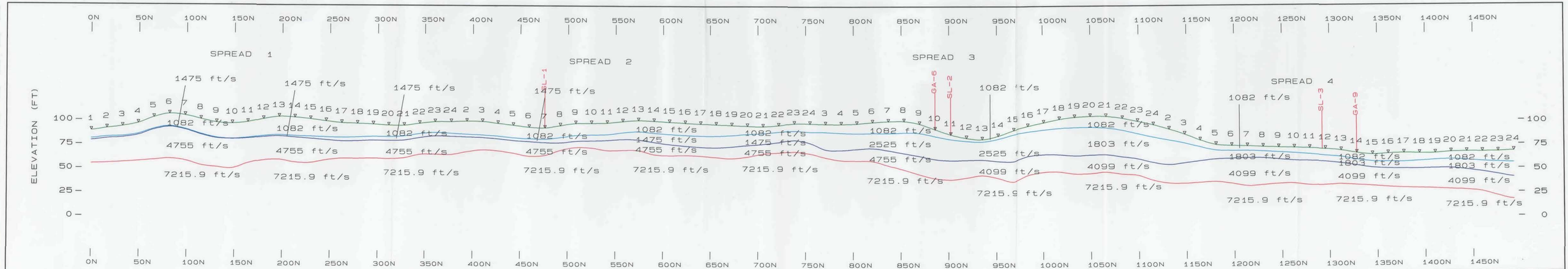
SEISMIC LINE WSDOT/MP326 SL-2



NOTES:
VERTICAL SCALE: 1 in = 50 ft
HORIZONTAL SCALE: 1 in = 50 ft
INSTRUMENT: GEOMETRICS STRATAVIEW

SEISMIC LINE WSDOT/MP326 SL-3

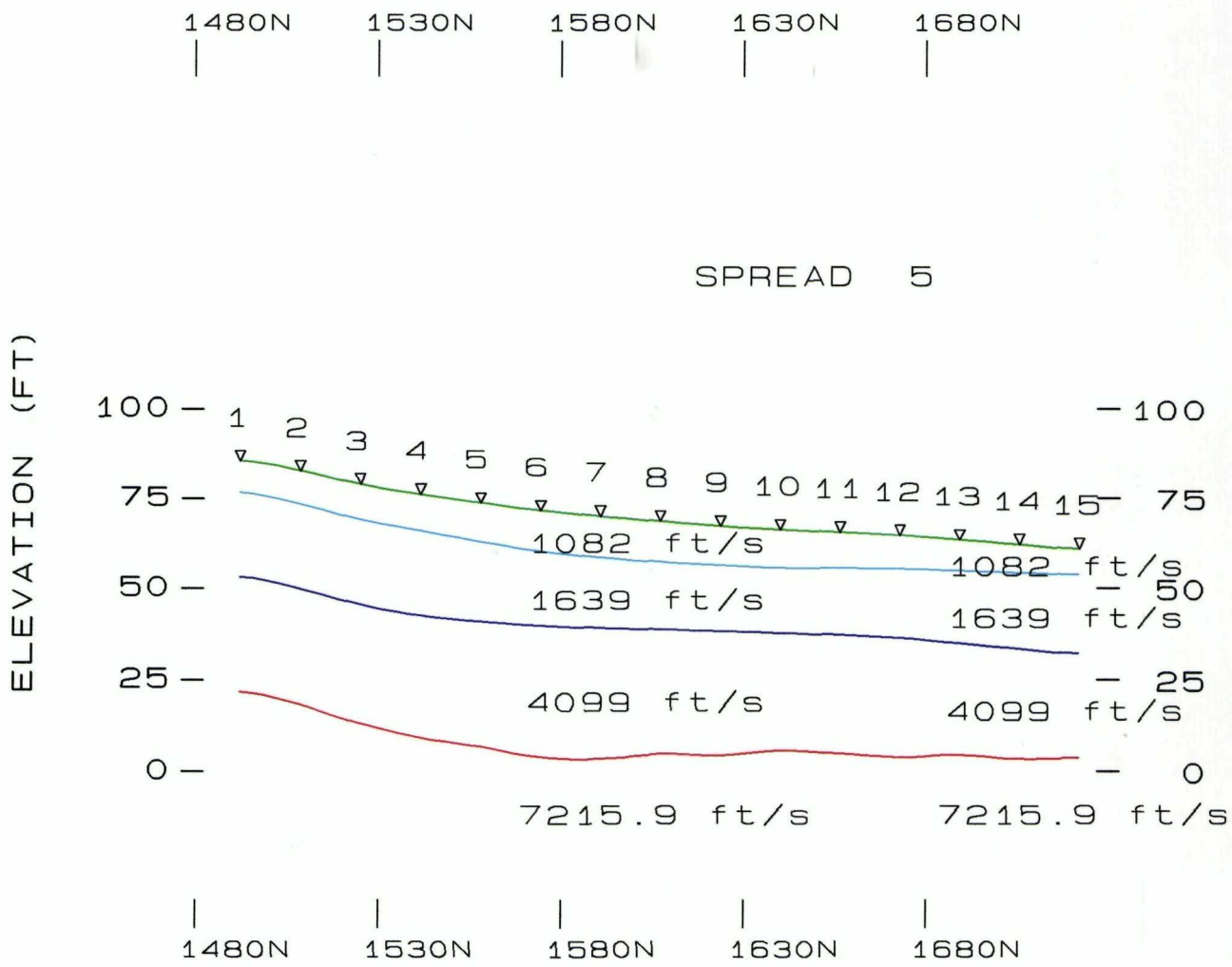
LANDSLIDE GEOPHYSICAL INVESTIGATION WSDOT/MP326/WA: 993-1467
SEISMIC REFRACTION SURVEY
INTERPRETED DEPTH SECTION
GOLDER ASSOCIATES INC.
DATE: MAY 1999 | | SL3



SEISMIC LINE WSDOT/MP326 SL-4

NOTES:
VERTICAL SCALE: 1 in = 50 ft
HORIZONTAL SCALE: 1 in = 50 ft
INSTRUMENT: GEOMETRICS STRATAVIEW

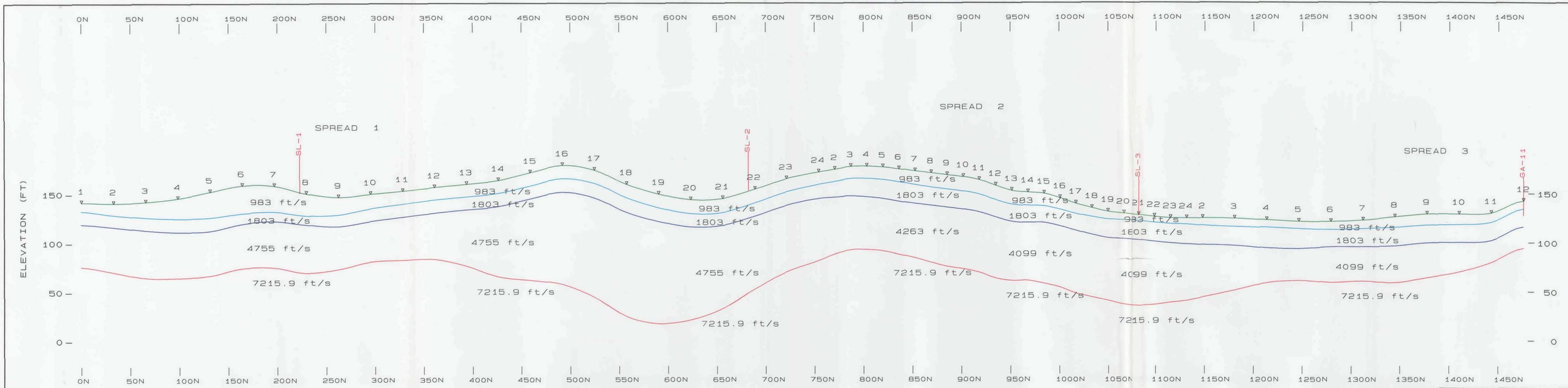
LANDSLIDE GEOPHYSICAL INVESTIGATION WSDOT/MP326/WA: 993-1467
SEISMIC REFRACTION SURVEY
INTERPRETED DEPTH SECTION
GOLDER ASSOCIATES INC.
DATE: MAY 1999 | SL4a-d



NOTES:
VERTICAL SCALE: 1 in = 50 ft
HORIZONTAL SCALE: 1 in = 50 ft
INSTRUMENT: GEOMETRICS STRATAVIEW

SEISMIC LINE WSDOT/MP326 SL-4

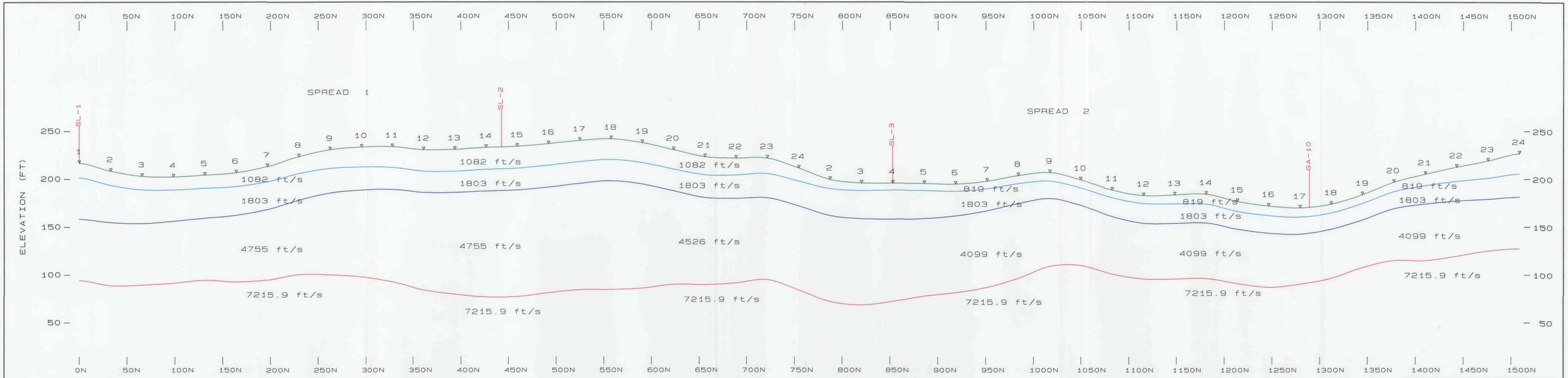
LANDSLIDE GEOPHYSICAL INVESTIGATION WSDOT/MP326/WA: 993-1467
SEISMIC REFRACTION SURVEY
INTERPRETED DEPTH SECTION
GOLDER ASSOCIATES INC.
DATE: MAY 1999 | | SL4e



SEISMIC LINE WSDOT/MP326 SL-5

NOTES:
VERTICAL SCALE: 1 in = 50 ft
HORIZONTAL SCALE: 1 in = 50 ft
INSTRUMENT: GEOMETRICS STRATAVIEW

LANDSLIDE GEOPHYSICAL INVESTIGATION WSDOT/MP326/WA: 993-1467
SEISMIC REFRACTION SURVEY
INTERPRETED DEPTH SECTION
GOLDER ASSOCIATES INC.
DATE: MAY 1999 SL-5

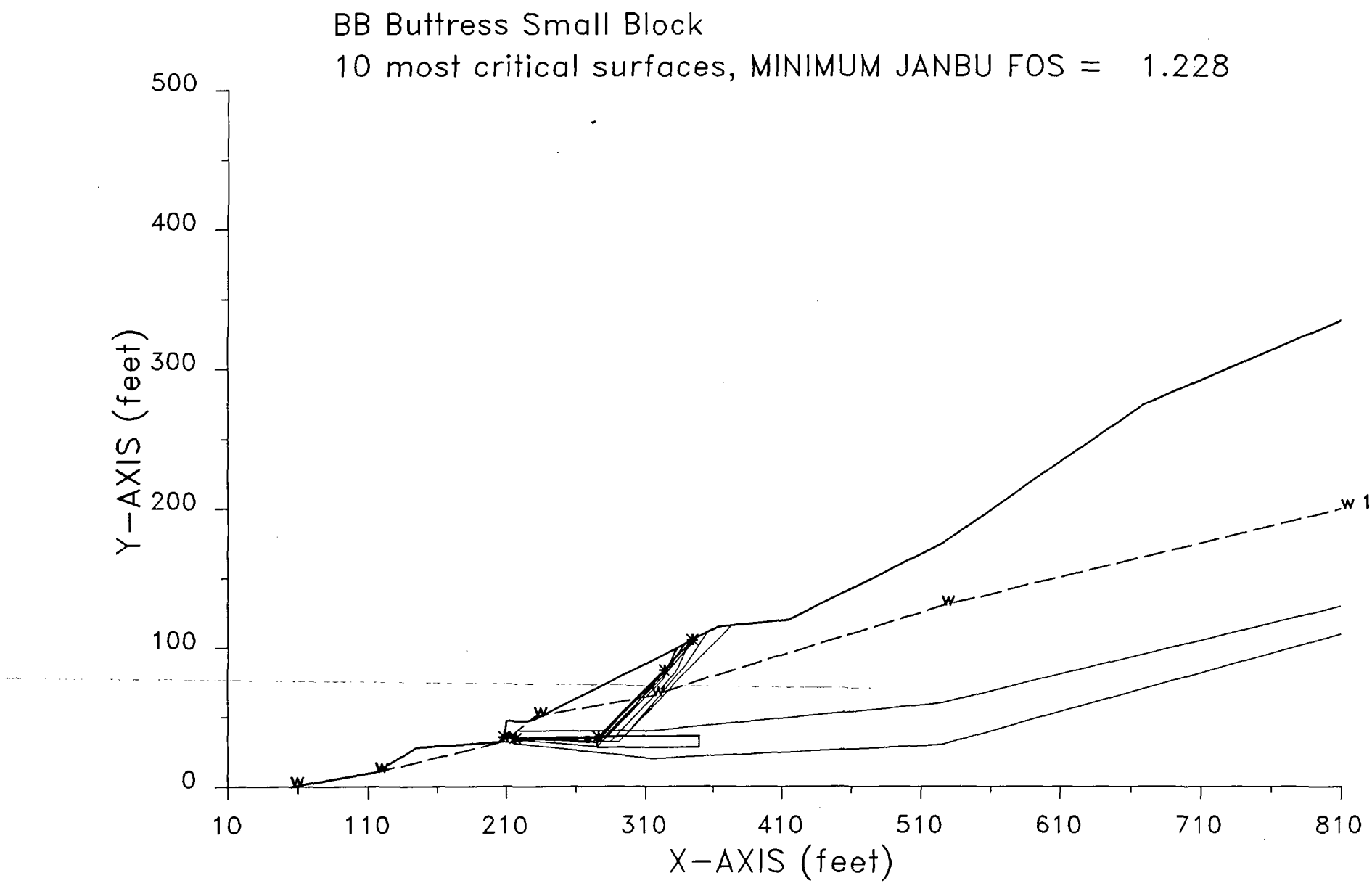


SEISMIC LINE WSDOT/MP326 SL-7

NOTES:
VERTICAL SCALE: 1 in = 50 ft
HORIZONTAL SCALE: 1 in = 50 ft
INSTRUMENT: GEOMETRICS STRATAVIEW

LANDSLIDE GEOPHYSICAL INVESTIGATION WSDOT/MP326/WA: 993-1467
SEISMIC REFRACTION SURVEY
INTERPRETED DEPTH SECTION
GOLDER ASSOCIATES INC.
DATE: MAY 1999 — SL7

BB1BUT 8-25-99 12:19



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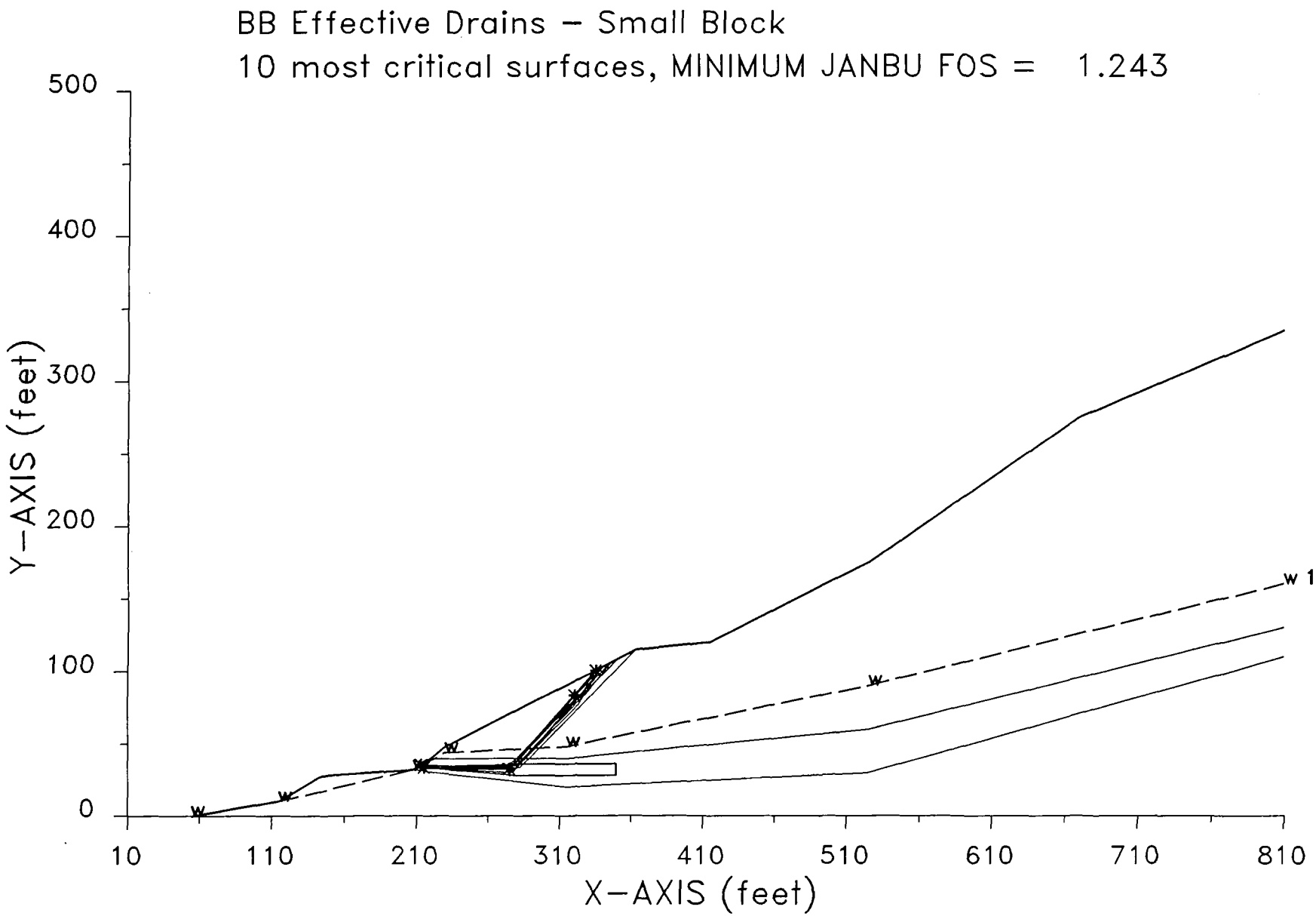

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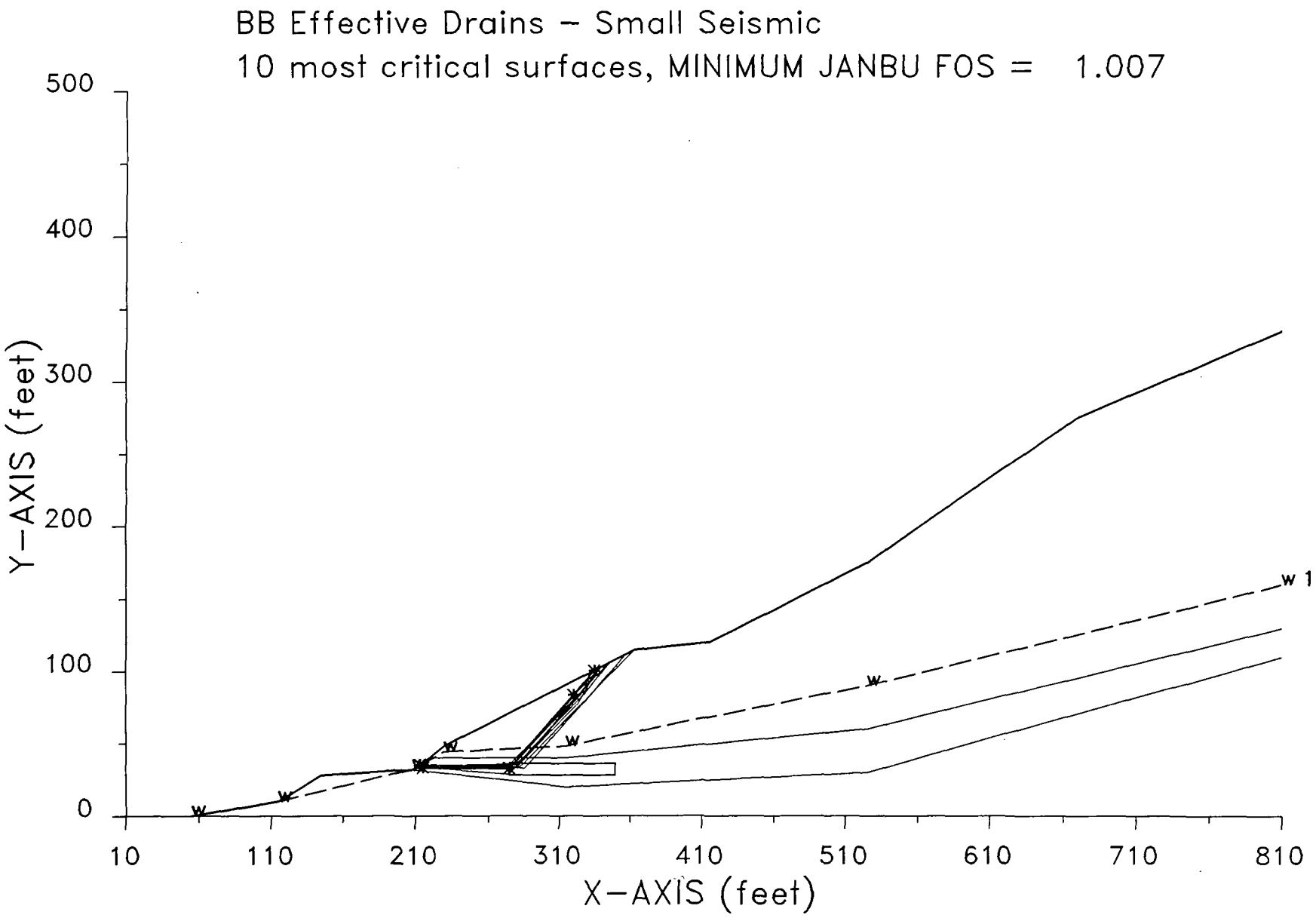

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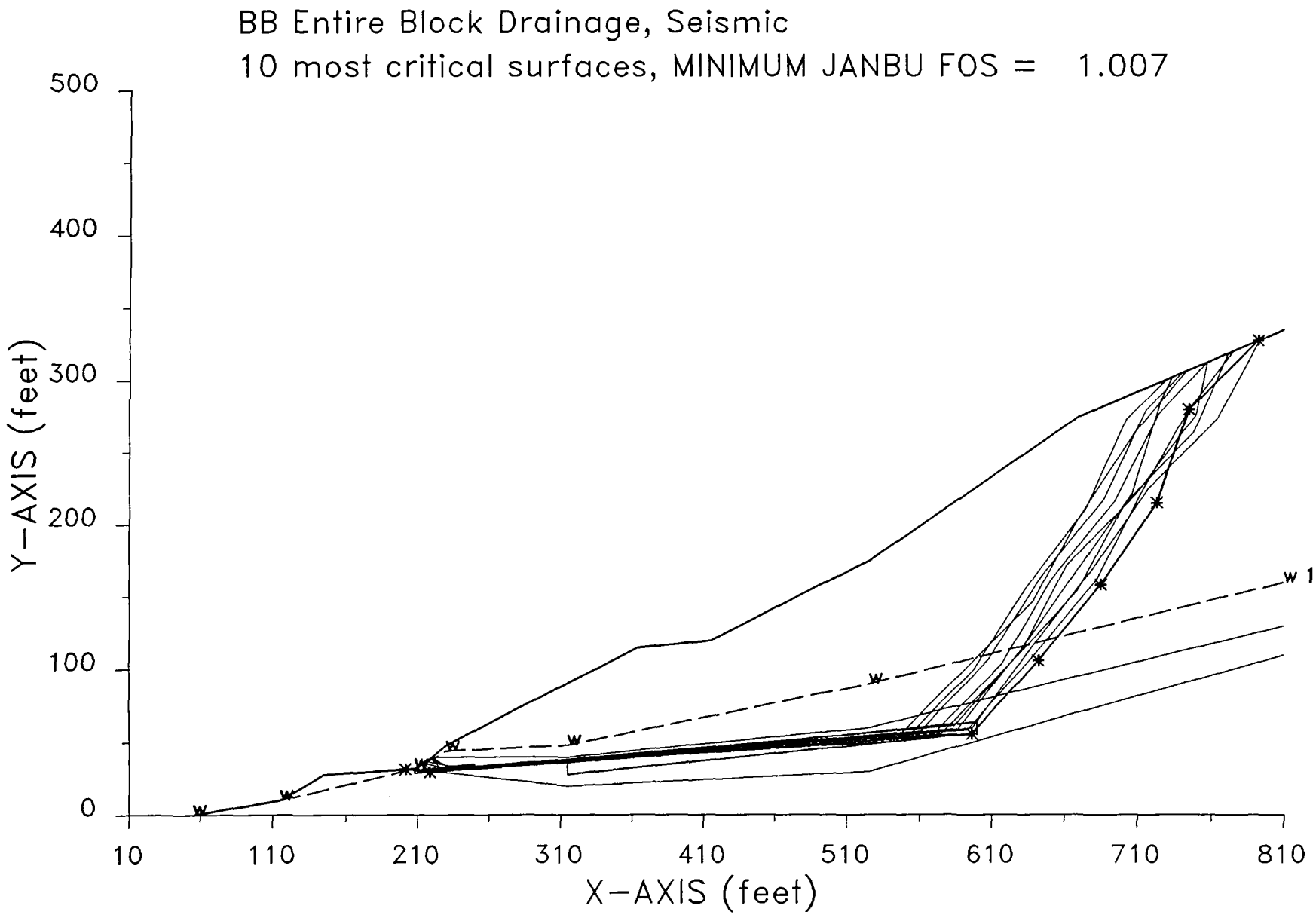

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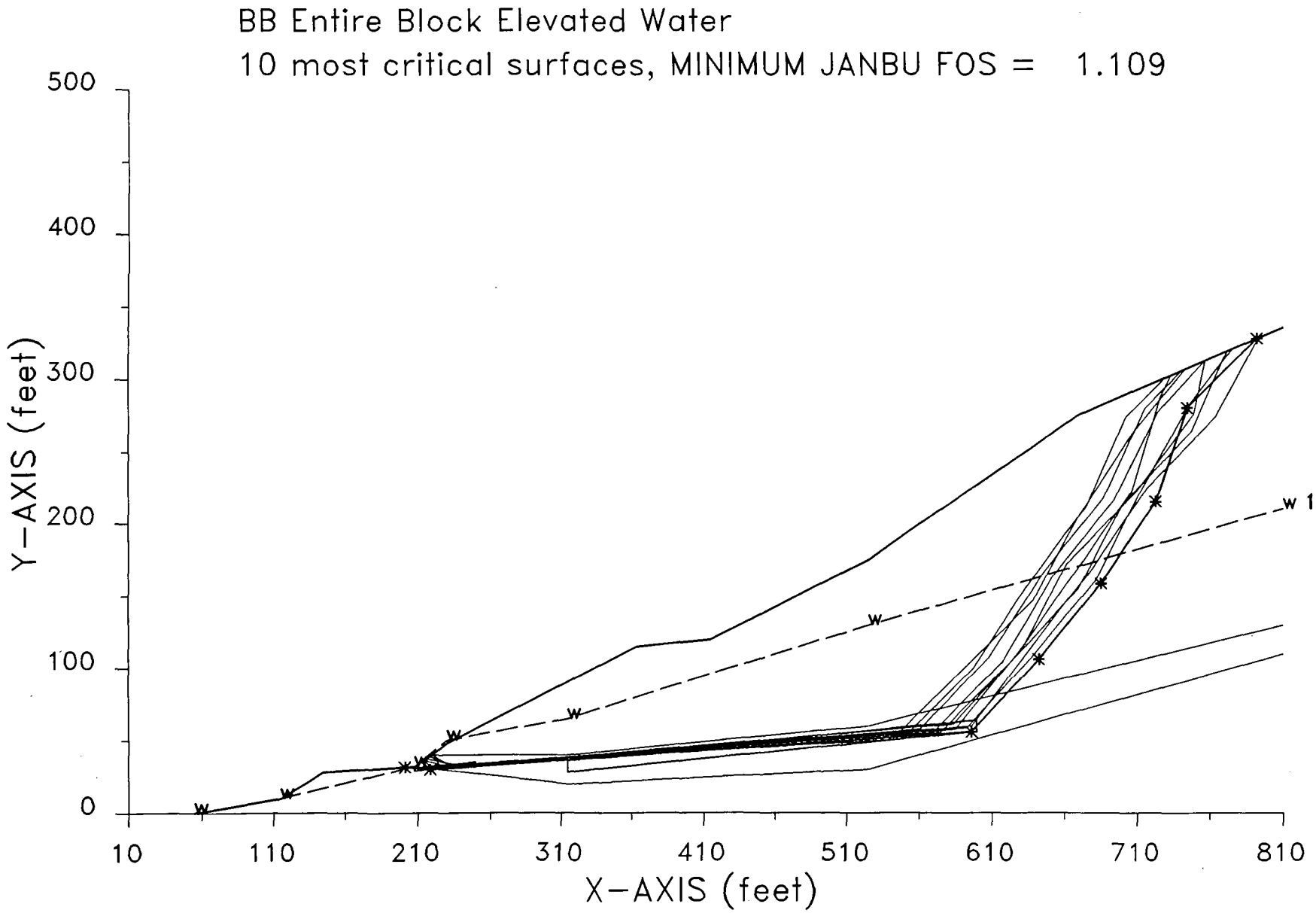

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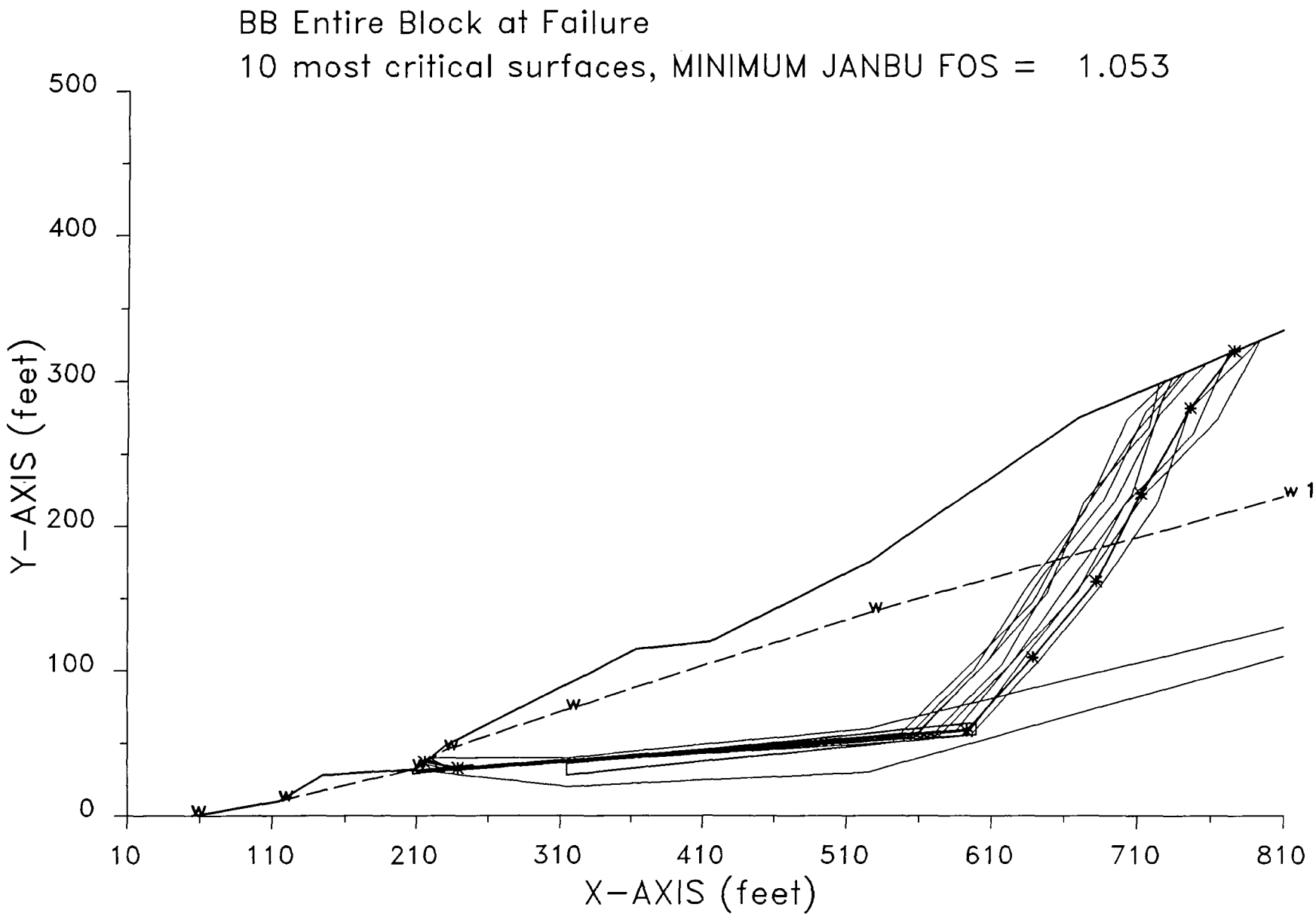

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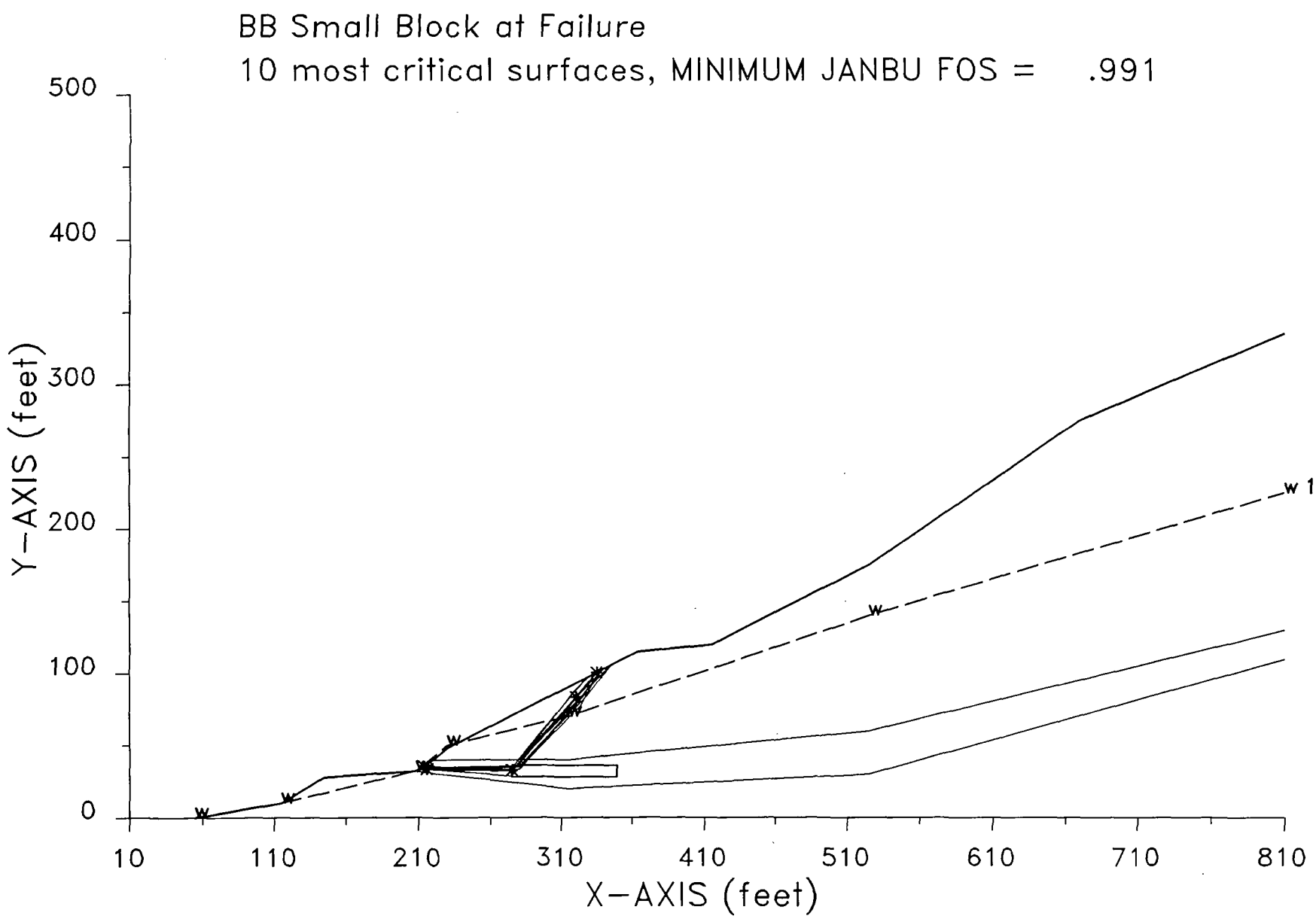

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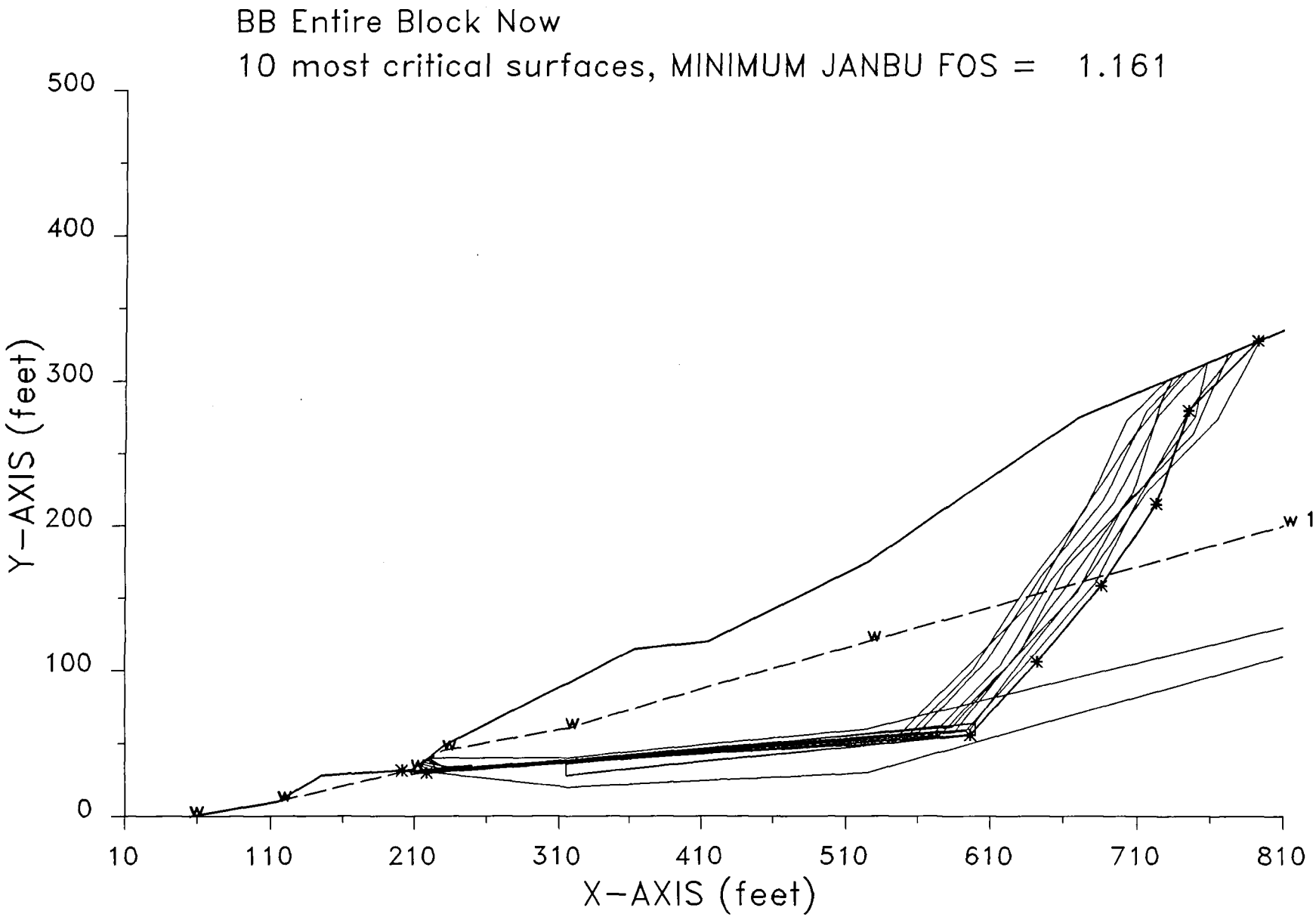

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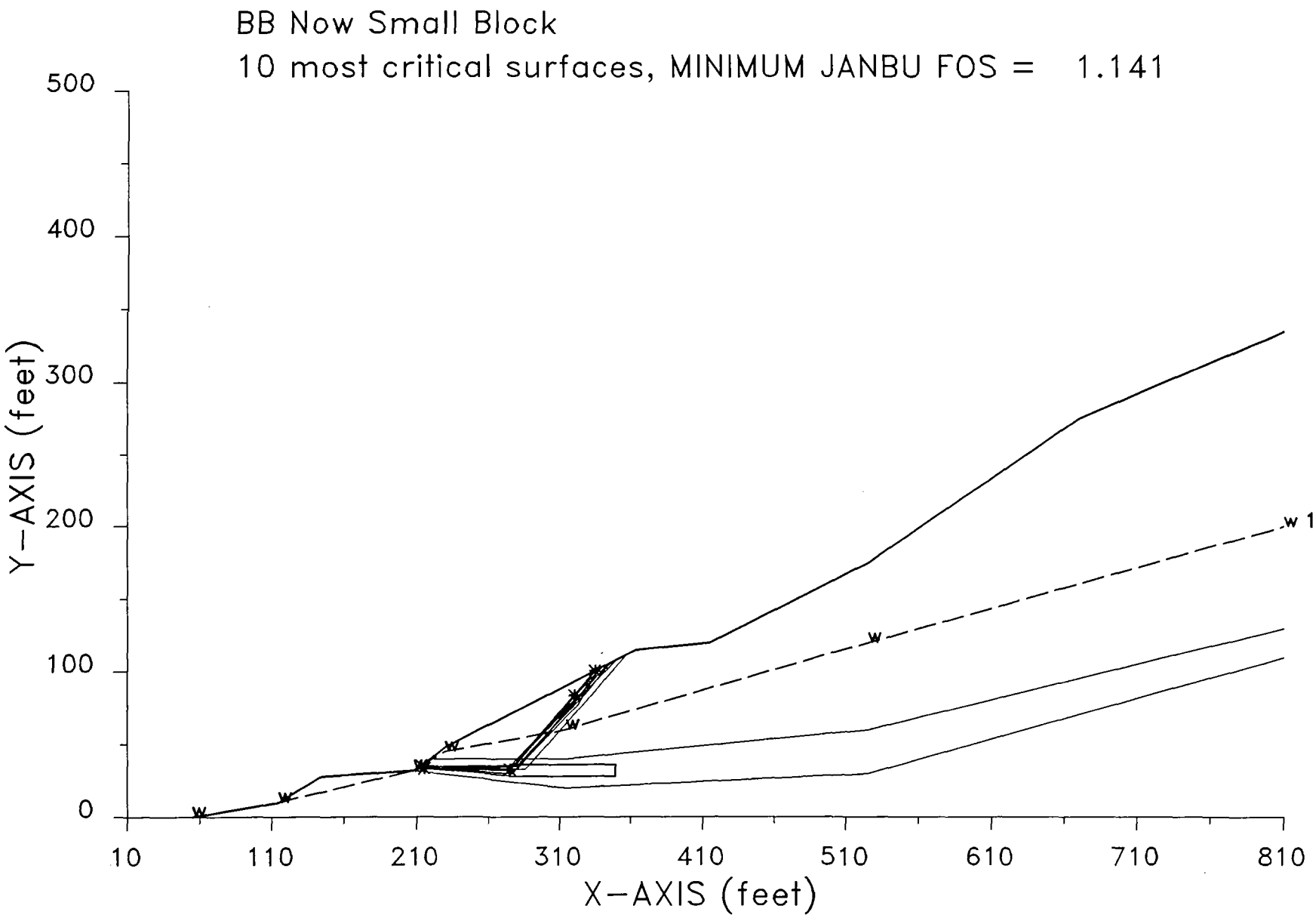

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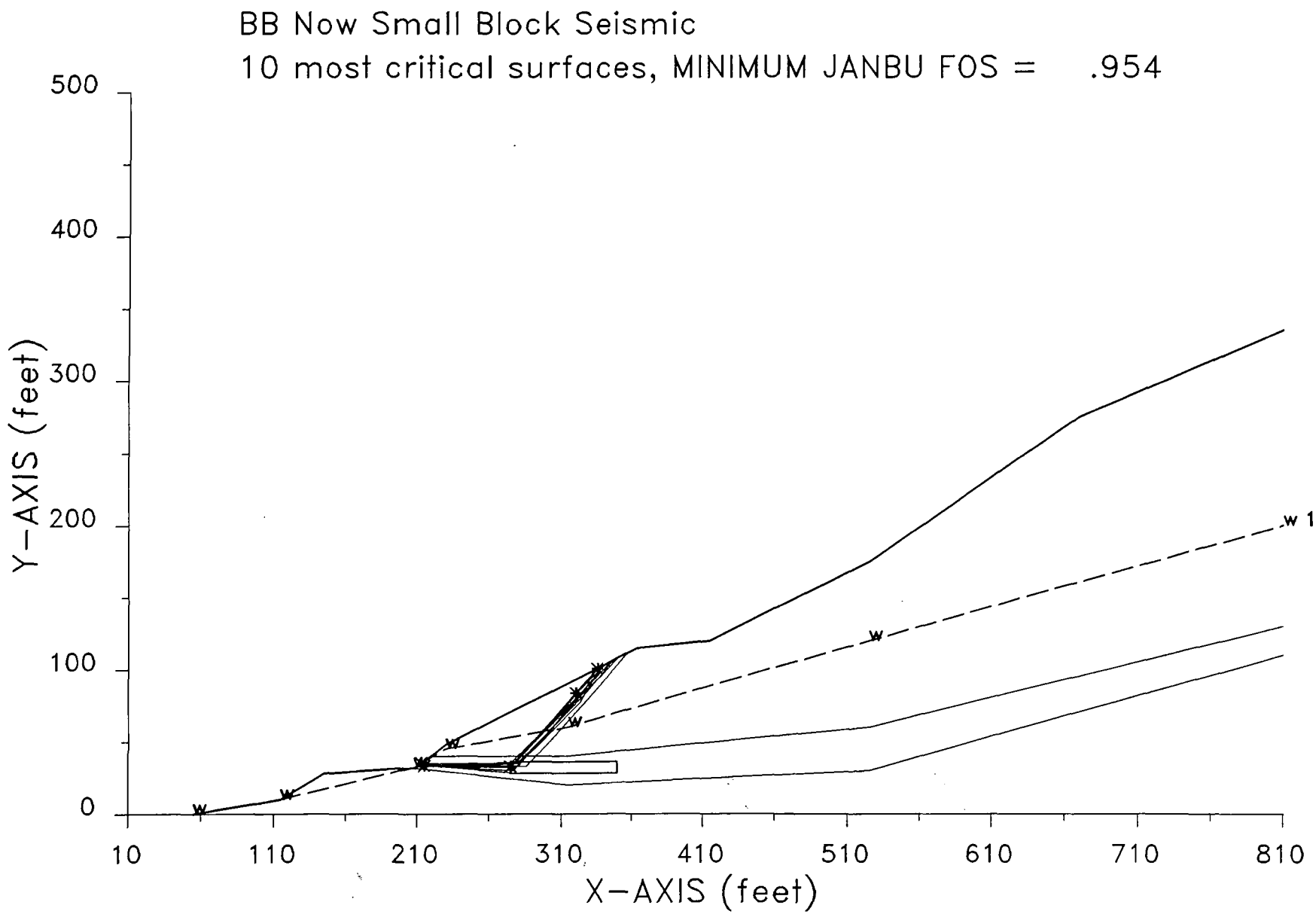

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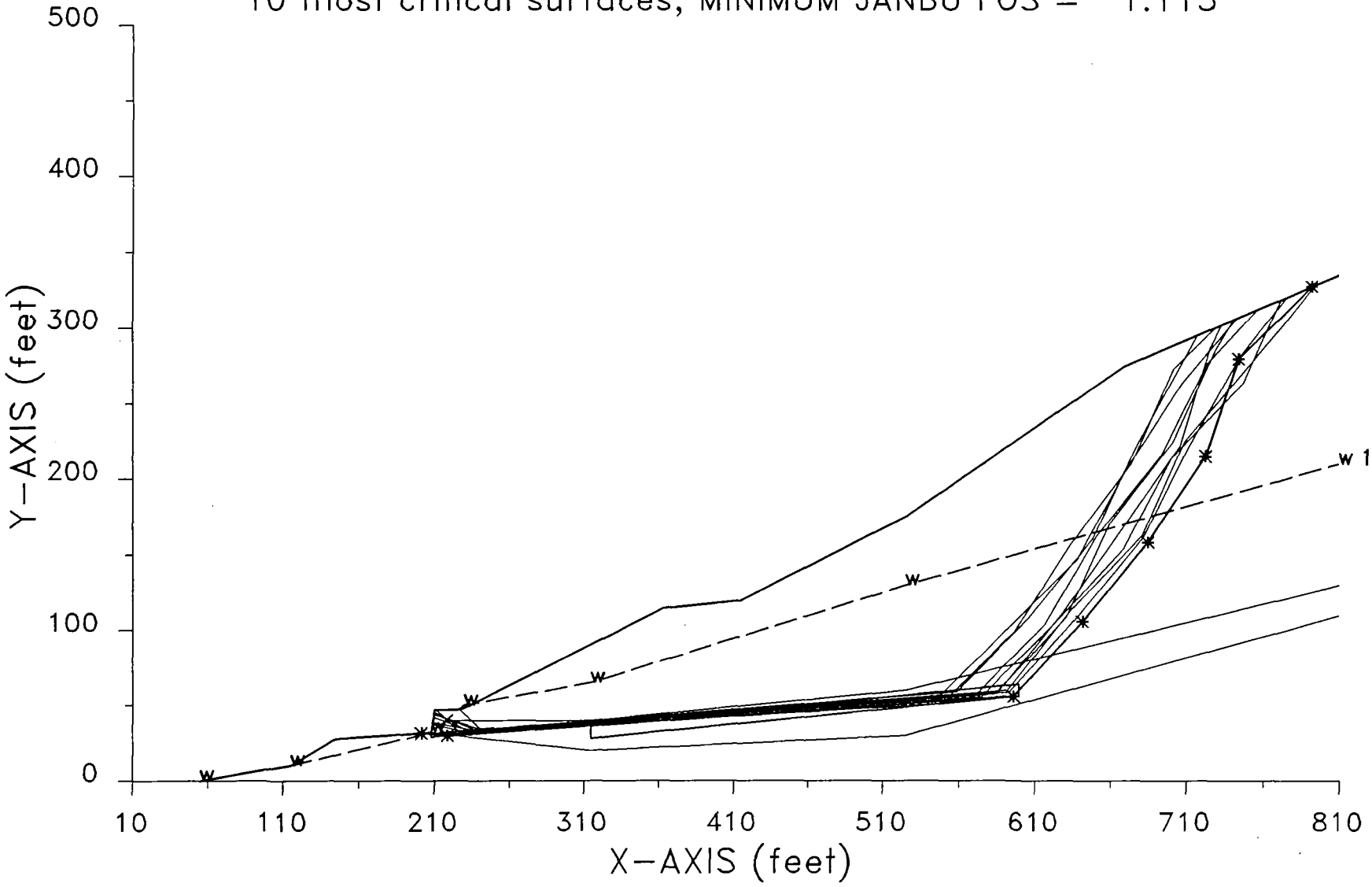
BB Entire Block Buttress

10 most critical surfaces, MINIMUM JANBU FOS = 1.115



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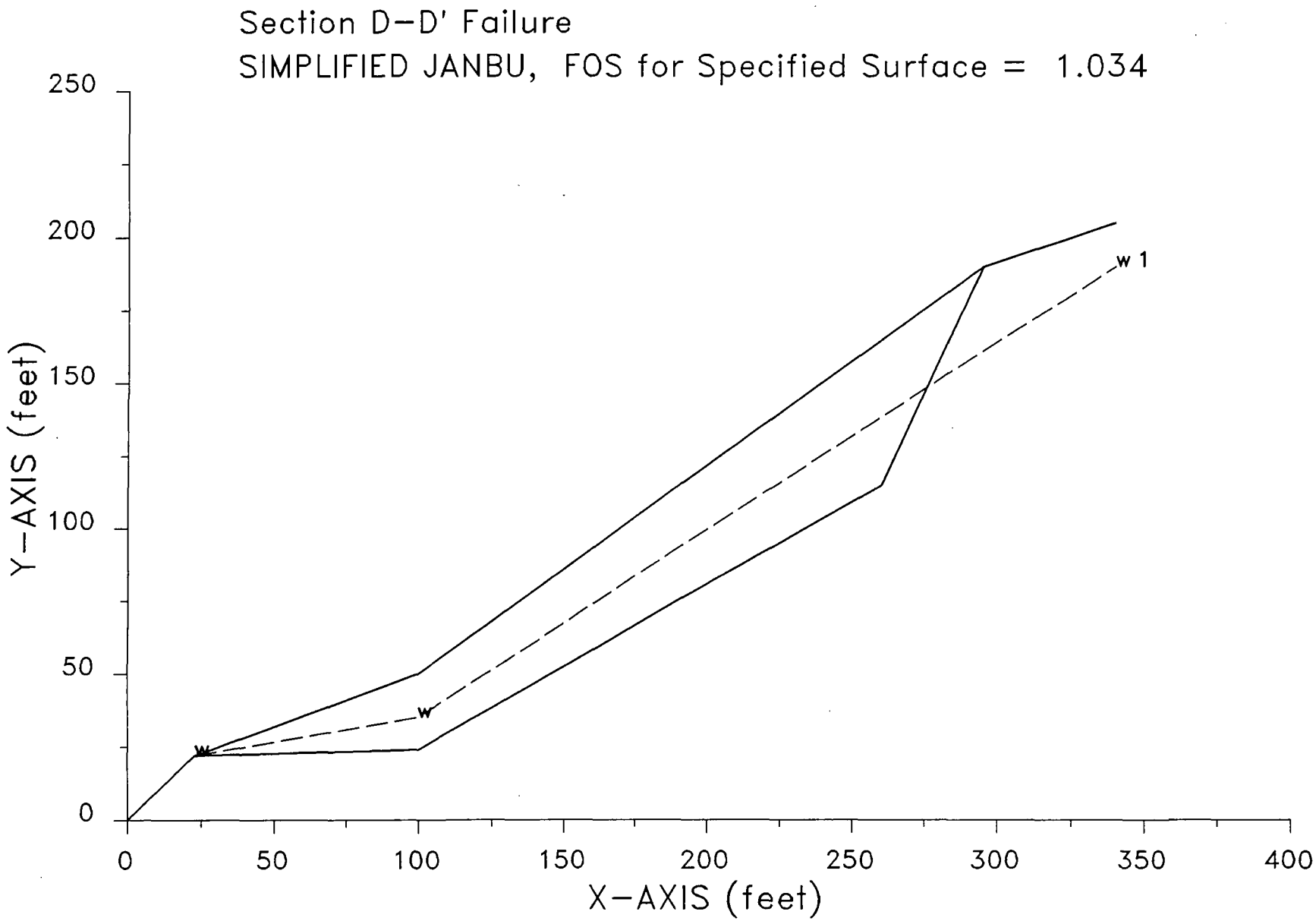
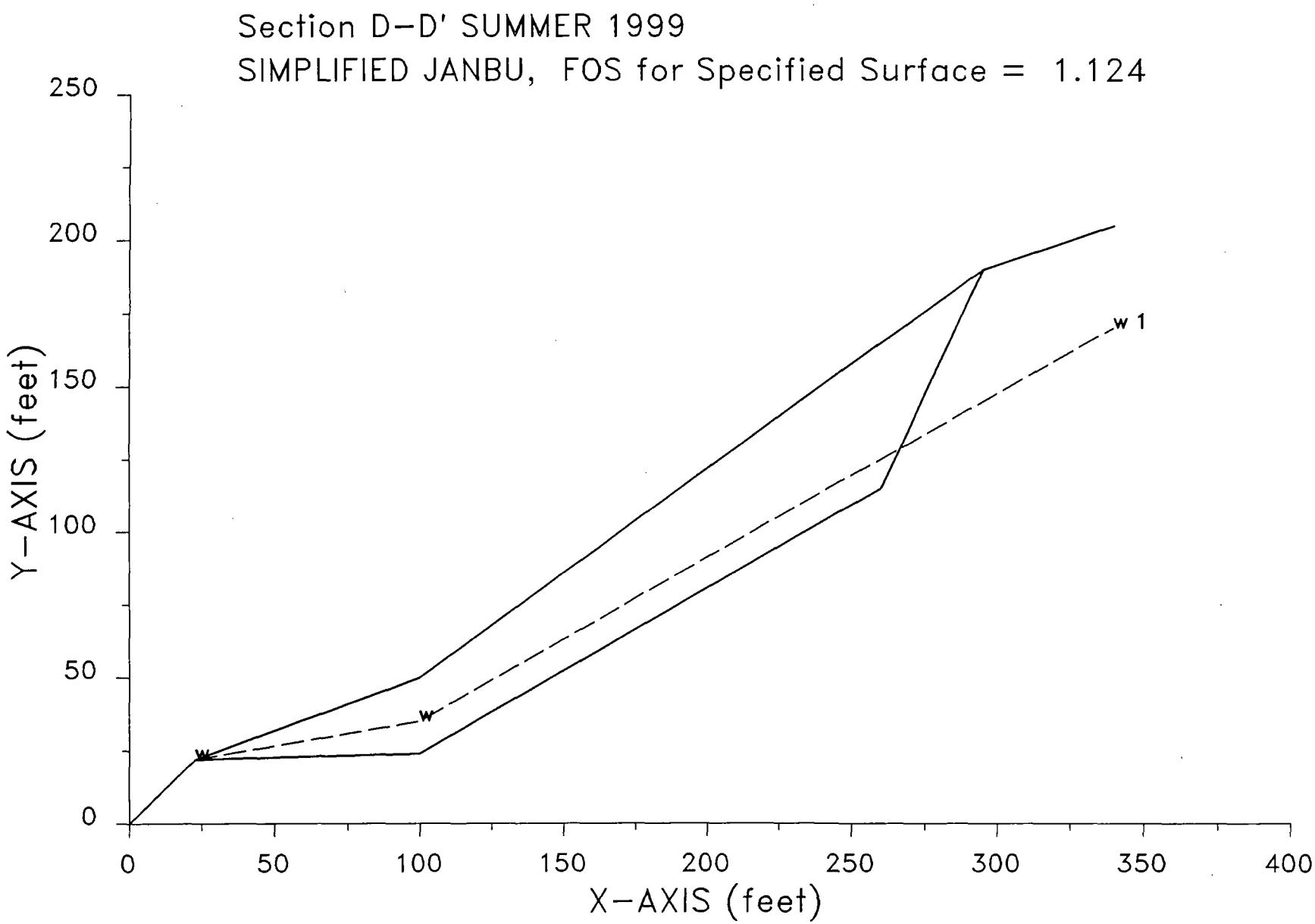
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