REPORT

CAPITOL CAMPUS SLOPES INSTRUMENTATION AND MONITORING PROGRAM GA# 08-076

Submitted To: Washington State Department of General Administration
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1.0 INTRODUCTION

Golder Associates Inc. (Golder) previously completed an evaluation of the slopes on the Capitol Campus for stability, probability of failure, and consequences of failure to assist the General Administration (GA) in determining risk and managing campus assets such as buildings and infrastructure. The results of this evaluation were presented in a report titled *Hillside Evaluation and Preliminary Design Olympia Capitol Campus, Olympia, Washington (08-076)* dated March 17, 2010 (Golder 2010). Together with the GA, Golder identified campus slopes with relatively higher probability and consequence of risk. The results were used to identify and prioritize potential campus projects that could mitigate these risks.

One project identified was a campus-wide instrumentation and monitoring program. Regular observation and monitoring of the campus slopes could help to identify signs of slope instability before large movements or damage occur. The overall goal of the instrumentation and monitoring program is to provide data on the performance of the slopes around the campus, particularly in areas where movement might damage key infrastructure. Monitoring does not improve the stability of the slope; however, it can provide quantitative data for identifying slope movement and groundwater conditions that may contribute to slope instability. Should a slide occur, monitoring data could provide valuable information on the effects or lack of effects from the slide by providing documentation of actual ground movements. Monitoring data also help provide information to assess qualitative observations (such as cracks in a building) that may or may not be related to slope movement.

The instrumentation program for the Capitol Campus slopes consists of three main components:

- inclinometers, to measure deformation within the ground
- piezometers, to measure groundwater elevations
- survey monitoring points, to measure the position of monuments on structures and at key locations on the ground surface

The program makes use of existing instruments installed during previous campus projects and additional instruments installed in previously-identified critical areas (Golder 2010). This report describes the components of the instrumentation program, establishes procedures for monitoring, and provides the recommended monitoring frequency. The new instruments installed under the instrumentation monitoring program are discussed in Section 2. The inclinometers and piezometers are discussed in Sections 3 and 4, respectively, while the survey monitoring program is discussed in Section 5. The overall recommended monitoring program is presented in Section 6.

2.0 EXPLORATIONS AND NEW INSTALLATIONS

Instruments and survey monitoring points were installed to complement the existing instruments on campus and to monitor key campus infrastructure. The new instruments installed specifically for this monitoring program are discussed in this section of the report.

2.1 Drilling

Golder field activities were performed on April 29 through May 5, 2010 and consisted of advancing three geotechnical borings (GB-3, GB-4, and GB-5), installing inclinometer casings, and installing vibrating wire piezometers. The approximate boring locations are shown on the Site and Exploration Plan, Figure 1. Borings were located near high-risk areas identified in the *Hillside Evaluation Report* (Golder 2010), taking into account accessible drilling locations, utility conflicts, and available project resources. Boring logs and a summary of the field procedures are provided in Appendix A.

Borings GB-3 and GB-4 were advanced using mud rotary drilling methods with a track-mounted drill rig equipped with an autohammer. Boring GB-5 was advanced using mud rotary drilling methods with a B-61, truck-mounted drill rig equipped with an autohammer. The drill rigs were operated by Holocene Drilling, Inc. under the full-time observation of Golder geologists Ted Sager or John deLaChappelle. The borings were advanced to depths of 102 feet to 105 feet below the existing ground surface (bgs). Logging and sampling of soils were performed in general accordance with Golder Associates procedures for field identification of soils. A summary of the soil, classification, and description terminology is presented on the Soil Classification Legend in Appendix A. The collected soil samples were returned to our Redmond, Washington laboratory for further classification and laboratory testing. Laboratory test results are presented in Appendix B.

The stratigraphic contacts indicated on the boring logs represent the approximate depths to boundaries between soil units; actual transitions between soil units may be more gradual. The subsurface descriptions are based on the conditions encountered at the time of exploration. Subsurface conditions between exploration locations may vary from those encountered, and groundwater elevations may vary during the year.

2.2 Inclinometer and Vibrating Wire Piezometer Installations

After completing each borehole, an inclinometer casing and vibrating wire piezometer (a type of electronic transducer used to measure groundwater pressure) were installed in each boring. The inclinometer and vibrating wire piezometer installation details are presented on the logs in Appendix A.

2.3 Survey Monuments

Survey monuments were established at key points near campus slopes. Monuments were located near slope edges and on adjacent structures. Parametrix, under subcontract to Golder, installed the survey monuments and established the baseline position of each monument. A summary of the survey monuments installed and the monitoring program is presented in Section 5. Complete survey monument reports are included in Appendix E.

Note that in addition to survey monuments specifically for slope monitoring, Parametrix replaced a monument across the street from the greenhouse that was destroyed during sidewalk construction. The old monument, PMX-2, was replaced by PMX-17 in January 2011.

3.0 INCLINOMETERS

3.1 Description and Locations

An inclinometer consists of a casing grouted into a borehole and a portable probe that runs in grooves slotted into the inside of the casing, parallel to the long axis of the casing. The inclinometer probe is lowered into the casing and measures the inclination of the casing with respect to vertical. Readings are taken and recorded at regular (typically 2-foot) intervals along the borehole. Subsequent readings at the same locations will show changes in the inclination of the casing if deformation of the soil mass around the borehole has occurred.

Inclinometers are typically used to monitor slopes for movement. They can detect the approximate depth where the movement is occurring and can measure small displacements that may not be perceptible at the ground surface. If slope movement occurs, the magnitude and the depth of the measured movement can be used to evaluate potential remediation alternatives. Additionally, the information would be helpful in evaluating the effects of the slope movement on campus infrastructure. Inclinometers that do not show movement are also helpful by identifying the approximate limits of a slide should a slope failure occur.

The monitoring program consists of eight inclinometers. Other inclinometers previously installed on the campus were not able to be located in the field. The approximate locations of the inclinometers are shown on Figure 1. A summary of inclinometer information is shown in Table 1.

Table 1: Inclinometer Information

Boring ID	Date Completed	Estimated Ground Surface Elevation (ft)^1	Casing Stick-up Above Ground Surface (ft)	Depth (ft)
J-1	12/15/87	32	-0.2	32
DH-1	1992	116	0	102
DH-2	1994	102	1.3	86
GB-1	5/29/09	145	-0.1	98
GB-2	5/27/09	133	3.4	102
GB-3	4/30/10	129	-0.3	98
GB-4	5/5/10	113	-0.2	98
GB-5	5/4/10	113	-0.3	98

Note:

1. Elevation datum NAVD 88; estimated from ground surface elevation on base map survey information when available

3.2 General Inclinometer Monitoring Procedures

The components of the inclinometer monitoring are summarized in Table 2:

Table 2: Summary of Inclinometer Components

Item	Description
Digitilt® Inclinometer Probe	Electronic device lowered into inclinometer casing to measure inclination
Digitilt DataMate ®II	Electronic device that records inclination measurements
DMM®	Computer program used to download and organize measured data
DigiPro®	Computer program used to graph measured data

The inclinometers are designed to be monitored using an inclinometer probe compatible with 2.75-inch diameter inclinometer casings. The GA purchased the Digitilt® Inclinometer Probe meeting these requirements from the Durham Geo Slope Indicator (Slope Indicator) company of Mukilteo, Washington. The Digitilt DataMate® II and the DigiPro® software were also purchased by the GA from Slope Indicator. The general operating procedure for reading the inclinometers is presented in the Inclinometer Probe Manual and Digitilt DataMate® II Manual (included in Appendices C-2 and C-3). Specific details for each inclinometer including the photographs of the inclinometer set-up, the inclinometer depth, and the initial reading direction (the A0 direction) are defined in Section 3.3 and presented in Appendix C-1. The inclinometer data is collected by pressing a button when the inclinometer probe is at the appropriate depth and is electronically stored in the Digitilt DataMate® II.

The computer program DMM® is used to download and manage inclinometer data from the Digitilt DataMate® II. The operating manual for the DMM® program, presented in Appendix C-4, describes the procedure for downloading the inclinometer data. The program DigiPro® is used to graphically present the inclinometer data, creating graphs of the deformation measurements using the inclinometer data stored in the DMM® database (see www.slopeindicator.com). The manual for the DigiPro® program is presented in Appendix C-5. Both the DMM® and DigiPro® computer programs can be downloaded from the Slope Indicator website. The GA purchased a license for the DigiPro® software that can be activated by contacting Slope Indicator. A license is not required for the DMM® program.

The inclinometer graphs provide a visual representation of measured ground deformation. The different types of graphical reports are discussed in the DigiPro® software manual. The most commonly presented is Cumulative Displacement. The Cumulative Displacement report presents a graph of each inclinometer reading compared to the baseline reading. By comparing each subsequent reading to the baseline reading, a graph of the measured ground deformation with depth is developed.

3.3 Inclinometer Definitions

Datasheets are provided in Appendix C-1 describing the specific measurement procedures for each inclinometer. Key terms presented on the datasheets are as follows:

- Inclinometer: The borehole ID for the inclinometer.
- Inclinometer ID in DataMate® II: The name of the inclinometer location in the DataMate® II under which to record inclinometer readings.
- Depth of Inclinometer: The first reading of each series will be taken at this depth below the Monitoring Point. For example, if the depth of inclinometer is 100 feet and the Monitoring Point is at the top of the casing, the inclinometer probe will be 100 feet below the top of the casing, and the 100-foot marker on the inclinometer cable will be at the top of the casing for the initial reading.
- Distance from Ground Surface to Monitoring Point: The approximate distance of the Monitoring Point of each inclinometer relative to the adjacent ground surface.
- A0 Direction: The direction in which the upper wheels point during the initial inclinometer traverse. The A0 direction is toward the slope and has been marked on inclinometer casings with permanent marker. The A180 direction is 180 degrees from the A0 direction. Consult the inclinometer manual for additional information.

4.0 PIEZOMETERS

Piezometers are used to monitor groundwater elevations. Two types of piezometers are present on the campus: vibrating wire piezometers and open-standpipe piezometers. Details of the vibrating wire piezometers and open-standpipe piezometers are summarized in the Tables 3 and 4.

Table 3: Vibrating Wire Piezometer Information

Boring ID	VW Piezometer Serial Number	Date Completed	Estimated Ground Surface Elevation (ft)[1]	Piezometer Depth Below Ground Surface (ft)	GW at time of Drilling (ft bgs)
GB-1	98943	5/29/09	145	80	-[2]
GB-2	98944	5/27/09	133	50	-[2]
GB-3	10-2580	4/30/10	129	72	-[2]
GB-4	10-2582	5/5/10	113	56	-[2]
GB-5	10-2581	5/4/10	113	30	-[2]

Notes:
[1] Elevation datum NAVD 88
[2] Groundwater not encountered during drilling

Table 4: Open-standpipe piezometer information

Boring ID	Date Completed	Estimated Ground Surface Elevation[2] (ft)	Casing Stick-up Above Ground Surface[3] (ft)	Measuring Point Elevation (ft)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	GW at time of drilling (ft bgs)
DH-7P[1]	1995	103	1.2	101.8	17	27	-
HC-2	7/18/2007	99	-0.5	98.5	92	102	63
HC-3	7/23/2007	95	-0.25	94.75	95	105	60
HC-5	7/25/2007	89	-0.25	89.75	85	95	56
HC-6	7/27/2007	84	-0.1	83.9	88	98	53
HC-7	7/30/2007	84	-0.25	83.75	86	96	53

Boring ID	**Date Completed**	**Estimated Ground Surface Elevation[2] (ft)**	**Casing Stick-up Above Ground Surface[3] (ft)**	**Measuring Point Elevation (ft)**	**Top of Screen (ft bgs)**	**Bottom of Screen (ft bgs)**	**GW at time of drilling (ft bgs)**
B-1	5/7/2008	125	-0.3	124.7	15	25	9.5
B-2	5/7/2008	125	-0.3	124.7	20	30	10
B-3	5/7/2008	125	-0.3	124.7	8	18	9.5

Notes:
[1] Piezometer installed by Palmer and Gerstel (1997). Boring ID not noted in report, identified as 5 ft west of boring DH-7. No boring log was provided for piezometer boring.
[2] Elevation datum NAVD 88; estimated from ground surface elevation on base map or survey information where available.
[3] A negative casing stick-up is reported for piezometers where the top of the casing is below the ground surface

4.1 Vibrating Wire Piezometers

Vibrating wire piezometers are embedded in the grout used to backfill the borehole annulus around the inclinometer casing. At the top of the borehole, the ends of the signal cables for each vibrating wire piezometer are enclosed in a plastic bag inside a protective monument. The vibrating wire piezometers in borings GB-1, GB-2, GB-3, GB-4, and GB-5 are measured by plugging the signal cables (color-coded) into the yellow VW Data Recorder. The VW Data Recorder measures the frequency of the vibrating wire piezometer and the temperature at the piezometer sensor body. These values should be recorded manually on the data forms in Appendix D-1 then input into the Excel spreadsheet described in the following paragraph to compute the water elevation. The wire frequency and temperature are used with a calibration equation to determine pressure at the vibrating wire sensor. This pressure can be converted to feet of water (e.g., groundwater) above the sensor.

An Excel spreadsheet created for the project converts the measured vibrating wire piezometer frequency and temperature into feet of water above the piezometer sensor. The Excel spreadsheet is named “Piezometer Readings.xlsx” and is included on the attached CD in Appendix F of this report. The spreadsheet uses the calibration factors specific to each vibrating wire piezometer. The calibration sheets for the vibrating wire piezometers are presented in Appendix D-2.

The procedure for using the Excel spreadsheet is:

- Select the tab name corresponding to the vibrating wire piezometer
- Enter the date and time of the measurement
- Enter the wire frequency (read off the screen on the VW Data Recorder)
- Enter the temperature (read off the screen on the VW Data Recorder

The Excel spreadsheet automatically computes the feet of water above the vibrating wire piezometer and the depth of water below the ground surface. Paper copies of the data forms for each vibrating wire piezometer are presented in Appendix D-1. The user's manual for the VW Data Recorder is presented in Appendix D-3.

4.2 Standpipe Piezometers

The Standpipe piezometers consist of a PVC casing installed in a borehole, with a length of the PVC casing slotted (screened) to allow water to infiltrate into the casing for measurement. The water measured in the PVC casing is generally representative of the groundwater conditions at the depth of the screened interval.

Standpipe piezometers at the Greenhouse and west of the GA building are constructed of 1- or 2-inch-diameter PVC casing. These piezometers are measured with a water level indicator lowered down the piezometer casing to determine the depth to groundwater. Groundwater levels should always be measured from the same Measuring Point, which has been defined as the top of PVC casing.

The depth to water from the Measuring Point should be recorded manually on a data form and then input into the Excel spreadsheet. The Excel spreadsheet was created for this project to convert the measured depth to groundwater to an equivalent groundwater elevation. The Excel spreadsheet is named "Piezometer Readings.xlsx" and is included on the attached CD in Appendix F.

The procedure for using the Excel spreadsheet is:

- Select the tab name corresponding to the standpipe piezometer (DH-7P, HC-2, HC-3, HC-5, HC-6, HC-7)
- Enter the date of measurement
- Enter the measured depth to groundwater from the top of the PVC casing (the Measuring Point)

The Excel spreadsheet automatically computes the elevation of the groundwater and the depth of groundwater below the ground surface at each standpipe piezometer. Paper copies of the data forms for each standpipe piezometer are presented in Appendix D-1.

5.0 SURVEY MONITORING PROGRAM

Survey monuments were established at key locations on the ground surface or on structures near campus slopes to provide an ongoing record of the position of key infrastructure. Monuments were installed and surveyed by Parametrix under subcontract to Golder. Parametrix in turn subcontracted installation of survey monuments on historic structures to Pioneer Masonry Restoration Company, Inc. because of their experience with building surfaces at the Capitol Campus.

The locations of survey monuments established on the campus are shown in Figure 1. The locations for survey monuments were selected jointly by the GA, Golder, and Parametrix. In general, monuments were established on structures near the slopes on the perimeter of the campus. Survey monuments were also established near the top of slopes where slope movement could impact key campus infrastructure (Table 5).

Table 5: Survey Monument Summary

Point ID	General Location	Purpose
S-1	General Administration (GA) Building	Failure of steep slope near GA building may impact structure
S-2	Slope crest west of GA Building	Failure of steep slope may impact infrastructure west of GA Building
S-3, S-4 S-3I, S-4I	GA Soldier Pile Wall	Performance of soldier pile wall
S-5	Greenhouse parking area	Failure of slope may impact infrastructure
S-6, S-7	Greenhouse	Failure of slope may impact Greenhouse, document settlement of Greenhouse
S-8, S-9	Temple of Justice	Failure of Heritage Park slope may impact Temple of Justice
S-10	Law Enforcement Memorial	Failure of Heritage Park slope may impact Law Enforcement Memorial
S-11, S-12	Legislative Mansion Parking Lot	Failure of north facing slope may impact parking lot
S-13	Utility Corridor	Failure of slopes above Powerhouse may impact utility corridor and Powerhouse
S-14	Slope above Powerhouse/Oil Tank	Failure of slope may impact Powerhouse or Oil Tank

Point ID	General Location	Purpose
S-15	Governor’s Mansion Garage	Failure of slope may impact Governor’s Mansion grounds
S-16, S-17	O’Brien Building	Failure of slope may impact O’Brien Building
S-18	O’Brien Building, manhole	Failure of slope may impact infrastructure behind O’Brien Building
S-19, S-21	Pritchard Building	Failure of slope may impact building
S-20	Pritchard Building, sidewalk	Failure of slope may impact sidewalk. Signs of previous sidewalk settlement observed.
S-22, S-23	Temple of Justice	Failure of slope may impact Temple of Justice Building. Monuments set near foundation of the building.
S-24, S-25	Greenhouse	Failure of slope may impact Greenhouse, document settlement of Greenhouse. Monuments from previous project incorporated into monitoring program.
S-26	Natural Gas Enclosure	Failure of slope may cause gas line break affecting powerhouse operation.

6.0 MONITORING FREQUENCY

The goal of the instrument monitoring is to document slope and groundwater conditions to assist in identifying slope movements and long-term groundwater conditions. Therefore, all inclinometer and piezometer data should be downloaded and reviewed by campus personnel within one week of measurement.

6.1 Routine Monitoring

The recommended routine monitoring frequency for inclinometers and piezometers is summarized in Table 6.

Table 6: Routine Monitoring Frequency Inclinometers and Piezometers

Year	**Recommended Readings**											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2011		X			X			X			X	
2012+ onward		X						X				

Routine monitoring of survey monuments should be performed on an annual basis in the spring.

6.2 Additional Monitoring and Contacting Geotechnical and Survey Firms

The intention of the guidance provided in this section is to help focus GA responses on hillside *risks*, where *risk* considers both likelihood of landsliding as well as the consequences of that ground movement. The routine monitoring program should be supplemented with additional monitoring and actions if certain conditions are observed. These conditions include:

- Observation of cracks in ground surface above or on a slope
- Surficial slope failure that occurs in the vicinity of an inclinometer or piezometer (i.e., within approximately 100 feet)
- Inclinometer readings that indicate slope movement greater than approximately 0.25 inches.

Additional monitoring for each of these conditions is summarized in the following sections.

6.2.1 Observation of cracks in ground surface above or on slope

If cracks are observed in the ground surface above or on the slope, the following actions are recommended:

1. Assess the location of the cracking. If cracking is within 30 feet of structure or infrastructure, notify the geotechnical engineer within one day describing location of cracks and any other observations.
2. Perform reading of nearby inclinometers and piezometers within one day.

3. If readings indicate slope movement, perform additional reading within three days to confirm movement.
4. If movement is confirmed, arrange for geotechnical engineer to visit site, review data, and provide recommendations.
5. **Contact surveyor to measure survey points near confirmed slope movement.**
6. Schedule supplemental monitoring round (inclinometer and piezometer) within 30 days of initial measurement or as recommended by the geotechnical engineer.

6.2.2 Surficial slope failure occurs in the vicinity of an inclinometer of piezometer

If a slope failure occurs on the campus slopes within approximately 100 feet of a piezometer or inclinometer, the following actions are recommended:

1. Assess the location of the slope failure with respect to the inclinometer location. If the failure is within 30 feet of inclinometer, notify the geotechnical engineer within one day describing observations.
2. Perform reading of inclinometers and piezometers within 3 days of failure.
3. Arrange for the geotechnical engineer to visit site, review data, and provide recommendations as appropriate.
4. Perform additional reading of inclinometers within two weeks of failure or as recommended by the geotechnical engineer.

6.2.3 Inclinometer readings that indicate slope movement greater than 0.25 inches

If inclinometer readings indicate slope movement greater than 0.25 inches, the following actions are recommended:

1. Perform additional reading within 3 days to confirm measurement.
2. If measurement is confirmed, contact geotechnical engineer to visit site, review data, and provide recommendations.
3. Schedule supplemental monitoring round (inclinometer and piezometer) within 30 days of initial measurement or as recommended by the geotechnical engineer.

7.0 CLOSURE

This report has been prepared exclusively for the use of the Washington State Department of General Administration and their consultants for specific application to slope stability assessment at the Capitol Campus in Olympia, Washington. Use of this report by any other party or for any other purpose should be limited to factual data only (exploration logs, laboratory results, etc.). The conclusions and recommendations presented in this report are based on the explorations and observations completed for this study and our previous work with the General Administration.

Judgment has been applied in interpreting and presenting the results. Variations in subsurface conditions are common, and actual conditions encountered may be different from those observed in the borings. If site project plans are developed based on our studies, we recommend that we be given the opportunity to review such plans and specifications to verify that they are in accordance with the conditions described in this report. The explorations were performed in general accordance with locally accepted geotechnical engineering practice, subject to the time limits and financial and physical constraints applicable to the services for this project, to provide information for the areas explored. There are possible variations in the subsurface conditions between the test locations and variations over time.

The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous site activities or uses of the site and/or resulting from the introduction onto the site of materials from offsite sources are outside the scope of service for this report and have not been investigated or addressed.

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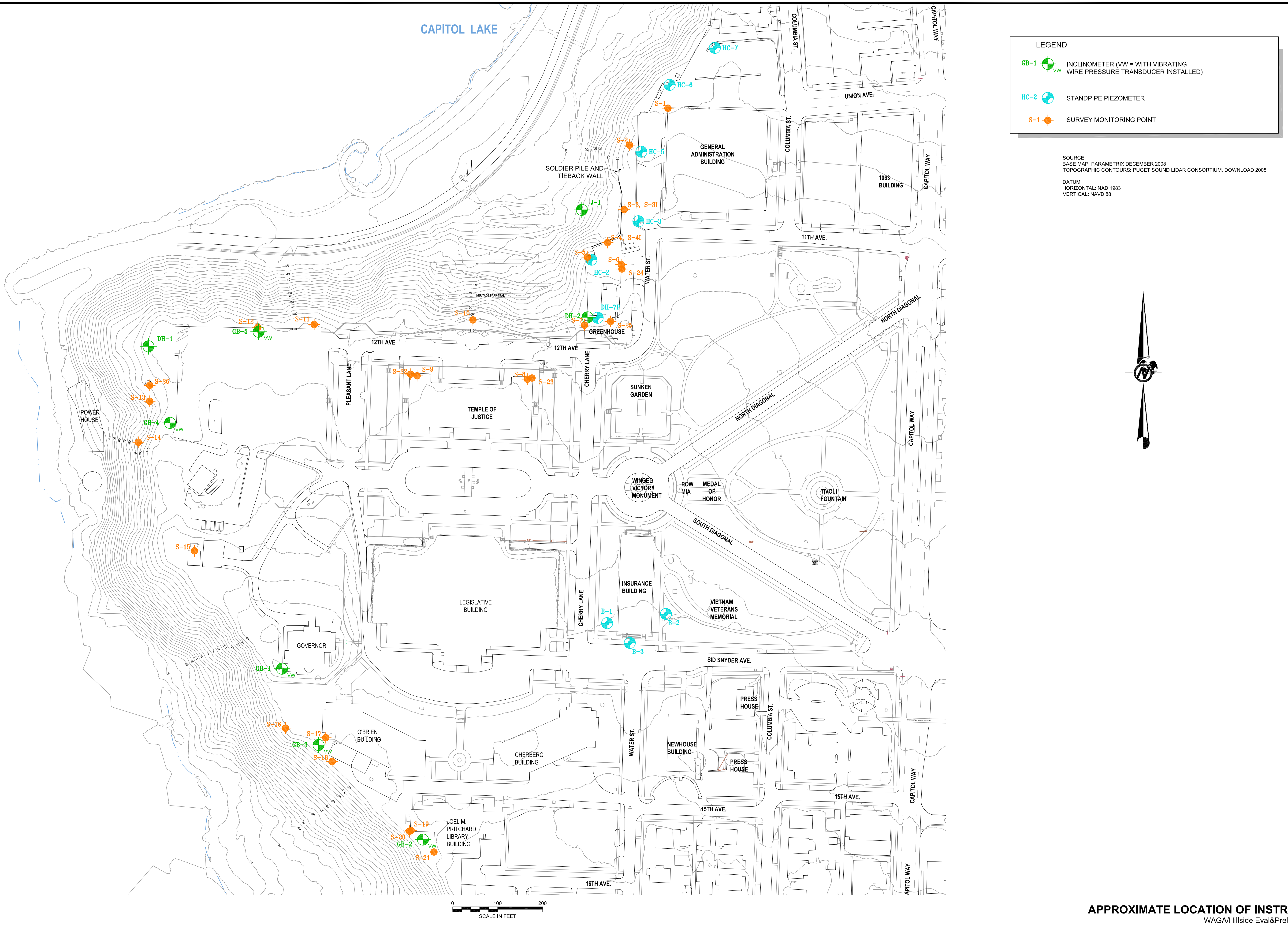
8.0 REFERENCES

Golder Associates Inc.(Golder). 2010. Hillside Evaluation and Preliminary Design, Olympia Capitol Campus, Olympia, Washington. March 17. Redmond, Washington. (GA Project 08-076)

Palmer, S.P. and Gerstel, W.J. 1997. Capital Campus Conservatory Soil and Slope Stability Investigation Final Report. Department of Natural Resources. August 1. (GA Project 93-077)

FIGURE



SOURCE:
BASE MAP: PARAMETRIX DECEMBER 2008
TOPOGRAPHIC CONTOURS: PUGET SOUND LIDAR CONSORTIUM, DOWNLOAD 2008

DATUM:
HORIZONTAL: NAD 1983
VERTICAL: NAVD 88

FIGURE 1
APPROXIMATE LOCATION OF INSTRUMENTS
WAGA/Hillside Eval&Prelim Design/WA

Golder Associates

K:\CAD\Projects\2008\08393287\600\083-93287_600_F1.dwg | F1 | Mod: 04/12/2011, 11:36 | Plotted: 04/12/2011, 11:38 | NDieterich

APPENDIX A
FIELD EXPLORATION PROCEDURES, DATA, AND LOGS

A-1
GOLDER EXPLORATIONS GB-3, GB-4, GB-5

APPENDIX A-1
Golder Explorations GB-3, GB-4, GB-5

The following sections describe the procedures associated with the field explorations and field tests that Golder conducted for this project. Descriptive logs are enclosed in this appendix.

Borings GB-3 and GB-4 were advanced using mud rotary drilling methods with a track-mounted drill rig equipped with an autohammer. Boring GB-5 was advanced using mud rotary drilling methods with a B-61, truck-mounted drill rig equipped with an autohammer. The drill rigs were operated by Holocene Drilling, Inc. under the full-time observation of Golder geologists Ted Sager or John deLaChappelle. The borings were advanced to depths of 102 feet to 105 feet below the existing ground surface (bgs).

Samples were stored in plastic bags/jars and later transported to Golder’s laboratory for further visual examination. After each boring was completed, the borehole was completed as described later in this appendix.

Throughout the drilling operation, soil samples were obtained at 2½ - or 5-foot depth intervals by the Standard Penetration Test (SPT) per ASTM D1586. This testing and sampling procedure consists of driving a standard 2-inch-outside diameter steel split-spoon sampler 18 inches into the soil with a 140-pound hammer free-falling 30 inches. The number of blows required to drive the sampler through each 6-inch interval is counted, and the total number of blows struck during the final 12 inches is recorded as the Standard Penetration Resistance, or "SPT blow count." If 50 blows are struck within any 6-inch interval, the driving is stopped and the blow count is recorded as 50 blows for the actual penetration distance. The resulting Standard Penetration Resistance values indicate the relative density of granular soils and the relative consistency of cohesive soils.

The enclosed Boring Logs describe the vertical sequence of soils and materials encountered in each boring, based on Golder field classifications, supported by subsequent laboratory examination, and testing. Field classification of soil and rock samples was generally based on ASTM D 2488 and ASTM D 2487. The dual-classifications “SP-SM” and “GP-GM” were used where silt content was estimated or tested to be 5 to 15 percent and soils are described as “little silt.”

Where a soil contact was observed to be gradational, Golder logs indicate the average contact depth. Where a soil type changed between sample intervals, we inferred the contact depth. Golder logs indicate the blow count, sample type, sample number, and approximate depth of each soil sample obtained from the borings, as well as any laboratory tests performed on these soil samples. If groundwater was observed in a borehole, the approximate groundwater depth is shown on the boring log.

After the borings were advanced to the planned depths, an inclinometer casing and vibrating wire piezometer were installed. The inclinometer casing consists of a 2.75-inch diameter acrylonitrile butadiene styrene (ABS) pipe with tracks on the inside surface that provide guideways for the inclinometer probe. The 10-foot long ABS pipe sections were assembled with self-sealing, grout proof, o-rings. An inclinometer casing anchor was used to help counter the buoyancy. The casing was set in a bentonite-cement grout consisting of approximately 1 part Portland cement (1, 94-pound bag), 2.5 parts water (30 gallons), and 0.3 parts bentonite (25 pounds).

Borings GB-3, GB-4, and GB-5 were completed with flush-mount monuments at the ground surface.

Vibrating wire piezometers were installed in the Golder borings to monitor porewater pressures. The vibrating wire piezometer was taped to the outside of the inclinometer casing and set in the grout at 72 feet bgs in GB-3, 56 feet bgs at GB-4, and at 30 feet bgs at GB-5. The instruments measure pressure that can be converted into the feet of water above the vibrating wire piezometer.

Unified Soil Classification System (USCS)

Criteria for Assigning Group Symbols and Names			Soil Classification Generalized Group Descriptions	
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve	GRAVELS More than 50% of coarse fraction retained on No. 4 Sieve	CLEAN GRAVELS Less than 5% fines	GW	Well-graded Gravels
			GP	Poorly-graded gravels
		GRAVELS WITH FINES More than 12% fines	GM	Gravel and Silt Mixtures
			GC	Gravel and Clay Mixtures
	SANDS 50% or more of coarse fraction passes No. 4 Sieve	CLEAN SANDS Less than 5% fines	SW	Well-graded Sand
			SP	Poorly-graded Sand
		SANDS WITH FINES More than 12% fines	SM	Silty Sand
			SC	Clayey Sand
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	SILTS AND CLAYS Liquid limit less than 50	INORGANIC	CL	Low-plasticity Clays
			ML	Non-plastic and Low-Plasticity Silts
		ORGANIC	OL	Organic Silts and Clays, liquid limit less than 50
	SILTS AND CLAYS Liquid limit greater than 50	INORGANIC	CH	High-plasticity Clays
			MH	Elastic Silts
		ORGANIC	OH	Organic Silts and Clays, liquid limit greater than 50
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat

Based on: ASTM D2487-06

Component Definitions by Gradation

Component	Size Range
Boulders	Above 12 in.
Cobbles	3 in. to 12 in.
Gravel	3 in. to No. 4 (4.76mm)
Coarse gravel	3 in. to 3/4 in.
Fine gravel	3/4 in. to No. 4 (4.76mm)
Sand	No. 4 (4.76mm) to No. 200 (0.074mm)
Coarse sand	No. 4 (4.76mm) to No. 10 (2.0mm)
Medium sand	No. 10 (2.0mm) to No. 40 (0.42mm)
Fine sand	No. 40 (0.42mm) to No. 200 (0.074mm)
Silt and Clay	Smaller than No. 200 (0.074mm)

Sample Types

Symbol	Description
SS	SPT Sampler (2.0" OD)
HD	Heavy Duty Split Spoon
SH	Shelby Tube
CA	California Sampler
B	Bulk
C	Cored
G	Grab
P	Pitcher Sampler

Cohesionless Soils (a)		
Density	N, blows/ft.(c)	Relative Density (%)
Very loose	0 to 4	0 - 15
Loose	4 to 10	15 - 35
Compact	10 to 30	35 - 65
Dense	30 to 50	65 - 85
Very Dense	over 50	>85

Cohesive Soils(b)		
Consistency	N, blows/ft.(c)	Undrained Shear Strength (psf) (d)
Very soft	0 to 2	<250
Soft	2 to 4	250-500
Firm	4 to 8	500-1000
Stiff	8 to 15	1000-2000
Very Stiff	15 to 30	2000-4000
Hard	over 30	>4000

(a) Soils consisting of gravel, sand, and silt, either separately or in combination, possessing no characteristics of plasticity, and exhibiting drained behavior.

(b) Soils possessing the characteristics of plasticity, and exhibiting undrained behavior.

(c) Refer to text of ASTM D 1586-84 for a definition of N; in normally consolidated cohesionless soils. Relative Density terms are based on N values corrected for overburden pressures.

(d) Undrained shear strength = 1/2 unconfined compression strength.

Laboratory Tests

Test	Designation
Moisture	(1)
Density	D
Grain Size	G
Hydrometer	H
Atterberg Limits	(1)
Consolidation	C
Unconfined	U
UU Triax	UU
CU Triax	CU
CD Triax	CD
Permeability	P

(1) Moisture and Atterberg Limits plotted on log.

Silt and Clay Descriptions

Description	Typical Unified Designation
Silt	ML (non-plastic)
Clayey Silt	CL-ML (low plasticity)
Silty Clay	CL
Clay	CH
Elastic Silt	MH
Organic Soils	OL, OH, Pt

Qualitative Descriptive Terminology for Moisture Content

Dry	No discernible moisture present
Damp	Enough moisture present to darken the appearance but no moisture on materials adheres to the hand
Moist	Will moisten the hand
Wet	Visible water present on materials

Descriptive Terminology Denoting Component Proportions

Descriptive Terms	Range of Proportion
Trace	0-5%
Little	5-12%
Some or Adjective (a)	12-30%
And	30-50%

(a) Use Gravelly, Sandy or Silty as appropriate.

Golder Associates

SOIL CLASSIFICATION LEGEND

RECORD OF BOREHOLE GB-3

SHEET 1 of 6

PROJECT: WAGA/Hillside Eval. 2010
PROJECT NUMBER: 083-93287.620
LOCATION: O'Brien Building

DRILLING METHOD: Mud Rotary
DRILLING DATE: 4/29&30/10
DRILL RIG: D 50 Track

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 629,652.79 E: 1,040,547.96

ELEVATION: 128.5
INCLINATION: -90

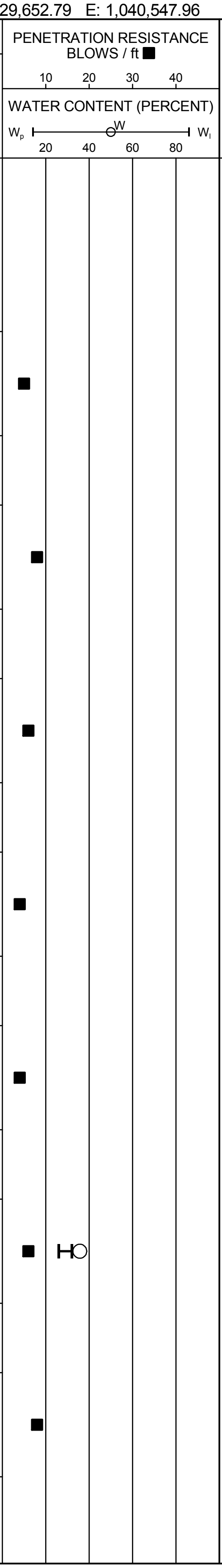
BORING METHOD: 6-inch outer diameter mud rotary w/ 140 lb auto hammer

SOIL PROFILE

DEPTH (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)
0	0.0 - 7.0 Loose, olive gray, non-stratified, fine to medium SAND, little angular fine gravel, trace Silt, trace Organics, moist, (SP) (FILL) NO RECOVERY	SP	▨	121.5 7.0
7.0	7.0 - 12.0 Loose, light olive brown, non-stratified, silty, fine SAND, trace fine gravel, trace organics, trace brick debris, trace charcoal, moist, (SM) (FILL)	SM	▨	116.5 12.0
12.0	12.0 - 13.0 Loose, olive brown, iron oxide stained, stratified, silty, fine SAND, moist, (SM) (VASHON RECESSIONAL DEPOSITS)	SM		115.5 13.0
13.0	13.0 - 14.5 Soft, greenish gray, weakly stratified, SILT, little fine sand, moist, (ML) (VASHON RECESSIONAL DEPOSITS)	ML		114.0 14.5
14.5	14.5 - 17.0 Firm, strong brown to greenish gray, heavy iron oxide staininining from 15.0 ft to 15.5 ft, SILT, moist, (ML) (VASHON RECESSIONAL DEPOSITS) ATTERBERG	ML		111.5 17.0
17.0	17.0 - 19.5 Firm, light olve brown, stratified, SILT, some fine sand interbeds up to 1 inch thick, moist, (ML) (VASHON RECESSIONAL DEPOSITS)	ML		109.0 19.5
19.5		SM		
20	Log continued on next page			

SAMPLES

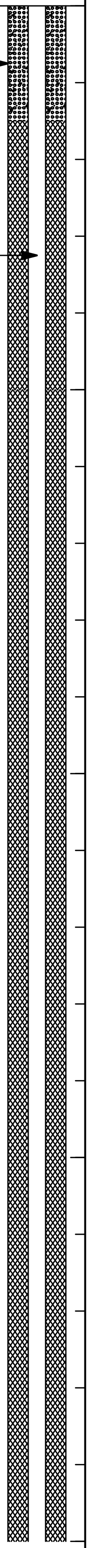
NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
1	SPT	3-3-2	5	0.4/1.5
2	SPT	4-5-3	8	0.0/1.5
3	SPT	3-3-3	6	1.0/1.5
4	SPT	3-2-2	4	1.3/1.5
5	SPT	1-2-2	4	1.5/1.5
6	SPT	2-3-3	6	1.5/1.5
7	SPT	2-3-5	8	1.5/1.5



NOTES
WATER LEVELS
GRAPHIC

Flush mount monument set ~0.1 ft below existing grade

2.75-inch diameter solid PVC inclinometer pipe embedded in grout and bentonite chips.



1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: T. Knipschield

LOGGED: T. Sager
CHECKED: D. Findley
DATE: 6/22/2010

Golder Associates

RECORD OF BOREHOLE GB-3

SHEET 2 of 6

PROJECT: WAGA/Hillside Eval. 2010
PROJECT NUMBER: 083-93287.620
LOCATION: O'Brien Building

DRILLING METHOD: Mud Rotary
DRILLING DATE: 4/29&30/10
DRILL RIG: D 50 Track

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 629,652.79 E: 1,040,547.96

ELEVATION: 128.5
INCLINATION: -90

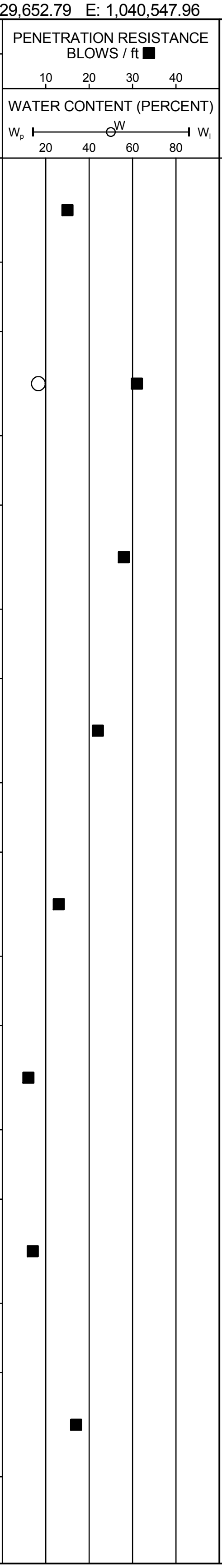
DEPTH (ft): 20, 25, 30, 35, 40

BORING METHOD: 6-inch outer diameter mud rotary w/ 140 lb auto hammer

SOIL PROFILE			
DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)
19.5 - 22.0 Compact, light olive brown, iron oxide stained, stratified, silty, fine SAND, moist, (SM) (VASHON RECESSIONAL DEPOSITS) *(Continued)*	SM		106.5 22.0
22.0 - 24.5 Dense, olive brown, non-stratified, fine to coarse SAND, little silt, trace fine gravel, moist, (SP-SM) (VASHON RECESSIONAL DEPOSITS) SIEVE	SP-SM		104.0 24.5
24.5 - 29.5 Compact, olive brown, weakly stratified, fine SAND, trace silt, moist, (SP) (VASHON RECESSIONAL DEPOSITS)	SP		99.0 29.5
29.5 - 32.0 Stiff, grayish brown, iron oxide stained, laminated, SILT, some very fine sand, moist, (ML) (VASHON RECESSIONAL DEPOSITS)	ML		96.5 32.0
32.0 - 37.0 Firm, light olive brown, weakly stratified, SILT to CLAY, becomes non-stratified, SILT below 35 feet, moist to wet, (ML/CL) (VASHON RECESSIONAL DEPOSITS)	ML/CL		91.5 37.0
37.0 - 38.1 Compact, olive brown, heavy iron oxide stain from 38.0 ft to 38.1 ft, stratified, silty, fine SAND, moist, (SM) (VASHON RECESSIONAL DEPOSITS)	SM		90.4 38.1
38.1 - 39.5 Very stiff, bluish gray, non-stratified, SILT, moist, (ML) (VASHON RECESSIONAL DEPOSITS)	ML		89.0 39.5
	SM		

Log continued on next page

SAMPLES				
NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT
8	SPT	4-7-8	15	1.0 / 1.5
9	SPT	9-15-16	31	1.5 / 1.5
10	SPT	12-14-14	28	1.5 / 1.5
11	SPT	12-12-10	22	1.5 / 1.5
12	SPT	4-5-8	13	1.5 / 1.5
13	SPT	3-2-4	6	1.5 / 1.5
14	SPT	2-3-4	7	1.5 / 1.5
15	SPT	4-7-10	17	1.3 / 1.5



NOTES
WATER LEVELS

GRAPHIC

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: T. Knipschield

LOGGED: T. Sager
CHECKED: D. Findley
DATE: 6/22/2010

Golder Associates

RECORD OF BOREHOLE GB-3

SHEET 3 of 6

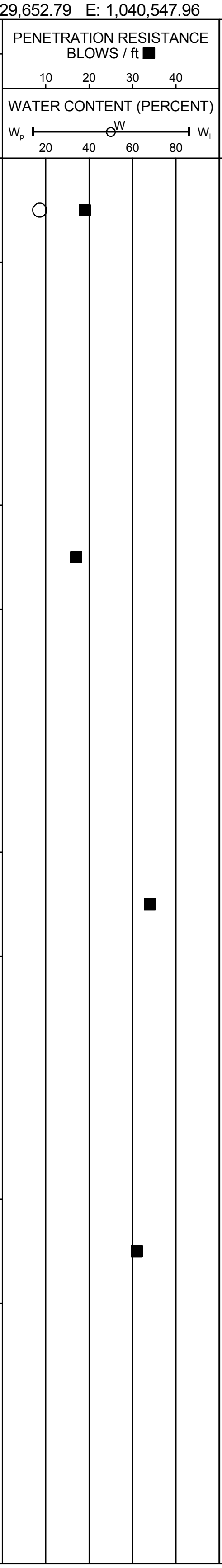
PROJECT: WAGA/Hillside Eval. 2010
PROJECT NUMBER: 083-93287.620
LOCATION: O'Brien Building

DRILLING METHOD: Mud Rotary
DRILLING DATE: 4/29&30/10
DRILL RIG: D 50 Track

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 629,652.79 E: 1,040,547.96

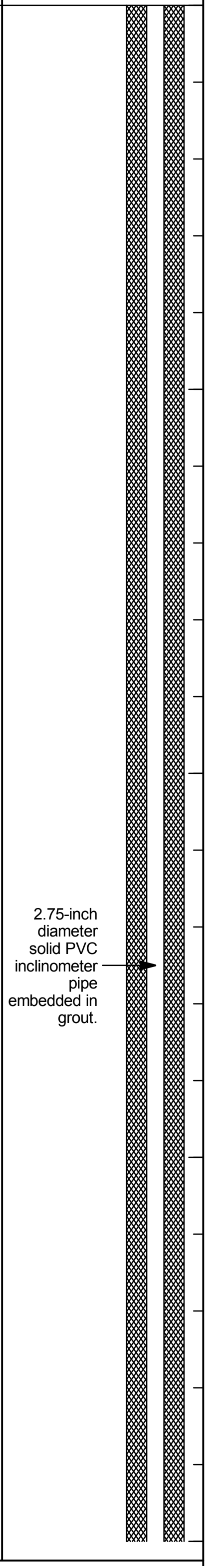
ELEVATION: 128.5
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
40	6-inch outer diameter mud rotary w/ 140 lb auto hammer	39.5 - 43.3 Compact, grayish brown, non-stratified, silty, fine SAND, moist, (SM) (VASHON RECESSIONAL DEPOSITS) #200 WASH *(Continued)*	SM			16	SPT	8-9-10	19	1.5/1.5
45		43.3 - 48.3 Very stiff, light olive brown, non-stratified, SILT, moist, (ML) (VASHON RECESSIONAL DEPOSITS)	ML		85.3 43.3	17	SPT	5-7-10	17	1.5/1.5
50		48.3 - 53.3 Hard, grayish brown, weakly stratified, sandy, SILT, moist, (ML) (VASHON RECESSIONAL DEPOSITS)	ML		80.3 48.3	18	SPT	10-15-19	34	1.5/1.5
55		53.3 - 58.3 Hard, grayish brown, with thin bands up to 1/16-inch thick of Fe oxide staining observed from 50 ft to 51.5 ft, stratifed, SILT, moist, (ML) (VASHON RECESSIONAL DEPOSITS)	ML		75.3 53.3	19	SPT	10-13-18	31	1.5/1.5
60		58.3 - 63.3 Very stiff, grayish brown, Fe oxide staining in thin bands up to 1/16-inch thick below, 61.0 ft, stratified, SILT, trace fine sand as a lens approximately 1/8-inch thick at 61.7 ft, moist, (ML) (VASHON RECESSIONAL DEPOSITS)	ML		70.3 58.3					



NOTES
WATER LEVELS

GRAPHIC



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1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: T. Knipschield

LOGGED: T. Sager
CHECKED: D. Findley
DATE: 6/22/2010

Golder Associates

RECORD OF BOREHOLE GB-3

SHEET 4 of 6

PROJECT: WAGA/Hillside Eval. 2010	DRILLING METHOD: Mud Rotary	DATUM: Geodetic	ELEVATION: 128.5
PROJECT NUMBER: 083-93287.620	DRILLING DATE: 4/29&30/10	AZIMUTH: N/A	INCLINATION: -90
LOCATION: O'Brien Building	DRILL RIG: D 50 Track	COORDINATES: N: 629,652.79 E: 1,040,547.96	

BORING METHOD: 6-inch outer diameter mud rotary w/ 140 lb auto hammer

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (ft)
60	58.3 - 63.3 Very stiff, grayish brown, Fe oxide staining in thin bands up to 1/16-inch thick below, 61.0 ft, stratified, SILT, trace fine sand as a lens approximately 1/8-inch thick at 61.7 ft, moist, (ML) (VASHON RECESSIONAL DEPOSITS) *(Continued)*	ML	65.3 63.3
	63.3 - 68.3 Stiff, dark greenish gray, Fe oxide stained band approximately 1-inch thick at 66.4 ft, CLAY, trace fine gravel (dropstones?), moist, (CL) (VASHON RECESSIONAL DEPOSITS)	CL	60.3 68.3
65			
	68.3 - 73.3 Very stiff, olive gray, Fe oxide staining from 71.0 to 71.5 ft, non-stratified, SILT, trace fine gravel (dropstones?), moist, (ML) (VASHON RECESSIONAL DEPOSITS)	ML	55.3 73.3
70			
	73.3 - 78.3 Dense, very dark gray, non-stratified, fine to medium SAND, trace fine gravel, trace silt, moist, (SP) (VASHON RECESSIONAL DEPOSITS)	SP	50.3 78.3
75			
	78.3 - 82.0 Compact, grayish brown, weakly stratified, silty, fine SAND, trace fine gravel, moist, (SM) (VASHON RECESSIONAL DEPOSITS) #200 WASH	SM	
80			

SAMPLES

NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
20	SPT	7-6-11	17	1.5/1.5
21	SPT	4-6-8	14	1.5/1.5
22	SPT	7-11-15	26	1.5/1.5
23	SPT	18-17-28	45	1.5/1.5

PENETRATION RESISTANCE BLOWS / ft ■ 10 20 30 40

WATER CONTENT (PERCENT) W_p W W_l 20 40 60 80

NOTES WATER LEVELS GRAPHIC

Vibrating Wire Piezometer set 72 ft bgs in grout (S/N 10-2580)

Log continued on next page

1 in to 3 ft	LOGGED: T. Sager
DRILLING CONTRACTOR: Holocene Drilling	CHECKED: D. Findley
DRILLER: T. Knipschield	DATE: 6/22/2010

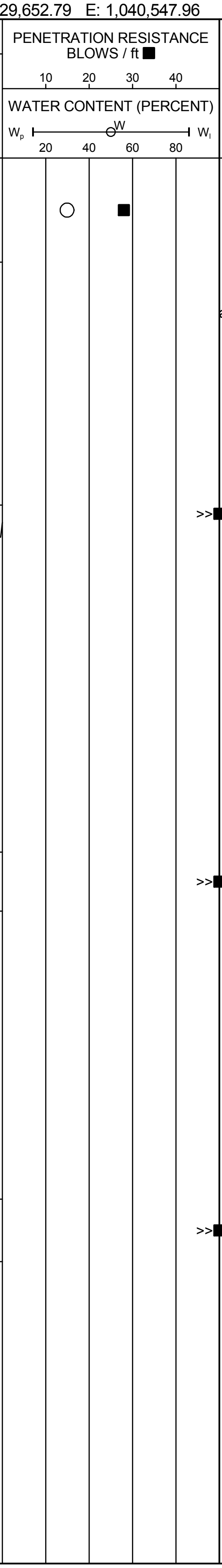
Golder Associates

RECORD OF BOREHOLE GB-3

SHEET 5 of 6

PROJECT: WAGA/Hillside Eval. 2010	DRILLING METHOD: Mud Rotary	DATUM: Geodetic	ELEVATION: 128.5
PROJECT NUMBER: 083-93287.620	DRILLING DATE: 4/29&30/10	AZIMUTH: N/A	INCLINATION: -90
LOCATION: O'Brien Building	DRILL RIG: D 50 Track	COORDINATES: N: 629,652.79 E: 1,040,547.96	

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	NOTES WATER LEVELS
80	6-inch outer diameter mud rotary w/ 140 lb auto hammer	78.3 - 82.0 Compact, grayish brown, weakly stratified, silty, fine SAND, trace fine gravel, moist, (SM) (VASHON RECESSIONAL DEPOSITS) #200 WASH *(Continued)*	SM		24	SPT	18-13-15	28	1.5/1.5	
		82.0 - 88.0 Very dense, olive gray, non-stratified, faceted, silty, fine GRAVEL and silty, fine to coarse SAND, moist, (GM/SM) (GLACIAL TILL OR PRE-VASHON DEPOSITS)	GM/SM	46.5 82.0						Driller reported gravel at approximately 82 ft.
85					25	SPT	50/3	>50	0.3/0.3	
		88.0 - 93.0 Very dense, olive brown, non-stratified, fine SAND, trace silt, moist, (SP) (PRE-VASHON DEPOSITS)	SP	40.5 88.0						Drillder reported easier drilling at 88 ft.
90					26	SPT	28-50/4	>50	0.5/0.9	
		93.0 - 102.0 Very dense, olive brown, non-stratified, silty, fine SAND, moist, (SM) (PRE-VASHON DEPOSITS) #200 WASH	SM	35.5 93.0						
95					27	SPT	37-50/5	>50	0.7/0.9	
100		Log continued on next page								



1 in to 3 ft

DRILLING CONTRACTOR: Holocene Drilling

DRILLER: T. Knipschield

LOGGED: T. Sager

CHECKED: D. Findley

DATE: 6/22/2010

Golder Associates

RECORD OF BOREHOLE GB-3

SHEET 6 of 6

PROJECT: WAGA/Hillside Eval. 2010
PROJECT NUMBER: 083-93287.620
LOCATION: O'Brien Building

DRILLING METHOD: Mud Rotary
DRILLING DATE: 4/29&30/10
DRILL RIG: D 50 Track

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 629,652.79 E: 1,040,547.96

ELEVATION: 128.5
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE			SAMPLES						PENETRATION RESISTANCE BLOWS / ft ■ 10 20 30 40 WATER CONTENT (PERCENT) Wp ⊢ W ○ ⊣ Wl 20 40 60 80	NOTES WATER LEVELS GRAPHIC
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT		
100		93.0 - 102.0 Very dense, olive brown, non-stratified, silty, fine SAND, moist, (SM) (PRE-VASHON DEPOSITS) #200 WASH *(Continued)*	SM		26.5 102.0	28	SPT	45-50/5	>50	0.9/0.9	○ >>■	Bentonite/cement grout.
		Boring completed at 102.0 ft.										
105												
110												
115												
120												

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: T. Knipschield

LOGGED: T. Sager
CHECKED: D. Findley
DATE: 6/22/2010

RECORD OF BOREHOLE GB-4

SHEET 1 of 6

PROJECT: WAGA/Hillside Eval. 2010
PROJECT NUMBER: 083-93287.620
LOCATION: Power House Slope

DRILLING METHOD: Mud Rotary
DRILLING DATE: 5/3-5/10
DRILL RIG: D 50 Track

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 630,368.79 E: 1,040,217.72

ELEVATION: 113.4
INCLINATION: -90

SOIL PROFILE

BORING METHOD	DESCRIPTION	USCS	ELEV. / DEPTH (ft)
Hand dug	0.0 - 0.3 Very soft, ORGANICS - SOD, moist, (OL) (TOPSOIL/SOD)	OL	113.1 0.3
Hand dug	0.3 - 2.5 Soft, black, non-stratified, SILT, little fine to coarse sand, little organics, trace fine gravel, trace man-made debris (terra cotta and clothing), moist, (ML) (FILL)	ML	110.9 2.5
6-inch outer diameter mud rotary w/ 140 lb auto hammer	2.5 - 12.0 Soft to very soft, olive brown to black, mottled, light iron oxide staining, non-stratified, SILT, trace to little fine sand, trace angular and subrounded fine gravel, trace organic debris, trace brick debris at 7.5 ft, moist, (ML) (FILL)	ML	101.4 12.0
6-inch outer diameter mud rotary w/ 140 lb auto hammer	12.0 - 23.0 Firm to very stiff, light olive brown, Fe oxide stained partings at 17.5 ft, non-stratified to weakly stratified, SILT to CLAY, trace fine to coarse sand, trace fine to coarse gravel, moist to wet, (ML/CL) (VASHON RECESSIONAL DEPOSITS) ATTERBERG	ML	

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SAMPLES

NUMBER	TYPE	BLOWS per 6 in (140 lb hammer, 30 inch drop)	N	REC / ATT
1	SPT	1-2-2	4	1.0/1.5
2	SPT	2-11-6	17	1.0/1.5
3	SPT	2-2-3	5	0.9/1.5
4	SPT	4-2-2	4	1.0/1.5
5	SPT	2-3-2	5	1.0/1.5
6	SPT	2-5-5	10	1.3/1.5
7	SPT	4-7-14	21	1.5/1.5

PENETRATION RESISTANCE BLOWS / ft ■ (10, 20, 30, 40)

WATER CONTENT (PERCENT) Wp —○W— Wl (20, 40, 60, 80)

NOTES WATER LEVELS GRAPHIC

Inclinometer set in flush-mount monument. Concrete used to set monutment.

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: T. Knipschield

LOGGED: T. Sager
CHECKED: D. Findley
DATE: 6/22/2010

Golder Associates

RECORD OF BOREHOLE GB-4

SHEET 2 of 6

PROJECT: WAGA/Hillside Eval. 2010	DRILLING METHOD: Mud Rotary	DATUM: Geodetic	ELEVATION: 113.4
PROJECT NUMBER: 083-93287.620	DRILLING DATE: 5/3-5/10	AZIMUTH: N/A	INCLINATION: -90
LOCATION: Power House Slope	DRILL RIG: D 50 Track	COORDINATES: N: 630,368.79 E: 1,040,217.72	

BORING METHOD: 6-inch outer diameter mud rotary w/ 140 lb auto hammer

SOIL PROFILE

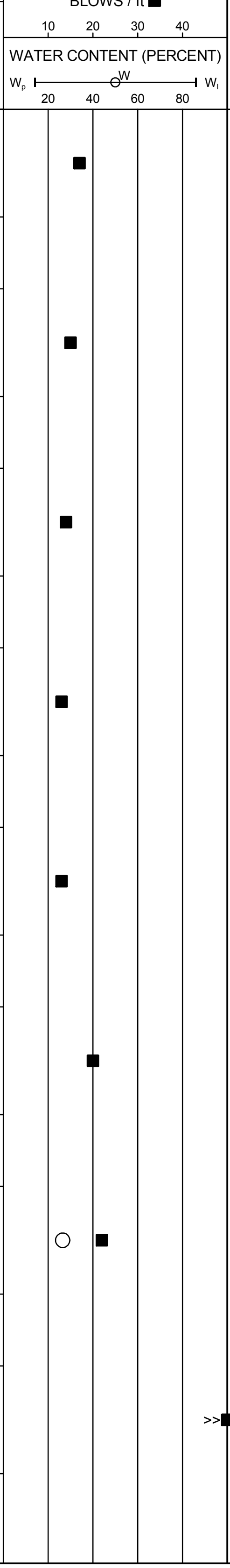
DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)
20	12.0 - 23.0 Firm to very stiff, light olive brown, Fe oxide stained partings at 17.5 ft, non-stratified to weakly stratified, SILT to CLAY, trace fine to coarse sand, trace fine to coarse gravel, moist to wet, (ML/CL) (VASHON RECESSIONAL DEPOSITS) ATTERBERG *(Continued)* Very poor recovery in sample 8 - one piece of light greenish gray, coarse gravel recovered in the mouth of the sample shoe from 20 to 21.5 ft.	ML	90.4 23.0
	23.0 - 29.5 Compact, olive brown, Fe oxide stained, non-stratified to stratified, fine SAND, silt lenses up to 4 inches thick, little silt and clay, moist to wet, (SP-SM) (VASHON RECESSIONAL DEPOSITS)	SP-SM	83.9 29.5
25			
30	29.5 - 31.5 Stiff, light olive brown, thin (1/16-inch to 1/8-inch thick) Fe oxide bands, non-stratified, SILT, moist, (ML) (VASHON RECESSIONAL DEPOSITS)	ML	81.9 31.5
	31.5 - 36.5 Very stiff, olive brown, with dark orangish iron oxide staining from 32.5 ft to 32.7 ft, stratified,silty fine SAND and sandy SILT interbeds up to 4 inches thick, little fine gravel from 32.5 ft to 32.7 ft, moist, (SM/ML) (VASHON RECESSIONAL DEPOSITS) #200 WASH	SM/ML	76.9 36.5
35			
	36.5 - 42.0 Very stiff to hard, olive brown, Fe oxide stained in thin 1/16-inch to 1/8-inch bands, stratified, sandy, SILT, moist, (ML) (VASHON RECESSIONAL DEPOSITS)	ML	
40	Log continued on next page		

SAMPLES

NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
8	SPT	4-7-10	17	0.2 / 1.5
9	SPT	6-7-8	15	1.5 / 1.5
10	SPT	6-7-7	14	1.5 / 1.5
11	SPT	9-9-4	13	1.3 / 1.5
12	SPT	5-6-7	13	1.5 / 1.5
13	SPT	10-9-11	20	1.5 / 1.5
14	SPT	4-10-12	22	1.5 / 1.5
15	SPT	17-25-42	>50	0.5 / 1.5

PENETRATION RESISTANCE BLOWS / ft ■

WATER CONTENT (PERCENT)



NOTES WATER LEVELS GRAPHIC

1 in to 3 ft

DRILLING CONTRACTOR: Holocene Drilling

DRILLER: T. Knipschield

LOGGED: T. Sager

CHECKED: D. Findley

DATE: 6/22/2010

Golder Associates

RECORD OF BOREHOLE GB-4

SHEET 3 of 6

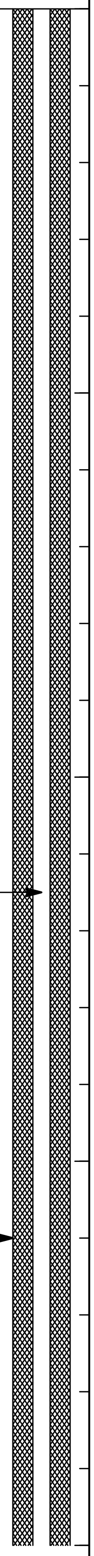
PROJECT: WAGA/Hillside Eval. 2010
PROJECT NUMBER: 083-93287.620
LOCATION: Power House Slope

DRILLING METHOD: Mud Rotary
DRILLING DATE: 5/3-5/10
DRILL RIG: D 50 Track

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 630,368.79 E: 1,040,217.72

ELEVATION: 113.4
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer, 30 inch drop)	N	REC / ATT	NOTES WATER LEVELS
40	6-inch outer diameter mud rotary w/ 140 lb auto hammer	36.5 - 42.0 Very stiff to hard, olive brown, Fe oxide stained in thin 1/16-inch to 1/8-inch bands, stratified, sandy, SILT, moist, (ML) (VASHON RECESSIONAL DEPOSITS) *(Continued)*	ML		16	SPT	10-12-15	27	1.5/1.5	
		42.0 - 50.9 Firm, dark gray, non-stratified, massive, SILT, moist, (ML) (VASHON RECESSIONAL DEPOSITS)	ML	71.4 42.0						
45					17	SPT	3-3-4	7	1.5/1.5	
50					18	SPT	9-11-20	31	1.3/1.5	
		50.9 - 55.9 Very stiff to hard, olive brown, heavy Fe oxide staining at 50.9 to 51.5 ft, weakly stratified, sandy SILT, trace faceted gravel, moist, (SM) (VASHON RECESSIONAL DEPOSITS)	ML	62.5 50.9						2.75-inch diameter solid PVC inclinometer pipe embedded in grout.
55		Heavy Fe oxide staining - 1-inch thick at 55.5 ft.			19	SPT	8-10-17	27	1.5/1.5	
		55.9 - 67.0 Dense to very dense, olive brown, weakly stratified to non-stratified, silty fine SAND, trace fine gravel, moist, (SM) (POSSIBLE PRE-VASHON RECESSIONAL DEPOSITS) 55 ft - #200 WASH 65 ft - SIEVE	SM	57.5 55.9						Vibrating Wire Piezometer set 56 ft bgs embedded in grout (S/N 10-2582)
60										



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1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: T. Knipschield

LOGGED: T. Sager
CHECKED: D. Findley
DATE: 6/22/2010

RECORD OF BOREHOLE GB-4

SHEET 4 of 6

PROJECT: WAGA/Hillside Eval. 2010
PROJECT NUMBER: 083-93287.620
LOCATION: Power House Slope

DRILLING METHOD: Mud Rotary
DRILLING DATE: 5/3-5/10
DRILL RIG: D 50 Track

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 630,368.79 E: 1,040,217.72

ELEVATION: 113.4
INCLINATION: -90

BORING METHOD: 6-inch outer diameter mud rotary w/ 140 lb auto hammer

SOIL PROFILE

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)
60	55.9 - 67.0 Dense to very dense, olive brown, weakly stratified to non-stratified, silty fine SAND, trace fine gravel, moist, (SM) (POSSIBLE PRE-VASHON RECESSIONAL DEPOSITS) 55 ft - #200 WASH 65 ft - SIEVE *(Continued)*	SM	
67.0	67.0 - 94.0 Very dense, very dark gray to dark greenish gray, sandy fine to coarse GRAVEL, trace silt, trace cobbles, very poor recovery from samples 22 to 26, moist (GP) (PRE-VASHON RECESSIONAL DEPOSITS) Note: Based on exposures on nearby slopes, likely sandy fine to coarse GRAVEL with little to trace silt.	GP	46.4 67.0

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SAMPLES

Depth (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
60.5	20	SPT	18-21-25	46	1.4 / 1.5
65.5	21	SPT	20-26-30	>50	1.5 / 1.5
70	22	SPT	50/3	>50	0.2 / 0.2
75	23	SPT	50/2.5	>50	0.2 / 0.2

PENETRATION RESISTANCE BLOWS / ft ■ (10, 20, 30, 40)
WATER CONTENT (PERCENT) W_p —○W— W_l (20, 40, 60, 80)

Sample 20: ■ ; Sample 21: ○, >>■ ; Sample 22: >>■ ; Sample 23: >>■

NOTES WATER LEVELS GRAPHIC

Driller reported hitting gravel and 67 ft.

Driller reported drilling through an estimated 6-inch to 8-inch diameter cobble at 73 ft.

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: T. Knipschield

LOGGED: T. Sager
CHECKED: D. Findley
DATE: 6/22/2010

Golder Associates

RECORD OF BOREHOLE GB-4

SHEET 5 of 6

PROJECT: WAGA/Hillside Eval. 2010
PROJECT NUMBER: 083-93287.620
LOCATION: Power House Slope

DRILLING METHOD: Mud Rotary
DRILLING DATE: 5/3-5/10
DRILL RIG: D 50 Track

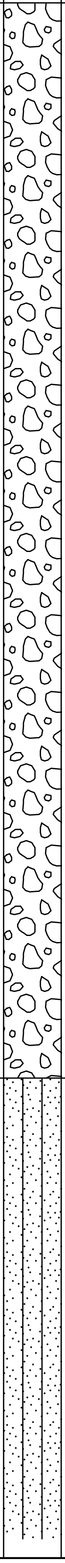
DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 630,368.79 E: 1,040,217.72

ELEVATION: 113.4
INCLINATION: -90

BORING METHOD: 6-inch outer diameter mud rotary w/ 140 lb auto hammer

SOIL PROFILE

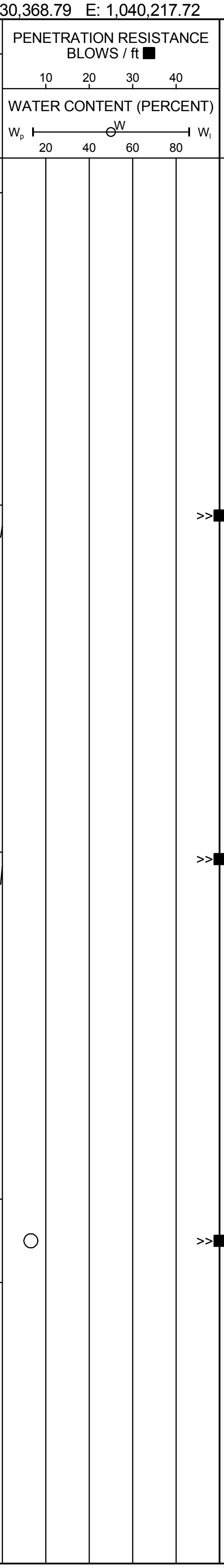
DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)
80	67.0 - 94.0 Very dense, very dark gray to dark greenish gray, sandy fine to coarse GRAVEL, trace silt, trace cobbles, very poor recovery from samples 22 to 26, moist (GP) (PRE-VASHON RECESSIONAL DEPOSITS) *(Continued)*	GP	
85	Note: Based on exposures on nearby slopes, likely sandy fine to coarse GRAVEL with little to trace silt.		
94.0	94.0 - 105.0 Very dense, light olive brown, non-stratified, silty, fine SAND, moist, (SM) (PRE-VASHON DEPOSITS) #200 WASH	SM	19.4 94.0



SAMPLES

NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
24	SPT	50		0.2 / 0.5
25	SPT	50/4	>50	0.3 / 0.3
26	SPT	50/3	>50	0.2 / 0.2
27	SPT	12-48-50/3	>50	0.5 / 1.2

PENETRATION RESISTANCE



NOTES WATER LEVELS GRAPHIC

Driller reported slow, difficult drilling at 80 ft.

Driller reported easier drilling at 94 ft.

Log continued on next page

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: T. Knipschield

LOGGED: T. Sager
CHECKED: D. Findley
DATE: 6/22/2010

Golder Associates

RECORD OF BOREHOLE GB-4

SHEET 6 of 6

PROJECT: WAGA/Hillside Eval. 2010
PROJECT NUMBER: 083-93287.620
LOCATION: Power House Slope

DRILLING METHOD: Mud Rotary
DRILLING DATE: 5/3-5/10
DRILL RIG: D 50 Track

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 630,368.79 E: 1,040,217.72

ELEVATION: 113.4
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ 10 20 30 40 WATER CONTENT (PERCENT) Wp ⊢—○W—⊣ Wl 20 40 60 80	NOTES WATER LEVELS GRAPHIC
100		94.0 - 105.0 Very dense, light olive brown, non-stratified, silty, fine SAND, moist, (SM) (PRE-VASHON DEPOSITS) #200 WASH *(Continued)*	SM			28	SPT	36-50		0.9 1.0		Bentonite/cement grout.
105		Boring completed at 105.0 ft.			8.4 105.0							
110												
115												
120												

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: T. Knipschield

LOGGED: T. Sager
CHECKED: D. Findley
DATE: 6/22/2010

Golder Associates

RECORD OF BOREHOLE GB-5

SHEET 1 of 6

PROJECT: WAGA/Hillside Eval. 2010
PROJECT NUMBER: 083-93287.620
LOCATION: North Mansion Parking Lot

DRILLING METHOD: Mud Rorary
DRILLING DATE: 5/3&4/10
DRILL RIG: BK 81 Truck

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 630,571.39 E: 1,040,414.66

ELEVATION: 112.9
INCLINATION: -90

BORING METHOD: 6-inch outer diameter mud rotary w/ 140 lb auto hammer

DEPTH (ft)	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0	0.0 - 0.4 ASPHALT		112.5 0.4					
	0.4 - 2.5 Fine to medium SAND and fine to coarse GRAVEL, some cobbles, dry, (GP/SP) (FILL)	GP/SP	110.4 2.5					
	2.5 - 4.5 Compact, tan to gray brown, mottled, non-stratified, fine to coarse GRAVEL, some fine to medium sand, trace to little silt, trace organics, trace brick fragments, moist, (GP) (FILL)	GP	108.4 4.5	1	SPT	5-6-15	21	1.5/1.5
5	4.5 - 9.5 Very stiff, tan to gray, mottled, massive, desicated, CLAY, trace fine gravel, damp, (CL) (VASHON RECESSIONAL DEPOSITS) ATTERBERG	CL		2	SPT	4-6-10	16	1.5/1.5
	Becomes hard, grayish tan, weekly laminated, CLAY, trace fine to coarse gravel,		103.4 9.5	3	SPT	5-12-20	32	1.5/1.5
10	9.5 - 12.0 Very stiff/compact, 2-inch to 4-inch thick interbedded, sandy SILT, and silty fine SAND, moist, (ML/SM) (VASHON RECESSIONAL DEPOSITS)	ML/SM	100.9 12.0	4	SPT	6-9-7	16	1.5/1.5
	12.0 - 19.5 Firm, tan with minor gray mottling, 2-inch to 4-inch thick interbedded, SILT, moist, (ML) (VASHON RECESSIONAL DEPOSITS)	ML		5	SPT	3-2-5	7	1.5/1.5
15	Becomes wet.			6	SPT	6-5-4	9	1.5/1.5
			93.4 19.5	7	SPT	3-6-7	13	1.5/1.5
20		SM/ML						

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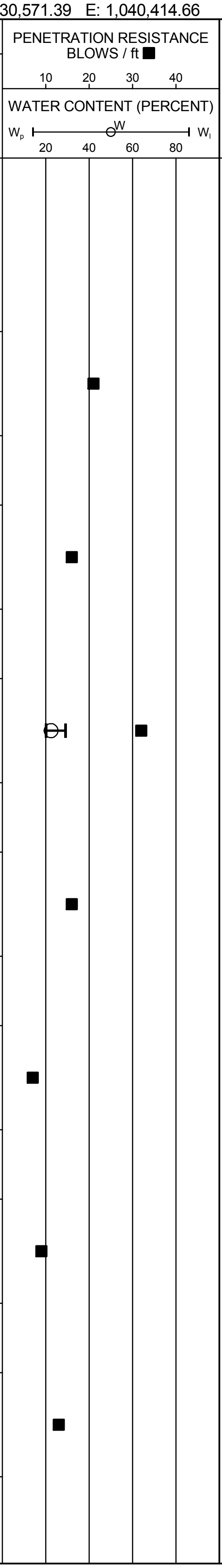

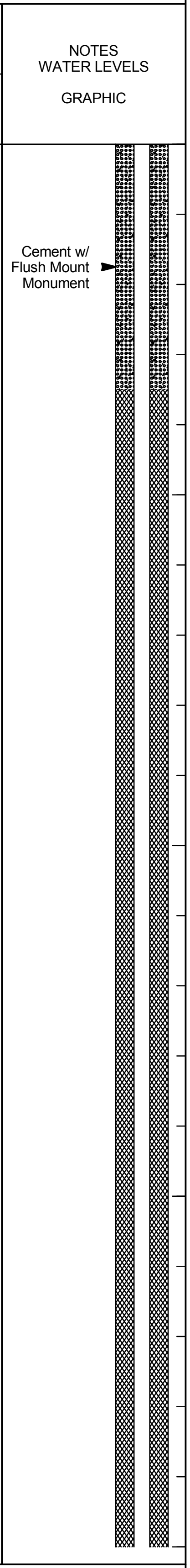

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: J. Thompson

LOGGED: J. deLaChapelle
CHECKED: D. Findley
DATE: 6/22/2010

Golder Associates

RECORD OF BOREHOLE GB-5

SHEET 2 of 6

PROJECT: WAGA/Hillside Eval. 2010
PROJECT NUMBER: 083-93287.620
LOCATION: North Mansion Parking Lot

DRILLING METHOD: Mud Rorary
DRILLING DATE: 5/3&4/10
DRILL RIG: BK 81 Truck

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 630,571.39 E: 1,040,414.66

ELEVATION: 112.9
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■	NOTES WATER LEVELS GRAPHIC
20	6-inch outer diameter mud rotary w/ 140 lb auto hammer	19.5 - 22.0 Compact/stiff, tan, 2-inch to 4-inch thick interbedded, silty, fine SAND and sandy, SILT, moist, (SM/ML) (VASHON RECESSIONAL DEPOSITS) *(Continued)*	SM/ML	90.9 22.0	8	SPT	5-6-8	14	1.5/1.5		
		22.0 - 27.0 Stiff, tan, 2-inch to 6-inch thick interbedded, SILT and SILT with some fine sand, trace fine gravel, moist to wet, (ML) (VASHON RECESSIONAL DEPOSITS)	ML		9	SPT	4-7-7	14	1.5/1.5		
25				85.9 27.0	10	SPT	5-5-8	13	1.5/1.5		
		27.0 - 32.0 Very stiff, tan, minor iron oxide staining, non-stratified to crudely bedded, SILT, moist, (ML) (VASHON RECESSIONAL DEPOSITS) ATTERBERG	ML		11	SPT	7-9-11	20	1.5/1.5		
30		Vibrating Wire Piezometer installed in grout at 30 ft. Becomes damp.		80.9 32.0	12	SPT	8-9-10	19	1.5/1.5		Vibrating Wire Piezometer set 30 ft bgs embedded in grout (S/N 10-2581)
		32.0 - 34.5 Hard, grayish tan, scattered horizontal iron oxide stained layers, thinly laminated, SILT and SILT with some fine sand, damp, (ML) (VASHON RECESSIONAL DEPOSITS)	ML	78.4 34.5	13	SPT	20-26-33	>50	1.5/1.5	>>	
35		34.5 - 37.0 Hard, gray to tan, interbedded, SILT, with some silty fine sand, damp, (ML) (VASHON RECESSIONAL DEPOSITS)	ML	75.9 37.0	14	SPT	10-11-15	26	1.0/1.5		
		37.0 - 39.5 Very dense, grayish tan, iron oxide stained layers, thinly to thickly laminated (1/16-inch to 2-inch), silty, fine SAND and sandy SILT, trace fine Gravel, damp, (SM/ML) (VASHON RECESSIONAL DEPOSITS)	SM/ML	73.4 39.5	15	SPT	14-23-29	>50	1.5/1.5	>>	
40			ML								

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1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: J. Thompson

LOGGED: J. deLaChapelle
CHECKED: D. Findley
DATE: 6/22/2010

Golder Associates

RECORD OF BOREHOLE GB-5

SHEET 3 of 6

PROJECT: WAGA/Hillside Eval. 2010	DRILLING METHOD: Mud Rorary	DATUM: Geodetic	ELEVATION: 112.9
PROJECT NUMBER: 083-93287.620	DRILLING DATE: 5/3&4/10	AZIMUTH: N/A	INCLINATION: -90
LOCATION: North Mansion Parking Lot	DRILL RIG: BK 81 Truck	COORDINATES: N: 630,571.39 E: 1,040,414.66	

BORING METHOD: 6-inch outer diameter mud rotary w/ 140 lb auto hammer

SOIL PROFILE

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)
40	39.5 - 48.3 Compact, banded tan and gray, non-stratified to crudely bedded, SILT, trace thinly bedded fine sand seams at the top of the sample, damp, (ML) (VASHON RECESSIONAL DEPOSITS) *(Continued)*	ML	
	48.3 - 53.3 Hard/very dense, banded gray to tan, crudely bedded to thinly laminated, sandy SILT and silty fine SAND, damp to moist, (ML/SM) (VASHON DEPOSITS) 1/4-inch thick organic silt layer at 51 ft.	ML/SM	64.7 48.3
	53.3 - 58.3 Dense, tan gray, iron oxide stained layers, crudely bedded, SILT, with some sandy silt layers, damp to moist, (ML) (POSSIBLE PRE-VASHON DEPOSITS)	ML	59.7 53.3
60	58.3 - 63.3 Dense, tan to tan gray, scattered iron oxide stained layers, thinly laminated, sandy SILT, damp, (ML) (POSSIBLE PRE-VASHON DEPOSITS) #200 WASH	ML	54.7 58.3

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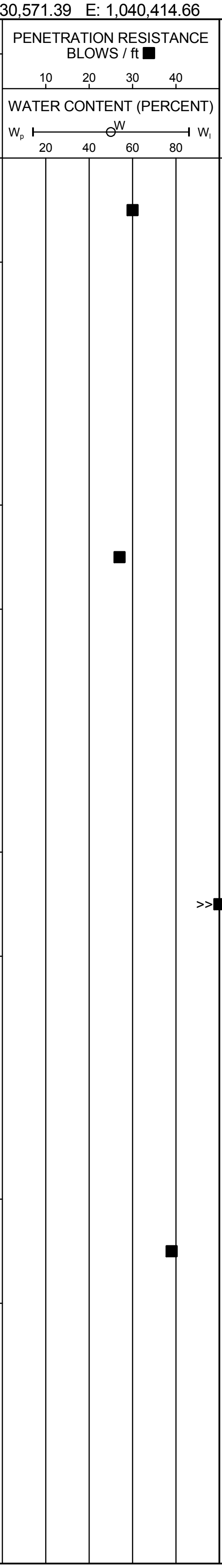
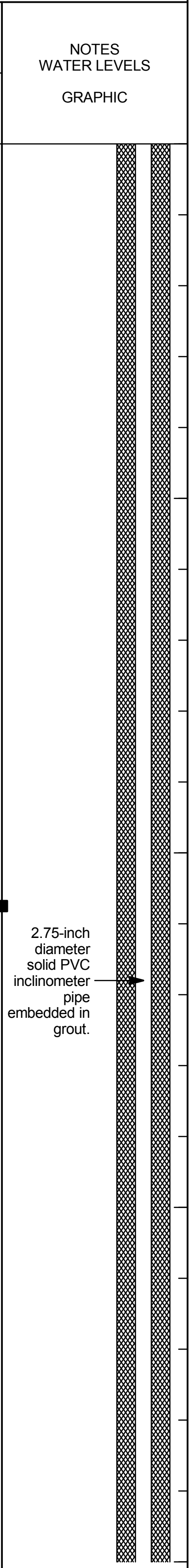
SAMPLES

NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
16	SPT	10-15-15	30	1.5/1.5
17	SPT	8-12-15	27	1.5/1.5
18	SPT	10-30-33	>50	1.5/1.5
19	SPT	11-18-21	39	1.5/1.5





2.75-inch diameter solid PVC inclinometer pipe embedded in grout.

1 in to 3 ft	LOGGED: J. deLaChapelle
DRILLING CONTRACTOR: Holocene Drilling	CHECKED: D. Findley
DRILLER: J. Thompson	DATE: 6/22/2010

Golder Associates

RECORD OF BOREHOLE GB-5

SHEET 4 of 6

PROJECT: WAGA/Hillside Eval. 2010
PROJECT NUMBER: 083-93287.620
LOCATION: North Mansion Parking Lot

DRILLING METHOD: Mud Rorary
DRILLING DATE: 5/3&4/10
DRILL RIG: BK 81 Truck

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 630,571.39 E: 1,040,414.66

ELEVATION: 112.9
INCLINATION: -90

BORING METHOD: 6-inch outer diameter mud rotary w/ 140 lb auto hammer

DEPTH (ft)	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	NOTES WATER LEVELS
60	58.3 - 63.3 Dense, tan to tan gray, scattered iron oxide stained layers, thinly laminated, sandy SILT, damp, (ML) (POSSIBLE PRE-VASHON DEPOSITS) #200 WASH *(Continued)*	ML		20	SPT	14-19-21	40	1.5/1.5	
	63.3 - 70.0 Dense, gray to grayish tan, non-stratified to crudely bedded, silt, trace coarse sand, trace coarse gravel, moist to damp, (ML) (POSSIBLE PRE-VASHON RECESSIONAL DEPOSITS)	ML	49.7 63.3						
65				21	SPT	9-14-17	31	1.5/1.5	
70	70.0 - 72.5 NO RECOVERY		42.9 70.0	22	SPT	10-16-24	40	0.0/1.5	
	72.5 - 77.0 Very dense, speckeled, white, gray, black, brown, non-stratified, silty fine to coarse SAND, some GRAVEL, damp, (GP) (PRE-VASHON DEPOSITS)	GP	40.4 72.5						
75				23	SPT	42-50/4	>50	0.8/0.8	
	77.0 - 88.3 Very dense, tan, scattered iron oxide stained layers, crudely laminated, silty, fine SAND, damp, (SM) (PRE-VASHON DEPOSITS)	SM	35.9 77.0						Easier drilling below 77 ft, as reported by driller.
80									

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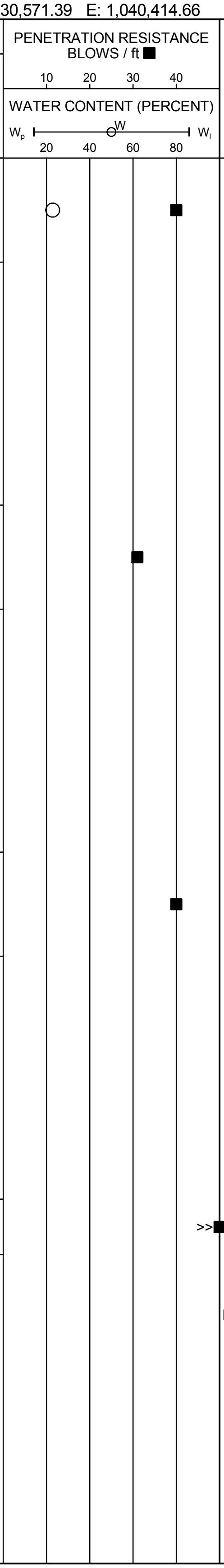

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: J. Thompson

LOGGED: J. deLaChapelle
CHECKED: D. Findley
DATE: 6/22/2010

Golder Associates

RECORD OF BOREHOLE GB-5

SHEET 5 of 6

PROJECT: WAGA/Hillside Eval. 2010
PROJECT NUMBER: 083-93287.620
LOCATION: North Mansion Parking Lot

DRILLING METHOD: Mud Rorary
DRILLING DATE: 5/3&4/10
DRILL RIG: BK 81 Truck

DATUM: Geodetic
AZIMUTH: N/A
COORDINATES: N: 630,571.39 E: 1,040,414.66

ELEVATION: 112.9
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40); WATER CONTENT (PERCENT) Wp —○W— Wl (20 40 60 80)	NOTES WATER LEVELS GRAPHIC
80	6-inch outer diameter mud rotary w/ 140 lb auto hammer	77.0 - 88.3 Very dense, tan, scattered iron oxide stained layers, crudely laminated, silty, fine SAND, damp, (SM) (PRE-VASHON DEPOSITS) *(Continued)*	SM		24	SPT	19-35-37	>50	1.5/1.5	>>■	
85					25	SPT	29-31-27	>50	1.5/1.5	>>■	
		88.3 - 93.3 Very dense/hard, grayish tan, non-stratified to thinly laminated, silty fine SAND and sandy, SILT, damp, (SM/ML) (PRE-VASHON DEPOSITS) #200 WASH	SM/ML	24.7 88.3							
90					26	SPT	22-26-33	>50	1.5/1.5	○ >>■	
		93.3 - 98.3 Very dense, grayish tan, non-stratified, fine SAND, damp, (SP) (PRE-VASHON DEPOSITS)	SP	19.7 93.3							
95					27	SPT	26-27-29	>50	1.5/1.5	>>■	
		98.3 - 102.3 Very dense/hard, tan gray, crudely stratifed, 2-inch to 4-inch beds, silty fine SAND and sandy SILT, with 2-inch thick light tan, clay lens at 100.5 ft, damp, (SM/ML) (PRE-VASHON DEPOSITS)	SM/ML	14.7 98.3							
100		Log continued on next page									

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: J. Thompson

LOGGED: J. deLaChapelle
CHECKED: D. Findley
DATE: 6/22/2010

Golder Associates

RECORD OF BOREHOLE GB-5

SHEET 6 of 6

PROJECT: WAGA/Hillside Eval. 2010	DRILLING METHOD: Mud Rorary	DATUM: Geodetic	ELEVATION: 112.9
PROJECT NUMBER: 083-93287.620	DRILLING DATE: 5/3&4/10	AZIMUTH: N/A	INCLINATION: -90
LOCATION: North Mansion Parking Lot	DRILL RIG: BK 81 Truck	COORDINATES: N: 630,571.39 E: 1,040,414.66	

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ 10 20 30 40 WATER CONTENT (PERCENT) W_p W W_l 20 40 60 80	NOTES WATER LEVELS GRAPHIC
100		98.3 - 102.3 Very dense/hard, tan gray, crudely stratifed, 2-inch to 4-inch beds, silty fine SAND and sandy SILT, with 2-inch thick light tan, clay lens at 100.5 ft, damp, (SM/ML) (PRE-VASHON DEPOSITS) *(Continued)*	SM/ML		10.7 102.3	28	SPT	17-43-46	>50	1.5/1.5	>>■	Bentonite/cement grout.
		102.3 - 103.5 Very dense, gray tan, minor iron oxide staining, fine SAND, little to trace silt, trace to little fine gravel, damp, (SP-SM) (PRE-VASHON DEPOSITS)	SP-SM		9.4 103.5	29	SPT	50/4	>50	0.4/0.4	>>■	
		Boring completed at 103.5 ft.										
105												
110												
115												
120												

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: J. Thompson

LOGGED: J. deLaChapelle
CHECKED: D. Findley
DATE: 6/22/2010

Golder Associates

A-2
OTHER INSTRUMENTATION

Unified Soil Classification System (USCS)

Criteria for Assigning Group Symbols and Names			Soil Classification Generalized Group Descriptions	
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve	GRAVELS More than 50% of coarse fraction retained on No. 4 Sieve	CLEAN GRAVELS Less than 5% fines	GW	Well-graded Gravels
			GP	Poorly-graded gravels
		GRAVELS WITH FINES More than 12% fines	GM	Gravel and Silt Mixtures
			GC	Gravel and Clay Mixtures
	SANDS 50% or more of coarse fraction passes No. 4 Sieve	CLEAN SANDS Less than 5% fines	SW	Well-graded Sand
			SP	Poorly-graded Sand
		SANDS WITH FINES More than 12% fines	SM	Silty Sand
			SC	Clayey Sand
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	SILTS AND CLAYS Liquid limit less than 50	INORGANIC	CL	Low-plasticity Clays
			ML	Non-plastic and Low-Plasticity Silts
		ORGANIC	OL	Organic Silts and Clays, liquid limit less than 50
	SILTS AND CLAYS Liquid limit greater than 50	INORGANIC	CH	High-plasticity Clays
			MH	Elastic Silts
		ORGANIC	OH	Organic Silts and Clays, liquid limit greater than 50
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat

Based on: ASTM D2487-06

Component Definitions by Gradation

Component	Size Range
Boulders	Above 12 in.
Cobbles	3 in. to 12 in.
Gravel	3 in. to No. 4 (4.76mm)
Coarse gravel	3 in. to 3/4 in.
Fine gravel	3/4 in. to No. 4 (4.76mm)
Sand	No. 4 (4.76mm) to No. 200 (0.074mm)
Coarse sand	No. 4 (4.76mm) to No. 10 (2.0mm)
Medium sand	No. 10 (2.0mm) to No. 40 (0.42mm)
Fine sand	No. 40 (0.42mm) to No. 200 (0.074mm)
Silt and Clay	Smaller than No. 200 (0.074mm)

Sample Types

Symbol	Description
SS	SPT Sampler (2.0" OD)
HD	Heavy Duty Split Spoon
SH	Shelby Tube
CA	California Sampler
B	Bulk
C	Cored
G	Grab
P	Pitcher Sampler

Laboratory Tests

Test	Designation
Moisture	(1)
Density	D
Grain Size	G
Hydrometer	H
Atterberg Limits	(1)
Consolidation	C
Unconfined	U
UU Triax	UU
CU Triax	CU
CD Triax	CD
Permeability	P

(1) Moisture and Atterberg Limits plotted on log.

Cohesionless Soils (a)		
Density	N, blows/ft.(c)	Relative Density (%)
Very loose	0 to 4	0 - 15
Loose	4 to 10	15 - 35
Compact	10 to 30	35 - 65
Dense	30 to 50	65 - 85
Very Dense	over 50	>85

Cohesive Soils(b)		
Consistency	N, blows/ft.(c)	Undrained Shear Strength (psf) (d)
Very soft	0 to 2	<250
Soft	2 to 4	250-500
Firm	4 to 8	500-1000
Stiff	8 to 15	1000-2000
Very Stiff	15 to 30	2000-4000
Hard	over 30	>4000

(a) Soils consisting of gravel, sand, and silt, either separately or in combination, possessing no characteristics of plasticity, and exhibiting drained behavior.
(b) Soils possessing the characteristics of plasticity, and exhibiting undrained behavior.
(c) Refer to text of ASTM D 1586-84 for a definition of N; in normally consolidated cohesionless soils. Relative Density terms are based on N values corrected for overburden pressures.
(d) Undrained shear strength = 1/2 unconfined compression strength.

Silt and Clay Descriptions

Description	Typical Unified Designation
Silt	ML (non-plastic)
Clayey Silt	CL-ML (low plasticity)
Silty Clay	CL
Clay	CH
Elastic Silt	MH
Organic Soils	OL, OH, Pt

Qualitative Descriptive Terminology for Moisture Content

Dry	No discernible moisture present
Damp	Enough moisture present to darken the appearance but no moisture on materials adheres to the hand
Moist	Will moisten the hand
Wet	Visible water present on materials

Descriptive Terminology Denoting Component Proportions

Descriptive Terms	Range of Proportion
Trace	0-5%
Little	5-12%
Some or Adjective (a)	12-30%
And	30-50%

(a) Use Gravelly, Sandy or Silty as appropriate.

SOIL CLASSIFICATION LEGEND

RECORD OF BOREHOLE GB-1

SHEET 1 of 6

PROJECT: WAGA/Hillside Evaluation
PROJECT NUMBER: 083-93287.300
LOCATION: Govenor's Mansion

DRILLING METHOD: Mud Rotary
DRILLING DATE: 5/28/09
DRILL RIG: B-61 Truck-Mounted

DATUM: Local
AZIMUTH: N/A
COORDINATES: N: 47.03 E: 122.91

ELEVATION: 145
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	NOTES WATER LEVELS
0	4-inch inner diameter mud rotary with 140 lbs auto hammer	0.0 - 2.0 Loose to compact, dark brown, non-stratified, silty fine to medium SAND, little fine to coarse gravel, some organics, damp (SM) (TOPSOIL/FILL).	SM							3-ft of inclinometer stick-up in monument. Concrete used to set monutment.
		2.0 - 4.5 Loose, yellow brown, heterogenous, fine SAND, little silt, trace medium sand, damp (SP-SM) (FILL) SIEVE	SP-SM	143.0 2.0	1	SS	3-3-4	7	1.5/1.5	
5		4.5 - 7.5 Loose, brown, heterogenous, fine to medium SAND, trace silt, moist to wet (SP) (FILL)	SP	140.5 4.5	2	SS	4-4-4	8	1.5/1.5	
		7.5 - 9.0 No recovery.		137.5 7.5	3	SS	1-2-4	6	0.1/1.5	
10		9.0 - 10.8 Firm, brown gray, non-stratified, SILT, trace fine to medium sand, trace iron-oxide stained pockets, moist (ML) (VASHON RECESSIONAL DEPOSITS)	ML	136.0 9.0	4	SS	2-4-5	9	1.5/1.5	
		10.8 - 12.0 Stiff, brown gray, non-stratified, sandy SILT, sand is fine, iron-oxide stained layers, moist (ML) (VASHON RECESSIONAL DEPOSITS) ATTERBERG	ML	134.2 10.8						
		12.0 - 13.3 Firm, brown gray, non-stratified, SILT, little fine sand, trace iron-oxide stained laminations, moist to wet (ML) (VASHON RECESSIONAL DEPOSITS) ATTERBERG	ML	133.0 12.0	5A 5B	SS	1-3-5	8	1.5/1.5	
15		13.3 - 17.0 Loose to compact, brown gray, non-stratified, sandy SILT, sand is fine, trace iron-oxide staining, moist (ML) (VASHON RECESSIONAL DEPOSITS) #200 WASH	ML	131.7 13.3	6	SS	4-6-8	14	1.5/1.5	
		17.0 - 19.5 Very stiff, brown gray, slightly stratified, SILT, little fine sand, iron-oxide staining, moist (ML) (VASHON RECESSIONAL DEPOSITS) #200 WASH	ML	128.0 17.0	7	SS	6-8-8	16	0.3/1.5	
20			ML	125.5 19.5						

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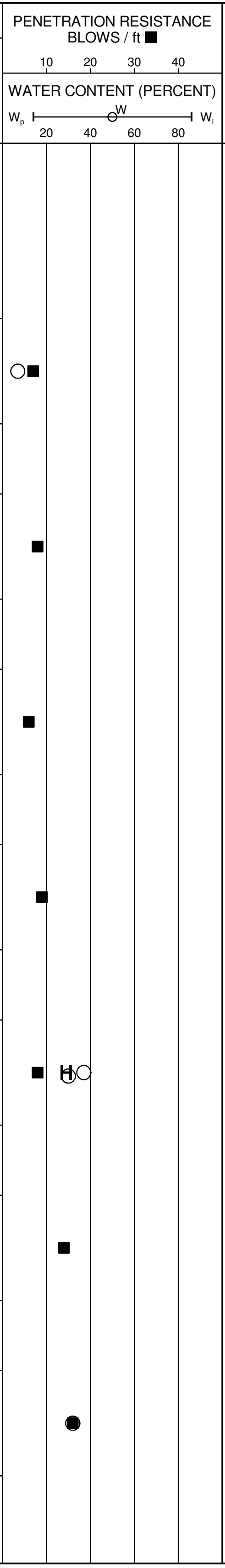


1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: Matt Graham

LOGGED: A. Dennison
CHECKED: D. Ladd
DATE: 8/3/2009

RECORD OF BOREHOLE GB-1

SHEET 2 of 6

PROJECT: WAGA/Hillside Evaluation
PROJECT NUMBER: 083-93287.300
LOCATION: Govenor's Mansion

DRILLING METHOD: Mud Rotary
DRILLING DATE: 5/28/09
DRILL RIG: B-61 Truck-Mounted

DATUM: Local
AZIMUTH: N/A
COORDINATES: N: 47.03 E: 122.91

ELEVATION: 145
INCLINATION: -90

BORING METHOD: 4-inch inner diameter mud rotary with 140 lbs auto hammer

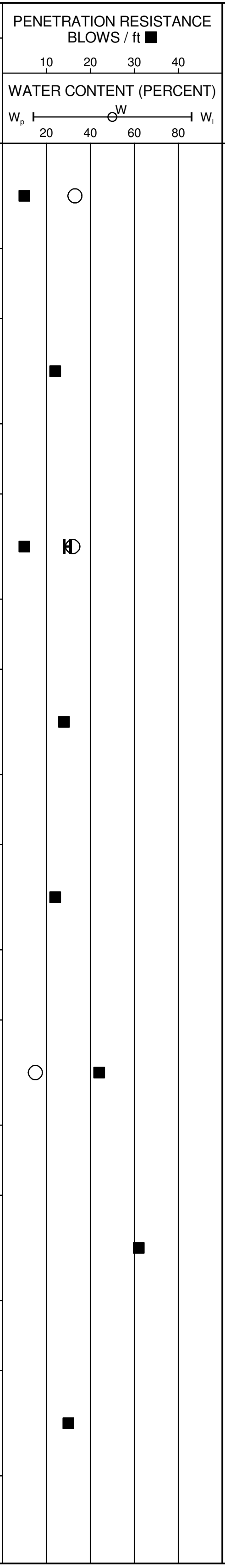
SOIL PROFILE

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)
20	19.5 - 22.0 Firm, brown gray, stratified, SILT, iron-oxide stained layers, moist (ML) (VASHON RECESSIONAL DEPOSITS) MOISTURE CONTENT *(Continued)*	ML	123.0 22.0
	22.0 - 24.5 Compact, brown gray, stratified, sandy SILT, sand is fine, 1-inch layers of clayey silt with trace fine gravel, moist (ML) (VASHON RECESSIONAL DEPOSITSF)	ML	120.5 24.5
25	24.5 - 29.0 Firm to stiff, brown gray, stratified, SILT, trace fine to coarse sand, trace iron-oxide staining, moist (ML) (VASHON RECESSIONAL DEPOSITS) ATTERBERG	ML	116.0 29.0
30	29.0 - 33.5 Compact, brown gray, stratified, fine SAND, little silt, clayey silt layers, trace iron-oxide staining layers, damp (SP-SM) (VASHON RECESSIONAL DEPOSITS) SIEVE	SP-SM	111.5 33.5
35	33.5 - 37.1 Compact to dense, light gray, non-stratified, fine to medium SAND, trace silt, damp (SP) (VASHON RECESSIONAL DEPOSITS)	SP	107.9 37.1
	37.1 - 39.5 Stiff, gray brown, stratified, SILT, little fine sand, trace iron-oxide staining, moist (ML) (VASHON RECESSIONAL DEPOSITS)	ML	105.5 39.5
40		ML	

Log continued on next page

SAMPLES

NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
8	SS	2-3-2	5	1.5/1.5
9	SS	6-5-7	12	1.1/1.5
10	SS	2-2-3	5	2.0/1.5
11	SS	5-5-9	14	1.5/1.5
12	SS	5-6-6	12	1.5/1.5
13	SS	3-10-12	22	1.5/1.5
14	SS	14-15-16	31	1.5/1.5
15	SS	5-9-6	15	1.5/1.5



NOTES
WATER LEVELS
GRAPHIC

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: Matt Graham

LOGGED: A. Dennison
CHECKED: D. Ladd
DATE: 8/3/2009

Golder Associates

RECORD OF BOREHOLE GB-1

SHEET 3 of 6

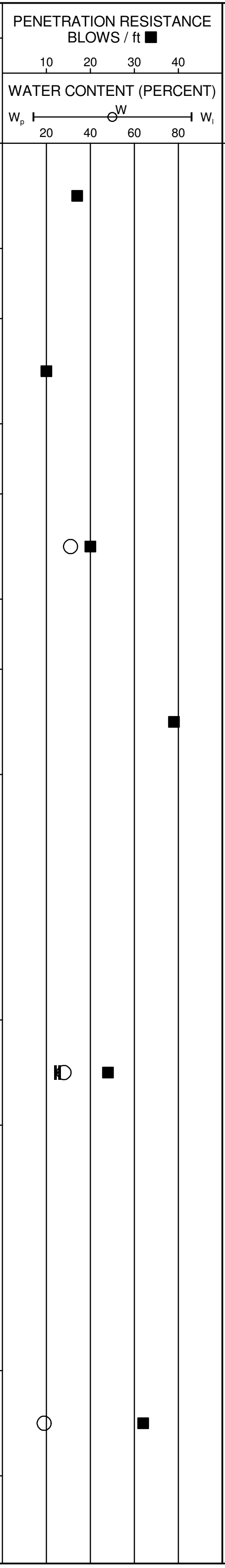
PROJECT: WAGA/Hillside Evaluation
PROJECT NUMBER: 083-93287.300
LOCATION: Govenor's Mansion

DRILLING METHOD: Mud Rotary
DRILLING DATE: 5/28/09
DRILL RIG: B-61 Truck-Mounted

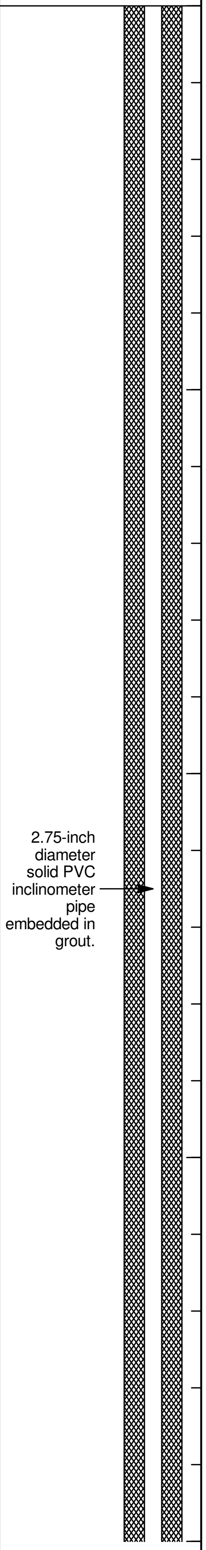
DATUM: Local
AZIMUTH: N/A
COORDINATES: N: 47.03 E: 122.91

ELEVATION: 145
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
40	4-inch inner diameter mud rotary with 140 lbs auto hammer	39.5 - 54.5 Stiff to hard, stratified, SILT, trace fine sand, strong iron-oxide staining in a narrow 2-inch layer with cemented iron-oxide stained fragments at 40.6 ft, moist (ML) (VASHON RECESSIONAL DEPOSITS) 45 ft - MOISTURE CONTENT 52.5 ft - ATTERBERG *(Continued)*	ML			16	SS	6-10-7	17	1.5/1.5
						17	SS	4-4-6	10	0.0/1.5
45						18	SS	9-9-11	20	1.5/1.5
						19	SS	10-15-24	39	1.5/1.5
50						20	SS	9-10-14	24	1.5/1.5
					90.5 54.5					
55			SM			21	SS	10-15-17	32	1.5/1.5
60		Log continued on next page								



NOTES
WATER LEVELS
GRAPHIC



1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: Matt Graham

LOGGED: A. Dennison
CHECKED: D. Ladd
DATE: 8/3/2009

Golder Associates

RECORD OF BOREHOLE GB-1

SHEET 4 of 6

PROJECT: WAGA/Hillside Evaluation
PROJECT NUMBER: 083-93287.300
LOCATION: Govenor's Mansion

DRILLING METHOD: Mud Rotary
DRILLING DATE: 5/28/09
DRILL RIG: B-61 Truck-Mounted

DATUM: Local
AZIMUTH: N/A
COORDINATES: N: 47.03 E: 122.91

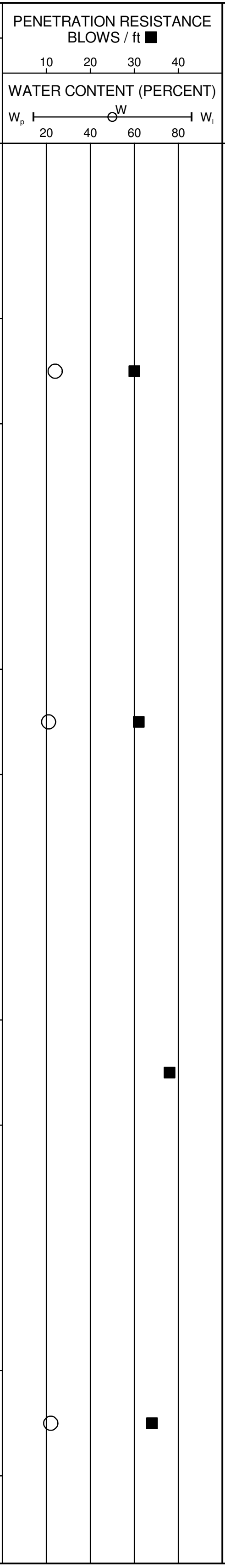
ELEVATION: 145
INCLINATION: -90

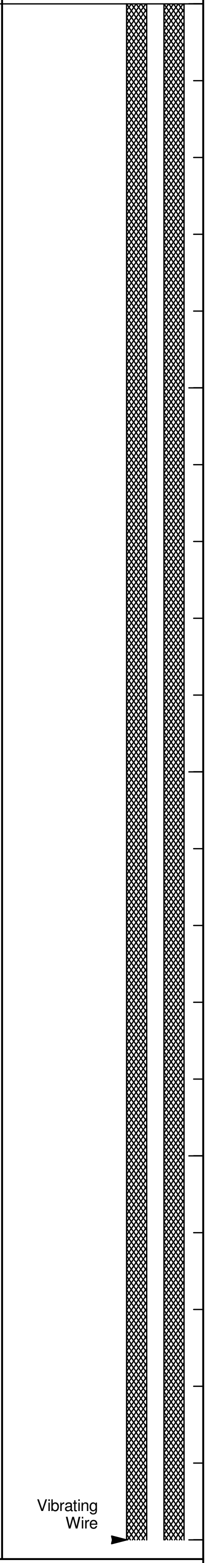
BORING METHOD: 4-inch inner diameter mud rotary with 140 lbs auto hammer

DEPTH (ft)	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH (ft)
60	54.5 - 61.0 Compact, brown gray, stratified, fine SAND and SILT, moist (SM) (VASHON RECESSIONAL DEPOSITS) SIEVE *(Continued)*	SM	84.0 61.0
	61.0 - 66.0 Hard, dark gray brown, non-stratified, SILT, some fine sand, moist (ML) (VASHON RECESSIONAL DEPOSITS) #200 WASH	ML	79.0 66.0
	66.0 - 81.0 Dense, dark gray brown, non-stratified, silty fine SAND, trace medium sand, moist (SM) (POSSIBLE VASHON RECESSIONAL DEPOSITS) SIEVE	SM	
80	Log continued on next page		

SAMPLES (BLOWS per 6 in: 140 lb hammer, 30 inch drop)

NUMBER	TYPE	BLOWS per 6 in	N	REC / ATT
22	SS	11-14-16	30	1.5/1.5
23	SS	12-14-17	31	1.5/1.5
24	SS	15-17-21	38	1.0/1.5
25	SS	13-15-19	34	1.0/1.5




NOTES
WATER LEVELS
GRAPHIC

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: Matt Graham

LOGGED: A. Dennison
CHECKED: D. Ladd
DATE: 8/3/2009

Golder Associates

RECORD OF BOREHOLE GB-1

SHEET 5 of 6

PROJECT: WAGA/Hillside Evaluation
PROJECT NUMBER: 083-93287.300
LOCATION: Govenor's Mansion

DRILLING METHOD: Mud Rotary
DRILLING DATE: 5/28/09
DRILL RIG: B-61 Truck-Mounted

DATUM: Local
AZIMUTH: N/A
COORDINATES: N: 47.03 E: 122.91

ELEVATION: 145
INCLINATION: -90

Boring method: 4-inch inner diameter mud rotary with 140 lbs auto hammer

DEPTH (ft)	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■	NOTES WATER LEVELS GRAPHIC
80		SM	64.0 / 81.0							Piezometer set 80 ft bgs in grout.
	81.0 - 86.0 Dense, dark gray brown, slightly stratified, silty fine SAND, moist (SM) (POSSIBLE VASHON RECESSIONAL OR PRE-VASHON DEPOSITS)	SM	59.0 / 86.0	26	SS	15-18-26	44	1.5 / 1.5	■	Driller noted softer drilling from 83 to 85 ft bgs.
85										
	86.0 - 88.0 Hard, red yellow brown, stratified, SILT, trace coarse gravel, trace fine to medium sand, socketing, moist (ML) (PRE-VASHON DEPOSITS)	ML	57.0 / 88.0							
	88.0 - 91.0 Very dense, dark gray brown, slightly stratified, fine to medium SAND, trace silt, moist (SP) (PRE-VASHON DEPOSITS)	SP	54.0 / 91.0	27	SS	14-28-35	>50	1.5 / 1.5	>>■	
90										
	91.0 - 96.0 Very dense, dark gray brown, non-stratified, silty fine to coarse SAND, trace fine to coarse gravel, socketing, moist (GM) (PRE-VASHON DEPOSITS)	GM	49.0 / 96.0	28	SS	50/6"	>50	0.3 / 0.5	>>■	Driller noted drilling through gravels.
95										
	96.0 - 101.0 Hard, gray to light gray, slightly stratified, SILT, trace iron-oxide stained layers, trace white gray silt layers, trace fine to medium sand, damp (ML) (PRE-VASHON DEPOSITS)	ML		29	SS	25-27-30	>50	1.5 / 1.5	>>■	
100										

PENETRATION RESISTANCE scale: 10 20 30 40
WATER CONTENT (PERCENT): W_p — W — W_l; 20 40 60 80

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1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: Matt Graham

LOGGED: A. Dennison
CHECKED: D. Ladd
DATE: 8/3/2009

Golder Associates

RECORD OF BOREHOLE GB-1

SHEET 6 of 6

PROJECT: WAGA/Hillside Evaluation
PROJECT NUMBER: 083-93287.300
LOCATION: Govenor's Mansion

DRILLING METHOD: Mud Rotary
DRILLING DATE: 5/28/09
DRILL RIG: B-61 Truck-Mounted

DATUM: Local
AZIMUTH: N/A
COORDINATES: N: 47.03 E: 122.91

ELEVATION: 145
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40); WATER CONTENT (PERCENT) Wp ⊢—○W—⊣ Wl (20 40 60 80)	NOTES WATER LEVELS GRAPHIC
100			ML		44.0 101.0							
		101.0 - 102.9 Very dense, light gray to gray to lavender, non-stratified, fine to medium SAND, trace silt, moist (SP) (PRE-VASHON DEPOSITS, QPS)	SP		42.1 102.9	30	SS	50/5"	>50	0.3 0.4	>>■	Grout backfill.
		Boring completed at 102.9 ft.										
105												
110												
115												
120												

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: Matt Graham

LOGGED: A. Dennison
CHECKED: D. Ladd
DATE: 8/3/2009

Golder Associates

RECORD OF BOREHOLE GB-2

SHEET 1 of 6

PROJECT: WAGA/Hillside Evaluation
PROJECT NUMBER: 083-93287.300
LOCATION: Pritchard Building

DRILLING METHOD: Mud Rotary
DRILLING DATE: 5/26&27/09
DRILL RIG: B-61 Truck-Mounted

DATUM: Local
AZIMUTH: N/A
COORDINATES: N: 47.04 E: 122.91

ELEVATION: 133
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	ELEV.	DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	NOTES WATER LEVELS
0	4-inch inner diameter mud rotary with 140 lbs auto hammer	0.0 - 1.5 Loose to compact, dark brown, non-stratified, silty fine to medium SAND, some organics, damp (SM) (TOPSOIL/FILL).	SM	131.5							Inclinometer set in flush-mount monument. Concrete used to set monutment.
		1.5 - 4.5 Stiff, brown gray, heterogenous, sandy SILT, sand is fine to coarse, some fine to coarse gravel, iron-oxide stained pockets, trace organic fragments, moist (ML) (FILL) SIEVE	ML	128.5	1.5	1	SS	6-7-7	14	1.5/1.5	
5		4.5 - 7.0 Firm, gray, stratified, SILT, iron-oxide stained and fine to coarse sand layers, trace fine gravel, moist (ML) (VASHON RECESSIONAL DEPOSITS) ATTERBERG	ML	126.0	4.5	2	SS	2-4-3	7	1.5/1.5	
		7.0 - 9.5 Firm/loose, brown gray, stratified, SILT and silty fine SAND, trace fine to coarse sand pockets, iron-oxide stained layers, trace fine gravel, damp to moist (ML/SM) (VASHON RECESSIONAL DEPOSITS) MOISTURE CONTENT	ML/SM	123.5	7.0	3	SS	2-4-4	8	1.5/1.5	
10		9.5 - 12.0 Loose, gray brown, stratified, silty fine to medium SAND, silt lenses, iron-oxide staining, moist (SM) (VASHON RECESSIONAL DEPOSITS)	SM	121.0	9.5	4	SS	2-3-6	9	1.0/1.5	
		12.0 - 14.5 Stiff, red brown, stratified, SILT, some fine sand, iron-oxide stained layers, moist (ML) (VASHON RECESSIONAL DEPOSITS) SIEVE	ML	118.5	12.0	5	SS	2-5-5	10	1.3/1.5	
15		14.5 - 17.0 Very soft to soft, stratified, SILT, trace iron-oxide stained lenses, trace coarse sand, moist (ML) (VASHON RECESSIONAL DEPOSITS) ATTERBERG	ML	116.0	14.5	6	SS	2-1-1	2	1.5/1.5	
		17.0 - 19.5 Loose to compact, gray brown, stratified, silty fine to medium SAND, trace silt layers less than 1/4-inch thick, iron-oxide stained layers near 17.5 ft, moist (SM) (VASHON RECESSIONAL DEPOSITS)	SM	113.5	17.0	7	SS	2-4-6	10	1.5/1.5	
20			ML		19.5						

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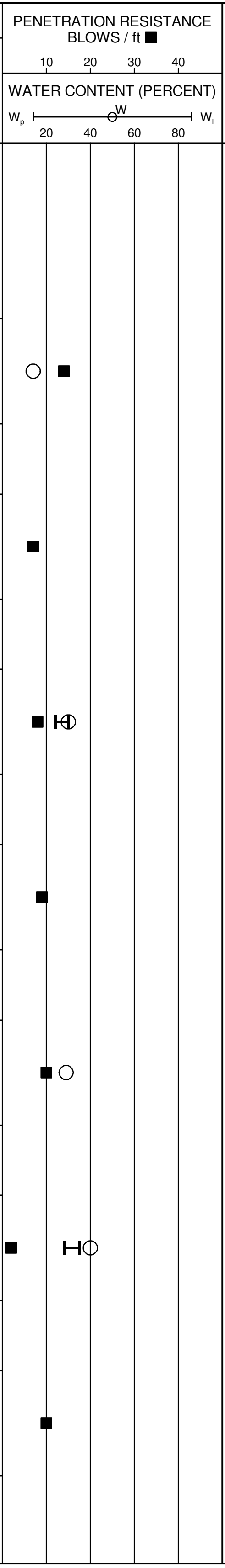
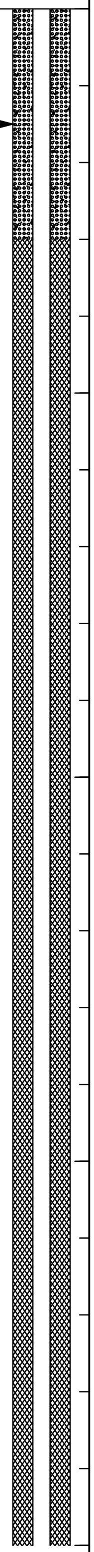




1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: Matt Graham

LOGGED: A. Dennison
CHECKED: D. Ladd
DATE: 8/3/2009

RECORD OF BOREHOLE GB-2

SHEET 2 of 6

PROJECT: WAGA/Hillside Evaluation
PROJECT NUMBER: 083-93287.300
LOCATION: Pritchard Building

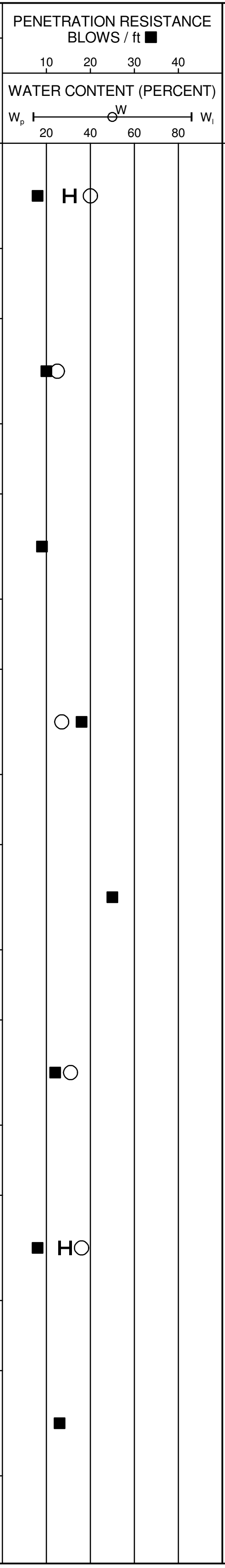
DRILLING METHOD: Mud Rotary
DRILLING DATE: 5/26&27/09
DRILL RIG: B-61 Truck-Mounted

DATUM: Local
AZIMUTH: N/A
COORDINATES: N: 47.04 E: 122.91

ELEVATION: 133
INCLINATION: -90

BORING METHOD: 4-inch inner diameter mud rotary with 140 lbs auto hammer

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
20	19.5 - 22.0 Firm, gray brown, stratified, SILT, trace silt layers less than 1/4-inch thick, iron-oxide stained layers near 20 ft, moist (ML) (VASHON RECESSIONAL DEPOSITS) 20-ATTERBERG *(Continued)*	ML		8	SS	1-3-5	8	1.5/1.5
	22.0 - 27.0 Loose to compact, brown gray, slightly stratified, sandy SILT, sand is fine to medium, trace iron-oxide stained partings, moist (ML) (VASHON RECESSIONAL DEPOSITS) #200 WASH	ML	111.0 22.0	9	SS	4-4-6	10	1.5/1.5
25				10	SS	4-5-4	9	1.5/1.5
	27.0 - 32.0 Compact, brown gray, slightly stratified, fine to medium SAND, little silt, iron-oxide stained layers, dark brown organic layers, damp to moist (SP-SM) (VASHON RECESSIONAL DEPOSITS) MOISTURE CONTENT	SP-SM	106.0 27.0	11	SS	4-9-9	18	1.5/1.5
30				12	SS	11-13-12	25	1.2/1.5
	32.0 - 38.5 Firm to stiff, gray brown, stratified, SILT, little fine sand, moist (ML) (VASHON RECESSIONAL DEPOSITS) 32.5-#200 WASH 35- ATTERBERG	ML	101.0 32.0	13	SS	6-6-6	12	1.5/1.5
35				14	SS	2-3-5	8	1.5/1.5
				15	SS	2-4-9	13	1.5/1.5
	38.5 - 39.5 Stiff, light gray, stratified, SILT, trace fine sand, trace iron-oxide stained hard silt layers up to 1/4-inch thick, moist (ML) (VASHON RECESSIONAL DEPOSITS)	ML	94.5 38.5					
40		SM	93.5 39.5					



NOTES WATER LEVELS GRAPHIC

Log continued on next page

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: Matt Graham

LOGGED: A. Dennison
CHECKED: D. Ladd
DATE: 8/3/2009

Golder Associates

RECORD OF BOREHOLE GB-2

SHEET 3 of 6

PROJECT: WAGA/Hillside Evaluation
PROJECT NUMBER: 083-93287.300
LOCATION: Pritchard Building

DRILLING METHOD: Mud Rotary
DRILLING DATE: 5/26&27/09
DRILL RIG: B-61 Truck-Mounted

DATUM: Local
AZIMUTH: N/A
COORDINATES: N: 47.04 E: 122.91

ELEVATION: 133
INCLINATION: -90

BORING METHOD: 4-inch inner diameter mud rotary with 140 lbs auto hammer

SOIL PROFILE

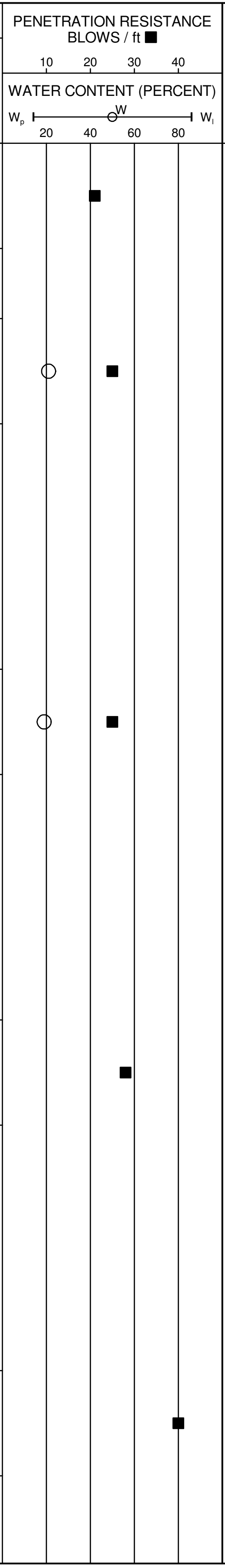
DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)
40	39.5 - 56.0 Compact, brown gray, slightly stratified, silty fine SAND, trace iron-oxide stained layers, moist (SM) (VASHON RECESSIONAL DEPOSITS) 42.5- MOISTURE CONTENT 47.5- SIEVE *(Continued)*	SM	
45			
50			
	-1-inch thick clayey silt layer with trace fine to coarse gravel, socketed.		
55			77.0 56.0
	56.0 - 61.0 Hard, brown gray, stratified, SILT, silty fine to medium sand layers 1 to 3 inches thick, iron-oxide stained layers, moist (ML) (VASHON RECESSIONAL DEPOSITS)	ML	
60	Log continued on next page		

SAMPLES

NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
16	SS	5-9-12	21	1.5/1.5
17	SS	10-11-14	25	1.5/1.5
18	SS	10-12-13	25	1.5/1.5
19	SS	12-13-15	28	1.5/1.5
20	SS	5-12-28	40	1.5/1.5

PENETRATION RESISTANCE BLOWS / ft ■

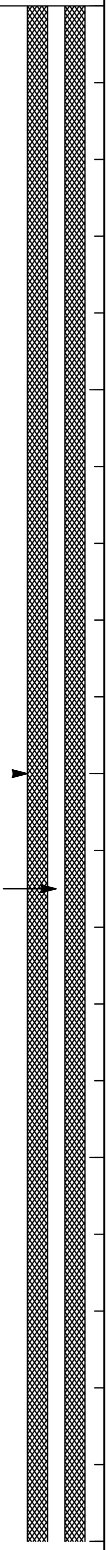
WATER CONTENT (PERCENT)



NOTES WATER LEVELS GRAPHIC

Vibrating Wire Piezometer set 50 ft bgs in grout.

2.75-inch diameter solid PVC inclinometer pipe embedded in grout.



1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: Matt Graham

LOGGED: A. Dennison
CHECKED: D. Ladd
DATE: 8/3/2009

Golder Associates

RECORD OF BOREHOLE GB-2

SHEET 4 of 6

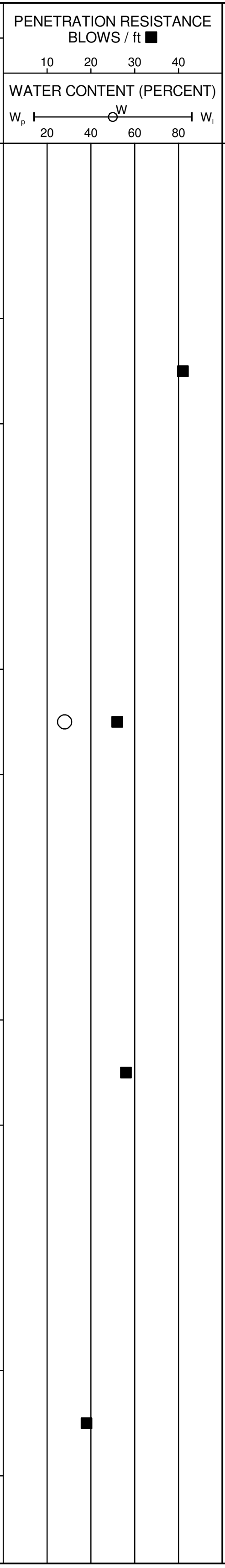
PROJECT: WAGA/Hillside Evaluation
PROJECT NUMBER: 083-93287.300
LOCATION: Pritchard Building

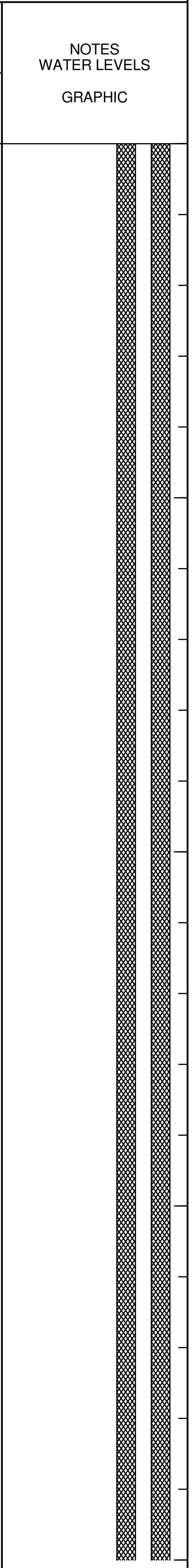
DRILLING METHOD: Mud Rotary
DRILLING DATE: 5/26&27/09
DRILL RIG: B-61 Truck-Mounted

DATUM: Local
AZIMUTH: N/A
COORDINATES: N: 47.04 E: 122.91

ELEVATION: 133
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT
60	4-inch inner diameter mud rotary with 140 lbs auto hammer		ML							
		61.0 - 71.0 Very stiff to hard, brown gray, slightly stratified, SILT, little fine sand, clayey silt layers, moist (ML) (VASHON RECESSIONAL DEPOSITS) 67.5- MOISTURE CONTENT	ML		72.0 61.0					
						21	SS	15-19-22	41	1.5/1.5
65										
						22	SS	9-13-13	26	1.5/1.5
70										
		71.0 - 77.5 Very stiff, brown gray, stratified, SILT, little fine sand, iron-oxide staining layers up to 1/4-inch thick, moist (ML) (VASHON RECESSIONAL DEPOSITS)	ML		62.0 71.0					
						23	SS	8-12-16	28	1.5/1.5
75										
		77.5 - 79.0 No recovery.			55.5 77.5	24	SS	6-8-11	19	0.0/1.5
			ML		54.0 79.0					
80		Log continued on next page								





1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: Matt Graham

LOGGED: A. Dennison
CHECKED: D. Ladd
DATE: 8/3/2009

Golder Associates

RECORD OF BOREHOLE GB-2

SHEET 5 of 6

PROJECT: WAGA/Hillside Evaluation
PROJECT NUMBER: 083-93287.300
LOCATION: Pritchard Building

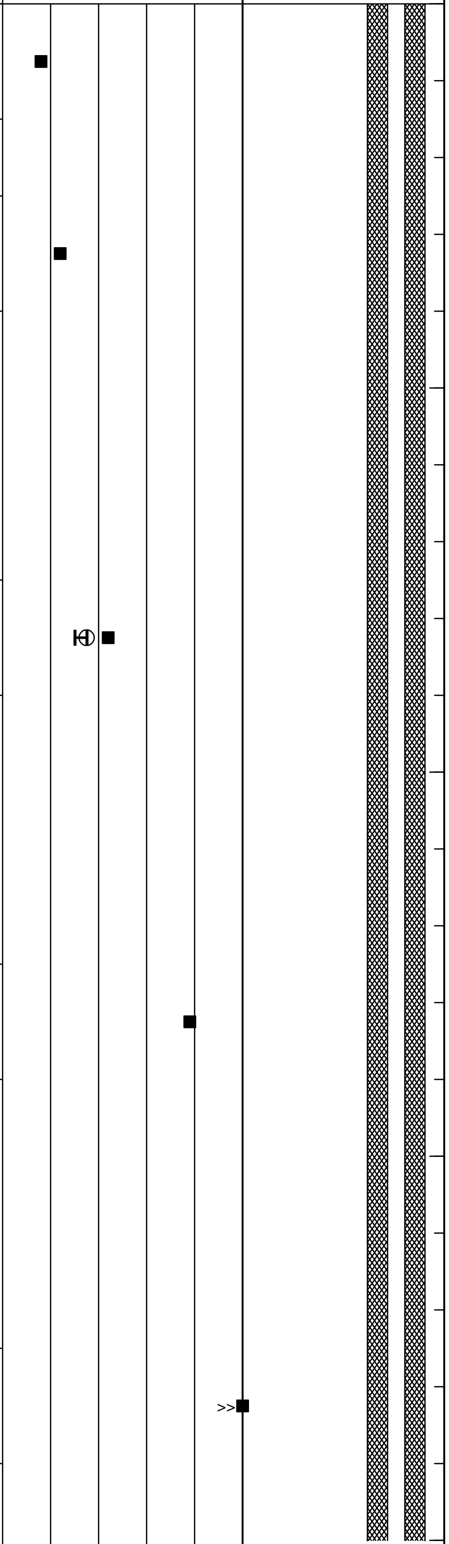
DRILLING METHOD: Mud Rotary
DRILLING DATE: 5/26&27/09
DRILL RIG: B-61 Truck-Mounted

DATUM: Local
AZIMUTH: N/A
COORDINATES: N: 47.04 E: 122.91

ELEVATION: 133
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
80	4-inch inner diameter mud rotary with 140 lbs auto hammer	79.0 - 91.0 Firm to very stiff, medium gray, stratified, SILT, little fine sand, iron-oxide staining layers up to 1/4-inch thick, moist (ML) (VASHON RECESSIONAL DEPOSITS) 82.5- MOISTURE CONTENT 87.5- ATTERBERG *(Continued)*	ML		24c	SS	3-4-4	8	1.5/1.5
					25	SS	2-4-8	12	1.5/1.5
85									
		-Became olive gray in color.			26	SS	0-7-15	22	1.5/1.5
90									
		91.0 - 96.0 Dense, green gray, stratified, fine to medium SAND, little silt, moist (SP-SM) (PRE-VASHON DEPOSITS)	SP-SM	42.0 91.0	27	SS	15-17-22	39	0.8/1.5
95									
		96.0 - 101.0 Very dense, green gray, stratified, fine to coarse SAND, little silt, trace fine gravel, moist (SP-SM) (PRE-VASHON DEPOSITS)	SP-SM	37.0 96.0	28	SS	27-30-30	>50	1.5/1.5
100		Log continued on next page							

PENETRATION RESISTANCE BLOWS / ft ■ — WATER CONTENT (PERCENT) — NOTES WATER LEVELS GRAPHIC



1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: Matt Graham

LOGGED: A. Dennison
CHECKED: D. Ladd
DATE: 8/3/2009

Golder Associates

RECORD OF BOREHOLE GB-2

SHEET 6 of 6

PROJECT: WAGA/Hillside Evaluation
PROJECT NUMBER: 083-93287.300
LOCATION: Pritchard Building

DRILLING METHOD: Mud Rotary
DRILLING DATE: 5/26&27/09
DRILL RIG: B-61 Truck-Mounted

DATUM: Local
AZIMUTH: N/A
COORDINATES: N: 47.04 E: 122.91

ELEVATION: 133
INCLINATION: -90

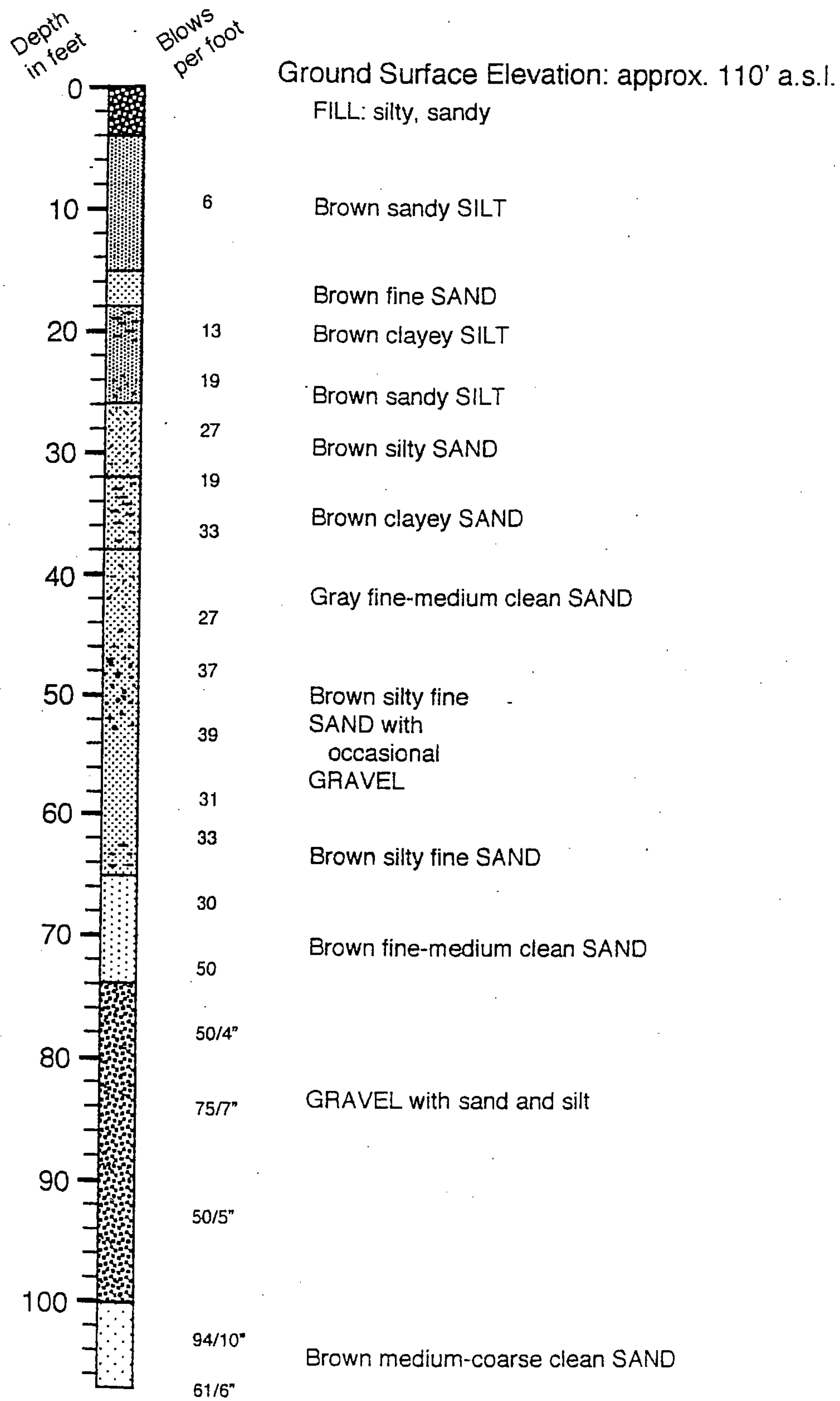
DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) WATER CONTENT (PERCENT) W_p —○W— W_l (20 40 60 80)	NOTES WATER LEVELS GRAPHIC
100		96.0 - 101.0 Very dense, green gray, stratified, fine to coarse SAND, little silt, trace fine gravel, moist (SP-SM) (PRE-VASHON DEPOSITS) *(Continued)*	SP-SM	32.0 101.0							
		101.0 - 104.0 Very dense, orange brown gray to gray, slightly stratified, fine to medium SAND, some fine gravel, socketing, moist (SM) (PRE-VASHON DEPOSITS)	SM	29.0 104.0	29	SS	30-32-50	>50	1.5 1.5	>>■	Grout backfill.
		Boring completed at 104.0 ft.									
105											
110											
115											
120											

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling
DRILLER: Matt Graham

LOGGED: A. Dennison
CHECKED: D. Ladd
DATE: 8/3/2009

Golder Associates

BORING NUMBER: DH-1
PROJECT: Capitol Campus Bluff Stability Investigation
DATE OF DRILLING: October 24, 1994



Bottom of Hole 107.0 feet

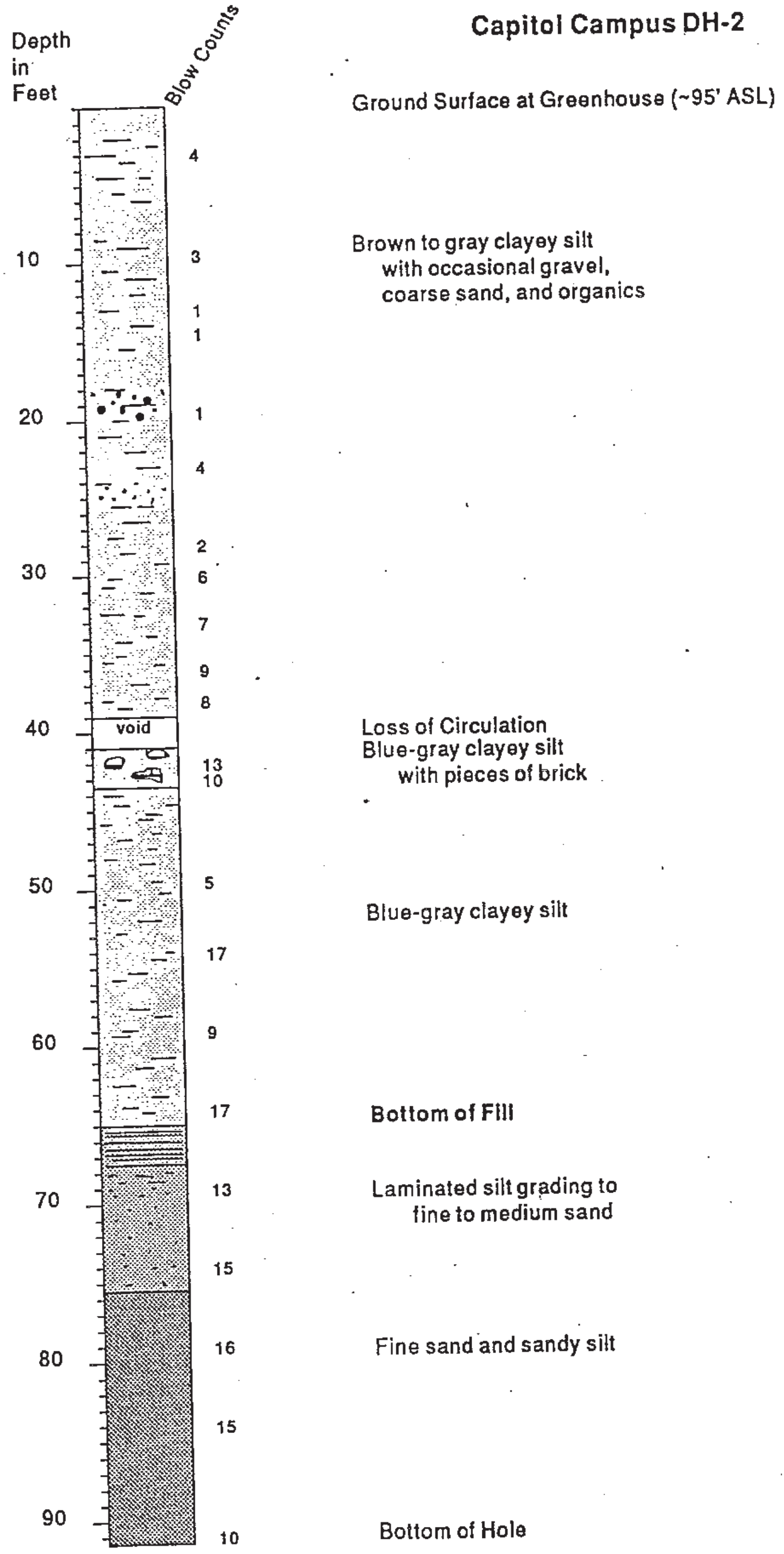


Figure 8 Boring log for DH-2, drilled in April, 1994, near the northwest corner of the Greenhouse building.

LOG OF TEST BORING

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

S.H. ____ S.R. NA SECTION Capitol Campus Job No. GC-8365

Hole No. J-1 Sub Section West of General Admin. Bldg--Slope Instability Cont. Sec. NA

Station Bottom of slide Offset ____ Ground El. Assumed 135'

Type of Boring Wash and Chop Casing 3" to 4' W.T. El. See bottom of log

Inspector ____ Date December 15, 1987 Sheet 1 of 2

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
	3		1 STD 1 PEN 2 1 3	SM, M.C. = 41.2% Very loose, brown, wet, very silty, fine SAND with roots and pieces of wood.
5	5		3 STD 2 PEN 3 2 2	Loose, brown, wet, gravelly, very silty, fine SAND with pieces of wood.
10	4		2 STD 2 PEN 2 3 2	SM, M.C. = 30.5% Very loose, brown and gray, wet, gravelly, very silty, fine SAND with roots.
15				
	7		2 STD 3 PEN 4 4 7	Loose, gray, wet, fine sandy, SILT, with orange streaks.
20	17		4 STD 5 PEN	ML, M.C. = 31.7% Medium dense, gray, wet, fine sandy SILT, with brown and

DOT FORM 351-003
REVISED 12/79

Original to Materials Engineer
Copy to Bridge Engineer
Copy to District Administrator

Copy to ____

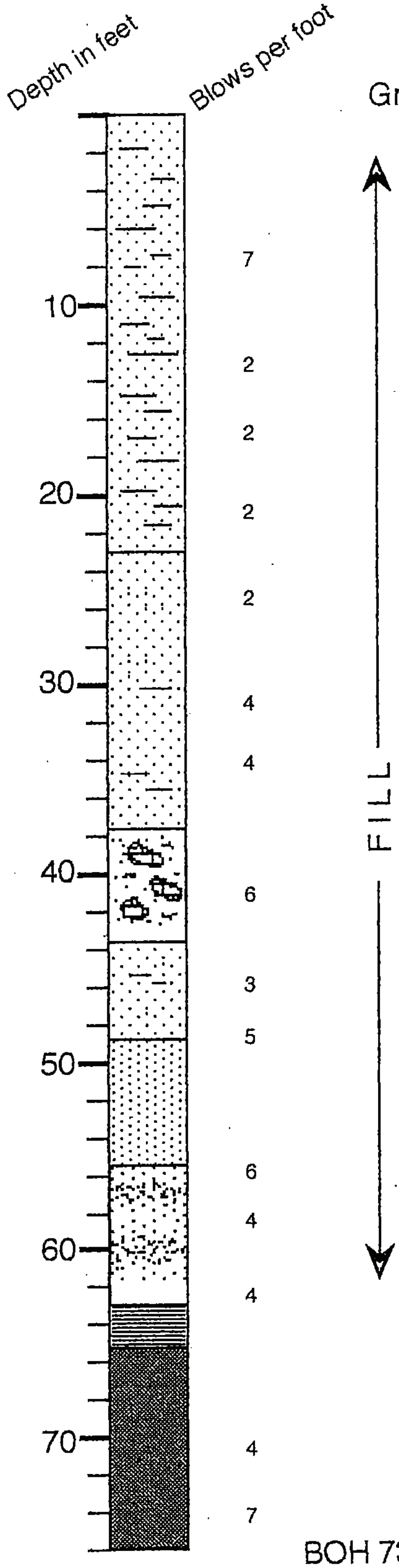
Hole No. J-1 Sub Section West of General Admin. Bldg--Slope Instability Sheet 2 of 2

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
			12 17 5	orange layers.
25	17		5 7 10 14 STD PEN 6	Medium dense, gray, moist, fine sandy SILT.
30	22		7 11 11 14 STD PEN 7	Medium dense, gray, moist, fine sandy SILT.
35	23		6 10 13 19 STD PEN 8	ML, M.C. = 27.6% Medium dense, gray, moist, fine sandy SILT.
				Test boring stopped 36' below ground elevation.
				34' of inclinometer pipe installed.
40				Water reading 1/5/88: 0' below ground elevation
				This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.

DOT FORM 351-003A REVISED 4/80

BORING NUMBER: DH-7
PROJECT: Capitol Campus Bluff Stability Investigation
DATE OF DRILLING: June 20, 1995

Ground Surface Elevation: ~95 ft ASL



Gray, wet/damp gravelly silty clay/clayey silt with some gravel, some organics, slightly sandy especially near bottom contact. At 17" two in. chunk weathered brick

Mottled gray-brown moist-wet clayey silt with some organics, some gravelly zones. Varies to silty clay.

Zone of water loss in drilling. Fine sandy silt with chunks of light-colored cement up to 1-2cm, crumbly.

Litght tan-brown, damp-wet clayey silt and fine sandy silt

1-3" zones of gray-green med. sands, sandy silt, silt, fine sand

Tan laminated sandy silt and moist, med-dense brown silty fine sand. NATIVE SOIL

BOH 73.0 FEET

Figure 6

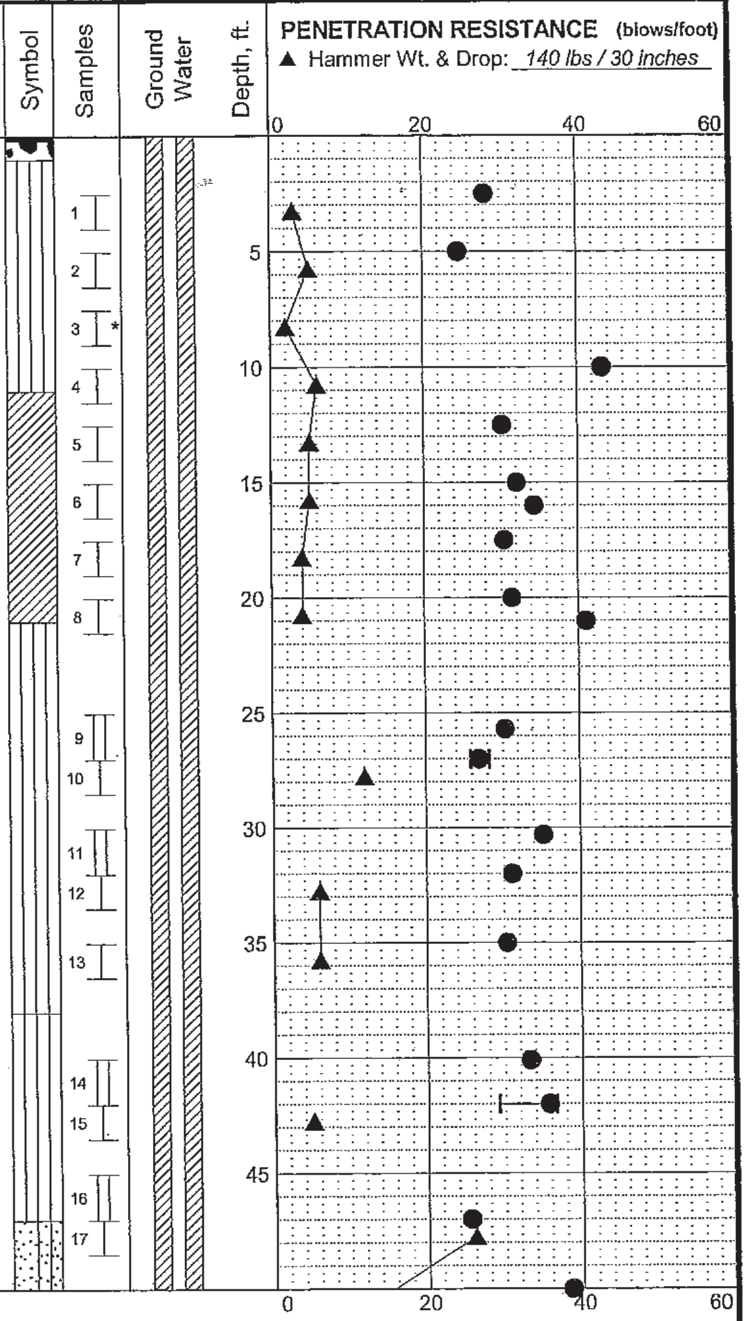
Total Depth:	*111.5 ft.*	Northing:		Drilling Method:	*Mud Rotary*	Hole Diam.:	*6 in.*
Top Elevation:	*~ 100 ft.*	Easting:		Drilling Company:	*Boart Longyear*	Rod Diam.:	*2*
Vert. Datum:		Station:		Drill Rig Equipment:	*Mobile B-59*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

SOIL DESCRIPTION	Depth, ft.
ASPHALT.	0.2
Crushed rock subbase; GW.	1.0
Soft to medium stiff, brown, clayey SILT, trace of gravel; moist; burnt wood debris at 5 feet and charcoal, brick, and glass debris at 10 feet; strong organic odor at 10 feet; (Fill) ML.	11.0
Medium stiff, gray and brown, stratified silty CLAY and clayey SILT; moist; mottled, scattered organics at 17.5 feet; (Fill) CL/ML.	21.0
Medium stiff, light brown, slightly fine sandy, clayey SILT; ML.	38.0
Medium stiff, light brown, clayey SILT with gray, fine sand seams; moist; ML.	47.0
Medium dense, gray, silty, fine SAND; moist; SP-SM.	

CONTINUED NEXT SHEET



◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

LEGEND

* Sample Not Recovered

I Split Spoon

II Thin Wall Sample

▦ Piezometer Screen and Sand Filter

▧ Bentonite-Cement Grout

⊠ Bentonite Chips/Pellets

▨ Bentonite Grout

∇ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured using a cloth tape from existing site features and should be considered approximate.

Heritage Center
Olympia, Washington

LOG OF BORING HC-2

October 2007 21-1-20767-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 3
Sheet 1 of 3

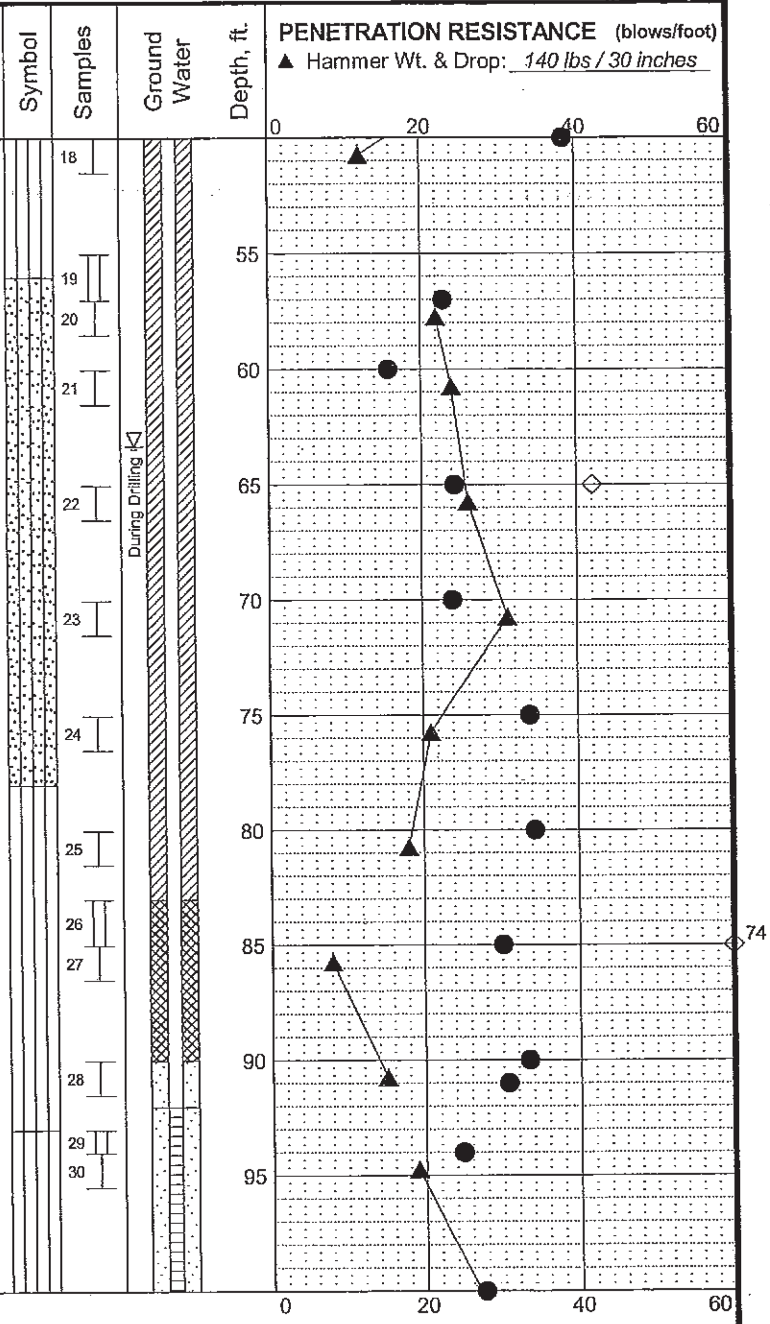
Total Depth:	111.5 ft.	Northing:		Drilling Method:	Mud Rotary	Hole Diam.:	6 in.
Top Elevation:	~ 100 ft.	Easting:		Drilling Company:	Boart Longyear	Rod Diam.:	2
Vert. Datum:		Station:		Drill Rig Equipment:	Mobile B-59	Hammer Type:	Automatic
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft.	SOIL DESCRIPTION
50.0	Stiff, gray-brown, clayey SILT: moist; ML.
56.0	Medium dense, brown, silty, fine SAND; moist; SM.
78.0	Very stiff, gray-brown, fine sandy SILT and clayey SILT; moist to wet; ML.
93.0	Medium dense to dense, gray, fine sandy SILT; moist to wet; ML.

CONTINUED NEXT SHEET



LEGEND

- * Sample Not Recovered
- ⌶ Split Spoon
- Ⅱ Thin Wall Sample
- ⊟ Piezometer Screen and Sand Filter
- ▧ Bentonite-Cement Grout
- ⊠ Bentonite Chips/Pellets
- ▨ Bentonite Grout
- ∇ Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured using a cloth tape from existing site features and should be considered approximate.

Heritage Center
Olympia, Washington

LOG OF BORING HC-2

October 2007 21-1-20767-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 3
Sheet 2 of 3

Total Depth: 111.5 ft.
Top Elevation: ~ 100 ft.
Vert. Datum:
Horiz. Datum:

Northing:
Easting:
Station:
Offset:

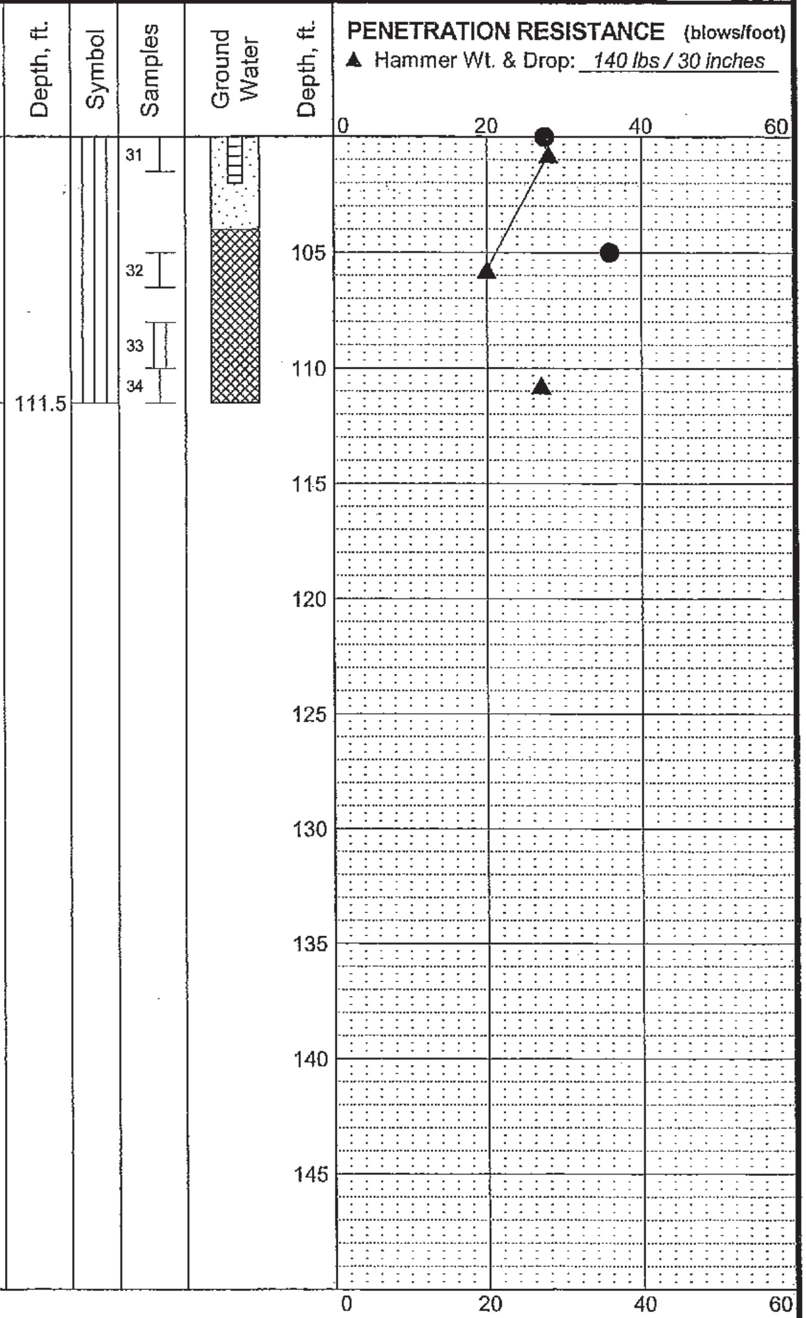
Drilling Method: Mud Rotary
Drilling Company: Boart Longyear
Drill Rig Equipment: Mobile B-59
Other Comments:

Hole Diam.: 6 in.
Rod Diam.: 2
Hammer Type: Automatic

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

BOTTOM OF BORING
COMPLETED 7/18/2007



◇ % Fines (<0.075mm)
● % Water Content
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

LEGEND

- * Sample Not Recovered
- Ⲓ Split Spoon
- Ⲽ Thin Wall Sample
- ☷ Piezometer Screen and Sand Filter
- ▧ Bentonite-Cement Grout
- ▩ Bentonite Chips/Pellets
- ▨ Bentonite Grout
- ⊻ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured using a cloth tape from existing site features and should be considered approximate.

Heritage Center
Olympia, Washington

LOG OF BORING HC-2

October 2007
21-1-20767-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 3
Sheet 3 of 3

Log: BZH Rev: PRM Typ: LKD

MASTER LOG E 21-20767.GPJ SHAN WIL.GDT 10/18/07

Total Depth: 111.5 ft.
Top Elevation: ~ 93 ft.
Vert. Datum:
Horiz. Datum:

Northing:
Easting:
Station:
Offset:

Drilling Method: Mud Rotary
Drilling Company: Boart Longyear
Drill Rig Equipment: Mobile B-59
Other Comments:

Hole Diam.: 6 in.
Rod Diam.: 2
Hammer Type: Automatic

SOIL DESCRIPTION

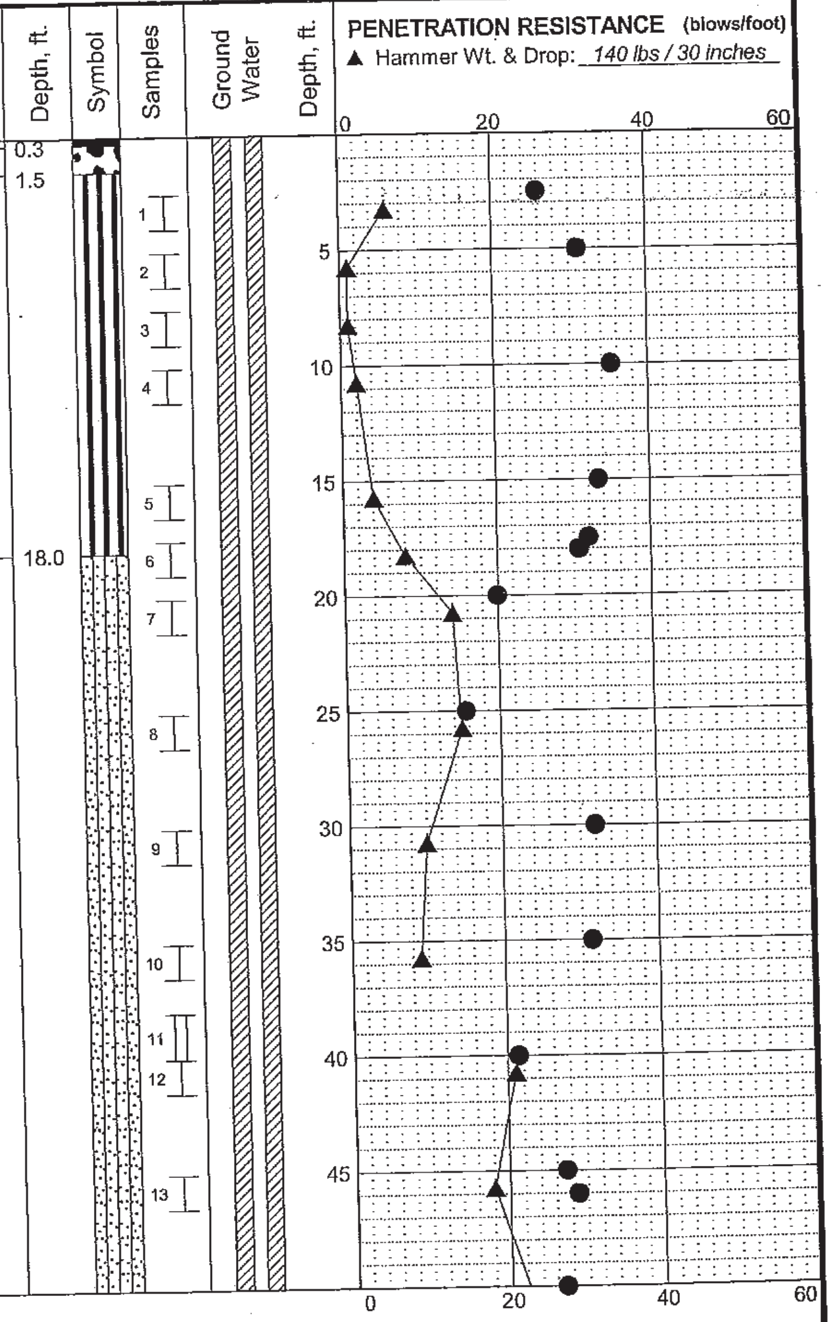
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Asphalt concrete/crushed rock subbase.

Medium dense, gray, sandy GRAVEL; moist; (Fill) GW.

Very soft to medium stiff, gray and brown, silty CLAY and clayey SILT, trace of fine sand; moist; mottled with wood and organics; (Fill) CL/ML.

Medium dense, light brown, silty, fine SAND and fine sandy SILT, trace of clay; moist; laminated and varve texture; SM/ML.



CONTINUED NEXT SHEET

LEGEND

* Sample Not Recovered
Ɪ Split Spoon
ǁ Thin Wall Sample
▦ Piezometer Screen and Sand Filter
▧ Bentonite-Cement Grout
⊠ Bentonite Chips/Pellets
▨ Bentonite Grout
▼ Ground Water Level in Well

◇ % Fines (<0.075mm)
● % Water Content
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured using a cloth tape from existing site features and should be considered approximate.

Heritage Center
Olympia, Washington

LOG OF BORING HC-3

October 2007
21-1-20767-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 4
Sheet 1 of 3

MASTER_LOG_E 21-20767.GPJ SHAN_WIL.GDT 10/18/07 Log: BZH Rev: PRM Typ: LKD

Total Depth: 111.5 ft.
Top Elevation: ~ 93 ft.
Vert. Datum:
Horiz. Datum:

Northing:
Easting:
Station:
Offset:

Drilling Method: Mud Rotary
Drilling Company: Boart Longyear
Drill Rig Equipment: Mobile B-59
Other Comments:

Hole Diam.: 6 in.
Rod Diam.: 2
Hammer Type: Automatic

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

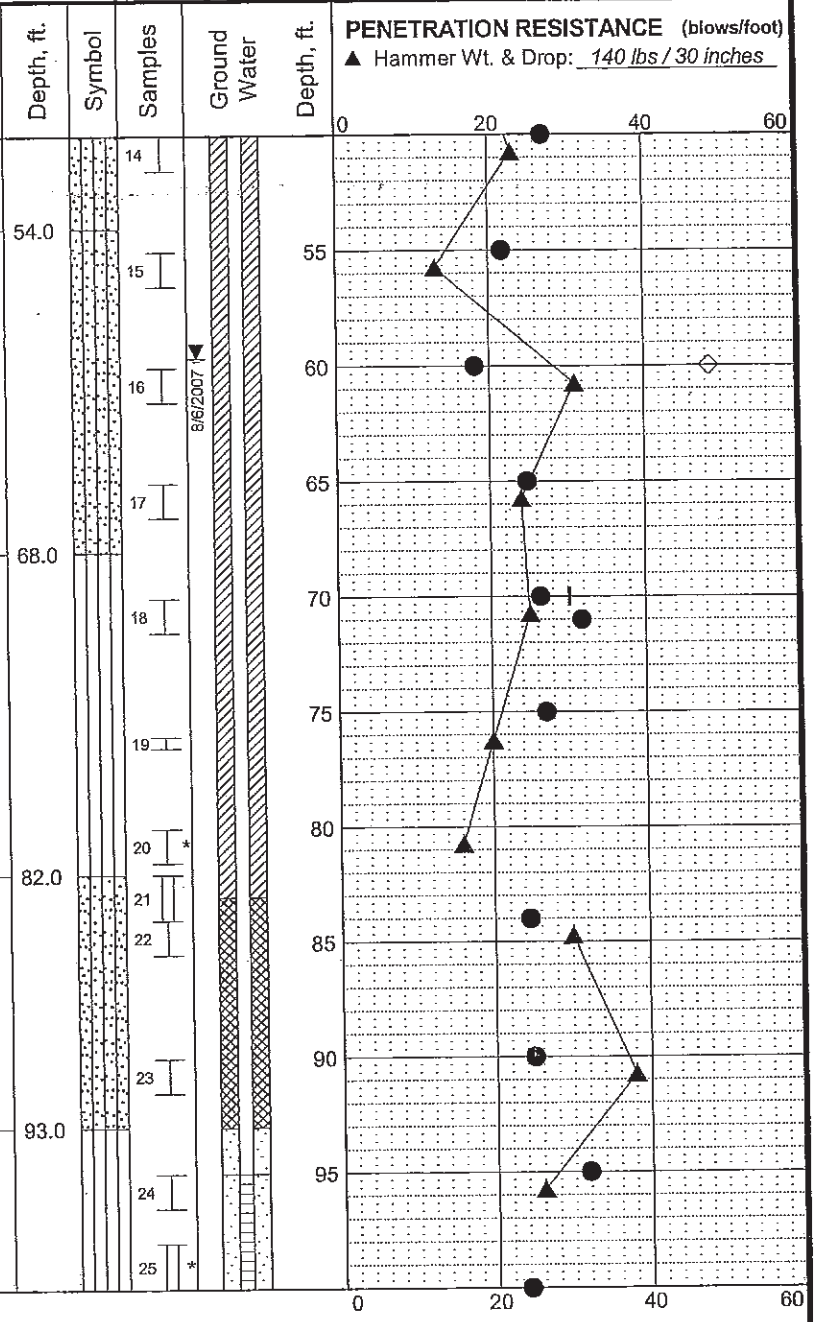
Medium dense to dense, gray-brown to brown, silty, fine SAND and gravelly, fine to medium sandy SILT; moist to wet; SM.

Very stiff, gray, slightly clayey SILT; moist to wet; silty, fine sand seams; ML.

Dense, gray, silty, fine SAND; moist; SM.

Medium dense, gray, fine sandy SILT; moist; ML.

CONTINUED NEXT SHEET



LEGEND

* Sample Not Recovered
I Split Spoon
II Thin Wall Sample

▤ Piezometer Screen and Sand Filter
▧ Bentonite-Cement Grout
▩ Bentonite Chips/Pellets
▨ Bentonite Grout
▼ Ground Water Level in Well

◇ % Fines (<0.075mm)
● % Water Content
Plastic Limit ├──●──┤ Liquid Limit
Natural Water Content

Heritage Center
Olympia, Washington

LOG OF BORING HC-3

October 2007 21-1-20767-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 4
Sheet 2 of 3

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured using a cloth tape from existing site features and should be considered approximate.

MASTER_LOG_E 21-20767.GPJ SHAN_WIL.GDT 10/18/07

Log: BZH Rev: PRM Typ: LKD

Total Depth: 111.5 ft.
Top Elevation: ~ 93 ft.
Vert. Datum:
Horiz. Datum:

Northing:
Easting:
Station:
Offset:

Drilling Method: Mud Rotary
Drilling Company: Boart Longyear
Drill Rig Equipment: Mobile B-59
Other Comments:

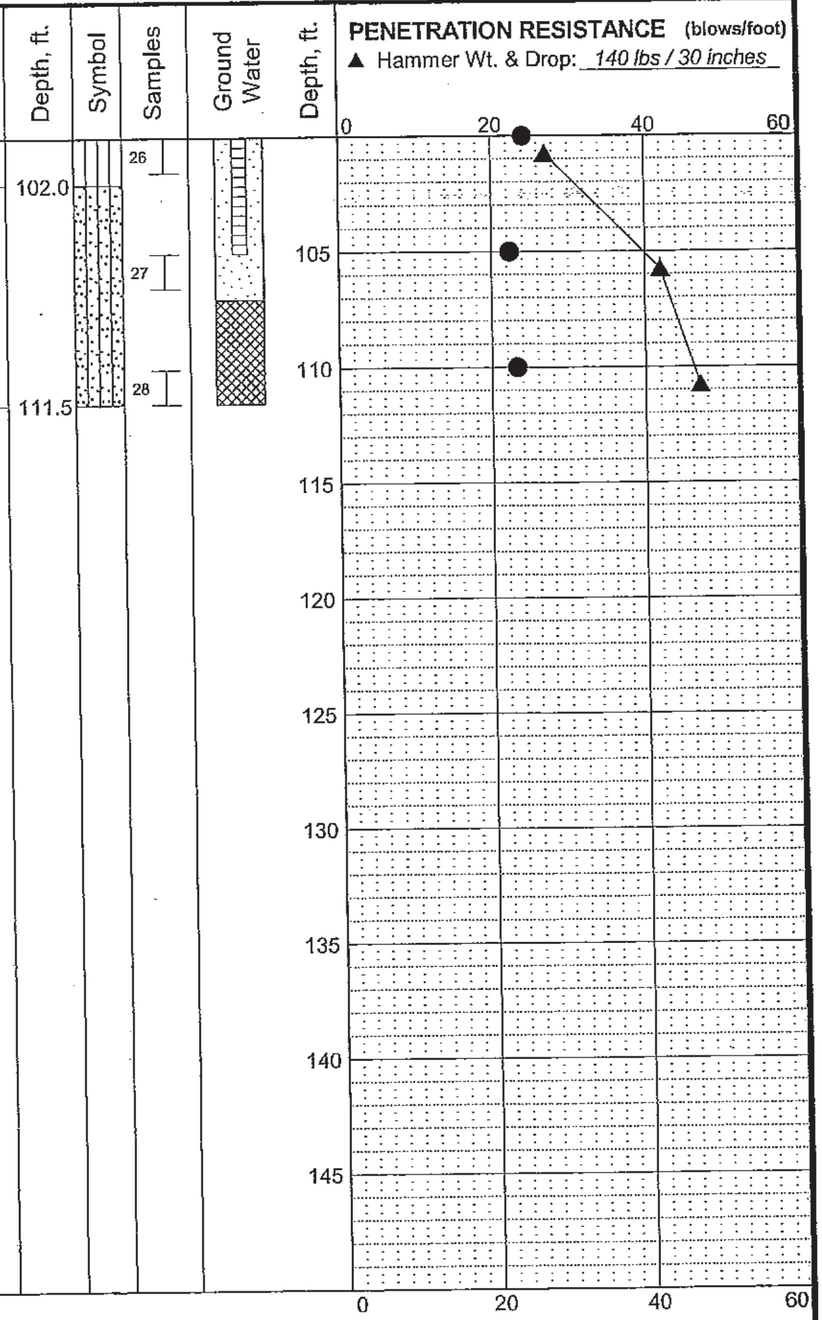
Hole Diam.: 6 in.
Rod Diam.: 2
Hammer Type: Automatic

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Dense, gray, silty, fine SAND; moist; SM.

BOTTOM OF BORING
COMPLETED 7/23/2007



◇ % Fines (<0.075mm)
● % Water Content
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

LEGEND

* Sample Not Recovered
⌶ Split Spoon
⌶ Thin Wall Sample

▦ Piezometer Screen and Sand Filter
▧ Bentonite-Cement Grout
▩ Bentonite Chips/Pellets
▨ Bentonite Grout
▼ Ground Water Level in Well

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured using a cloth tape from existing site features and should be considered approximate.

Log: BZH Rev: PRM Typ: LKD

MASTER LOG E 21-20767.GPJ SHAN WIL.GDT 10/18/07

Heritage Center
Olympia, Washington

LOG OF BORING HC-3

October 2007 21-1-20767-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 4
Sheet 3 of 3

Total Depth:	111.5 ft.	Northing:		Drilling Method:	Mud Rotary	Hole Diam.:	6 in.
Top Elevation:	~ 90 ft.	Easting:		Drilling Company:	Boart Longyear	Rod Diam.:	2
Vert. Datum:		Station:		Drill Rig Equipment:	Mobile B-59	Hammer Type:	Automatic
Horiz. Datum:		Offset:		Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

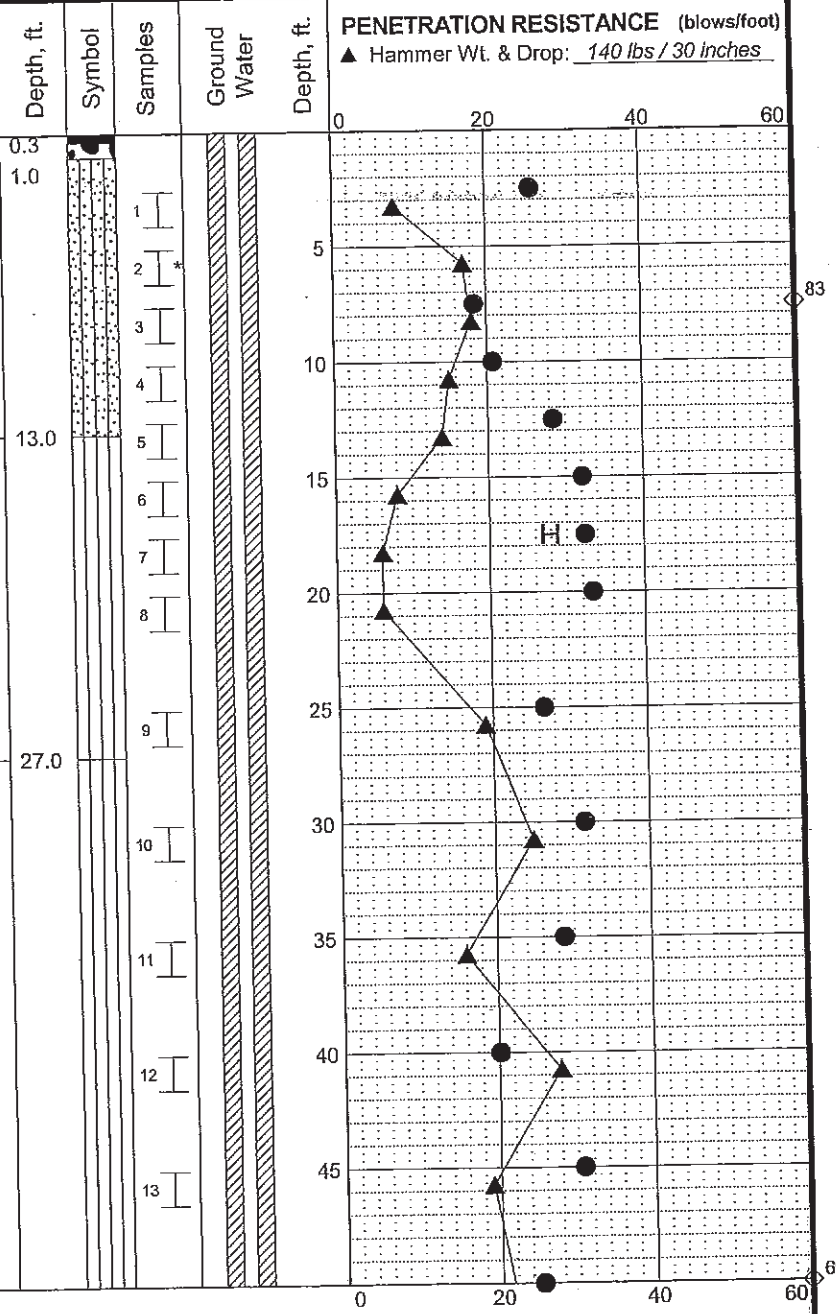
ASPHALT.

Crushed rock subbase.

Loose to medium dense, brown, silty, fine SAND to fine sandy SILT; moist; laminated; SM/ML.

Medium stiff to very stiff, gray, slightly to clayey, slightly fine sandy SILT; moist; iron-oxide staining; decayed organics at 26.0 feet; ML.

Very stiff, brown and gray-brown, clayey SILT and fine sandy SILT; moist to wet; laminated; iron-oxide staining at 45 feet; ML.



CONTINUED NEXT SHEET

LEGEND

* Sample Not Recovered

Ⅰ Split Spoon

Ⅱ Thin Wall Sample

▯ Piezometer Screen and Sand Filter

▧ Bentonite-Cement Grout

⊠ Bentonite Chips/Pellets

▨ Bentonite Grout

▼ Ground Water Level in Well

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured using a cloth tape from existing site features and should be considered approximate.

Heritage Center
Olympia, Washington

LOG OF BORING HC-5

October 2007 21-1-20767-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 6
Sheet 1 of 3

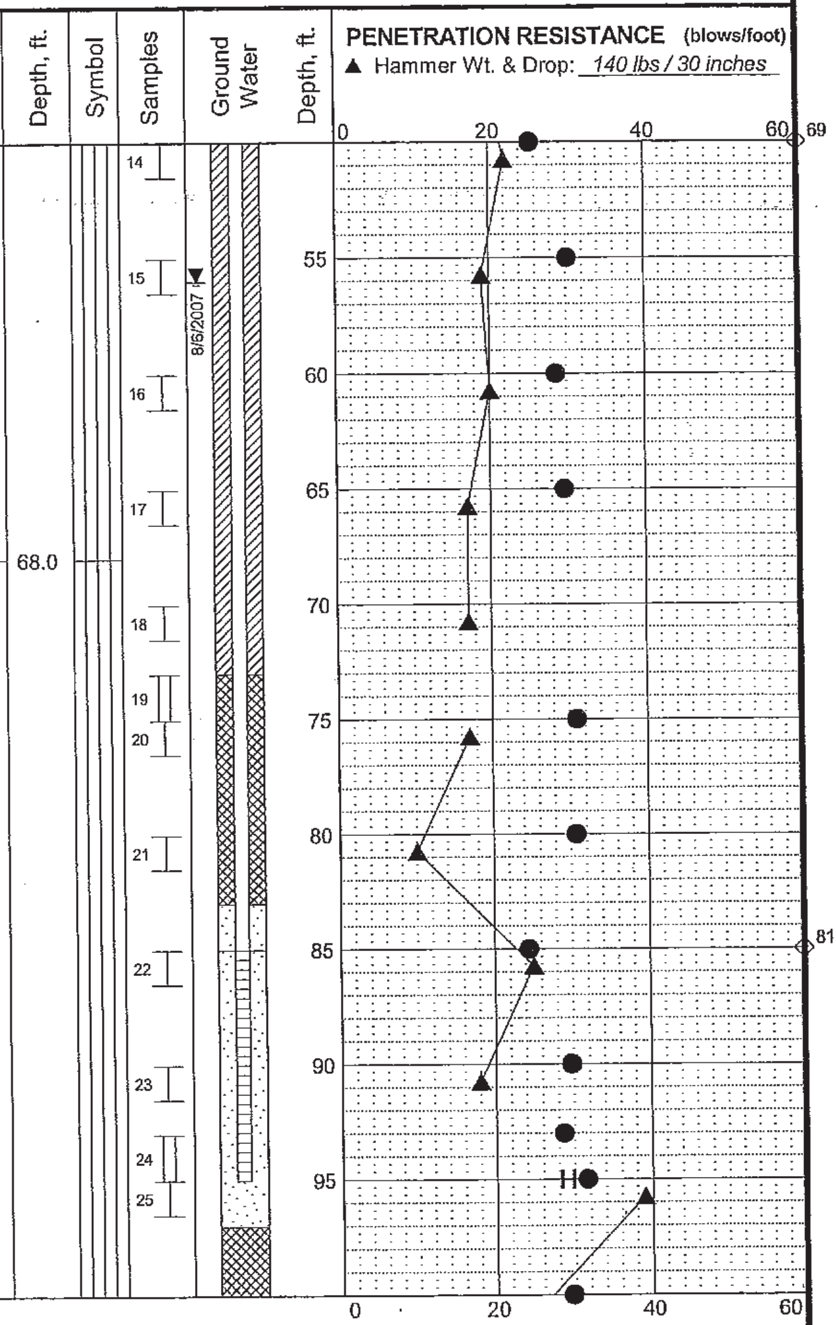
Total Depth: 111.5 ft.
Top Elevation: ~ 90 ft.
Vert. Datum:
Horiz. Datum:
Northing:
Easting:
Station:
Offset:
Drilling Method: Mud Rotary
Drilling Company: Boart Longyear
Drill Rig Equipment: Mobile B-59
Other Comments:
Hole Diam.: 6 in.
Rod Diam.: 2
Hammer Type: Automatic

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Very stiff to hard, gray, slightly clayey to clayey, slightly fine sandy SILT; moist to wet; ML.

CONTINUED NEXT SHEET



LEGEND

* Sample Not Recovered
I Split Spoon
II Thin Wall Sample
▥ Piezometer Screen and Sand Filter
▧ Bentonite-Cement Grout
▩ Bentonite Chips/Pellets
▨ Bentonite Grout
▼ Ground Water Level in Well

◇ % Fines (<0.075mm)
● % Water Content
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured using a cloth tape from existing site features and should be considered approximate.

Heritage Center
Olympia, Washington

LOG OF BORING HC-5

October 2007
21-1-20767-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

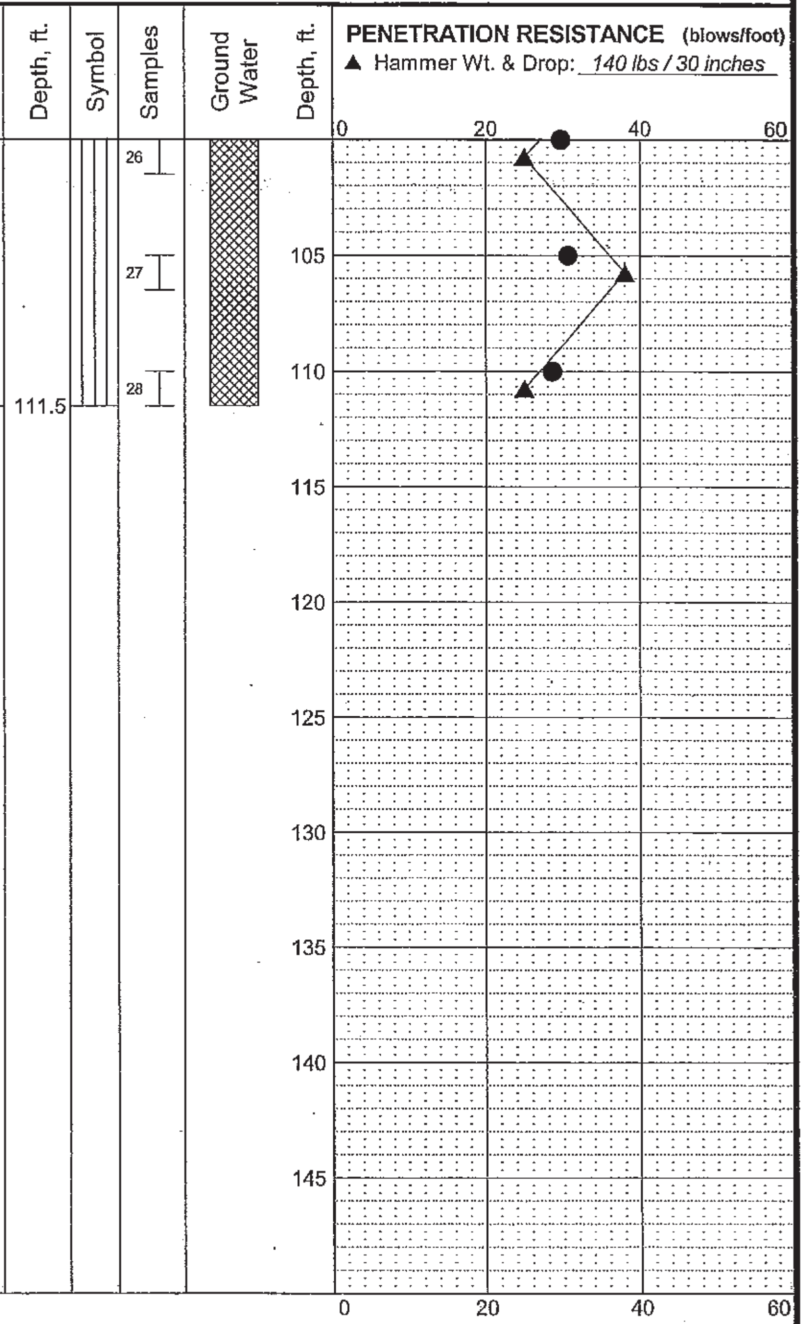
FIG. 6
Sheet 2 of 3

Total Depth: 111.5 ft.
Top Elevation: ~ 90 ft.
Vert. Datum:
Horiz. Datum:
Northing:
Easting:
Station:
Offset:
Drilling Method: Mud Rotary
Drilling Company: Boart Longyear
Drill Rig Equipment: Mobile B-59
Other Comments:
Hole Diam.: 6 in.
Rod Diam.: 2
Hammer Type: Automatic

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

BOTTOM OF BORING
COMPLETED 7/25/2007



◇ % Fines (<0.075mm)
● % Water Content
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

LEGEND

- * Sample Not Recovered
- Ⅰ Split Spoon
- Ⅱ Thin Wall Sample
- ⬚ Piezometer Screen and Sand Filter
- ▧ Bentonite-Cement Grout
- ▩ Bentonite Chips/Pellets
- ▨ Bentonite Grout
- ▼ Ground Water Level in Well

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured using a cloth tape from existing site features and should be considered approximate.

Heritage Center
Olympia, Washington

LOG OF BORING HC-5

October 2007 21-1-20767-001

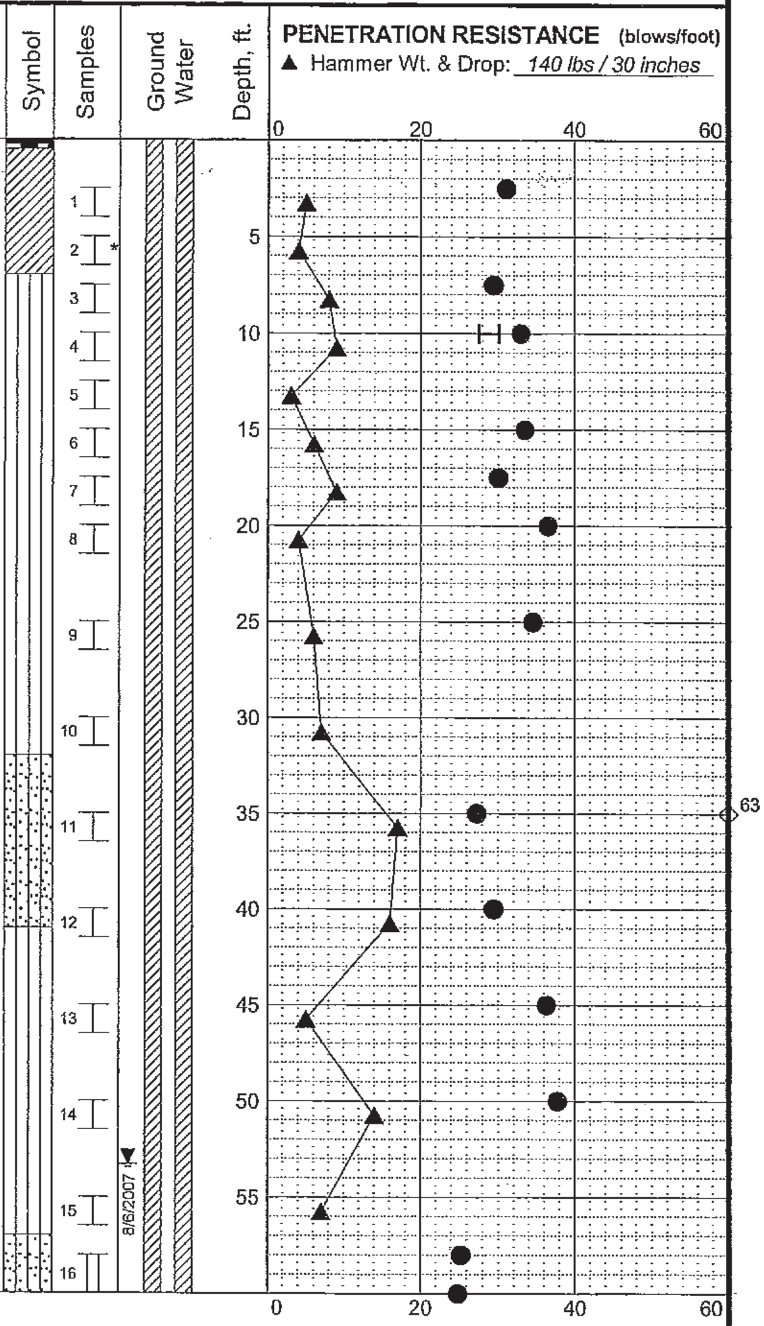
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 6
Sheet 3 of 3

Total Depth: 101.5 ft.
Top Elevation: ~ 82 ft.
Vert. Datum:
Horiz. Datum:
Northing:
Easting:
Station:
Offset:
Drilling Method: Mud Rotary
Drilling Company: Boart Longyear
Drill Rig Equipment: Mobile B-59
Other Comments:
Hole Diam.: 6 in.
Rod Diam.: 2
Hammer Type: Automatic

SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.
ASPHALT.	0.3
Crushed rock subbase.	0.5
Medium stiff, brown and gray, silty CLAY; moist; mottled trace of charcoal; (Fill) CL.	7.0
Medium stiff to stiff, gray-brown, slightly clayey to clayey SILT and silty CLAY; moist to wet; iron staining below 18 feet, fine sand partings; massive to varved; ML/CL.	32.0
Medium dense, brown, silty, fine SAND and fine sandy SILT; moist; laminated; SM/ML.	41.0
Medium stiff to stiff, gray-brown and gray, clayey SILT; ML.	57.0
Medium dense, gray-brown, silty, fine SAND; moist to wet at 60 feet; SM.	

CONTINUED NEXT SHEET



LEGEND

- * Sample Not Recovered
- Ⲓ Split Spoon
- Ⲽ Thin Wall Sample
- ▦ Piezometer Screen and Sand Filter
- ▧ Bentonite-Cement Grout
- ▩ Bentonite Chips/Pellets
- ▨ Bentonite Grout
- ▼ Ground Water Level in Well

◇ % Fines (<0.075mm)
● % Water Content
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured using a cloth tape from existing site features and should be considered approximate.

Heritage Center
Olympia, Washington

LOG OF BORING HC-6

October 2007 21-1-20767-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 7
Sheet 1 of 2

MASTER_LOG_E 21-20767.GPJ SHAN WIL.GDT 10/18/07 Log: BZH Rev: PRM Typ: LKD

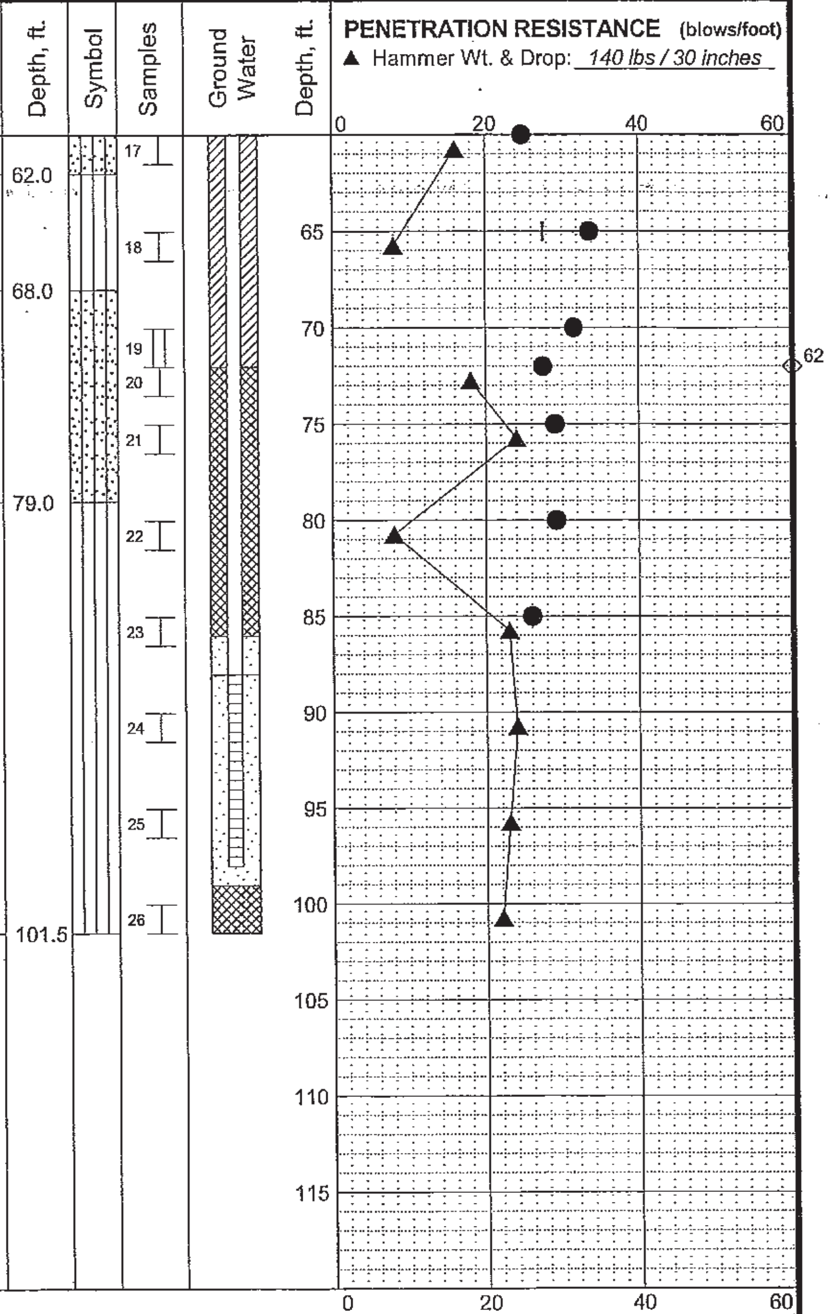
Total Depth: 101.5 ft.
Top Elevation: ~ 82 ft.
Vert. Datum:
Horiz. Datum:
Northing:
Easting:
Station:
Offset:
Drilling Method: Mud Rotary
Drilling Company: Boart Longyear
Drill Rig Equipment: Mobile B-59
Other Comments:
Hole Diam.: 6 in.
Rod Diam.: 2
Hammer Type: Automatic

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Soil Description	Depth, ft.
	62.0
Stiff, gray, clayey SILT, trace of fine sand; moist; ML.	68.0
Medium dense, gray, silty, fine SAND to fine sandy SILT; moist to wet; SM/ML.	79.0
Stiff, gray, fine sandy, clayey SILT; wet; ML.	101.5

BOTTOM OF BORING
COMPLETED 7/27/2007



◇ % Fines (<0.075mm)
● % Water Content
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

LEGEND

* Sample Not Recovered
Ⅰ Split Spoon
Ⅱ Thin Wall Sample
▦ Piezometer Screen and Sand Filter
▧ Bentonite-Cement Grout
▩ Bentonite Chips/Pellets
▨ Bentonite Grout
▼ Ground Water Level in Well

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured using a cloth tape from existing site features and should be considered approximate.

Heritage Center
Olympia, Washington

LOG OF BORING HC-6

October 2007
21-1-20767-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

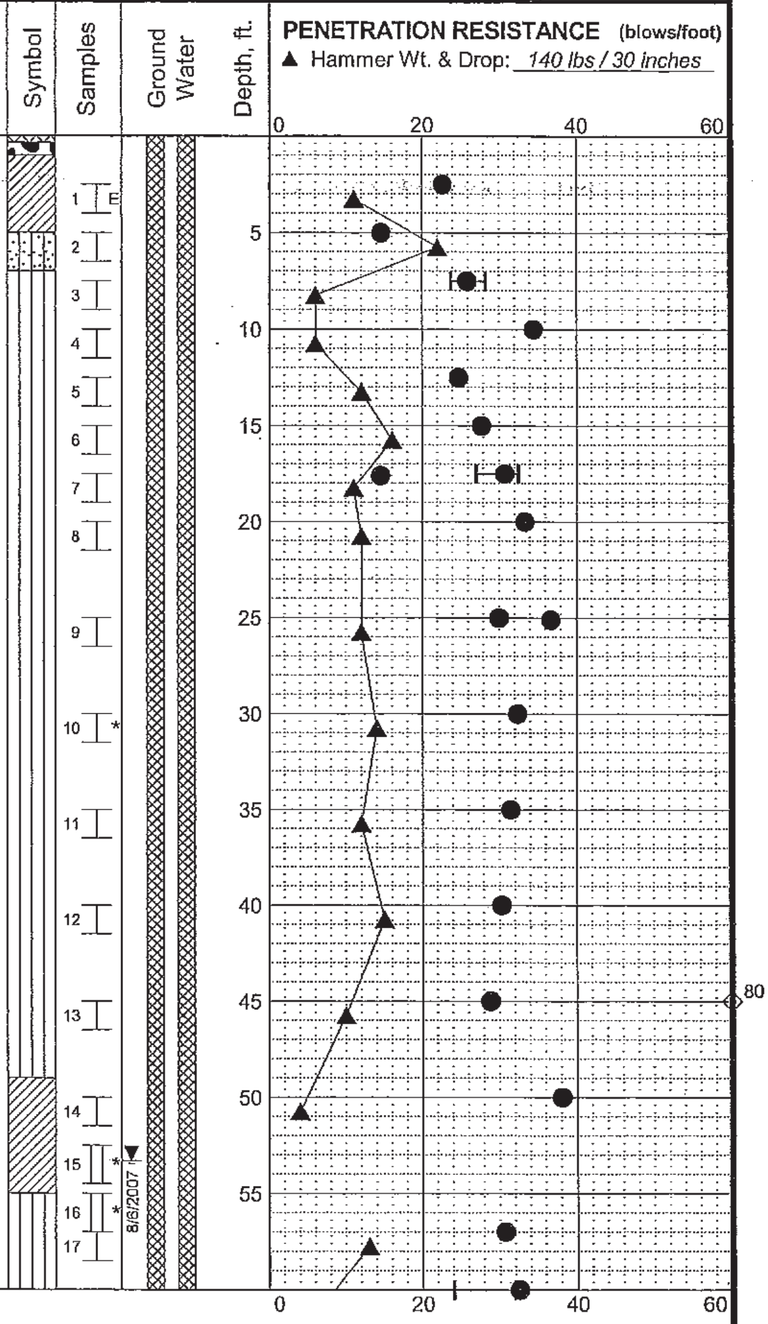
FIG. 7
Sheet 2 of 2

Total Depth: 101.5 ft.
Top Elevation: ~ 80 ft.
Vert. Datum:
Horiz. Datum:
Northing:
Easting:
Station:
Offset:
Drilling Method: Mud Rotary
Drilling Company: Boart Longyear
Drill Rig Equipment: Mobile B-59
Other Comments:
Hole Diam.: 6 in.
Rod Diam.: 2
Hammer Type: Automatic

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

SOIL DESCRIPTION	Depth, ft.
ASPHALT.	0.3
Crushed rock subbase.	1.0
Stiff, light brown, slightly fine sandy, silty CLAY to clayey SILT, trace of fine gravel; moist; mottled; (Colluvium) CL/ML.	5.0
Medium dense, brown, silty, fine SAND; moist; SM.	7.0
Medium stiff to stiff, brown and gray, slightly fine sandy, clayey SILT; moist to wet at 35 feet, interbedded with silty, fine sand seams and layers, iron-oxide staining from 20 to 42 feet; ML. - Silty, fine sand layer. - Silty, fine sand seam. - Silty, fine SAND layer.	49.0
Soft, light brown, silty CLAY; moist to wet; CL.	55.0
Medium stiff, gray-brown, slightly fine sandy, clayey SILT; moist to wet; massive; silty, fine sand seam at 57 feet; ML.	



CONTINUED NEXT SHEET

◇ % Fines (<0.075mm)
● % Water Content
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

LEGEND

*	Sample Not Recovered
E	Environmental Sample Obtained
Ⅰ	Split Spoon
Ⅱ	Thin Wall Sample
⊞	Piezometer Screen and Sand Filter
▧	Bentonite-Cement Grout
▩	Bentonite Chips/Pellets
▨	Bentonite Grout
▼	Ground Water Level in Well

NOTES
1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured using a cloth tape from existing site features and should be considered approximate.

Heritage Center
Olympia, Washington

LOG OF BORING HC-7

October 2007
21-1-20767-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 8
Sheet 1 of 2

MASTER_LOG_E 21-20767.GPJ SHAN_WIL.GDT 10/18/07
Log: BZH Rev: PRM Typ: LKD

Total Depth: *101.5 ft.*
Top Elevation: *~ 80 ft.*
Vert. Datum:
Horiz. Datum:
Northing:
Easting:
Station:
Offset:
Drilling Method: *Mud Rotary*
Drilling Company: *Boart Longyear*
Drill Rig Equipment: *Mobile B-59*
Other Comments:
Hole Diam.: *6 in.*
Rod Diam.: *2*
Hammer Type: *Automatic*

SOIL DESCRIPTION

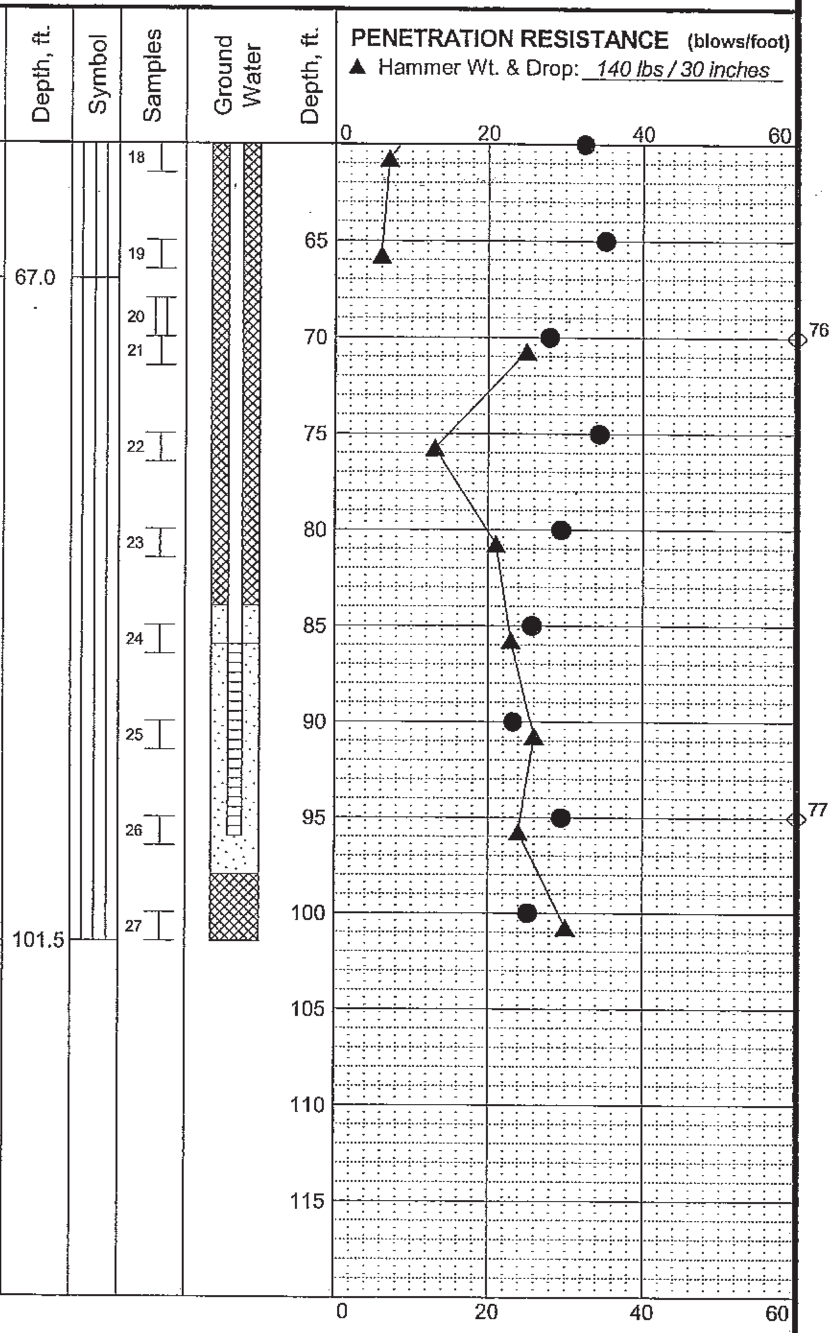
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

67.0

Medium dense, gray, fine sandy SILT; wet; ML.

101.5

BOTTOM OF BORING
COMPLETED 7/30/2007



◇ % Fines (<0.075mm)
● % Water Content
Plastic Limit ├──●──┤ Liquid Limit
Natural Water Content

LEGEND

- * Sample Not Recovered
- E Environmental Sample Obtained
- Ι Split Spoon
- ΙΙ Thin Wall Sample
- ▦ Piezometer Screen and Sand Filter
- ▧ Bentonite-Cement Grout
- ▩ Bentonite Chips/Pellets
- ▨ Bentonite Grout
- ▼ Ground Water Level in Well

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured using a cloth tape from existing site features and should be considered approximate.

Heritage Center
Olympia, Washington

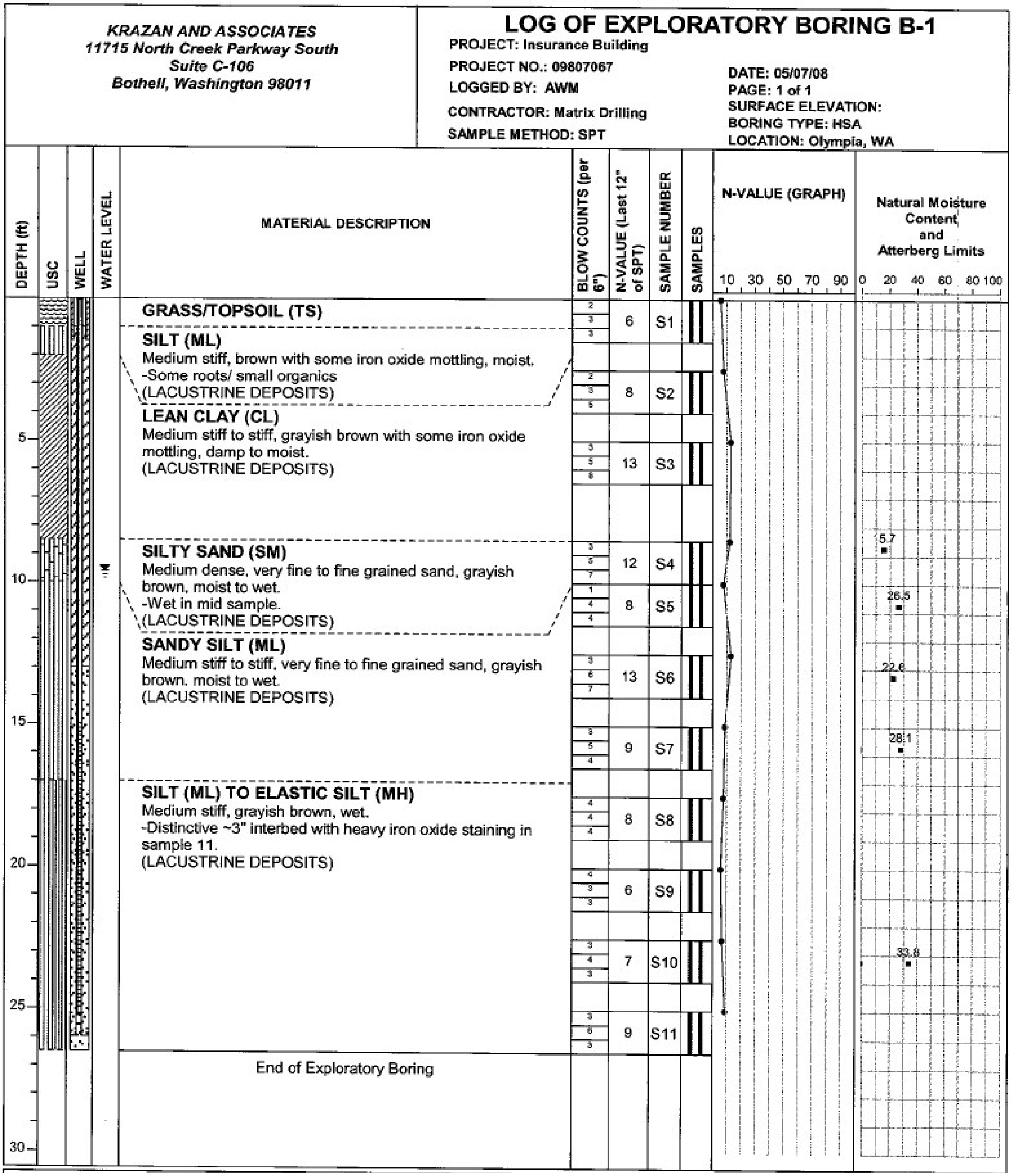
LOG OF BORING HC-7

October 2007 21-1-20767-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 8
Sheet 2 of 2

B. Boring Logs



KRAZAN AND ASSOCIATES
11715 North Creek Parkway South
Suite C-106
Bothell, Washington 98011

LOG OF EXPLORATORY BORING B-1

PROJECT: Insurance Building
PROJECT NO.: 09807067
LOGGED BY: AWM
CONTRACTOR: Matrix Drilling
SAMPLE METHOD: SPT

DATE: 05/07/08
PAGE: 1 of 1
SURFACE ELEVATION:
BORING TYPE: HSA
LOCATION: Olympia, WA

MATERIAL DESCRIPTION

GRASS/TOPSOIL (TS)

SILT (ML)
Medium stiff, brown with some iron oxide mottling, moist.
-Some roots/ small organics
(LACUSTRINE DEPOSITS)

LEAN CLAY (CL)
Medium stiff to stiff, grayish brown with some iron oxide mottling, damp to moist.
(LACUSTRINE DEPOSITS)

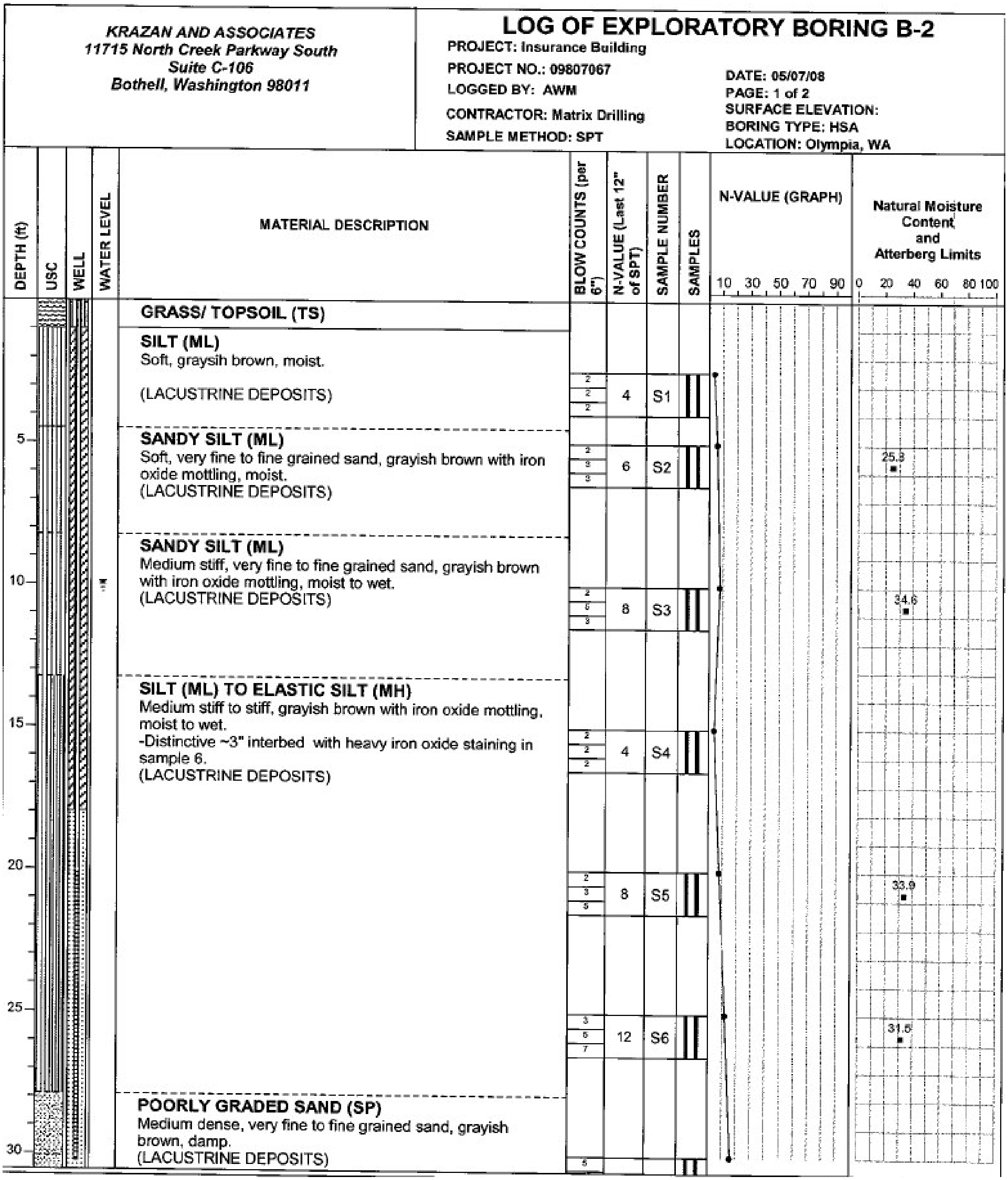
SILTY SAND (SM)
Medium dense, very fine to fine grained sand, grayish brown, moist to wet.
-Wet in mid sample.
(LACUSTRINE DEPOSITS)

SANDY SILT (ML)
Medium stiff to stiff, very fine to fine grained sand, grayish brown, moist to wet.
(LACUSTRINE DEPOSITS)

SILT (ML) TO ELASTIC SILT (MH)
Medium stiff, grayish brown, wet.
-Distinctive ~3" interbed with heavy iron oxide staining in sample 11.
(LACUSTRINE DEPOSITS)

End of Exploratory Boring

BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLE NUMBER
2 3 3	6	S1
2 3 5	8	S2
3 5 8	13	S3
3 5 7	12	S4
1 4 4	8	S5
3 6 7	13	S6
3 5 4	9	S7
4 4 4	8	S8
4 3 3	6	S9
3 4 3	7	S10
3 6 3	9	S11



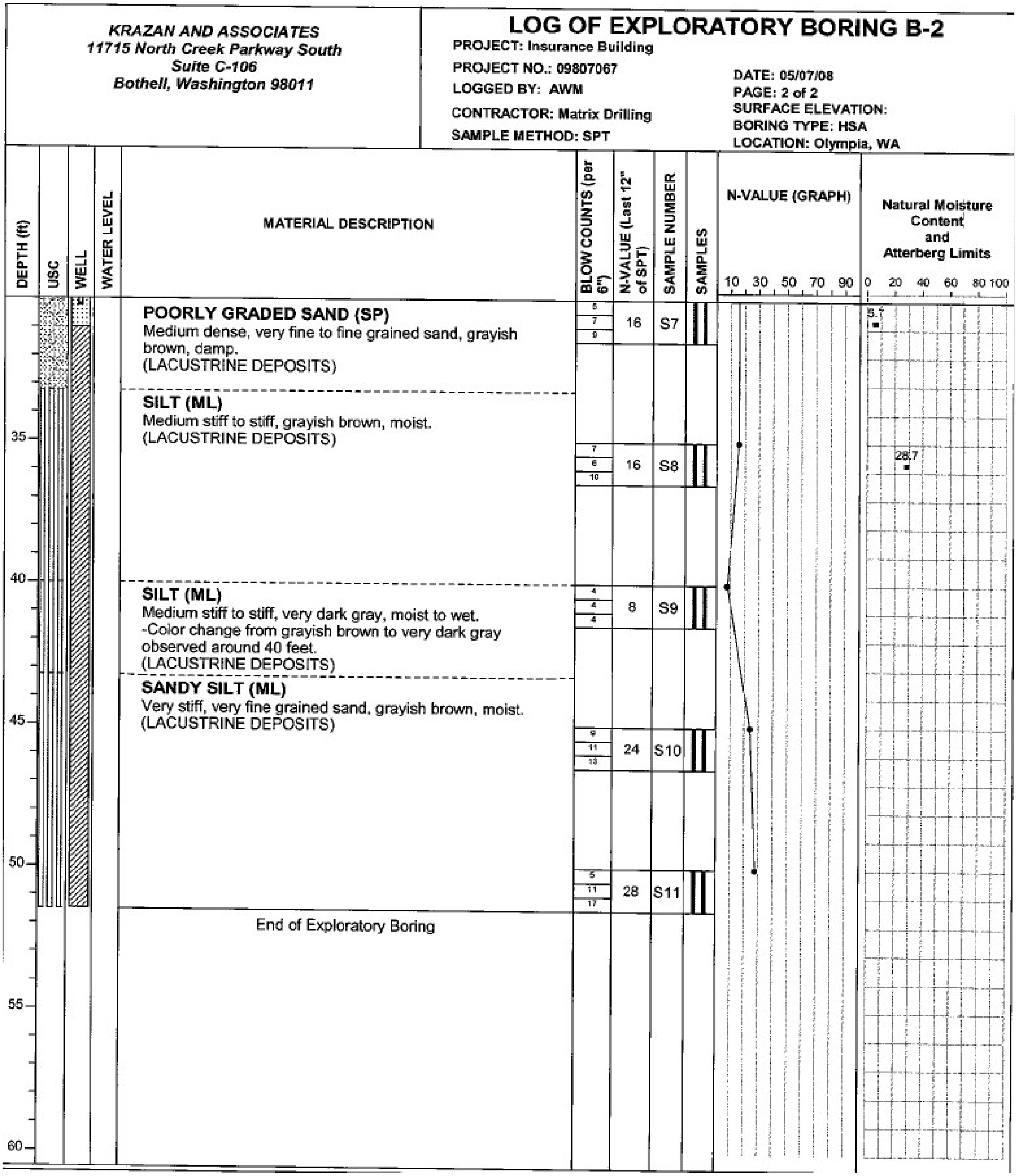
KRAZAN AND ASSOCIATES
11715 North Creek Parkway South
Suite C-106
Bothell, Washington 98011

LOG OF EXPLORATORY BORING B-2

PROJECT: Insurance Building
PROJECT NO.: 09807067
LOGGED BY: AWM
CONTRACTOR: Matrix Drilling
SAMPLE METHOD: SPT

DATE: 05/07/08
PAGE: 1 of 2
SURFACE ELEVATION:
BORING TYPE: HSA
LOCATION: Olympia, WA

DEPTH (ft)	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLE NUMBER	Natural Moisture Content and Atterberg Limits
0	**GRASS/ TOPSOIL (TS)**				
	SILT (ML) Soft, graysih brown, moist. (LACUSTRINE DEPOSITS)	2 2 2	4	S1	
5	**SANDY SILT (ML)** Soft, very fine to fine grained sand, grayish brown with iron oxide mottling, moist. (LACUSTRINE DEPOSITS)	2 3 3	6	S2	25.3
10	**SANDY SILT (ML)** Medium stiff, very fine to fine grained sand, grayish brown with iron oxide mottling, moist to wet. (LACUSTRINE DEPOSITS)	2 5 3	8	S3	34.6
15	**SILT (ML) TO ELASTIC SILT (MH)** Medium stiff to stiff, grayish brown with iron oxide mottling, moist to wet. -Distinctive ~3" interbed with heavy iron oxide staining in sample 6. (LACUSTRINE DEPOSITS)	2 2 2	4	S4	
20		2 3 5	8	S5	33.9
25		3 6 7	12	S6	31.5
30	**POORLY GRADED SAND (SP)** Medium dense, very fine to fine grained sand, grayish brown, damp. (LACUSTRINE DEPOSITS)	5			



KRAZAN AND ASSOCIATES
11715 North Creek Parkway South
Suite C-106
Bothell, Washington 98011

LOG OF EXPLORATORY BORING B-2

PROJECT: Insurance Building
PROJECT NO.: 09807067
LOGGED BY: AWM
CONTRACTOR: Matrix Drilling
SAMPLE METHOD: SPT

DATE: 05/07/08
PAGE: 2 of 2
SURFACE ELEVATION:
BORING TYPE: HSA
LOCATION: Olympia, WA

MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLE NUMBER	Natural Moisture Content and Atterberg Limits
POORLY GRADED SAND (SP) Medium dense, very fine to fine grained sand, grayish brown, damp. (LACUSTRINE DEPOSITS)	5 7 9	16	S7	5.7
SILT (ML) Medium stiff to stiff, grayish brown, moist. (LACUSTRINE DEPOSITS)	7 6 10	16	S8	28.7
SILT (ML) Medium stiff to stiff, very dark gray, moist to wet. -Color change from grayish brown to very dark gray observed around 40 feet. (LACUSTRINE DEPOSITS)	4 4 4	8	S9	
SANDY SILT (ML) Very stiff, very fine grained sand, grayish brown, moist. (LACUSTRINE DEPOSITS)	9 11 13	24	S10	
	5 11 17	28	S11	

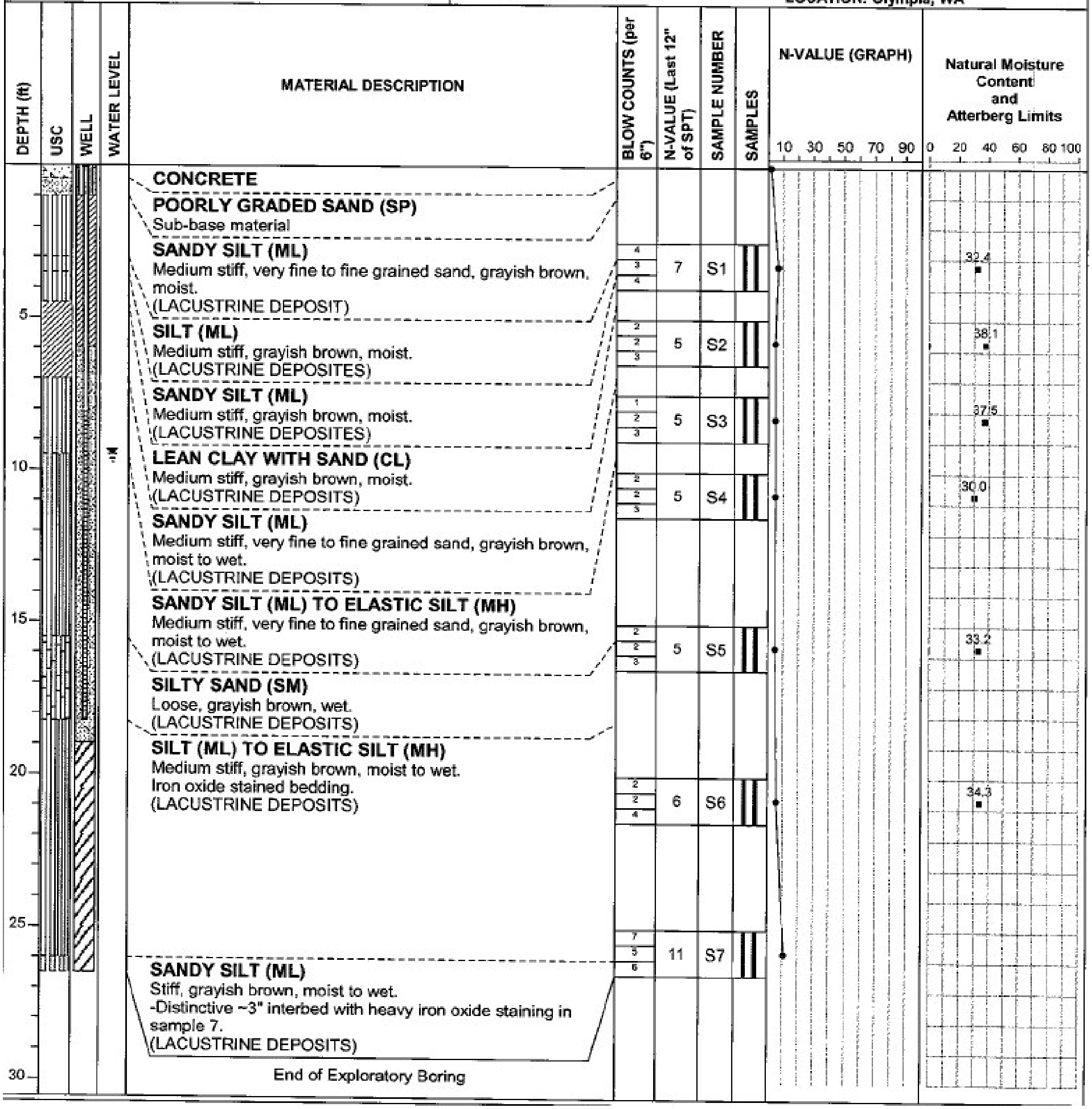
End of Exploratory Boring

KRAZAN AND ASSOCIATES
11715 North Creek Parkway South
Suite C-106
Bothell, Washington 98011

LOG OF EXPLORATORY BORING B-3

PROJECT: Insurance Building
PROJECT NO.: 09807067
LOGGED BY: AWM
CONTRACTOR: Matrix Drilling
SAMPLE METHOD: SPT

DATE: 05/07/08
PAGE: 1 of 1
SURFACE ELEVATION:
BORING TYPE: HSA
LOCATION: Olympia, WA



MATERIAL DESCRIPTION
CONCRETE
POORLY GRADED SAND (SP) Sub-base material
SANDY SILT (ML) Medium stiff, very fine to fine grained sand, grayish brown, moist. (LACUSTRINE DEPOSIT)
SILT (ML) Medium stiff, grayish brown, moist. (LACUSTRINE DEPOSITES)
SANDY SILT (ML) Medium stiff, grayish brown, moist. (LACUSTRINE DEPOSITES)
LEAN CLAY WITH SAND (CL) Medium stiff, grayish brown, moist. (LACUSTRINE DEPOSITS)
SANDY SILT (ML) Medium stiff, very fine to fine grained sand, grayish brown, moist to wet. (LACUSTRINE DEPOSITS)
SANDY SILT (ML) TO ELASTIC SILT (MH) Medium stiff, very fine to fine grained sand, grayish brown, moist to wet. (LACUSTRINE DEPOSITS)
SILTY SAND (SM) Loose, grayish brown, wet. (LACUSTRINE DEPOSITS)
SILT (ML) TO ELASTIC SILT (MH) Medium stiff, grayish brown, moist to wet. Iron oxide stained bedding. (LACUSTRINE DEPOSITS)
SANDY SILT (ML) Stiff, grayish brown, moist to wet. -Distinctive ~3" interbed with heavy iron oxide staining in sample 7. (LACUSTRINE DEPOSITS)
End of Exploratory Boring

BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLE NUMBER	Natural Moisture Content
4 3 4	7	S1	32.4
2 2 3	5	S2	38.1
1 2 3	5	S3	37.5
2 2 3	5	S4	30.0
2 2 3	5	S5	33.2
2 2 4	6	S6	34.3
7 5 6	11	S7	

APPENDIX A-2

Other Instrumentation

The following table includes a list of the boring logs related to the instrumentation program from both Golder and other consultants. Copies of the boring logs are also attached. The approximate locations of the borings are shown on Figure 1.

Summary of Other Instrumentation by Golder and Others

Boring ID	Exploration Date	Depth	Completion	Location
GB-1	5/28/09	102.9	Inclinometer	Governor's Mansion
GB-2	5/27/09	104.0	Inclinometer	Pritchard
DH-1	10/24/1994	107	Inclinometer/Piezometer	Hillside
DH-2	4/1994	91.5	Inclinometer	Greenhouse
J-1	12/15/1987	36	Inclinometer	Below Soldier Pile Wall
DH-7	6/20/1995	73	Piezometer	Greenhouse
HC-2	7/18/2007	111.5	Piezometer	Heritage Center
HC-3	7/23/2007	111.5	Piezometer	Heritage Center
HC-5	7/25/2007	111.5	Piezometer	Heritage Center
HC-6	7/27/2007	101.5	Piezometer	Heritage Center
HC-7	7/30/2007	101.5	Piezometer	Heritage Center
B-1	5/7/08	26	Piezometer	Insurance Building
B-2	5/7/08	31	Piezometer	Insurance Building
B-3	5/7/08	26.5	Piezometer	Insurance Building

APPENDIX B
LABORATORY TESTING

APPENDIX B
Laboratory Testing

Geotechnical laboratory tests were performed by Golder's Redmond, Washington, soils lab. Laboratory tests were performed on selected representative soil samples to characterize engineering and index properties of the soils. Results of lab testing are presented in this Appendix.

Moisture Content

Moisture content testing was performed on representative samples to aid in identification and correlation of soil types. All determinations were made in general accordance with ASTM D2216, Standard Test Method for Laboratory Determination of Moisture (Water) Content of Soil and Rock.

Grain Size Analysis

A grain size analysis indicates the range of soil particle diameters included in a particular sample. Grain size analyses were performed on representative samples in general accordance with ASTM D422, Standard Test Method for Particle-Size Analysis of Soils.

Atterberg Limits

Atterberg limits are used for classifying cohesive soils. The liquid and plastic limits were determined for selected samples. The tests were performed in general accordance with ASTM D4318, Standard Test Method for Liquid Limit (LL), Plastic Limit (PL), and Plasticity Index (PI) of Soils.

200-Wash

For a 200-wash test, the fine-grained soil fraction is separated from the sand and gravel by washing the soil on a U.S. No. 200 Sieve. The 200-wash was performed on selected soil samples in general accordance with ASTM D1140, Test Method for Amount of Material in Soils Finer than the No. 200 (75-µm) Sieve.

Laboratory Results Summary

Boring ID	Sample Depth (ft bgs)	Sample Number	Gravel %	Sand %	Silt or Clay %	PL %	LL %	PI %	Natural Moisture Content %	USCS Soil Type
GB-3	15	6				26	32	6	36	ML
GB-3	22.5	9	1	89	10				17	SP-SM
GB-3	40	16			15				17	SM
GB-3	80	24			43				30	SM
GB-3	100	28			23				18	SM
GB-4	12.5	5				23	31	8	31	ML
GB-4	35	14			65				26	ML
GB-4	55	19			55				19	ML
GB-4	65	21	2	69	28				20	SM
GB-4	95	27			20				13	SM
GB-5	7.5	3				20	29	9	22	CL
GB-5	27.5	11				28	29	1	29	ML
GB-5	60	20			78				23	ML
GB-5	75	23	21	33	47				14	SM
GB-5	90	26			44				21	SM

Note: USCS determined from laboratory testing and visual observations.

ATTERBERG LIMITS

ASTM D 4318

PROJECT NAME: WAGA / Hillside Eval and prelim Design / WA
PROJECT NUMBER: 083-93287.610
SAMPLE ID: GB-3 S-6 **SAMPLE DEPTH:** 15ft
SAMPLE TYPE:

SAMPLE PREPARATION

Wet or Dry: Dry

Minus #40 Sieve: Yes

	PLASTIC LIMIT DETERMINATION			LIQUID LIMIT DETERMINATION			NATURAL MOISTURE
Number of Blows				37	24	19	
Weight of Wet Soil & Tare (gm)	27.80	28.20	34.60	46.50	46.90	45.30	36.10
Weight of Dry Soil & Tare (gm)	27.20	27.50	33.90	41.50	41.70	40.20	33.10
Weight of Tare (gm)	24.90	25.00	31.00	25.10	25.20	24.80	24.70
Weight of Water (gm)	0.60	0.70	0.70	5.00	5.20	5.10	3.00
Weight of Dry Soil (gm)	2.30	2.50	2.90	16.40	16.50	15.40	8.40
Water Content %	26.09	28.00	24.14	30.49	31.52	33.12	35.71

PLASTIC LIMIT (PL) 26

LIQUID LIMIT (LL) 32

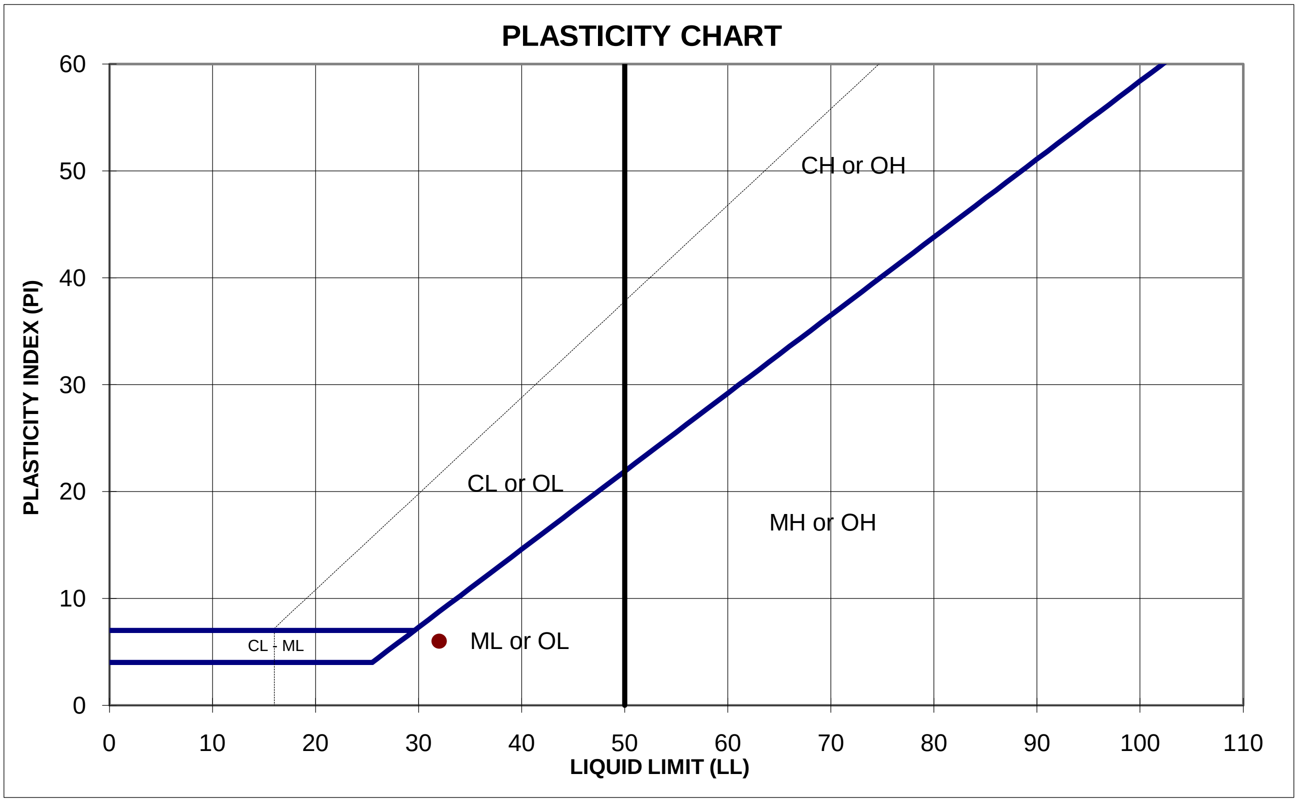
PLASTICITY INDEX (PI) 6

LIQUIDITY INDEX (LI) 1.6

NOTE:

DESCRIPTION

USCS ML



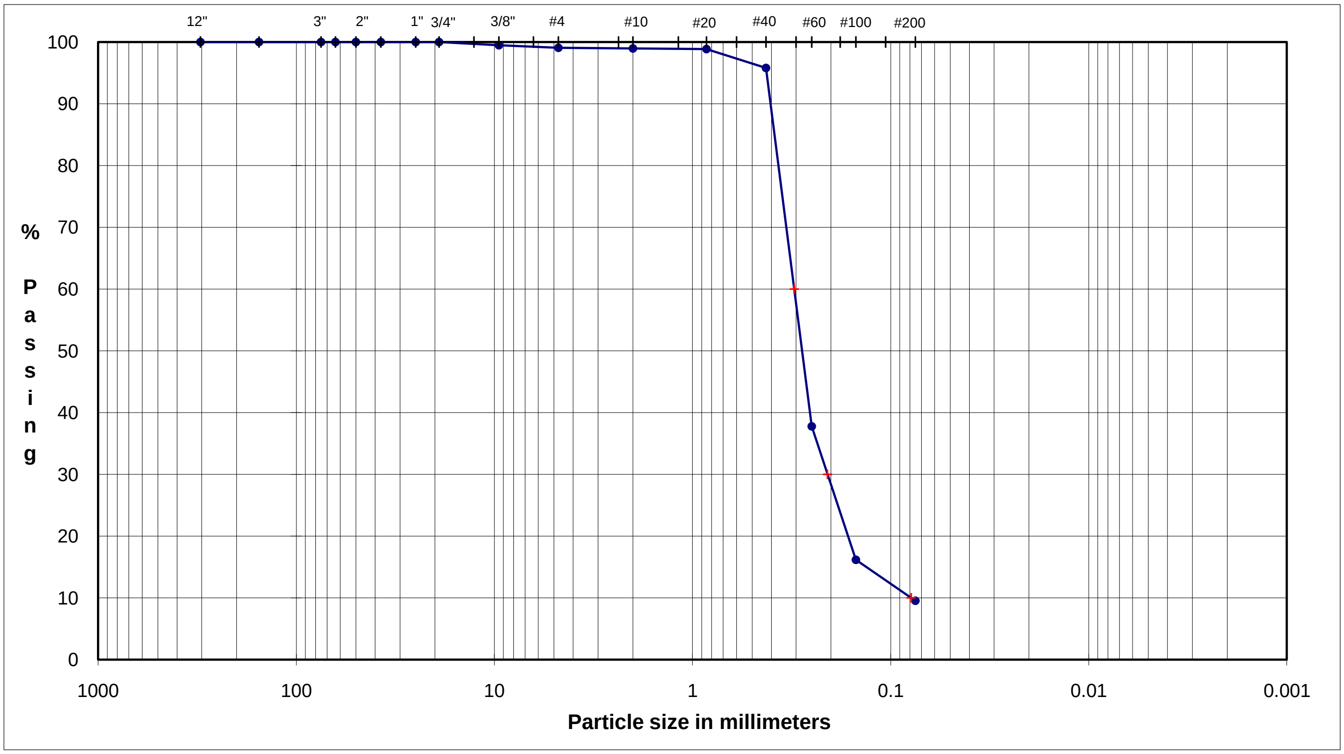
TECH	TCM
DATE	6/16/2010
CHECK	TCM
REVIEW	KSC

6/16/10 **083-93287.610**

PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **WAGA / Hillside Eval and Prelim Design / WA**
SAMPLE ID: **GB-3** **S-9** Depth: **22.5ft**
TYPE: **-**



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers	Particle Size (mm)	% Passing	Particle Size Classification	Particle Size Percentage
12.0"	304.8	**100.0**	Cobbles	**0.0**
6.0"	154.2	**100.0**		
3.0"	75	**100.0**		
2.5"	63.5	**100.0**	Coarse Gravel	**0.0**
2.0"	50	**100.0**		
1.5"	37.5	**100.0**		
1.0"	25	**100.0**		
0.75"	19	**100.0**		
0.375"	9.5	**99.5**	Fine Gravel	**0.9**
#4	4.75	**99.1**		
#10	2.00	**98.9**	Coarse Sand	**0.1**
#20	0.85	**98.9**	Medium Sand	**3.2**
#40	0.43	**95.8**		
#60	0.25	**37.8**	Fine Sand	**86.2**
#100	0.15	**16.2**		
#200	0.075	**9.5**		
			Fines	**9.5**

Moisture Content: 16.6

D_{60}= 0.31	D_{30}= 0.21	D_{10}= 0.08
Cu = D60/D10 =	**3.9**	< 6
Cc = D30^2/(D10*D60) =	**1.8**	> 1

DESCRIPTION: C-F SAND
little silt, trace f gravel

USCS: SP/SM

TECH	TCM
DATE	6/16/10
CHECK	TCM
REVIEW	KSC

Golder Associates Inc.

ATTERBERG LIMITS

ASTM D 4318

PROJECT NAME: WAGA / Hillside Eval and prelim Design / WA
PROJECT NUMBER: 083-93287.610
SAMPLE ID: GB-4 S-5 **SAMPLE DEPTH:** 12.5ft
SAMPLE TYPE:

SAMPLE PREPARATION

Wet or Dry: Dry

Minus #40 Sieve: Yes

	PLASTIC LIMIT DETERMINATION			LIQUID LIMIT DETERMINATION			NATURAL MOISTURE
Number of Blows				32	26	19	
Weight of Wet Soil & Tare (gm)	30.00	38.40	31.20	40.70	43.30	43.20	35.40
Weight of Dry Soil & Tare (gm)	29.10	37.10	30.10	36.10	39.00	37.80	32.00
Weight of Tare (gm)	24.90	31.70	25.10	21.20	25.20	21.10	21.10
Weight of Water (gm)	0.90	1.30	1.10	4.60	4.30	5.40	3.40
Weight of Dry Soil (gm)	4.20	5.40	5.00	14.90	13.80	16.70	10.90
Water Content %	21.43	24.07	22.00	30.87	31.16	32.34	31.19

PLASTIC LIMIT (PL): 23

LIQUID LIMIT (LL): 31

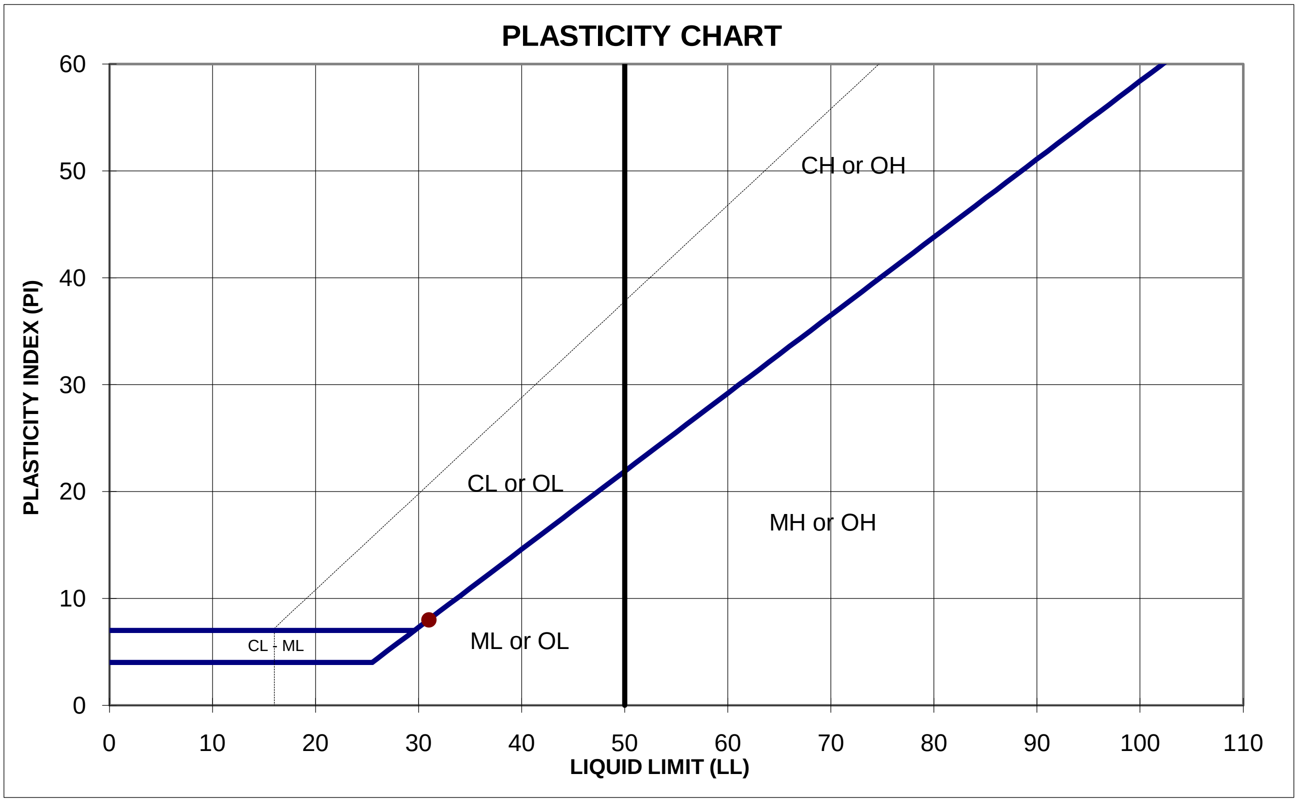
PLASTICITY INDEX (PI): 8

LIQUIDITY INDEX (LI): 1.09

NOTE:

DESCRIPTION:

USCS: ML



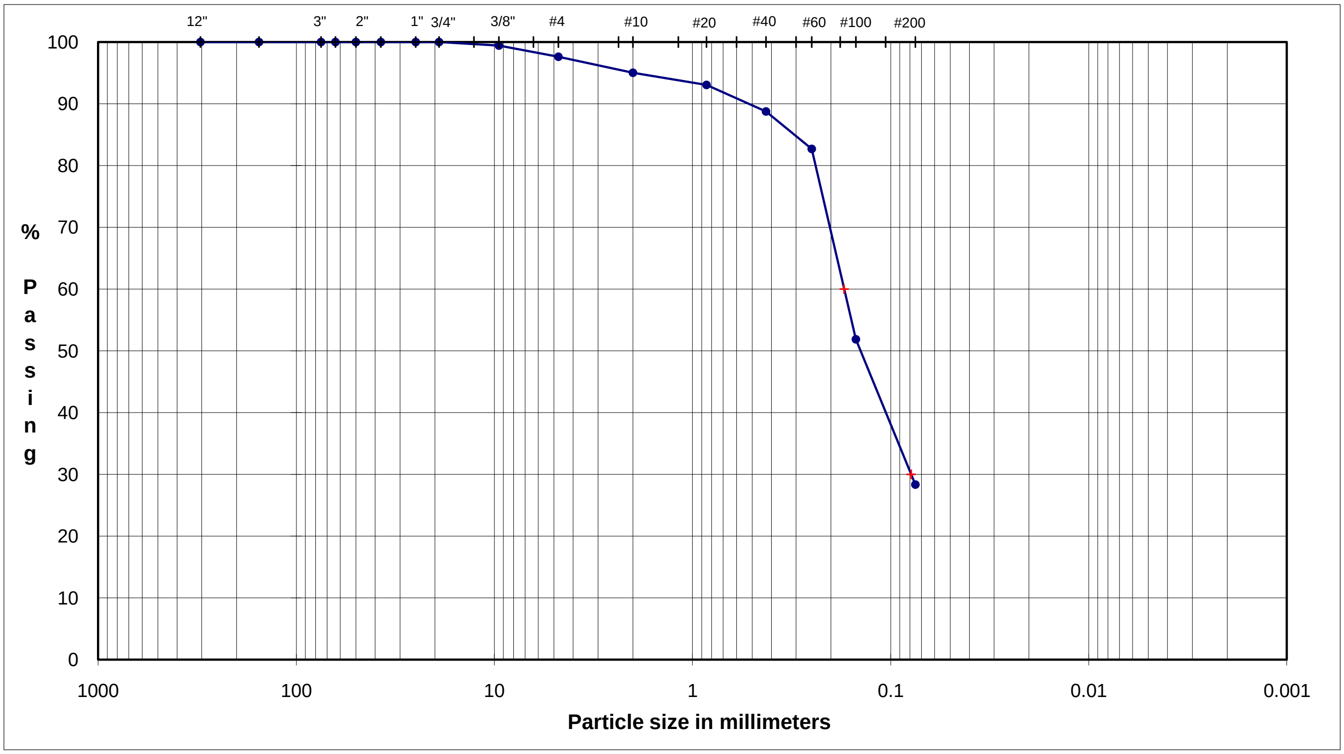
TECH	TCM
DATE	6/16/2010
CHECK	TCM
REVIEW	BDC

6/16/10 **083-93287.610**

PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **WAGA / Hillside Eval and Prelim Design / WA**
SAMPLE ID: **GB-4** **S-21** Depth: **65ft**
TYPE: -



COBBLES	GRAVEL		SAND			FINES
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

U.S. Standard Sieves Sizes and Numbers	Particle Size (mm)	% Passing	Particle Size Classification	Particle Size Percentage
12.0"	304.8	**100.0**	Cobbles	**0.0**
6.0"	154.2	**100.0**		
3.0"	75	**100.0**		
2.5"	63.5	**100.0**	Coarse Gravel	**0.0**
2.0"	50	**100.0**		
1.5"	37.5	**100.0**		
1.0"	25	**100.0**		
0.75"	19	**100.0**		
0.375"	9.5	**99.4**	Fine Gravel	**2.4**
#4	4.75	**97.6**		
#10	2.00	**95.0**	Coarse Sand	**2.6**
#20	0.85	**93.1**	Medium Sand	**6.3**
#40	0.43	**88.8**		
#60	0.25	**82.7**	Fine Sand	**60.4**
#100	0.15	**51.9**		
#200	0.075	**28.3**		
			Fines	**28.3**

Moisture Content
19.91

D_{60}= 0.17	D_{30}= 0.08	D_{10}= #N/A
Cu = D60/D10 =	**#N/A**	#N/A
Cc = D30^2/(D10*D60) =	**#N/A**	#N/A

DESCRIPTION: C-F SAND
some silt, trace f gravel

USCS: SM

TECH	TCM
DATE	6/16/10
CHECK	TCM
REVIEW	BDC

ATTERBERG LIMITS

ASTM D 4318

PROJECT NAME: WAGA / Hillside Eval and prelim Design / WA
PROJECT NUMBER: 083-93287.610
SAMPLE ID: GB-5 S-3 **SAMPLE DEPTH:** 7.5ft
SAMPLE TYPE:

SAMPLE PREPARATION

Wet or Dry: Dry

Minus #40 Sieve: Yes

	PLASTIC LIMIT DETERMINATION			LIQUID LIMIT DETERMINATION			NATURAL MOISTURE
Number of Blows				37	27	18	
Weight of Wet Soil & Tare (gm)	28.70	30.00	27.00	52.10	46.70	55.90	54.80
Weight of Dry Soil & Tare (gm)	28.10	29.10	26.10	47.60	41.80	48.00	50.60
Weight of Tare (gm)	25.00	24.70	21.70	32.00	25.00	21.20	31.90
Weight of Water (gm)	0.60	0.90	0.90	4.50	4.90	7.90	4.20
Weight of Dry Soil (gm)	3.10	4.40	4.40	15.60	16.80	26.80	18.70
Water Content %	19.35	20.45	20.45	28.85	29.17	29.48	22.46

PLASTIC LIMIT (PL) 20

LIQUID LIMIT (LL) 29

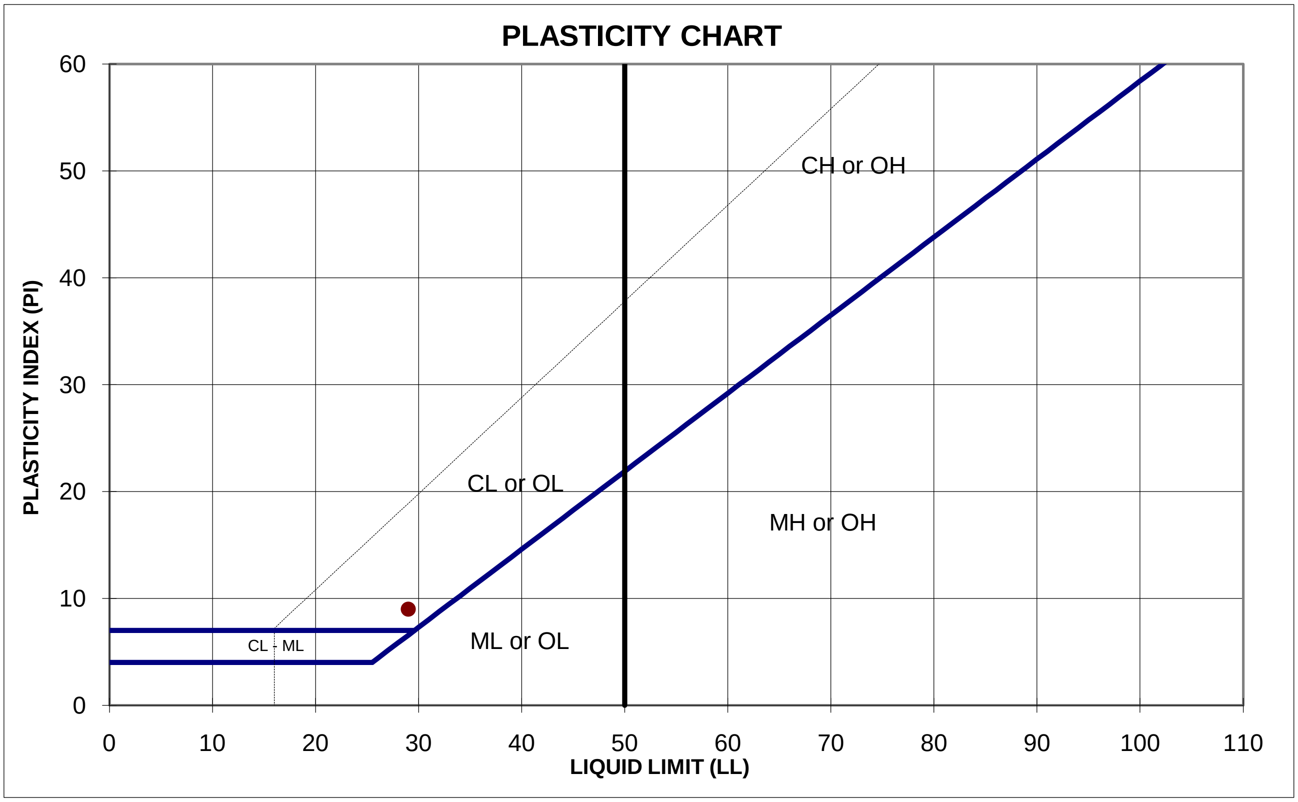
PLASTICITY INDEX (PI) 9

LIQUIDITY INDEX (LI) 0.26

NOTE:

DESCRIPTION

USCS CL



TECH	TCM
DATE	6/16/2010
CHECK	TCM
REVIEW	BDC

ATTERBERG LIMITS

ASTM D 4318

PROJECT NAME: WAGA / Hillside Eval and prelim Design / WA
PROJECT NUMBER: 083-93287.610
SAMPLE ID: GB-5 S-11 **SAMPLE DEPTH:** 27.5ft
SAMPLE TYPE:

SAMPLE PREPARATION

Wet or Dry: Dry

Minus #40 Sieve: Yes

	PLASTIC LIMIT DETERMINATION			LIQUID LIMIT DETERMINATION			NATURAL MOISTURE
Number of Blows				30	25	17	
Weight of Wet Soil & Tare (gm)	29.60	36.80	35.20	44.10	58.90	53.50	45.40
Weight of Dry Soil & Tare (gm)	28.60	35.60	34.30	39.90	52.80	48.20	40.90
Weight of Tare (gm)	25.10	31.30	30.90	25.10	31.70	30.90	25.30
Weight of Water (gm)	1.00	1.20	0.90	4.20	6.10	5.30	4.50
Weight of Dry Soil (gm)	3.50	4.30	3.40	14.80	21.10	17.30	15.60
Water Content %	28.57	27.91	26.47	28.38	28.91	30.64	28.85

PLASTIC LIMIT (PL) 28

LIQUID LIMIT (LL) 29

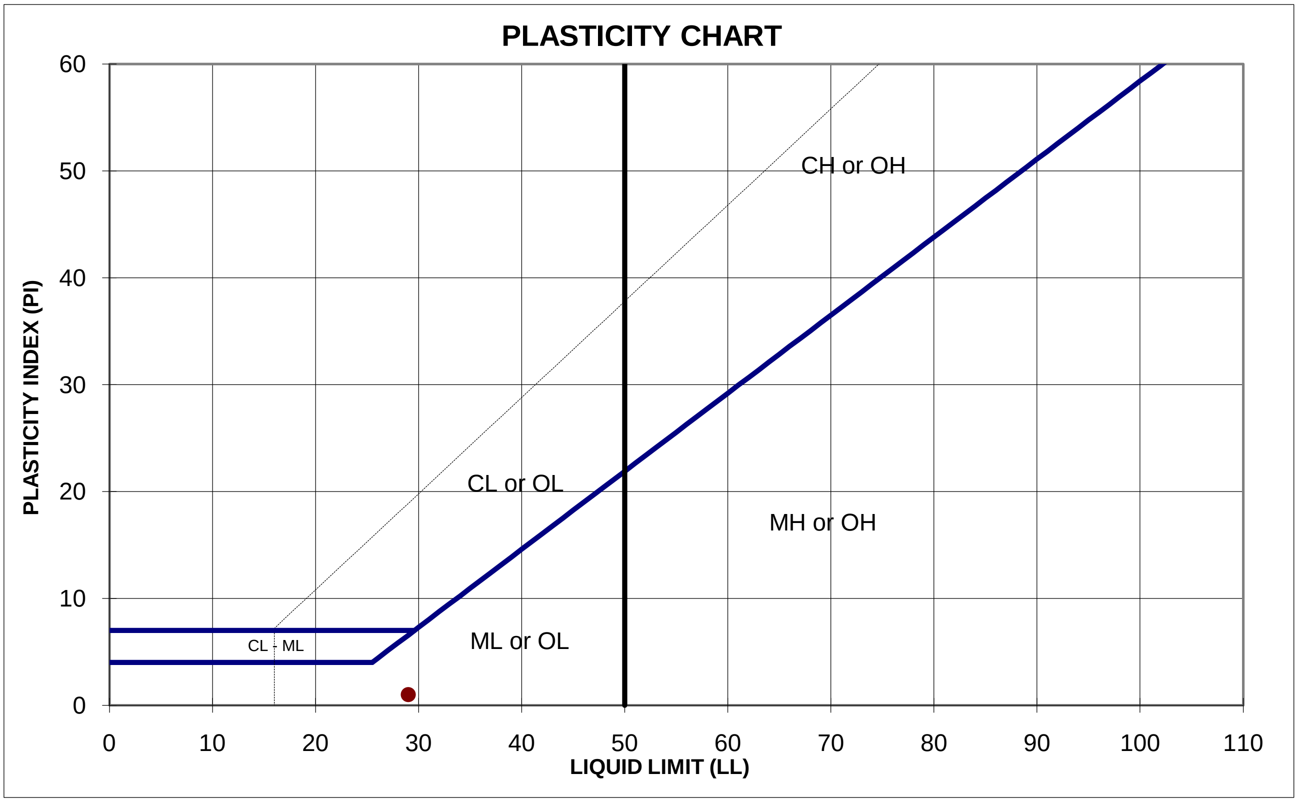
PLASTICITY INDEX (PI) 1

LIQUIDITY INDEX (LI) 1.20

NOTE:

DESCRIPTION

USCS ML



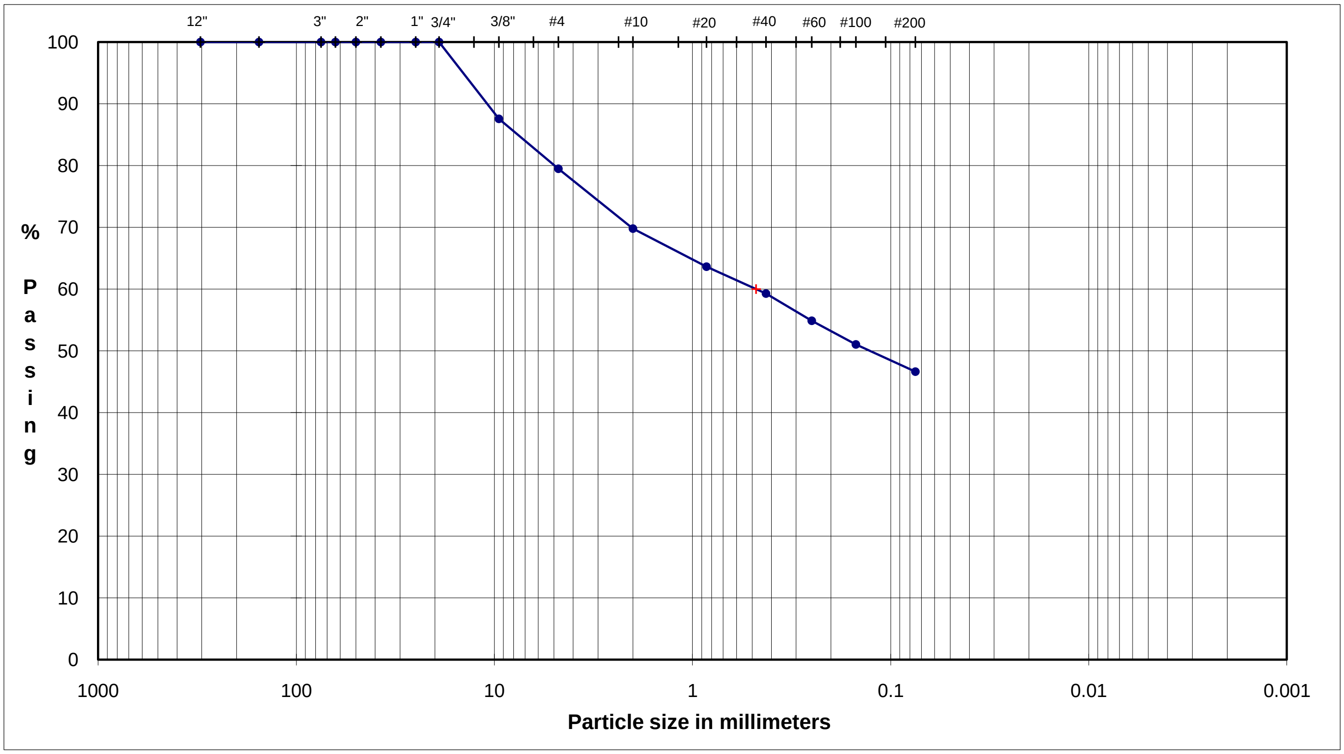
TECH	TCM
DATE	6/16/2010
CHECK	TCM
REVIEW	BDC

6/16/10 083-93287.610

PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **WAGA / Hillside Eval and Prelim Design / WA**
SAMPLE ID: **GB-5** **S-23** Depth: **75ft**
TYPE: -



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	**100.0**	Cobbles	**0.0**
6.0"	154.2	**100.0**		
3.0"	75	**100.0**		
2.5"	63.5	**100.0**	Coarse Gravel	**0.0**
2.0"	50	**100.0**		
1.5"	37.5	**100.0**		
1.0"	25	**100.0**		
0.75"	19	**100.0**		
0.375"	9.5	**87.5**	Fine Gravel	**20.5**
#4	4.75	**79.5**		
#10	2.00	**69.8**	Coarse Sand	**9.7**
#20	0.85	**63.6**	Medium Sand	**10.5**
#40	0.43	**59.3**		
#60	0.25	**54.9**	Fine Sand	**12.6**
#100	0.15	**51.0**		
#200	0.075	**46.6**		
			Fines	**46.6**

Moisture Content
13.76

D_{60}= 0.48	D_{30}= #N/A	D_{10}= #N/A
Cu = D60/D10 =	**#N/A**	#N/A
Cc = D30^2/(D10*D60) =	**#N/A**	#N/A

DESCRIPTION: SILT and C-F SAND
some f gravel

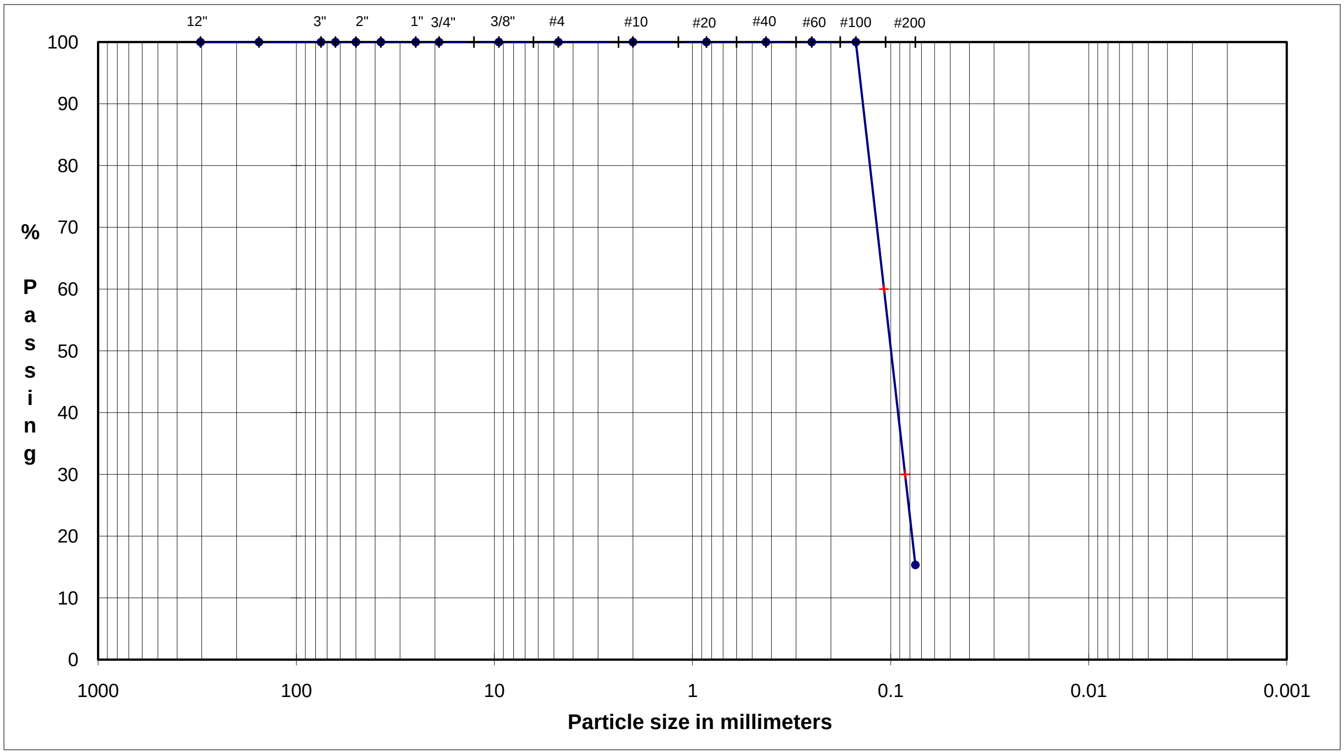
USCS: SM

TECH	TCM
DATE	6/16/10
CHECK	TCM
REVIEW	BDC

PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **WAGA / Hillside Eval and Prelim Design / WA**
SAMPLE ID: **GB-3** **S-16** Depth: **40ft**
TYPE: -



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers	Particle Size (mm)	% Passing	Particle Size Classification	Particle Size Percentage
12.0"	304.8	**100.0**	Cobbles	**0.0**
6.0"	154.2	**100.0**		
3.0"	75	**100.0**		
2.5"	63.5	**100.0**	Coarse Gravel	**0.0**
2.0"	50	**100.0**		
1.5"	37.5	**100.0**		
1.0"	25	**100.0**		
0.75"	19	**100.0**		
0.375"	9.5	**100.0**	Fine Gravel	**0.0**
#4	4.75	**100.0**		
#10	2.00	**100.0**	Coarse Sand	**0.0**
#20	0.85	**100.0**	Medium Sand	**0.0**
#40	0.43	**100.0**		
#60	0.25	**100.0**	Fine Sand	**84.6**
#100	0.15	**100.0**		
#200	0.075	**15.4**		
			Fines	**15.4**

Moisture Content
17.20

D_{60}= 0.11	D_{30}= 0.08	D_{10}= #N/A
Cu = D60/D10 =	**#N/A**	#N/A
Cc = D30^2/(D10*D60) =	**#N/A**	#N/A

DESCRIPTION: #200 WASH ONLY
0

USCS: 0

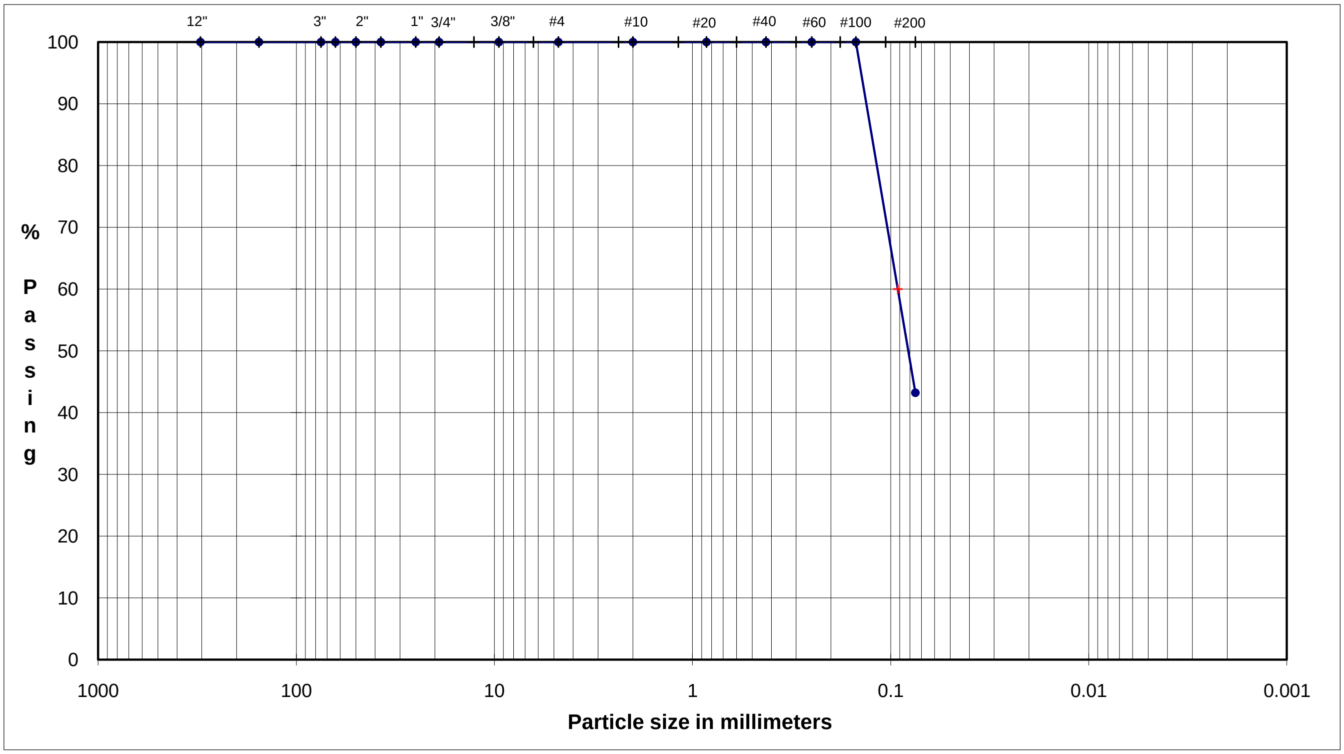
TECH	TCM
DATE	6/16/10
CHECK	TCM
REVIEW	BDC

6/16/10 **083-93287.610**

PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **WAGA / Hillside Eval and Prelim Design / WA**
SAMPLE ID: **GB-3** **S-24** Depth: **80ft**
TYPE: -



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	**100.0**		
6.0"	154.2	**100.0**		
3.0"	75	**100.0**	Cobbles	**0.0**
2.5"	63.5	**100.0**		
2.0"	50	**100.0**		
1.5"	37.5	**100.0**		
1.0"	25	**100.0**		
0.75"	19	**100.0**	Coarse Gravel	**0.0**
0.375"	9.5	**100.0**		
#4	4.75	**100.0**	Fine Gravel	**0.0**
#10	2.00	**100.0**	Coarse Sand	**0.0**
#20	0.85	**100.0**		
#40	0.43	**100.0**	Medium Sand	**0.0**
#60	0.25	**100.0**		
#100	0.15	**100.0**		
#200	0.075	**43.2**	Fine Sand	**56.8**
			Fines	**43.2**

Moisture Content: 29.82

D_{60}= 0.09	D_{30}= #N/A	D_{10}= #N/A
Cu = D60/D10 =	**#N/A**	#N/A
Cc = D30^2/(D10*D60) =	**#N/A**	#N/A

DESCRIPTION: #200 WASH ONLY
0

USCS: 0

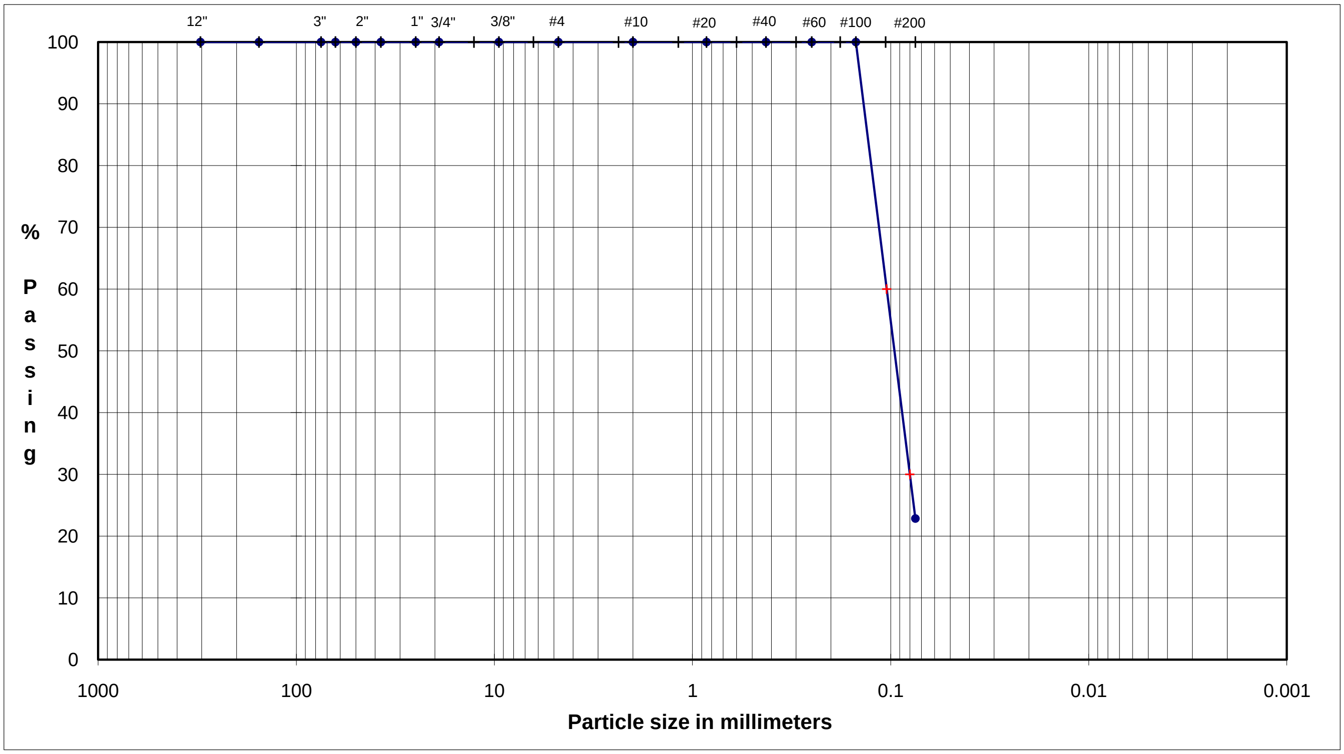
TECH	TCM
DATE	6/16/10
CHECK	TCM
REVIEW	BDC

6/16/10 083-93287.610

PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **WAGA / Hillside Eval and Prelim Design / WA**
SAMPLE ID: **GB-3** **S-28** Depth: **100ft**
TYPE: -



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Particle Size Percentage
12.0"	304.8	**100.0**	Cobbles	**0.0**
6.0"	154.2	**100.0**		
3.0"	75	**100.0**		
2.5"	63.5	**100.0**	Coarse Gravel	**0.0**
2.0"	50	**100.0**		
1.5"	37.5	**100.0**		
1.0"	25	**100.0**		
0.75"	19	**100.0**		
0.375"	9.5	**100.0**	Fine Gravel	**0.0**
#4	4.75	**100.0**		
#10	2.00	**100.0**	Coarse Sand	**0.0**
#20	0.85	**100.0**	Medium Sand	**0.0**
#40	0.43	**100.0**		
#60	0.25	**100.0**	Fine Sand	**77.2**
#100	0.15	**100.0**		
#200	0.075	**22.8**		
			Fines	**22.8**

Moisture Content
17.77

D_{60}= 0.10	D_{30}= 0.08	D_{10}= #N/A
Cu = D60/D10 =	**#N/A**	#N/A
Cc = D30^2/(D10*D60) =	**#N/A**	#N/A

DESCRIPTION: #200 WASH ONLY
0

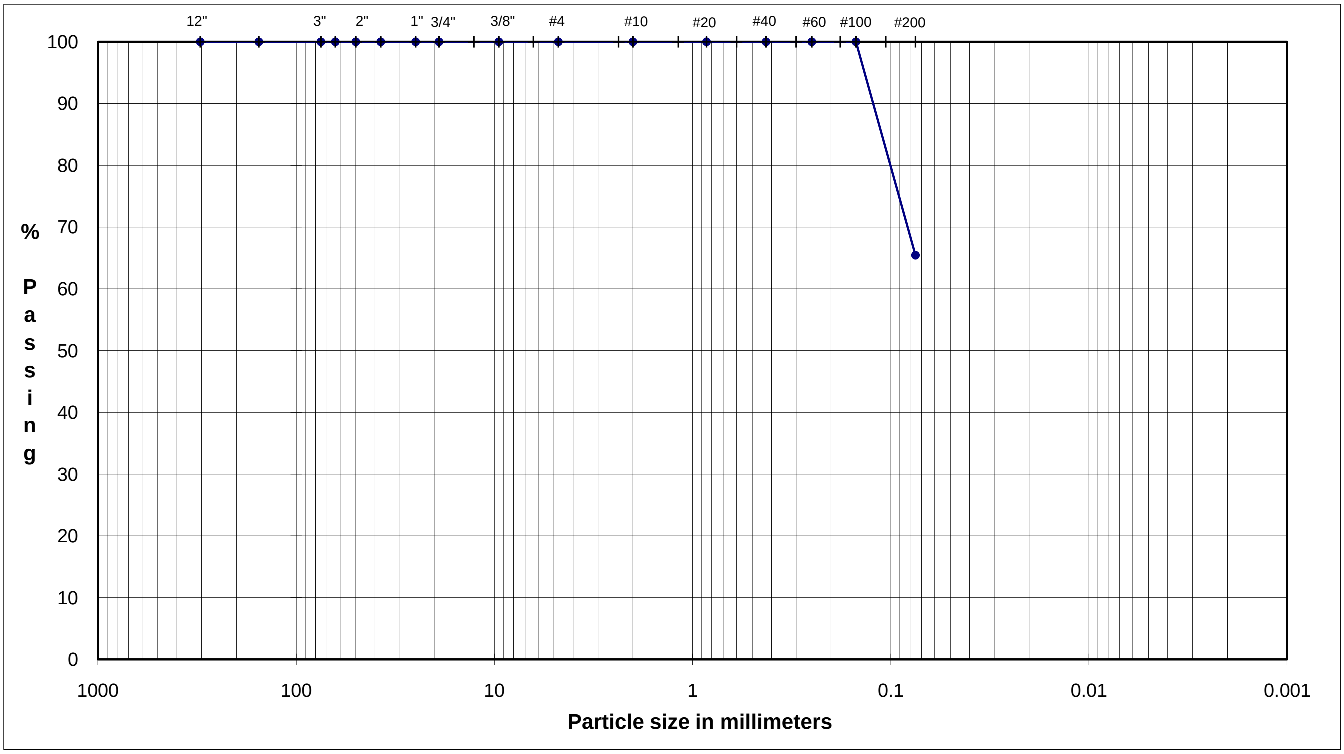
USCS: 0

TECH	TCM
DATE	6/16/10
CHECK	TCM
REVIEW	BDC

PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **WAGA / Hillside Eval and Prelim Design / WA**
SAMPLE ID: **GB-4** **S-14** Depth: **35ft**
TYPE: -



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	**100.0**	Cobbles	**0.0**
6.0"	154.2	**100.0**		
3.0"	75	**100.0**		
2.5"	63.5	**100.0**	Coarse Gravel	**0.0**
2.0"	50	**100.0**		
1.5"	37.5	**100.0**		
1.0"	25	**100.0**		
0.75"	19	**100.0**		
0.375"	9.5	**100.0**	Fine Gravel	**0.0**
#4	4.75	**100.0**		
#10	2.00	**100.0**	Coarse Sand	**0.0**
#20	0.85	**100.0**	Medium Sand	**0.0**
#40	0.43	**100.0**		
#60	0.25	**100.0**	Fine Sand	**34.6**
#100	0.15	**100.0**		
#200	0.075	**65.4**		
			Fines	**65.4**

Moisture Content
26.48

D_{60}= #N/A	D_{30}= #N/A	D_{10}= #N/A
#N/A	**#N/A**	#N/A
#N/A	**#N/A**	#N/A

DESCRIPTION: #200 WASH ONLY
0

USCS: 0

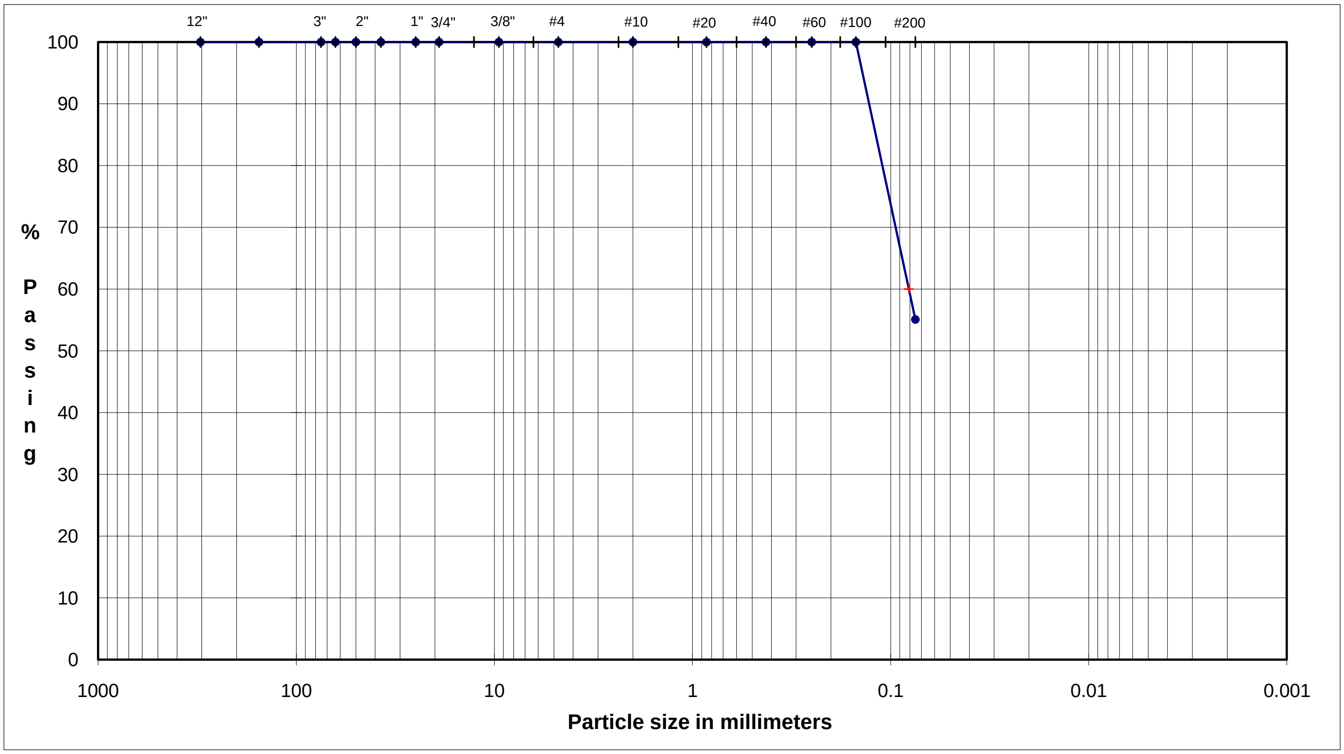
TECH	TCM
DATE	6/16/10
CHECK	TCM
REVIEW	BDC

6/16/10 **083-93287.610**

PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **WAGA / Hillside Eval and Prelim Design / WA**
SAMPLE ID: **GB-4** **S-19** Depth: **55ft**
TYPE: -



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Particle Size Percentage
12.0"	304.8	**100.0**	Cobbles	**0.0**
6.0"	154.2	**100.0**		
3.0"	75	**100.0**		
2.5"	63.5	**100.0**	Coarse Gravel	**0.0**
2.0"	50	**100.0**		
1.5"	37.5	**100.0**		
1.0"	25	**100.0**		
0.75"	19	**100.0**		
0.375"	9.5	**100.0**	Fine Gravel	**0.0**
#4	4.75	**100.0**		
#10	2.00	**100.0**	Coarse Sand	**0.0**
#20	0.85	**100.0**	Medium Sand	**0.0**
#40	0.43	**100.0**		
#60	0.25	**100.0**	Fine Sand	**44.9**
#100	0.15	**100.0**		
#200	0.075	**55.1**		
			Fines	**55.1**

Moisture Content
19.15

D_{60}= 0.08	D_{30}= #N/A	D_{10}= #N/A
Cu = D60/D10 =	**#N/A**	#N/A
Cc = D30^2/(D10*D60) =	**#N/A**	#N/A

DESCRIPTION: #200 WASH ONLY
0

USCS: 0

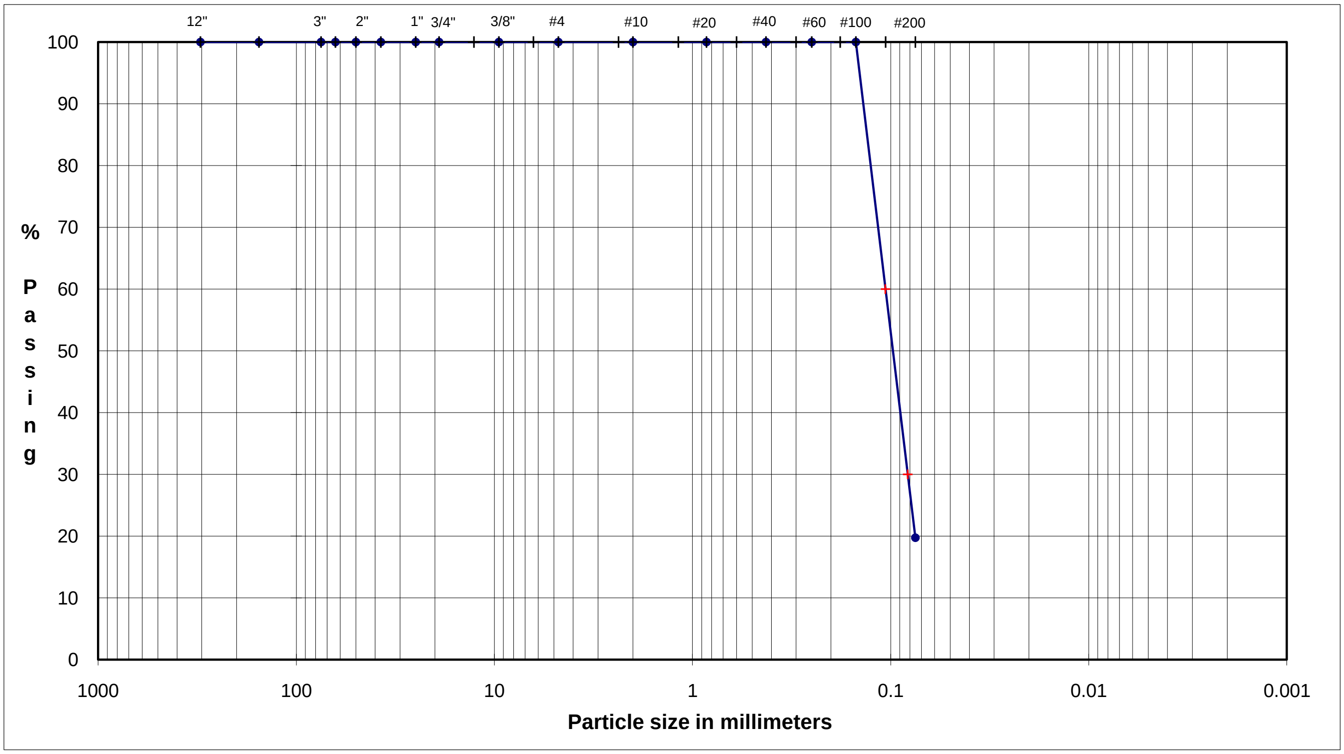
TECH	TCM
DATE	6/16/10
CHECK	TCM
REVIEW	BDC

6/16/10 **083-93287.610**

PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **WAGA / Hillside Eval and Prelim Design / WA**
SAMPLE ID: **GB-4** **S-27** Depth: **95ft**
TYPE: -



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	**100.0**	Cobbles	**0.0**
6.0"	154.2	**100.0**		
3.0"	75	**100.0**		
2.5"	63.5	**100.0**	Coarse Gravel	**0.0**
2.0"	50	**100.0**		
1.5"	37.5	**100.0**		
1.0"	25	**100.0**		
0.75"	19	**100.0**		
0.375"	9.5	**100.0**	Fine Gravel	**0.0**
#4	4.75	**100.0**		
#10	2.00	**100.0**	Coarse Sand	**0.0**
#20	0.85	**100.0**	Medium Sand	**0.0**
#40	0.43	**100.0**		
#60	0.25	**100.0**	Fine Sand	**80.3**
#100	0.15	**100.0**		
#200	0.075	**19.7**		
			Fines	**19.7**

Moisture Content

13.12

D_{60}= 0.11	D_{30}= 0.08	D_{10}= #N/A
Cu = D60/D10 =	**#N/A**	#N/A
Cc = D30^2/(D10*D60) =	**#N/A**	#N/A

DESCRIPTION: #200 WASH ONLY
0

USCS: 0

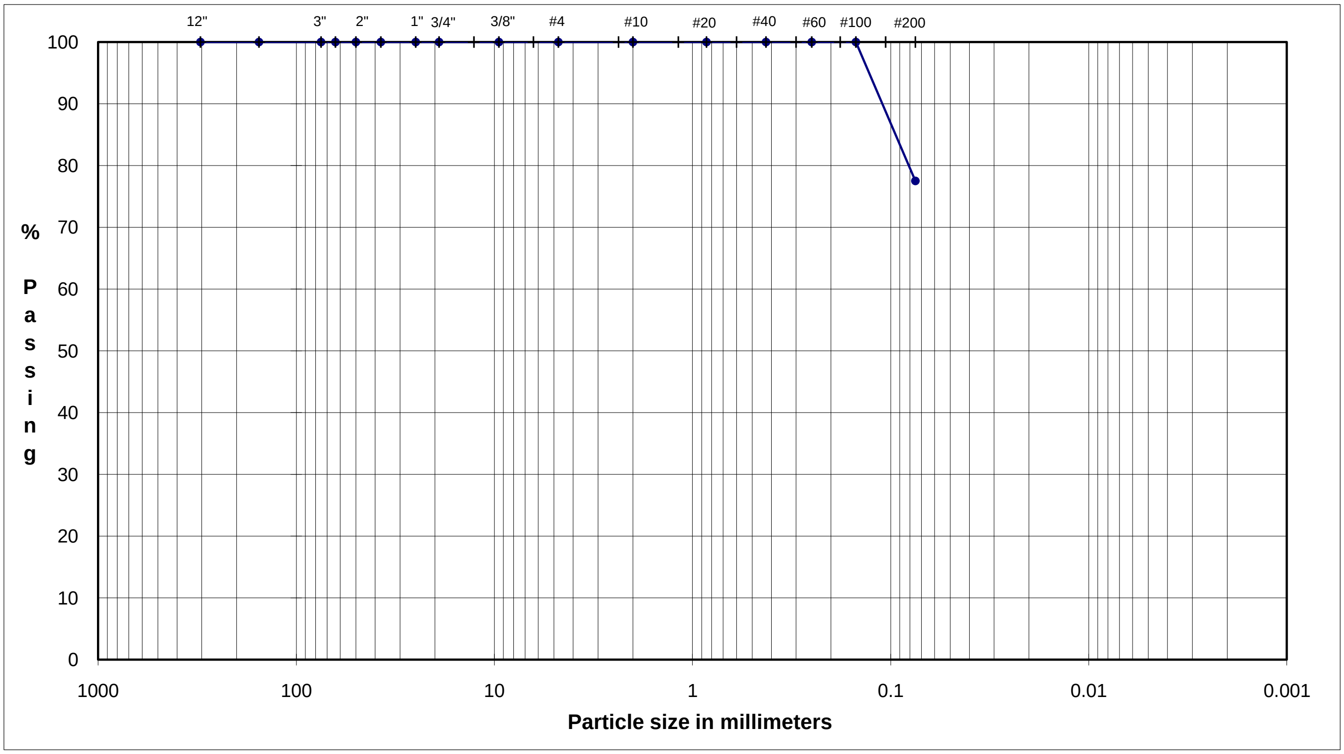
TECH	TCM
DATE	6/16/10
CHECK	TCM
REVIEW	BDC

6/16/10 **083-93287.610**

PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **WAGA / Hillside Eval and Prelim Design / WA**
SAMPLE ID: **GB-5** **S-20** Depth: **60ft**
TYPE: -



COBBLES	GRAVEL		SAND			FINES
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	**100.0**		
6.0"	154.2	**100.0**		
3.0"	75	**100.0**	Cobbles	**0.0**
2.5"	63.5	**100.0**		
2.0"	50	**100.0**		
1.5"	37.5	**100.0**		
1.0"	25	**100.0**		
0.75"	19	**100.0**	Coarse Gravel	**0.0**
0.375"	9.5	**100.0**		
#4	4.75	**100.0**	Fine Gravel	**0.0**
#10	2.00	**100.0**	Coarse Sand	**0.0**
#20	0.85	**100.0**		
#40	0.43	**100.0**	Medium Sand	**0.0**
#60	0.25	**100.0**		
#100	0.15	**100.0**		
#200	0.075	**77.5**	Fine Sand	**22.5**
			Fines	**77.5**

Moisture Content
22.84

D_{60}= #N/A	D_{30}= #N/A	D_{10}= #N/A
#N/A	**#N/A**	#N/A
#N/A	**#N/A**	#N/A

DESCRIPTION: #200 WASH ONLY
0

USCS: 0

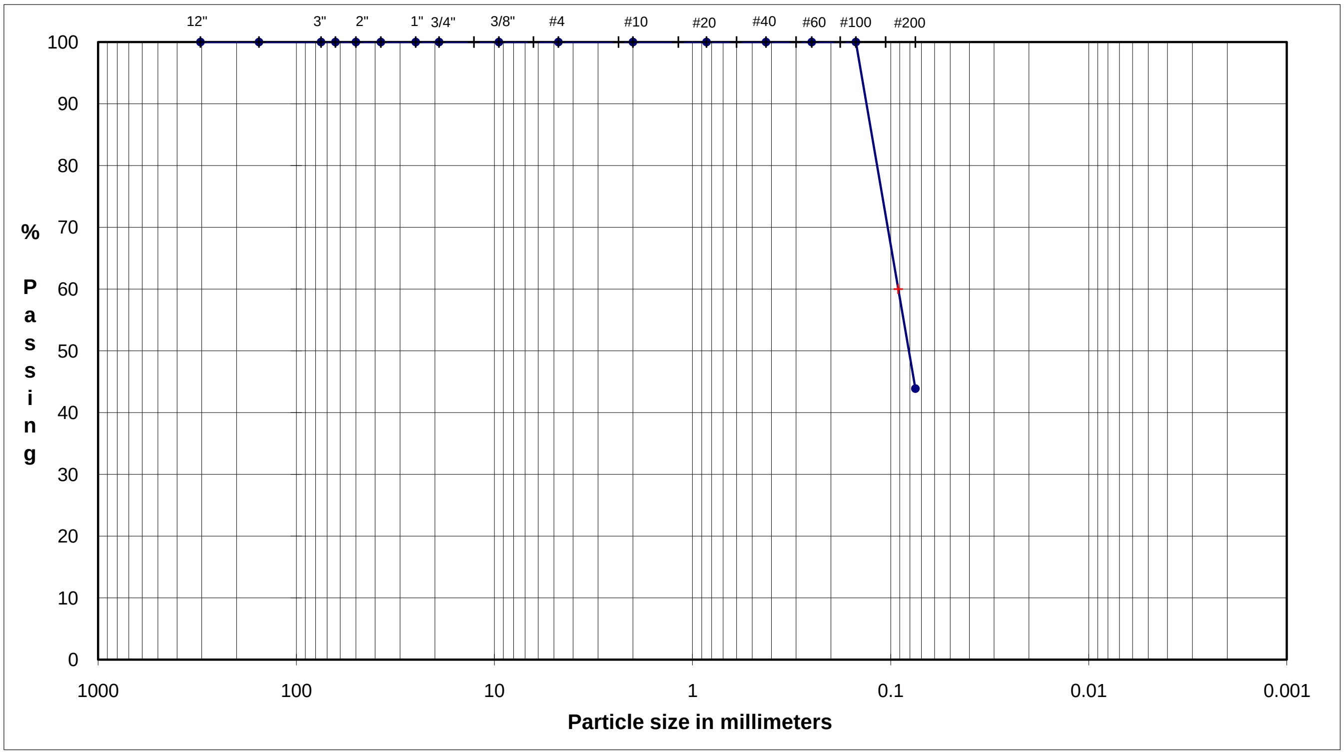
TECH	TCM
DATE	6/16/10
CHECK	TCM
REVIEW	BDC

Golder Associates Inc.

PARTICLE SIZE DISTRIBUTION

ASTM D421, D422, D4318

PROJECT NAME: **WAGA / Hillside Eval and Prelim Design / WA**
SAMPLE ID: **GB-5** **S-26** Depth: **90ft**
TYPE: -



	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Particle Size Percentage
12.0"	304.8	**100.0**	Cobbles	**0.0**
6.0"	154.2	**100.0**		
3.0"	75	**100.0**		
2.5"	63.5	**100.0**	Coarse Gravel	**0.0**
2.0"	50	**100.0**		
1.5"	37.5	**100.0**		
1.0"	25	**100.0**		
0.75"	19	**100.0**		
0.375"	9.5	**100.0**	Fine Gravel	**0.0**
#4	4.75	**100.0**		
#10	2.00	**100.0**	Coarse Sand	**0.0**
#20	0.85	**100.0**	Medium Sand	**0.0**
#40	0.43	**100.0**		
#60	0.25	**100.0**	Fine Sand	**56.1**
#100	0.15	**100.0**		
#200	0.075	**43.9**		
			Fines	**43.9**

Moisture Content: 20.74

D_{60}= 0.09	D_{30}= #N/A	D_{10}= #N/A
Cu = D60/D10 =	**#N/A**	#N/A
Cc = D30^2/(D10*D60) =	**#N/A**	#N/A

DESCRIPTION: #200 WASH ONLY
0

USCS: 0

TECH	TCM
DATE	6/16/10
CHECK	TCM
REVIEW	BDC

APPENDIX C
INCLINOMETERS

APPENDIX C-1
INCLINOMETER SUMMARY AND DATASHEETS

APPENDIX C-1
Inclinometer Summary

Inclinometer Installation Information for Instruments Installed by Golder

Boring ID	Date Completed	Estimated Ground Surface Elevation (ft)[1]	Casing Stick-up Above Ground Surface (ft)	Depth (ft)
GB-1	5/29/09	145	-0.1	98
GB-2	5/27/09	133	3.4	102
GB-3	4/30/10	129	Flush	98
GB-4	5/5/10	113	Flush	98
GB-5	5/4/10	113	Flush	98

[1] Elevation datum NAVD 88; ground surface from survey where available or estimated from base map.

Inclinometer Installation Information for Instruments Installed by Others

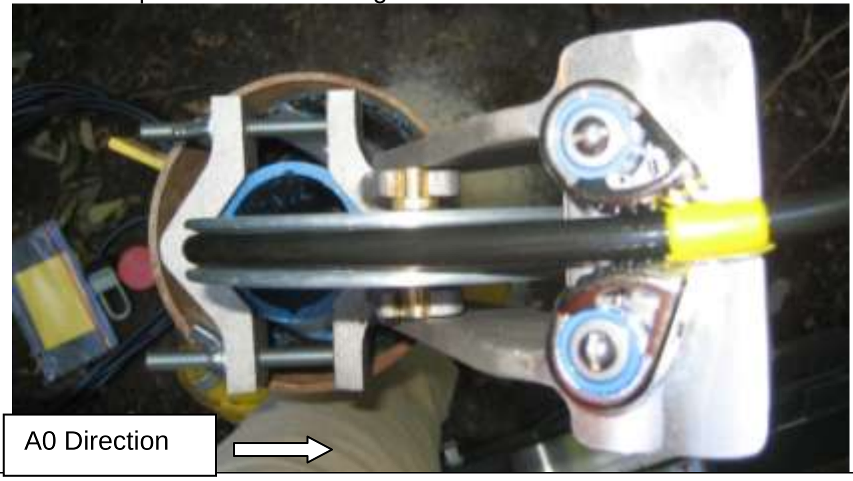
Boring ID	Date Completed	Estimated Ground Surface Elevation[1] (ft)	Casing Stick-up Above Ground Surface (ft)	Depth (ft)
DH-1	1992	116	0	102
DH-2	1994	102	1.3	86
J-1	12/15/1987	32	Flush	32

[1] Elevation datum NAVD 88; ground surface from survey where available or estimated from base map.

Inclinometer	**GB-1**
Inclinometer ID in DataMate	CAP 1GOV
Campus Area	Governor’s Mansion
Location	End of brick driveway, in planting bed
Installation Date	May 2009
Depth of Inclinometer	98 ft
Distance from Ground Surface to Monitoring Point	0.8 ft
A0 Direction	West-Southwest
Notes	Affix pulley assembly to top of casing in A0 direction (Photograph 1). Do not use wheel. Need 9/16” socket wrench to open monument.
Monitoring Point	Top of marker in line with edge of pulley assembly. (Photograph 2).

Photograph 1: GB-1 Set-up

Photograph 2: GB-1 Marker position for recording

<table>
<tr><th>Inclinometer</th><th>GB-2</th></tr>
<tr><td>Inclinometer ID in DataMate</td><td>CAP 2</td></tr>
<tr><td>Campus Area</td><td>Pritchard Building</td></tr>
<tr><td>Location</td><td>Yellow monument in planter adjacent to sidewalk south of Pritchard Building</td></tr>
<tr><td>Installation Date</td><td>May 2009</td></tr>
<tr><td>Depth of Inclinometer</td><td>102 ft</td></tr>
<tr><td>Distance from Ground Surface to Monitoring Point</td><td>4.4 ft</td></tr>
<tr><td>A0 Direction</td><td>Southwest</td></tr>
<tr><td>Notes</td><td>Affix entire pulley assembly to top of casing in A0 direction (Photograph 3). Combination of lock on monument: 3287</td></tr>
<tr><td>Monitoring Point</td><td>Top of marker in line with edge of pulley assembly. (Photograph 4).</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2">Photograph 3: GB-2 Pulley assembly set-up
</td></tr>
<tr><td colspan="2">Photograph 4: GB-2 Marker position for recording.

</td></tr>
</table>

Inclinometer	**GB-3**
Inclinometer ID in DataMate	GB3
Campus Area	O'Brien Building
Location	Approximately 5 feet from slope edge at north end of O'Brien building.
Installation Date	May 2010
Depth of Inclinometer	98 ft
Distance from Ground Surface to Monitoring Point	-0.3 ft
A0 Direction	South West
Notes	Manually hold cable centered in the inclinometer casing. Requires 2 people to perform reading. (pulley assembly not used)
Monitoring Point	Top of marker in line with the top of the low side of the casing. Low side toward the slope.

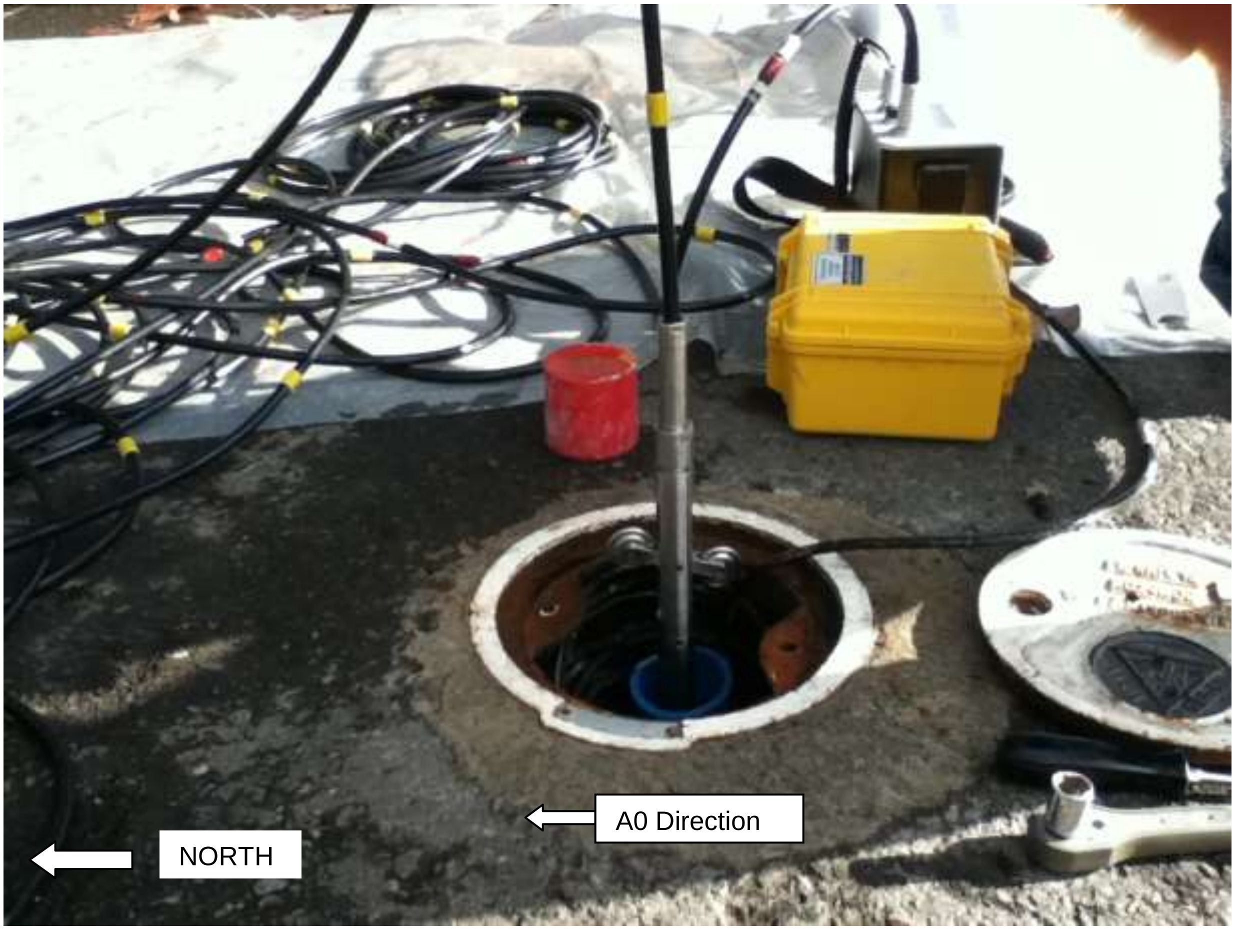
Photograph 5: GB-3 A0 Direction

Inclinometer	**GB-4**
Inclinometer ID in DataMate	GB4
Campus Area	West of Mansion Parking Lot
Location	At top of slope, west edge of parking lot
Installation Date	May 2010
Depth of Inclinometer	98 ft
Distance from Ground Surface to Monitoring Point	-0.2 ft
A0 Direction	West
Notes	Manually hold cable centered in the inclinometer casing. Requires 2 people to perform reading. (pulley assembly not used)
Monitoring Point	Top of marker flush with top of inclinometer casing.

Photograph 6: GB-4 Marker position for recording

Inclinometer	**GB-5**
Inclinometer ID in DataMate	GB5
Campus Area	Mansion Parking Lot
Location	North end of Mansion Parking Lot
Installation Date	May 2010
Depth of Inclinometer	98 ft
Distance from Ground Surface to Monitoring Point	-0.3 ft
A0 Direction	North
Notes	Manually hold cable centered in the inclinometer casing. Requires 2 people to perform reading. (pulley assembly not used)
Monitoring Point	Top of marker flush with top of inclinometer casing.

Photograph 7: GB-5 Set-up and A0 direction



Inclinometer	**DH-1**
Inclinometer ID in DataMate	CAP DH-1 I5
Campus Area	North Parking Lot
Location	Behind weather station at NW corner of north parking lot
Installation Date	1992
Depth of Inclinometer	102 ft
Distance from Ground Surface to Monitoring Point	0 ft
A0 Direction	West (see photograph 6)
Notes	Manually hold cable centered in the inclinometer casing. Requires 2 people to perform reading. (pulley assembly not used)
Monitoring Point	Top of marker flush with top of inclinometer casing.

Photograph 9: A0 Direction and casing.

Inclinometer	**DH-2**
Inclinometer ID in DataMate	CAP I3
Campus Area	Greenhouse
Location	Behind Greenhouse, westernmost of the three monuments. Marked I-3 on top of monument.
Installation Date	April 1994
Depth of Inclinometer	86 ft
Distance from Ground Surface to Monitoring Point	1.2 ft
A0 Direction	West
Notes	Manually hold cable centered in the inclinometer casing. Pulley assembly not used
Monitoring Point	Top of marker flush with top of inclinometer casing. (Photograph 5).

Photograph 8: DH-2 Marker position at recording

Inclinometer	**J-1**
Inclinometer ID in DataMate	J1
Campus Area	Heritage Park
Location	South side of trail at toe of slope below soldier pile wall. Flush mount monument. Located adjacent to trail approximate opposite last fence post.
Installation Date	1987
Depth of Inclinometer	32 ft
Distance from Ground Surface to Monitoring Point	-0.2 ft
A0 Direction	NW
Notes	Manually hold cable centered in the inclinometer casing. Requires 2 people to perform reading. (pulley assembly not used)
Monitoring Point	Top of marker flush with top of inclinometer casing.

Photograph 10: J-1 Location and A0 direction

APPENDIX C-2
DIGITILT INCLINOMETER PROBE MANUAL

Digitilt
Inclinometer Probe
50302599

SLOPE INDICATOR
12123 Harbour Reach Drive
Mukilteo, Washington, USA, 98275
Tel: 425-493-6200 Fax: 425-493-6250
E-mail: solutions@slope.com
Website: www.slopeindicator.com

Contents

Introduction

Inclinometer System

An inclinometer system includes inclinometer casing, an inclinometer probe and control cable, and an inclinometer readout unit.

Inclinometer casing is typically installed in a near-vertical borehole that passes through a zone of suspected movement. The bottom of the casing is anchored in stable ground.

The inclinometer probe is used to survey the casing and establish its initial position. Ground movement causes the casing to move away from its initial position. The rate, depth, and magnitude of this movement is calculated by comparing data from the initial survey to data from subsequent surveys.

This Manual

This manual addresses the use and maintenance of the inclinometer probe and control cable. It also provides an overview of taking readings and reducing data.

Other manuals cover casing installation, inclinometer readouts, and software for reducing data.

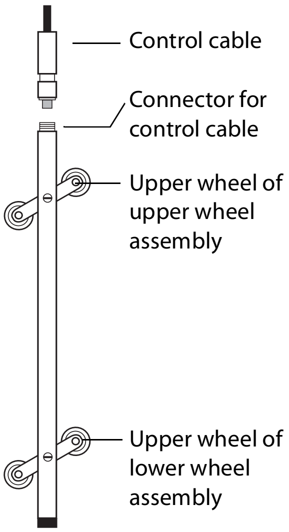
The Inclinometer Probe

Parts of the Probe

The inclinometer probe consists of a stainless steel body, a connector for control cable, and two pivoting wheel assemblies.

When properly connected to the control cable, the probe is waterproof and has been used deeper than 1000 feet.

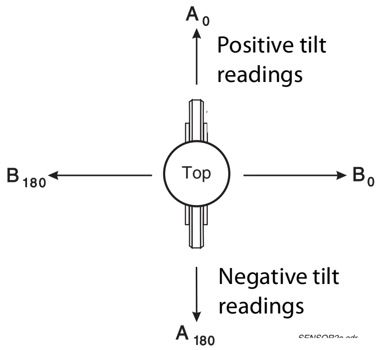
The wheel assemblies consists of a yoke and two wheels. One of the wheels in each assembly is higher than the other. This wheel is called the "upper wheel" and has special significance, as explained below.



Measurement Planes

The inclinometer probe employs two force-balanced servo-accelerometers to measure tilt. One accelerometer measures tilt in the plane of the inclinometer wheels. This is the "A"axis. The other accelerometer measures tilt in the plane that is perpendicular to the wheels. This is the "B" axis.

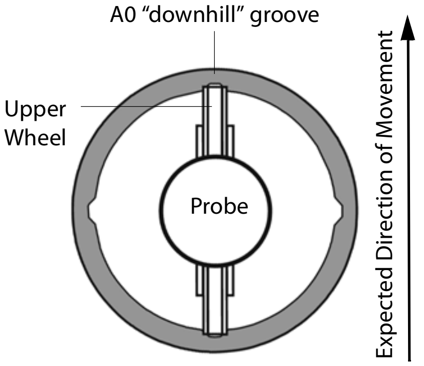
The drawing at right shows the probe from the top. When the probe is tilted toward the A0 or B0 direction, readings are positive. When the probe is tilted in the A180 or B180 directions, readings are negative.



Orientation of the Probe

Inclinometer casing is installed so that one set of grooves is aligned with the expected direction of movement. One groove, typically the "downhill" groove should be marked A0.

In a standard inclinometer survey, the probe is drawn from the bottom to the top of the casing two times. In the first pass, the upper wheels of the probe should be inserted into the A0 groove. This ensures that movements are positive values.



Always start surveys with upper wheel in A0 groove.

Handling the Probe

The inclinometer probe is a sensitive measuring instrument. Handle it with care.

- Transport the probe in its carrying case. If you drive to the site, carry the casing in the passenger compartment, preferrably on a passenger seat.
- When you connect control cable to the probe, avoid overtightening the nut, since this will flatten the O-ring and reduce its effectiveness.
- Before you lower the probe into the casing, turn the power on.
- When you insert the probe into the casing, cup the wheels with your hands to compress the springs and allow smooth insertion.
- When you lower the probe into the borehole, do not allow it to strike the bottom.
- When you withdraw the probe from the casing, again cup the wheels with your hands to prevent them from snapping out.
- When you rotate the probe, keep it upright and perform the rotation smoothly.
- The probe is rated for temperatures from -20 to 50 °C (-4 to 122 °F). Avoid using the probe in temperatures outside this range.

Caring for the Probe

This is an overview. See the last chapter, Inspection and Maintenance, for additional information.

Cleaning the Probe: When you finish a survey, wipe moisture off the probe and replace the protective cap. If necessary, rinse the probe in clean water or wash it with a laboratory grade detergent when you return to the office.

Cleaning the Connectors: Do not clean connectors with spray lubricants or electrical contact cleaners. Solvents in these products will attack the neoprene inside the connector. When it is necessary to clean the connectors, use a cotton swab slightly moistened with alcohol. Be careful to use only a small amount of alcohol.

Drying the Probe: When you return to the office, remove protective caps from the control cable, probe, and readout unit. Allow connectors to air-dry thoroughly for a number of hours. Afterwards, replace the caps.

Storing the Probe: The probe, control cable, and readout unit should be stored in a dry place. For extended storage, keep the probe in a vertical position.

Lubricating the Wheels: Lubricate the wheels regularly. Spray a small amount of lubricant or place a drop of oil on both sides of the wheel bearings. Check that the wheels turn smoothly.

O-Ring Care: Periodically clean and lubricate the O-ring on the connector end of the inclinometer probe. Use O-ring lubricant.

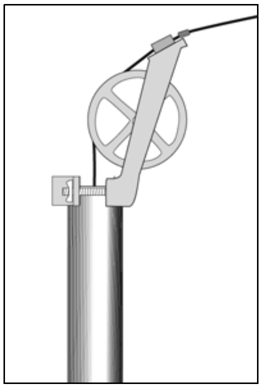
Control Cable

Introduction

Control cable is used to control the depth of the inclinometer probe. It also conducts power to the probe and returns signals to the readout.

- Metric control cables are graduated with yellow marks at 0.5 meter intervals and red marks at 1-meter intervals. There are numeric marks at 5-meter intervals.
- English control cables are graduated with yellow markers at 2-foot intervals and red marks at 5-foot intervals. There are numeric marks at 50-foot intervals. In addition, there are yellow bands of tape at 10 foot intervals. Each band represents 10 feet from the last numeric mark. For example, 4 bands represent 40 feet from the last numeric depth mark.

Depth Control



Accurate inclinometer measurements depend on consistent placement of the inclinometer probe. Always align the depth marks on the control cable with the same reference. Aim for placement repeatability of 6 mm (1/4 inch) or better.

We recommend using a pulley assembly to assist with depth control. The jam cleat on the pulley assembly holds the cable and the top edge of the chassis provides a convenient reference for cable depth marks.

The small pulley assembly is used with 48 mm and 70 mm casing (1.9 and 2.75 inch). The large pulley assembly is used with 70 mm and 85 mm casing (2.75 and 3.34 inch).

Using the Pulley Assembly

1. Remove the pulley from the chassis.
2. Clamp the chassis to the top of the casing.
3. Insert the inclinometer probe and control cable.
4. Replace the pulley.

Note: The distance between the top edge of the pulley chassis and the top of the casing is one foot. Your data reduction software can automatically adjust for this, so keep your survey procedure simple: use the marks on the cable and the top edge of the pulley chassis for reference. Let the software do any extra work required.

Check that operators consistently use the pulley assembly. If the pulley is used for one survey and not for the next, the resulting data sets will not be directly comparable. Sometimes a monument case or a protective pipe makes it impossible to attach the pulley assembly to the casing. In this case, you can make a removable adapter for the pulley assembly. If you use an adapter, be sure to use it consistently.

Cable Tips

Connecting Cable: When you connect control cable to the probe, avoid overtightening the nut, since this will flatten the O-ring and reduce its effectiveness.

Calibrate your Cable: If you have time, “calibrate” your cable, recording the exact position of cable marks. This can be important for long term monitoring projects.

Caring for Cable

Cleaning the cable: If necessary, rinse the cable in clean water or wash the cable in a laboratory-grade detergent, such as Liquinox.® Do not use solvents to clean the cable. Be sure the protective cap is in place before immersing the end of the cable in water. Do not immerse the Lemo connector.

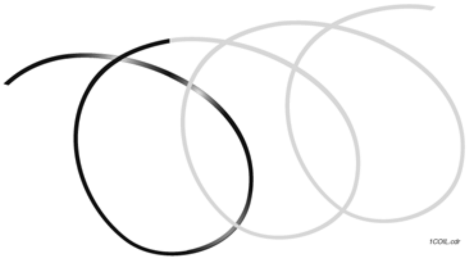
Cleaning Connectors: If it is necessary to clean the connector, use a cotton swab moistened with a small amount of alcohol. Do not use spray lubricants or electric contact cleaners. Solvents contained in such products will attack the neoprene inserts in the connectors.

Drying Connectors: When you return to the office, remove protective caps from the control cable, probe, and readout unit. Allow connectors to air-dry well for a number of hours.

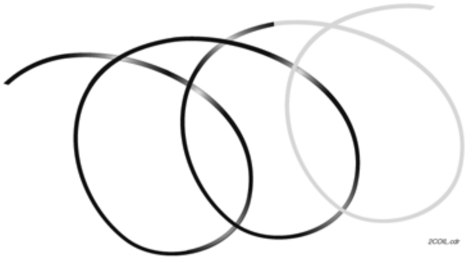
Storage: Store cable on a cable reel when possible. The reel should have a minimum hub diameter of 300 mm (12 inches). If a reel is not available, use the technique below to coil the cable.

Coiling Cable

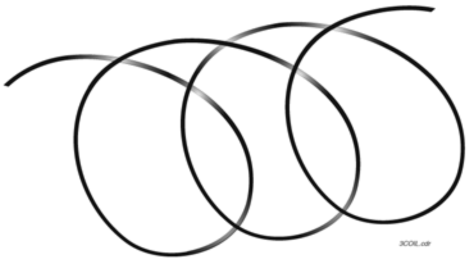
1. Loop cable forward as shown in drawing.



2. Twist cable backwards to make a second loop as shown in drawing.



3. Continue coiling cable, alternating loops as in steps 1 and 2.



Taking Readings

Good Practices

- Use the same probe and control cable for each survey, if possible.
- Use a pulley assembly, if possible. It protects the control cable and provides a good reference.
- Use a consistent top reference. The goal is placement repeatability within 5 mm or 1/4 inch. If one technician uses a pulley and another technician does not, probe positioning will be inconsistent, and data will have to be manipulated before it is useful.
- Always draw the probe upward to the reading depth. If you accidentally draw the probe above the intended depth, lower the probe down to the previous depth, then draw it back up to the intended depth. This technique ensures the probe will be positioned consistently.
- Wait 10 minutes for the probe to adjust to the temperature of the borehole.
- Wait for displayed readings to stabilize as much as possible. If the readings do not stabilize, try to record an average reading.

Setting Up

1. When you arrive at the site, lay out a plastic sheet or tarp to set the equipment on. You should have the inclinometer probe, the indicator, the control cable, and the pulley assembly. Some people find it is useful to bring a basket or box to hold the control cable and a rag to wipe off the probe and cable after readings have been taken.
2. Unlock and remove the protective cap from the casing. Attach the pulley assembly.
3. Remove protective caps from probe and control cable.
4. Align the connector key with the keyway in the probe. Then insert the connector and tighten the nut to secure the connection. Do not over-tighten the nut, since this will flatten the O-ring and reduce its effectiveness.

Position the Probe

1. Turn on the indicator. This energizes the accelerometers, making them less susceptible to shock.
2. Insert the probe into the casing with the upper wheels of both wheel assemblies in the A0 groove. (Cup the wheels with your hands to compress the springs for a smooth insertion). If you are using the pulley assembly, take out the pulley wheel, insert the probe, and then replace the wheel.
3. Lower the probe slowly to the bottom. Do not allow it to strike the bottom. Allow the probe to adjust to the temperature inside the casing. Five or ten minutes is usually sufficient.

Record Data

1. Raise the probe to the starting depth. Wait for the numbers on the readout to stabilize. If you are using the DataMate, press the button to record both the A and B axis readings. If you are using a manual indicator, write down the A-axis reading, then switch to the B-axis and record that reading.
2. Raise the probe to the next depth. Wait for a stable reading, and then record it. Repeat this process until the probe is at the top of the casing.
3. Remove the probe and rotate it 180 degrees, so that the lower wheels of both wheel assemblies are inserted into the A0 groove. When you remove the probe, cup the wheels with your hands to prevent them from snapping outwards. Also, hold the probe upright when rotating it.
4. Lower the probe to the bottom, raise it to the starting depth, and continue the survey. Take readings at each depth until you have reached the top. Remove the probe. At this point, you may want to validate the data set and make any corrections necessary.

Leaving the Site

Wipe off the probe and cable. Replace end-caps on cable and probe and return the probe to its protective case. Replace the indicator's protective plugs. Coil the cable. Remove the pulley assembly and replace and lock the protective cap.

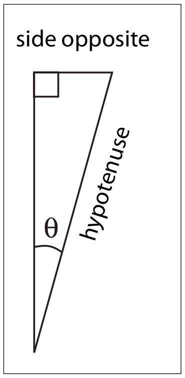
At the Office

Wipe off the indicator and recharge its batteries. Transfer the data set to a PC. Oil the probe wheels. If the storage place is dry, remove protective caps from probe, indicator, and control cable to allow all connectors to dry.

Data Reduction

Inclinometer Measurements

The inclinometer probe measures tilt, rather than lateral movement. How does tilt provide information about lateral movement? The basic principle involves the sine function, an angle, and the hypotenuse of a right triangle. We are interested in the length of the side opposite the angle θ.

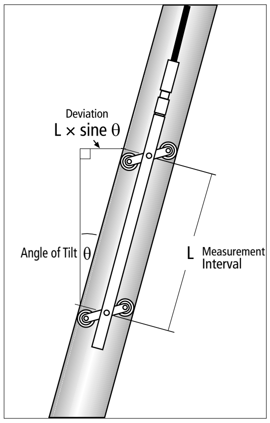


$$\sin\theta = \frac{\text{side opposite}}{\text{hypotenuse}}$$

$$\text{side opposite} = \text{hypotenuse} \times \sin\theta$$

Deviation

In the drawing at right, the hypotenuse of the right triangle is the measurement interval. The measurement interval is typically 0.5 m with metric-unit inclinometers or 2 feet with English-unit inclinometers.

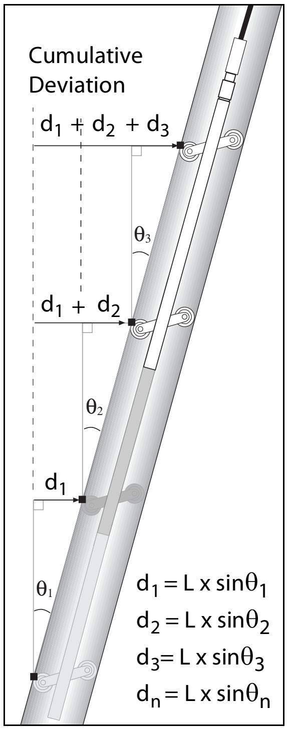


The side opposite the angle of tilt is deviation. It is calculated by multiplying the sine of the angle of tilt by the measurement interval. This calculation translates the angular measurement into a lateral distance and is the first step to calculating lateral movement.

Cumulative Deviation

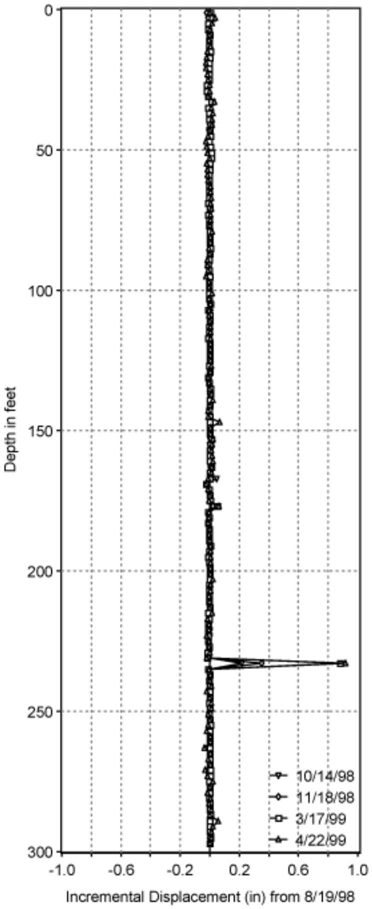
By summing and plotting the deviation values obtained at each measurement interval, we can see the profile of the casing.

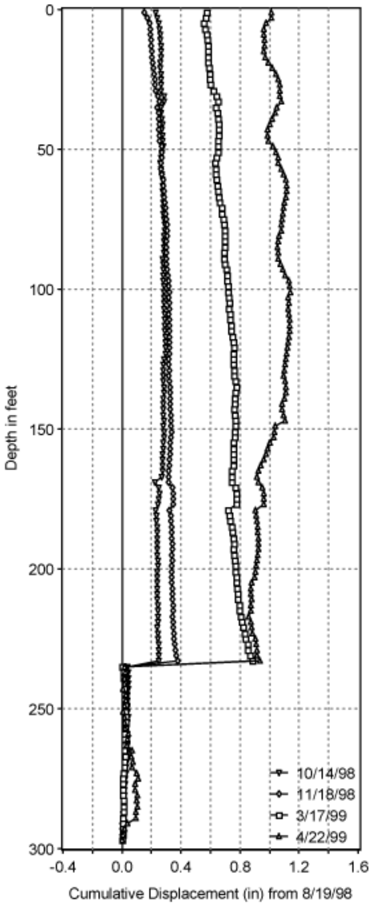
The black squares at each measurement interval represent cumulative deviation values that would be plotted to show the profile of the casing.



Displacements

Changes in deviation are called displacements, since the change indicates that the casing has moved away from its original position. When displacements are summed and plotted, the result is a high resolution representation of movement.





Incremental displacement plot shows movement at each measurement interval. The growing “spike indicates a shear movement.

Cumulative displacement plot shows a displacement profile. Displacements are summed from bottom to top.

Reducing Data Manually

Normally, computer software is used to reduce inclinometer data. Here, we show only a simple overview.

Displayed Readings

Slope Indicator's readouts display "reading units" rather than angles or deviation. Reading units are defined below:

$$\text{Displayed Reading} = \sin\theta \times \text{Instrument Constant}$$

$$\text{Reading}_{\text{English}} = \sin\theta \times 20{,}000$$

$$\text{Reading}_{\text{Metric}} = \sin\theta \times 25{,}000$$

Combining Readings

The standard two-pass survey provides two readings per axis for each interval. The probe is oriented in the "0" direction for the first reading and in the "180" direction for the second reading. During data reduction, we find the algebraic difference of the two readings, and then we divide by 2, since there were two readings. Use of the algebraic difference lets us preserve the direction of the tilt, as indicated with a positive or negative sign.

$$\text{A0 Reading} = 359 \qquad \text{A180 Reading} = -339$$

$$\text{Combined Reading} = \frac{359-(-339)}{2} = 349$$

Calculating Deviation

To calculate lateral deviation, we find the algebraic difference of the two readings, divide by 2, divide by the instrument constant, and multiply by the measurement interval. In the example below, the English-unit measurement interval is 24 inches and the English-unit instrument constant is 20,000.

$$\text{Lateral Deviation} = \text{Measurement Interval x} \sin\theta$$

$$= 24\text{ inches} \times \frac{359-(-339)}{2\times 20,000}$$

Find the algebraic difference of the A0 & 180 readings and divide by 2.

Divide reading unit by instrument constant to obtain sine of angle.

$$= 0.4188\text{ inches}$$

Calculating Displacement

Displacement, the change in lateral deviation, indicates movement of the casing. To calculate displacement, we need two surveys. We subtract the initial combined reading from the current combined reading, divide by 2 x the instrument constant, and, and multiply by the length of the measurement interval.

$$\text{Combined Reading}_{\text{current}} = 700 \qquad \text{Combined Reading}_{\text{initial}} = 698$$

$$\text{Displacement} = \text{Measurement Interval} \times \Delta\sin\theta$$

$$= 24\text{ inches} \times \frac{700-698}{2\times 20,000}$$

$$= 0.0012\text{ inches}$$

Calculating Checksums

A checksum is the sum of a “0” reading and a “180” reading at the same depth.

A0 reading = 359   A180 reading = -339

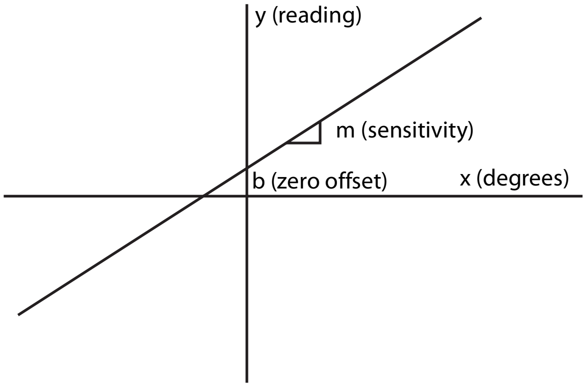
Checksum = 359 + (-339)

= 20

Bias (zero offset)

If you hold your inclinometer probe absolutely vertical and check the reading, you will typically see a non-zero value for each axis. The non-zero value is the result of a slight bias in the output of the accelerometers. The bias (or zero offset) may be negative or positive and will change over the life of the probe. This is not normally a matter for concern, because the zero offset is effectively eliminated by the standard two-pass survey and the data reduction procedure.

Below, we show an readings that have a zero offset of 10. During the first pass the probe measures a tilt of 1 degree. During the second pass the probe measures a tilt of -1 degree, because it has been rotated 180 degrees. See how the offset increases the positive reading and decreases the negative reading, even though the measured angle has not changed. However, when the two readings are combined, as discussed in “Combining Readings” above, the offset is eliminated and the correct value emerges.



Tilt angle = 1 degree.   Theoretical reading unit = 349   (20,000 x sin (1))

Offset = 10

Displayed A0 reading = 359   (349 + 10)

Displayed A180 reading = -339   (-349 + 10)

Combined reading = 698   (359 - (-339))

Averaged reading = 349

Inspection & Maintenance

Probe Inspection

Part	What to check for	Remedy
Wheel yoke	Side to side movement	Check pivot pin, which looks like screw. If pivot pin has been turned too far, it may spread the wheel yoke. Turn the pivot pin counter-clockwise to see if movement disappears. If movement persists, replace the nylon spacers or the entire wheel assembly. The wheel assembly can be replaced by the user: kit number 50302555.
Wheel yoke	Yoke does not return to fully extended position.	If yoke is dirty, clean it. If problem persists, spring may be broken or weak. Replace spring and roll pins or replace wheel assembly using kit 50302555.
Wheel	Side to side movement	Bad bearing. Replace wheel assembly.
Wheel	Does not turn freely	Lubricate. If movement is still bad, replace wheel assembly.
Body screws	Loose screws, wobble in body, loose bumper	Tighten screws. (Do not tighten pivot pin).
Connector keyways	Wear, corrosion	Worn keyway may degrade O-ring seal. Learn how to connect cable without "hunting." Remove corrosion and change practice - allow connector to dry after use.
Connector O-ring	Flattened, split	Replace if flattened or split.
Connector pins	Bent pins	Bent pins are easily broken when straightened. Replacement of connector requires recuperation of probe (expensive). Change connection practice - no hunting.

Probe Maintenance

Moisture Management	Wipe off the control cable and probe when you finish the day's final survey, then wipe off the probe. Do not store wet cloth with the probe. Allow the connector to dry thoroughly: remove connector cap and allow connector to air-dry for a number of hours. Lubricate the wheels. This helps displace moisture.
Wheels	Lubricate the wheels by spraying a small amount of lubricant or placing drops of oil on both sides of the wheel bearings.
O-Ring	Lubricate regularly with O-ring lube or silicone based grease. Do *not* use WD-40 or any other lubricant spray that contains chlorinated solvents.
Connectors	Clean connectors as necessary. Use a slim cotton swab moistened with alcohol. Be careful not to bend pins. Do not use electrical contact cleaners, especially sprays. Solvents in these products will attack the neoprene inside the connectors. When attacked, the neoprene swells and reduces the effectiveness of the O-ring seal.
Storage	Store probe in dry place. Be sure that the box is dry, the wheels are oiled, the connector is dry. If probe is to be stored for an extended period, stand it vertically.

Control Cable Inspection

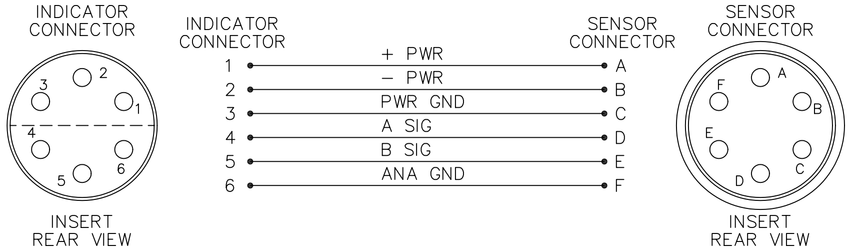
Part	**What to check for**	**Remedy**
Cable	Continuity	If you have intermittent failures, perform continuity tests. If a wire fails continuity test, you can check the Lemo connector or return cable for servicing or replacement.
Cable	Twists, worn markings, kinks, gouges	Twists indicate poor coiling technique. Change practice: use cable reel, figure-8 coils, or over-under coils. Worn markings: user is dragging cable over the edge of the casing. Change practice - but must keep consistent depths. Kinks: if kinks do not straighten, there is probably internal damage and likelihood of intermittent reading failures. If any deep gouges, water can enter cable. In both cases, bad section of cable must be removed, either by shortening the cable or replacing the cable.
Connector key	Wear, corrosion	Change connection practice - no hunting. Remove corrosion and change practice - allow connector to dry after use.
Connector rubber insert	Swelling, poor seal	Rubber swells when attacked by WD-40 or contact cleaners. Swelling may prevent good seal and allow water to enter connector. Return for service if sealing is compromised.
Connector for Indicator (Lemo)	Corrosion, bad connection.	Perform continuity check first. Then check this connector to eliminate as possible source of intermittent failures. Unscrew bottom nut, being careful not to twist cable. Slide shell off the end of the cable. Slide strain relief collet out of the way and inspect connections. Twist and pull wires gently. Good connections will not break. Repair as necessary.
Connector for Probe	Check O-ring	Do *not* disassemble this connector. Requires about two hours and a pressure test to reassemble.

Control Cable Maintenance

Moisture Management	Wipe off the control cable as you draw the probe up on the last run of the day. When you return to the office, remove connector caps and allow connectors to air-dry for a number of hours.
Cable	When necessary, rinse cable (but not connectors) in clean water or wash the cable in a laboratory-grade detergent, such as Liquinox. Do not use solvents to clean the cable.
Connectors	If it is necessary to clean the connector, use a cotton swab moistened with alcohol. Sockets can be cleaned with a brush. Do not use spray lubricants or electric contact cleaners. Solvents contained in such products will attack the neoprene inserts in the connectors.
Storing Control Cable	Improper coiling of any electrical cable twists conductors and can cause reliability problems. There are several ways to control twisting: • Use cable reel with hub diameter of at least 200mm or 8". • Coil cable in a figure-8. • Coil cable using over-under loops (2-foot diameter loops).

Control Cable Connectors

Below is the wiring diagram for the connectors on the control cable.



Testing

Connectors are made to mate with each other but not with any other objects. Never insert the probe of your multimeter into a socket. In making the measurements below, simply touch the probe to the top of the socket.

Continuity Test: Pin 1 to Pin A, Pin 2 to Pin B, etc, should measure a little less than 1 ohm per 30 m (100 feet).

Isolation Test: Pin to pin should measure infinity. Also any pin to the body of the connector should measure infinity.

Servicing

Use caution when attempting to service either connector.

The Lemo connector on the indicator end of the cable is easier to service. When you disassemble the connector, be sure that you do not twist the cables.

The heavy connector on the sensor (probe) end of the cable is more difficult to service. We recommend that you send it to the factory unless you are experienced and are willing to spend some time working with it.

APPENDIX C-3
DIGITILT DATAMATE II MANUAL

Digitilt DataMate II

50310999

This equipment should be installed, maintained, and operated by technically qualified personnel. Any errors or omissions in data, or the interpretation of data, are not the responsibility of Durham Geo Slope Indicator. The information herein is subject to change without notification.

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Contents

Digitilt DataMate II

What is the DataMate II?

The Digitilt DataMate II is a recording readout used with the Digitilt inclinometer probes, the portable Digitilt tiltmeter, and the spiral sensor. It works with both metric and English-unit versions of these sensors.

The Digitilt DataMate records readings from inclinometer surveys. DMM software is used to transfer the recorded readings to a PC. The use of DMM software is covered by a separate manual: DMM for Windows.

DataMate Controls

Power Switch

The power switch locks into position. To switch on, pull the lever up, then move it to the On position. To switch off, pull the lever up, and then move it to the off position. The DataMate displays a copyright notice for ten seconds when you switch it on. The copyright date serves as the version number for the DataMate.

Connector Sockets

Probe: Socket for inclinometer control cable.

Charger: Socket for battery charger or external power.

USB: Socket for computer interface cable and remote hand switch.

Sockets are waterproof only when connectors are plugged in or when protective caps are in place.

KeyPad

Up: Moves cursor up. Also scrolls forward through the alphabet (a...z).

Down: Moves cursor down. Also scrolls backwards through the alphabet (z...a).

Left: Moves cursor to the left.

Right: Moves cursor to the right.

Esc: Cancels current process and returns to menu.

Enter: Chooses menu items. In record mode, records readings.

DataMate Menus

1. Use the arrow keys to select a menu item with the cursor.
2. Press Enter to choose the item or Esc to exit the item.

Main Menu

The Main menu appears when you turn on the DataMate. The Main menu shows the main functions of the DataMate.

```
Read          Surveys
Comm          Utilities
```

Read Menu

The Read menu lets you record inclinometer readings, edit inclinometer installation parameters, review and correct readings, and operate the readout in manual mode, which displays readings but does not record them.

```
Record        Installation
Correct       Manual Read
```

Surveys Menu

The Surveys menu lets you list the surveys that are stored in memory, validate a survey, check available memory, delete a survey, compare one survey to another, and print a survey to a terminal program.

```
Dir     Validate     Memory
Del     Compare      Print
```

Comm Menu

Comm puts the DataMate into communications mode for transferring data to and from a computer. Communications requires that the DataMate II is connected to the computer's USB port via the interface cable that is supplied with the DataMate.

```
Waiting for PC . . .
```

Utilities Menu

The Utilities menu lets you set defaults, and check battery voltage and memory.

```
Batt       Beep       Light
Temp       Date       Contrast
```

Setting Defaults

Go to the Utilities menu to set the defaults below:

Date and Time: Choose Date. The DataMate displays the current date and time. Press Enter to edit the date. Press Up or Down to change the year, then press Right to move the cursor to month, etc. Press Enter when done.

Beeper: Choose Beep. Press Enter to toggle the beeper on or off. The beeper produces a noise when you record a reading.

Backlight: Choose Light to toggle the backlight on and off. Backlight increases battery drain by about 12 percent.

LCD Contrast: Choose Contrast. Press Up or Down to adjust contrast for easy viewing. Press Esc when done.

Checking the Battery

Go to the Utilities menu. Choose Batt. A new, fully charged battery shows approximately 6.6 volts with a full charge. Recharge if below 6 volts.

Recharging the Battery

Recharge the battery after every use of the DataMate. It is best to charge overnight.

Plug the charger into an AC mains socket. Plug the Lemo connector into the DataMate's Charger socket. You can verify that charging is taking place by going to the Utilities menu and choosing Batt. You should see increasing voltage value.

Checking Memory

Go to the Surveys menu. Choose Memory. The DataMate displays how many depths and surveys are free (available to store data). The maximum numbers are 32000 depths and 320 surveys.

Moisture Management

When you return to the office, remove caps from the DataMate's connectors and allow connectors to air-dry for a number of hours.

Use desiccant to keep the inside dry. This is particularly important in hot humid weather. Warm moist air trapped in the readout can condense when the readout is brought into a cool air-conditioned office.

To check the moisture level in the DataMate, go to the Utilities menu and choose Temp. The DataMate displays humidity and temperature. Humidity levels from 20% to 60% are normal. If humidity exceeds 75%, replace the desiccant. See instructions in the chapter on inspection and maintenance.

Set Up

Overview

Setting up the DataMate involves entering a list of inclinometer installations into the DataMate's memory. You can do this with DMM software or with the DataMate's keypad.

Setting Up with DMM Software

This method is convenient when you are in the office:

1. Use DMM to create a setup database on your PC.
2. Connect the DataMate to your PC.
3. Use DMM to transfer the setup to the DataMate.

Setting Up with DataMate Keypad

This method is convenient when you are in the field.

1. Choose Read.
2. Choose Installation.
3. Press Down key to scroll past any previously entered installations. The cursor stops on the word, "Create." Press Enter.
4. Enter the required information into each field. The fields are explained on the next page. To make an entry:

   Press the Right key to enter edit mode.

   Press the Up or Down key to change the character under the cursor.

   Press the Right key to move to the next column.

   Press Enter when you are done. The DataMate exits edit mode and moves the cursor to the next line.
5. To correct a mistake, press the Up or Down key to display the line that you want to correct. Then press the Right key to enter edit mode.

Installation Fields

Site & Installation: Every installation has a two-part identifier consisting of a “site” and an “installation.” Enter a 6 character identifier for each.

A0 dir: (Optional) Enter up to 3 characters to identify the compass heading of the A grooves. Not used for any calculation.

Operator: Optional) Enter up to 3 characters to identify the operator. Optional.

Sensor#: Enter the serial number of the probe. Optional, but recommended.

Sens Type: Choose Digitilt for inclinometer probes or Spiral for spiral sensors.

Units: Choose Metric or English. If you don’t know, check the distance between the upper and lower wheels of the probe: 0.5 m for metric systems; 2 feet for English-unit systems.

Ins Constant: Use 25000 for metric-unit systems or 20000 for English-unit systems.

Start: Enter the starting depth for the survey. Surveys typically start at the bottom of the casing. With English-systems, it is best to use an even number so that 2-foot intervals coincide with cable markings.

End: Enter the ending depth for the survey, typically 0.5 for metric-unit systems or 2 for English-unit systems.

Interval: Interval is typically 0.5 for metric-unit systems and 2 for English unit systems. For a Spiral Sensor, set the interval to 1.5 meters or 5 feet.

Check the Installations

Verify that the DataMate now holds your installation list:

1. Choose Read from the main menu.
2. Choose Installation.
3. Scroll through the list of installations.

Recording Surveys

Good Practices

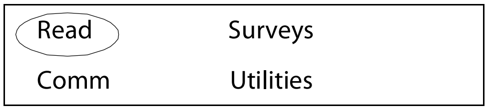
1. Use the same probe and control cable for each survey, if possible.
2. Use a pulley assembly, if possible. It prevents damage to the control cable.
3. Use a consistent top reference. The goal is repeatable placement of the probe within 5 mm or 1/4 inch. If one technician uses a pulley and another technician does not, probe positioning will be inconsistent, and data will be unusable.
4. Connect the probe to the DataMate and switch the power on before you insert the probe into the casing. Powered-up sensors resist shock better than unpowered sensors.
5. Wait 10 minutes for the probe to adjust to the temperature of the borehole. This helps prevent bias-shift (offset) errors.
6. Always pull the probe upward to the reading depth. If you accidentally pull the probe past the intended depth, lower it to the previous depth, then pull it back up to the intended depth. This ensures consistent placement.
7. Wait for displayed readings to stabilize. The DataMate displays 3 diamonds when readings have stabilized within two units. If the reading does not stabilize, watch the display and try to record an average reading.
8. When you remove the probe from the casing, use your hand to compress the wheels so that they don't spring free or force the body of the probe to strike the side of the casing. This helps prevent bias-shift errors.
9. Check your readings using the DataMate's Validate command. If necessary, reposition the probe at the required depth and use the Correct command to obtain a new reading for that depth. The Correct command is explained later.
10. If you accidently turn off the DataMate during a survey, turn it back on, and then use the Correct command resume the survey. There is no need to start a new survey.

Recording a Survey

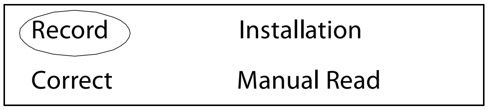
1. Connect the control cable to the probe. Do not over-tighten. Plug the other end of the control cable into the Probe socket on the DataMate. Plug the handswitch into the USB socket.

2. Insert the probe into the casing with upper wheels in the A0 direction. Lower the probe to slightly below the start depth.

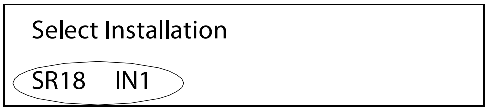
3. Switch on the DataMate and wait for the main menu. Choose Read.



4. Choose Record.



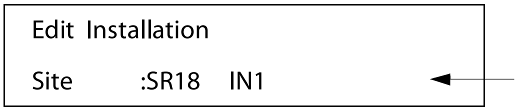
5. Choose an installation from the list.



Select Installation

[✓ SR18 IN1]

6. Press Enter to step past the installation parameters without making changes. Normally, no editing is required.



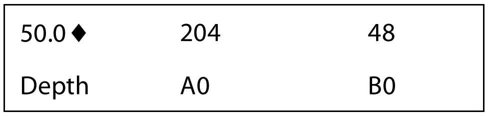
Edit Installation

Site :SR18 IN1

Press Enter or Down to step past each parameters

7. Finally, the DataMate displays the Start depth (bottom depth).

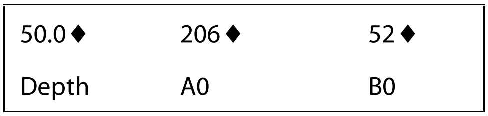
Start depth



50.0♦	204	48
Depth	A0	B0

8. Wait ten minutes for the probe to adjust to the temperature at the bottom. This step is important for consistent readings.

9. Begin the survey. Raise the probe to the start depth, then watch for a stable reading. You will see three diamonds, as shown below. Press Enter to record the reading.



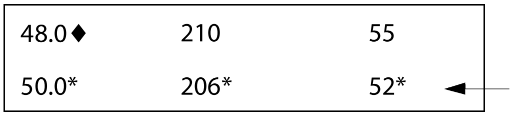
50.0♦	206♦	52♦
Depth	A0	B0

Three diamonds ♦ ♦ ♦ indicate stable reading. Press Enter to record.

Recording a Survey continued

10.The DataMate beeps and scrolls to the next depth. The reading just recorded is now on the bottom line. Raise the probe to the next depth (shown in the top line of the display) and wait for the numbers to stabilize. Press Enter to record the reading.

After you record the reading, pull the probe up to the next depth.



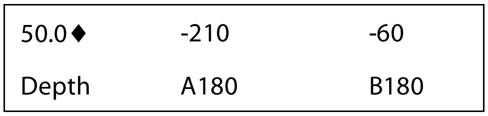
```
48.0♦     210     55
50.0*     206*    52*
```

Recorded readings are marked with a *

11. Repeat this process until you have recorded the reading for the top depth. The DataMate displays a menu. Choose Continue.

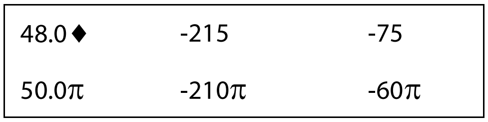
```
[✓ Continue]    0
Done            Del
```

12.The DataMate now displays the starting depth for the second pass. Remove the probe from the casing and rotate it 180 degrees so that the upper wheels point to the A180 direction. Insert the probe and lower to the bottom of the casing, or slightly below the start depth.



```
50.0♦     -210     -60
Depth     A180     B180
```

13.Pull the probe up to the start depth. Wait for the numbers to stabilize. Press Enter to record.



```
48.0♦     -215     -75
50.0π     -210π    -60π
```

Recorded readings for the second pass are marked with the Pi symbol.

14.Repeat these steps until you have recorded the reading for the top depth. A menu appears. This time, choose Done. Then remove the probe from the casing.

```
Continue        0
[✓ Done]        Del
```

15.You may want to validate the survey using the DataMate's validate command. See Appendix 1 for instructions.

Making Corrections

If you make a mistake during the survey, you can easily correct it.

1. Use the Down key to return to the depth where the mistake was made. Stop scrolling when the depth appears in the top line of the display.
2. Now position the probe to that depth: lower it below the depth and then pull it upwards to the exact depth.
3. Press Enter to activate the top line of the display. A diamond appears next to the depth.
4. Wait for the readings to stabilize, then press Enter to record.
5. Continue recording just as you would in a normal survey. Or if you are finished, scroll to the top depth and complete the survey as you normally would.

Cancelling a Survey

1. Press Esc. If you press Esc by mistake, press Continue.
2. Choose Del to delete the survey that you cancelled. Cancelled surveys remain in memory until deleted.
3. The DataMate prompts for confirmation. Press Up to confirm.

Deleting a Survey

If you want to record a survey, but the DataMate prompts “no room in memory” or “too many surveys,” you must free some memory by deleting a survey.

1. Choose Surveys from the main menu.
2. Choose Del.
3. Select a survey to delete and press Enter. (Surveys marked with the ^ symbol have been retrieved by a PC, so it might be safe to delete one of them.)
4. Press Up to confirm the deletion or Esc to cancel. The DataMate deletes the survey. To avoid possible loss of data, do not switch the DataMate off during this process.

Deleting an Installation

The DataMate itself provides no way to delete installations. DMM is required for deleting installations.

Retrieving Surveys

Overview

To retrieve surveys, connect your DataMate to your PC and run the DMM program. This is the normal and most efficient way to retrieve data.

Using DMM

Detailed instructions are provided in the DMM manual. The basic steps are:

1. Connect the DataMate to your PC. Choose Comm on the DataMate.
2. Start DMM, go to Datamate in the menu, and choose either Retrieve New or Retrieve all.
3. Drag and drop the retrieved surveys into your project database (or export surveys to a text file).

Using a Terminal Program

You can "print" surveys, one by one, to a PC that is running a terminal program on your PC to receive it. This is mainly for troubleshooting. The DMM program can import print files.

1. Connect the DataMate to the PC.
2. Start your terminal program. Set it for 8-bit, no parity at 9600 bps.
3. Set the terminal program to "capture" or "log" the data sent from the DataMate. Specify a file name for the captured data.
4. Choose Print from the DataMate survey menu. Set the baud rate for 9600 and press Enter. Then select the survey and press Enter to "print" it.
5. Your terminal program will usually display the readings as they are sent from the DataMate.
6. Close the file with your terminal program.

Validating Surveys

About Checksums

A checksum is the sum of 0 and 180 degree readings at the same depth. Ideally, the sum should be zero since the readings have opposite signs. In practice, checksums are rarely zero.

In general, you should look for consistency in checksums. A checksum that is significantly different from checksums above and below it may indicate that the probe wasn't positioned correctly or the reading was not stable when recorded. A large checksum may also be caused by debris in the groove, an out-of-round casing section, a separated casing section, or a wheel falling in the joint of a telescoping casing section.

A graph of checksums shows very clearly whether checksums are consistent or not. Alternatively, scanning through a column of checksums gives you an idea of consistency. Unfortunately, the DataMate provides neither graphs nor columns of checksums. However, the DataMate does provide the standard deviation of checksums, which can be used as a measure of reading quality, as explained below.

Standard Deviation of Checksums

The standard deviation of checksums can be used as a way to confirm that the current survey is comparable to other surveys for the same borehole.

You must first establish a "typical SD" for each axis. This is obtained from your initial survey. (It is good practice to take several surveys initially, then compare them and select one to be the "official" initial.) Since the initial survey represents good set of readings, the standard deviation of checksums for that survey can be used as a "typical SD" for that installation. Note that the "typical" is likely to be different for every installation.

When you obtain a new survey, run the DataMate's validation routine. Compare its SD to those of the initial survey. If the typical standard deviation of the A-axis is 3 to 5 units, the data is probably good. For example, if the typical standard deviation is 4, then acceptable standard deviations for subsequent surveys could range as high as 7 or 9 (typical for B-axis).

Narrower limits may be appropriate for deeper installations and critical measurements. Wider limits may be appropriate for shallower installations or for poorly-installed casing.

Validating a survey

Here is a typical validation procedure:

1. Check the standard deviation of checksums. Is it typical for this casing? If so, the survey is probably good and needs no further validation. You can quit the validation routine.
2. If the standard deviation is not typical, check the standard deviation for the different zones. If any group shows an obvious problem, examine the individual checksums in that group. Also look for drifting mean checksums. A drifting mean may indicate a problem with the electronics inside the probe.
3. If you find a checksum that is too large, examine the readings at that depth to determine whether the bad reading was recorded in the 0 or the 180 orientation. Afterwards, you can correct the data by taking another reading for that depth.
4. The steps below explain this in detail.

Check the Standard Deviation

1. Choose Validate from the Surveys menu.
2. Choose a survey to validate.
3. After a short delay, you will see a display that shows both the mean (MN) checksum and the standard deviation (SD) of checksums:

```
MN  A=51.337      B=45.674
 SD  A=4.1781      B=5.7170
```

4. Compare the standard deviation with the “typical” SD that you have established for the installation. If the standard deviation is acceptable, press Esc to quit. Otherwise, look at the SD for each zone.

Check Zone Statistics

1. Press Enter to view the zone with the largest SD. You will see a display that looks something like this:

```
 25.  -  20.      S.D.
A=3.2264         B=10.3388
```

Zone statistics include 10 readings. In this case, there are 10 half-meter readings in the zone from 25m to 20m.

2. To view the mean checksum for this zone, press the Left arrow. Press Right to redisplay the SD.
3. Press Up or Down to display other zones. Again, the Left and Right keys toggle between mean and standard deviation.
4. If you decide the survey is acceptable, press Esc to quit. Otherwise, note the zones (depths) that you want to inspect and continue.

View Individual Checksums

Follow the steps below to find depths with large checksums:

1. After viewing the checksum statistics, press Enter to view checksums. The DataMate first displays the largest checksum in the survey. In this case, the 89 in the B axis is largest.

25.	20	89
25.5	25	34
Depths	A	B

2. Use the Up and Down keys to view checksums at other depths. When you are finished viewing checksums, press Esc.

Isolating the Bad Reading

A large checksum may indicate a bad reading, but does not indicate which reading was bad (Was it the 0 or the 180 reading?). To isolate the bad reading, you must view readings above and below the suspect reading.

1. Choose Read from the main menu.
2. Choose Correct, then choose a survey (If necessary, press Right to see dates).
3. Press the Enter key to skip through parameters.
4. Choose 0 (orientation). Scroll through readings to the suspect depth. Check readings above and below the depth. A bad reading does not fit with the readings above and below it.
5. To view 180 readings at the same depth, press the Right arrow. Press again to display the 0 readings.
6. Note the depth and orientation of the bad reading. Then press Esc.

Correcting a Reading

1. Choose Correct from the Read menu.
2. Choose 0 or 180, and scroll the DataMate to the required depth. The depth should be displayed on the top line.
3. Lower the probe to the required depth. Wait for the probe to adjust to the temperature in the borehole (5 to 10 minutes if the probe has been in open air)
4. Press Enter to activate the reading. Press Enter again to record the reading.

Comparing Surveys

Overview

The DataMate can calculate a single value for cumulative deviation or for cumulative displacement.

Cumulative Deviation

1. At the Main Menu, select "Surveys." Then select "Compare."
2. The DataMate prompts for the current survey. Press Enter to select the suggested survey or scroll to find a different survey.
3. The DataMate prompts for a "previous" survey. Press Esc since you do not want to calculate displacement.
4. The DataMate asks you to confirm a conversion value of 1. Press Enter. This will display metric data in meters and English data in feet.
5. The DataMate then calculates the cumulative deviation for the survey and displays it.
6. Press Esc to return to the Surveys menu.

Note The DataMate calculates cumulative deviation by summing incremental deviations from the bottom of the casing to the top.

If you are interested in borehole drift, you probably want the top of the borehole to be used as reference. The DataMate does not offer this as a choice, but when summing from the top, the deviation at the bottom of the borehole will be the same value except in the opposite direction.

Cumulative Displacement

To calculate displacement, the DataMate must contain two surveys for the same installation.

1. Choose Surveys from the main menu, then choose Compare.
2. The DataMate prompts for the current survey. Press Enter to select the suggested survey or scroll to find a different survey. Then the DataMate prompts for a "previous" survey. Scroll to find the initial set, then press Enter.
3. The DataMate prompts for a conversion value. Enter 1000 for a displacement in millimeters (with metric data). Enter 12 for a displacement in inches (with English unit data).
4. The DataMate then calculates the cumulative displacement for the survey and displays it. Press Esc when done.

Inspection and Maintenance

Inspection

Part	What to check for	Remedy
Desiccant	Check humidity under utilities menu.	If humidity exceeds 75%, replace or recharge desiccant.
Batteries	Check main battery and Memory keep alive power under utilities menu.	Main battery can be recharged. If battery does not hold charge, battery can be replaced. Lithium backup battery is good for 7 to 10 years if main battery keeps charge. Return for servicing if memory power is bad.
Connectors	Dirt, bent pins, o-ring	Clean with alcohol moistened swab. Note that connectors are "water proof" only when capped or when connector is plugged in.
Self Test	Error A input Error B input	Bad signal input. Return for servicing. A value is displayed, but is not useful.
	Error +12volt Error -12volt	±12V sensor power. Disconnect control cable and probe. Try again. If error goes away, problem could be in probe or cable. Connect cable only. If no error, then probe is the problem. This error could also be caused by discharged battery. Try recharging battery first. If error persists, some component must be returned for servicing.
	Error battery	Main battery is low. Try recharging. If error persists, replace battery.
	Error +3v pwr	Memory keep alive power is bad. Retrieve any data before switching off, then return for service.
	Error temp	Operating temperature range exceeded. Either below -20 or above 60C.
	Error humidity	Humidity above 80%. Replace desiccant.

Maintenance

Battery	Recharge battery after every use. Charge at least two hours for every hour of use. Charging overnight is common practice. Do not charge longer than 72 hours. Longer charge time may damage the battery. A new, recharged battery will show 6.6V or higher. The DataMate displays a low battery warning when voltage drops to 5.5 volts. Turn off the DataMate when the warning appears and then recharge as soon as possible. Deep discharge of the main battery can reduce its performance and shorten its life.
Desiccant	Check humidity under utilities menu. If humidity exceeds 75%, replace desiccant.
Connector sockets	If it is necessary to clean the connector, use a small brush or a slim cotton swab. Do not use spray lubricants or electric contact cleaners. Solvents contained in such products will attack the neoprene inserts in the connectors.

Replacing Desiccant

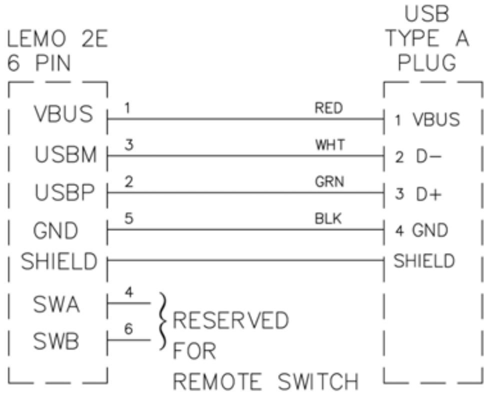
You must open the DataMate to change the desiccant. You should ground yourself to prevent a static discharge that could damage the DataMate's electronics.

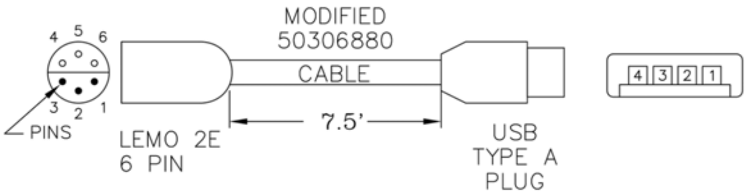
Remove the two screws from the bottom of the case. Hold the top panel and pull off the case. Look for the desiccant pack between the battery and the panel connectors. Replace the desiccant pack with a new one. You may be able to renew the desiccant in an oven at 250 °F (121 °C) for 16 hours. Do not use a microwave oven to renew the desiccant. You may damage your microwave oven.

Before you replace the case, apply a light coat of silicone grease to the gasket. Also lubricate the O-rings on the screws. Then slip the DataMate back into its case, checking that the gasket is seated properly. Replace the screws and tighten to draw the top panel squarely against the case. Do not over-tighten the screws

Wiring Diagram for USB Interface Cable

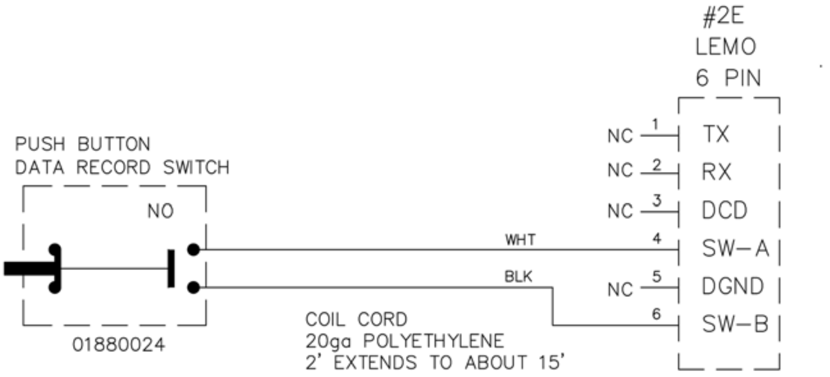
Below is the wiring diagram for the connectors on the USB interface.





Wiring Diagram for Hand Switch

Below is the wiring diagram for the hand switch.



Trouble-Shooting

Tech Notes on slopeIndicator.com

Many questions can be answered by a visit to the Tech Notes section of www.slopeindicator.com. Go to Support - TechNotes. Then scroll down the page to find the inclinometer tech notes. Take a look at the Digitilt DataMate Q & A page.

Readings Not Stable

The DataMate's ready signal is displayed when readings in both axes are stable within 2 digits. If this happens occasionally, but readings vary within 3 or 4 digits, you can record the readings with no significant loss of accuracy.

- If this problem always occurs at a single installation and at a just a few depths, it is possible that the backfill around the casing has washed away or was simply incomplete.
- In some situations, such as when there is no water in the inclinometer casing, control cable can go into a slow oscillation, shaking the probe, and preventing full stabilization of readings. The same may occur at sites where heavy construction machines are active. In this case, look for the average reading.
- Reading instability can also be caused by a low battery, so always check battery voltage before you leave the office.
- If readings always take a long time to stabilize, and this happens at all installations, contact Slope Indicator.

Strange Readings

A & B readings are midrange or higher (e.g. +6000 or -6000): Mid-range readings like this point to a cable problem. It is likely that one of the power wires is bad. The problem may be in a broken or corroded wire in the connector.

Readings are very high, for example 12,000: If your DataMate shows a full scale reading, such as 10,000 or 12,500, when the probe is near vertical, there is probably water in the connector or in the cable.

Reading of +1786 (English) or 3125 (Metric): This is the same number that the DataMate displays when the probe is not connected, so there is most likely a problem in the cable or a connector.

Reading of 60 or some other low number: If you see a low number that stays constant in one axis, the problem is mostly likely in the probe. The accelerometer for that axis is not working and the op amp is trying to compensate, resulting in a constant value.

APPENDIX C-4
DMM FOR WINDOWS MANUAL

DMM for Windows

50310970

This equipment should be installed, maintained, and operated by technically qualified personnel. Any errors or omissions in data, or the interpretation of data, are not the responsibility of Durham Geo Slope Indicator. The information herein is subject to change without notification.

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Contents

Introduction

Read This

- If you hate manuals, at least read the Quick-Tour pages.
- If you can’t find a way to do something, read the “How To” pages.
- If you have the DataMate II, be sure to install the latest version of DMM.

What is DMM?

DMM (DataMate Manager) is software supplied for the Digitilt DataMate inclinometer readout. DMM is used to:

- Retrieve readings stored by the DataMate.
- Send setup data to the DataMate.
- Retrieve readings from the DataMate.
- Store readings on disk, either in a database or in an ASCII file.
- Edit and maintain the database.
- Print data, and statistics. DMM also has a simple graphing function to compare two surveys.

Installation

Obtaining DMM

We recommend that you download the DMM setup file from the the Slope Indicator web site: www.slopeindicator.com. The web site always offers the most recent version.

You can also install DMM from a Resource CD, but be sure to check the date on the Resource CD. If it is more than four months old, you may have better results by downloading DMM from the website.

Instructions for both methods follow.

Downloading DMM

1. Start your browser and navigate to www.slopeindicator.com.
2. Choose Downloads.
3. Choose Software.
4. Choose DMM for Windows.
5. Follow on screen instructions to download and install the software. You may want to print the instructions.

Installing DMM from a Resource CD

1. Insert the Resource CD in your CD-ROM drive.
2. Wait for your browser to start. If necessary, eject and reinsert the CD, or start your browser, navigate to the CD, and open the file called cdmenu.html.
3. Choose software from the menu.
4. Choose DMM for Windows.
5. Follow on screen instructions. It may be useful to print the instructions.

Installing USB Drivers (DataMate II Only)

The DataMate II connects to the PC via a USB cable. Follow the steps below to install the USB software. There are two drivers, so you go through two installation procedures.

1. Start your PC.
2. Connect the DataMate to the PC.
3. Switch the DataMate on.
4. The hardware wizard appears and asks to search for software.
5. Choose “No, not this time.”
6. Click Next.

Welcome to the Found New Hardware Wizard

Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission).

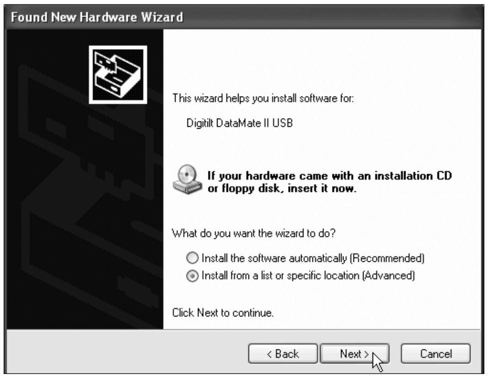
Read our privacy policy

Can Windows connect to Windows Update to search for software?

○ Yes, this time only
○ Yes, now and every time I connect a device
● No, not this time

Click Next to continue.

1. Windows wants to install software for the Digitilt DataMate II USB.
2. Choose “Install from a list or specific location.”
3. Click Next.



This wizard helps you install software for:

Digitilt DataMate II USB

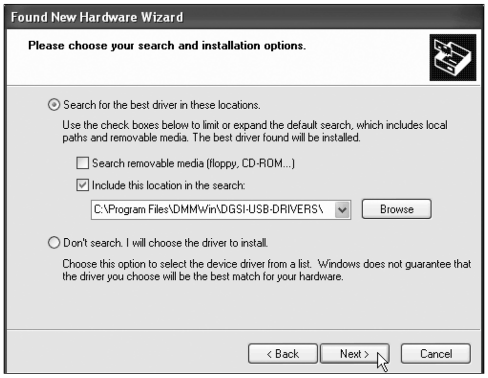
If your hardware came with an installation CD or floppy disk, insert it now.

What do you want the wizard to do?

○ Install the software automatically (Recommended)
● Install from a list or specific location (Advanced)

Click Next to continue.

1. Windows asks for the location of the driver.
2. Click “Include this location in the search.”
3. Enter the following path. You can also browse to the path:



Please choose your search and installation options.

● Search for the best driver in these locations.

Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.

☐ Search removable media (floppy, CD-ROM...)
☑ Include this location in the search:
C:\Program Files\DMMWin\DGSI-USB-DRIVERS\

○ Don't search. I will choose the driver to install.

Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.

C: \program files\dmmwin\DGSI-USB-Drivers\Win2k-XP

This folder contains 32-bit drivers. In the future, there will also be a folder with 64-bit drivers, which you would choose if you have a 64 bit operating system.

4. Click Next.

Installing USB Drivers Continued

1. Windows starts the installation process.
2. If you see this warning message, choose “Continue Anyway.”

The software you are installing for this hardware:

Digitilt DataMate II USB

has not passed Windows Logo testing to verify its compatibility with Windows XP. (Tell me why this testing is important.)

Continuing your installation of this software may impair or destabilize the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the hardware vendor for software that has passed Windows Logo testing.

1. Windows completes the installation and displays this screen.
2. Click Finish.

Completing the Found New Hardware Wizard

The wizard has finished installing the software for:

Digitilt DataMate II USB

Click Finish to close the wizard.

1. Windows immediately detects new hardware.
2. Another wizard appears and asks to search for software. Choose “No, not this time.”
3. Click Next.

Welcome to the Found New Hardware Wizard

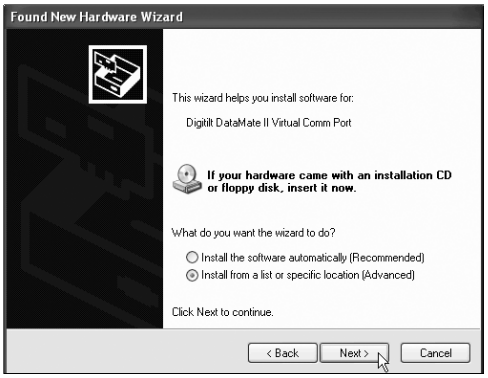
Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission).

Can Windows connect to Windows Update to search for software?

○ Yes, this time only
○ Yes, now and every time I connect a device
● No, not this time

Click Next to continue.

1. Windows wants to install software for the Digitilt DataMate II Virtual Comm Port.
2. Choose “Install from a list or specific location.”
3. Click Next.



This wizard helps you install software for:

Digitilt DataMate II Virtual Comm Port

If your hardware came with an installation CD or floppy disk, insert it now.

What do you want the wizard to do?

○ Install the software automatically (Recommended)
● Install from a list or specific location (Advanced)

Click Next to continue.

Installing USB Drivers Continued

1. Windows asks for the location of the driver.
2. Click “Include this location in the search.”
3. The path you recently entered should appear. If not, enter or browse to the following path:

Please choose your search and installation options.

● Search for the best driver in these locations.

Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.

☐ Search removable media (floppy, CD-ROM...)

☑ Include this location in the search:

C:\Program Files\DMMWin\DGSI-USB-DRIVERS\

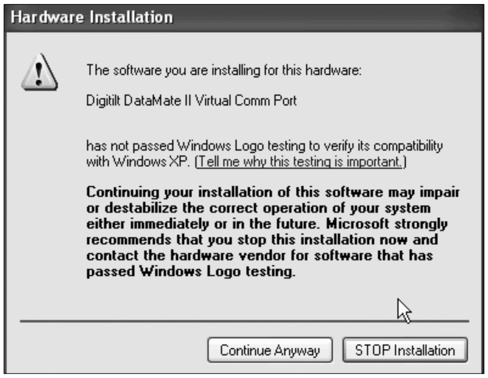
○ Don't search. I will choose the driver to install.

Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.

C: \program files\dmmwin\DGSI-USB-Drivers\Win2k-XP

(or the 64-bit folder name, if you have a 64-bit OS.)

1. Windows starts the installation process.
2. If you see this warning message, choose “Continue Anyway.”



The software you are installing for this hardware:

Digitilt DataMate II Virtual Comm Port

has not passed Windows Logo testing to verify its compatibility with Windows XP. (Tell me why this testing is important.)

Continuing your installation of this software may impair or destabilize the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the hardware vendor for software that has passed Windows Logo testing.

1. Windows completes the installation and displays this screen.
2. Click finish.

Completing the Found New Hardware Wizard

The wizard has finished installing the software for:

Digitilt DataMate II Virtual Comm Port

Click Finish to close the wizard.

Note: You must tell DMM which com port to use for the USB device:

1. Start DMM.
2. Choose DataMate - Options. DMM displays the available com ports.

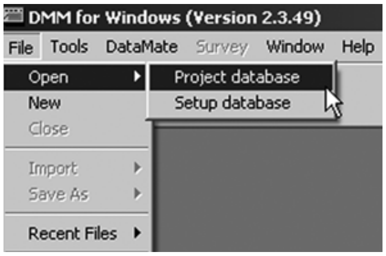
This USB device is likely to use the Com port with the highest number. For example, if DMM lists Com1, Com4, and Com7, try Com7 first.

Quick Tour of DMM

Start DMM

1. Click the Start button.
2. Choose Programs.
3. Choose DMM for Windows.
4. Click on DMMWin.exe from the slide-out menu.

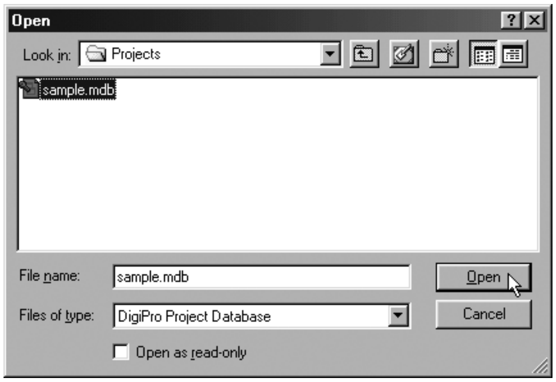
Open the Sample Database



1. Choose File.
2. Choose Open - Project Database.
3. DMM displays a folder of project databases. The default folder is called Projects and is located in the DMM folder.

   You can use different folders for your projects. DMM remembers the last folder used. DMM keeps a recent file list, so you can also select your database from File-Recent Files.

4. For now, select “sample.mdb” and click the Open button.



File name: sample.mdb

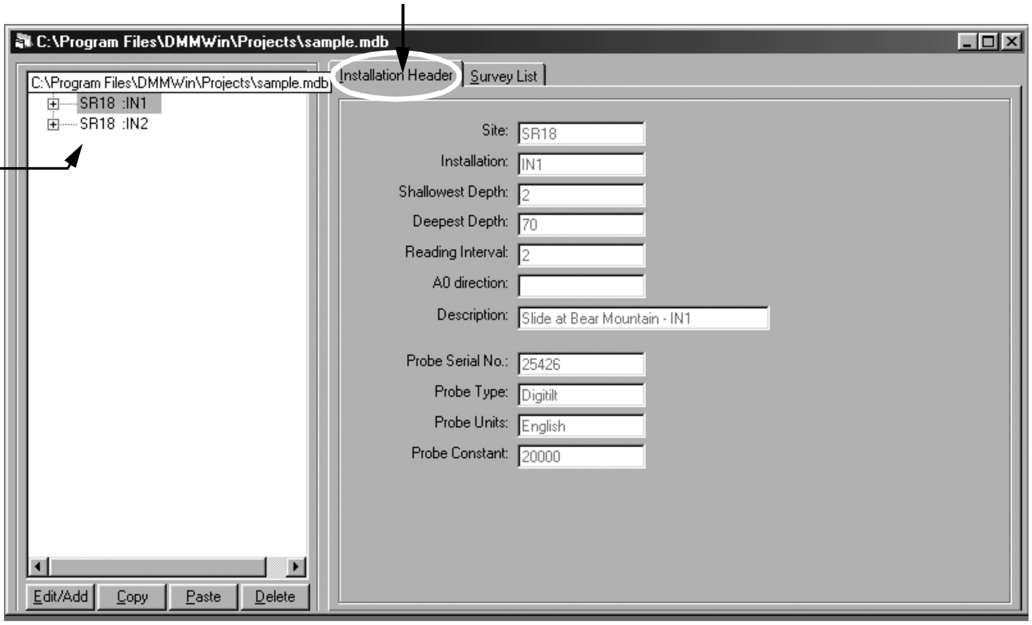
Files of type: DigiPro Project Database

The Database Window

DMM opens a window to show the database. You can open other databases, too. Every database appears in its own window.

Viewing Installations

The first view of a database shows inclinometer installations. An installation, sometimes called a “borehole” or “hole” is the installed inclinometer casing.



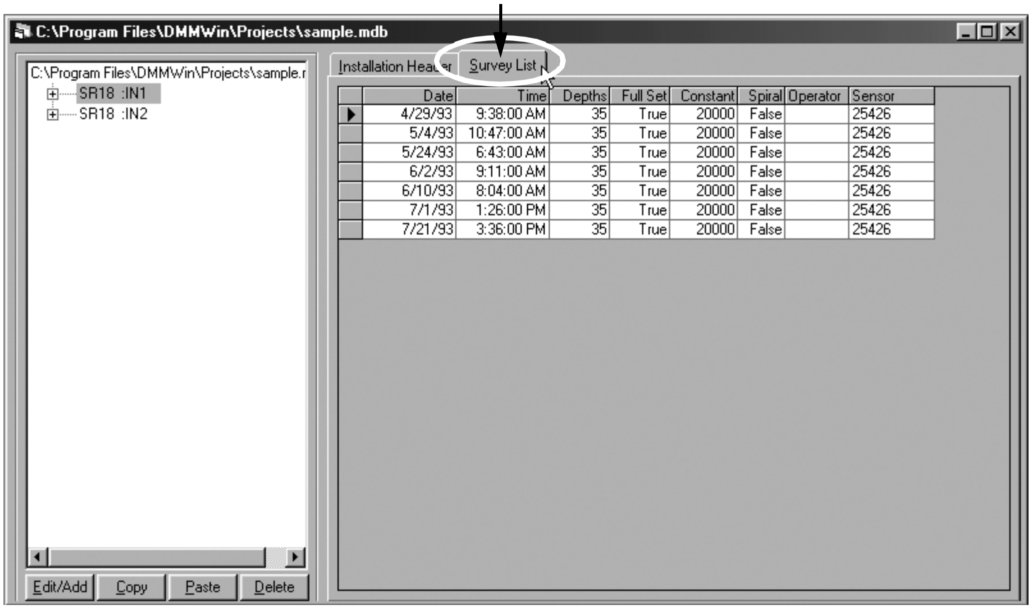
Site: SR18
Installation: IN1
Shallowest Depth: 2
Deepest Depth: 70
Reading Interval: 2
A0 direction:
Description: Slide at Bear Mountain - IN1

Probe Serial No.: 25426
Probe Type: Digitilt
Probe Units: English
Probe Constant: 20000

The Installation Header tab shows installation parameters.

Database name

These are installations.



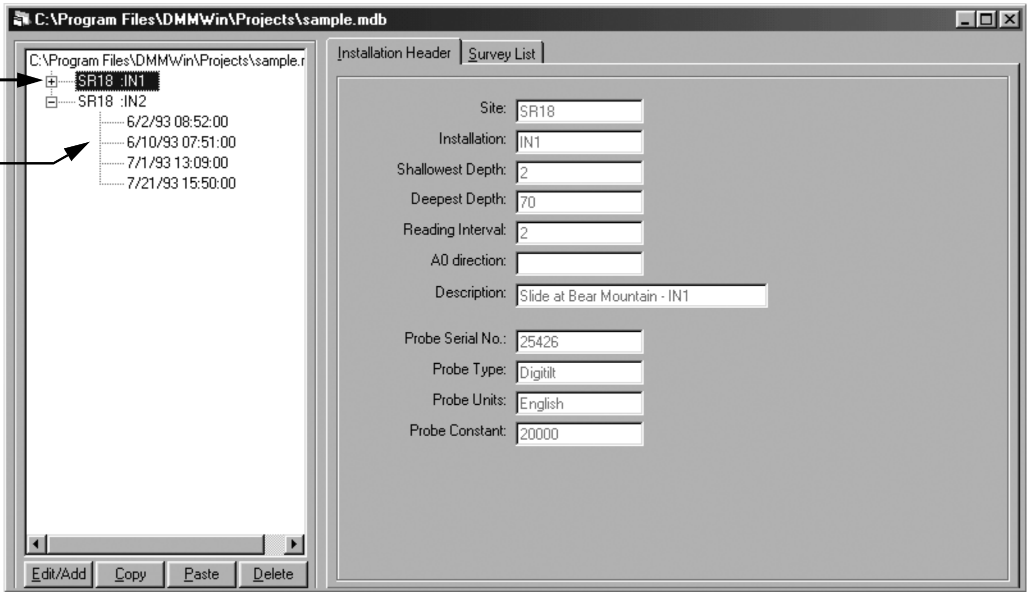
	Date	Time	Depths	Full Set	Constant	Spiral	Operator	Sensor
▶	4/29/93	9:38:00 AM	35	True	20000	False		25426
	5/4/93	10:47:00 AM	35	True	20000	False		25426
	5/24/93	6:43:00 AM	35	True	20000	False		25426
	6/2/93	9:11:00 AM	35	True	20000	False		25426
	6/10/93	8:04:00 AM	35	True	20000	False		25426
	7/1/93	1:26:00 PM	35	True	20000	False		25426
	7/21/93	3:36:00 PM	35	True	20000	False		25426

The Survey List tab shows surveys for the installation.

The fields in this view are mainly for trouble-shooting. It lets you check that the number of depths is the same for each survey, etc.

Viewing Surveys

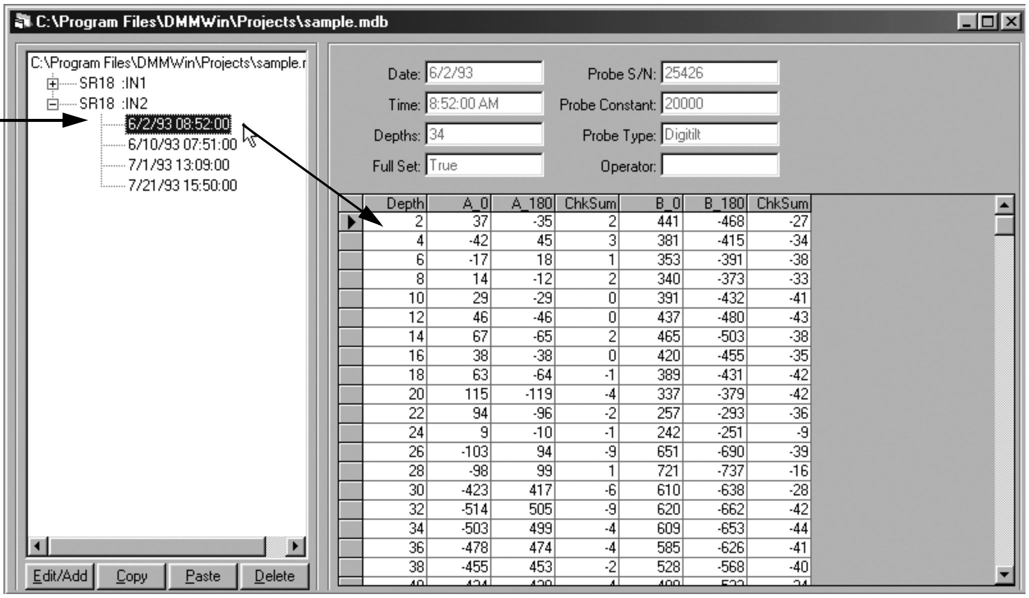
Click the + next to an installation to see surveys sorted by date. Surveys, sometimes called datasets, are the readings from the inclinometer probe.



Click + to see surveys.

Surveys are listed by date and time.

Site: SR18
Installation: IN1
Shallowest Depth: 2
Deepest Depth: 70
Reading Interval: 2
A0 direction:
Description: Slide at Bear Mountain - IN1
Probe Serial No.: 25426
Probe Type: Digitilt
Probe Units: English
Probe Constant: 20000



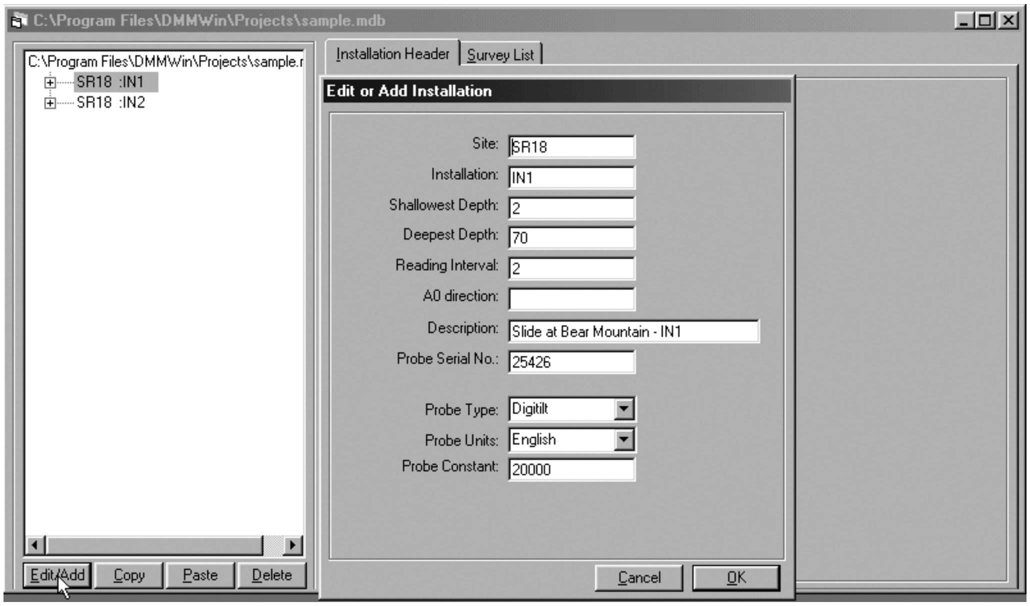
When you select a survey, readings appear at right

Date: 6/2/93
Time: 8:52:00 AM
Depths: 34
Full Set: True
Probe S/N: 25426
Probe Constant: 20000
Probe Type: Digitilt
Operator:

Depth	A_0	A_180	ChkSum	B_0	B_180	ChkSum
2	37	-35	2	441	-468	-27
4	-42	45	3	381	-415	-34
6	-17	18	1	353	-391	-38
8	14	-12	2	340	-373	-33
10	29	-29	0	391	-432	-41
12	46	-46	0	437	-480	-43
14	67	-65	2	465	-503	-38
16	38	-38	0	420	-455	-35
18	63	-64	-1	389	-431	-42
20	115	-119	-4	337	-379	-42
22	94	-96	-2	257	-293	-36
24	9	-10	-1	242	-251	-9
26	-103	94	-9	651	-690	-39
28	-98	99	1	721	-737	-16
30	-423	417	-6	610	-638	-28
32	-514	505	-9	620	-662	-42
34	-503	499	-4	609	-653	-44
36	-478	474	-4	585	-626	-41
38	-455	453	-2	528	-568	-40

Editing Installations

Select an installation, then click the Edit/Add button.



Site: SR18
Installation: IN1
Shallowest Depth: 2
Deepest Depth: 70
Reading Interval: 2
A0 direction:
Description: Slide at Bear Mountain - IN1
Probe Serial No.: 25426
Probe Type: Digitilt
Probe Units: English
Probe Constant: 20000

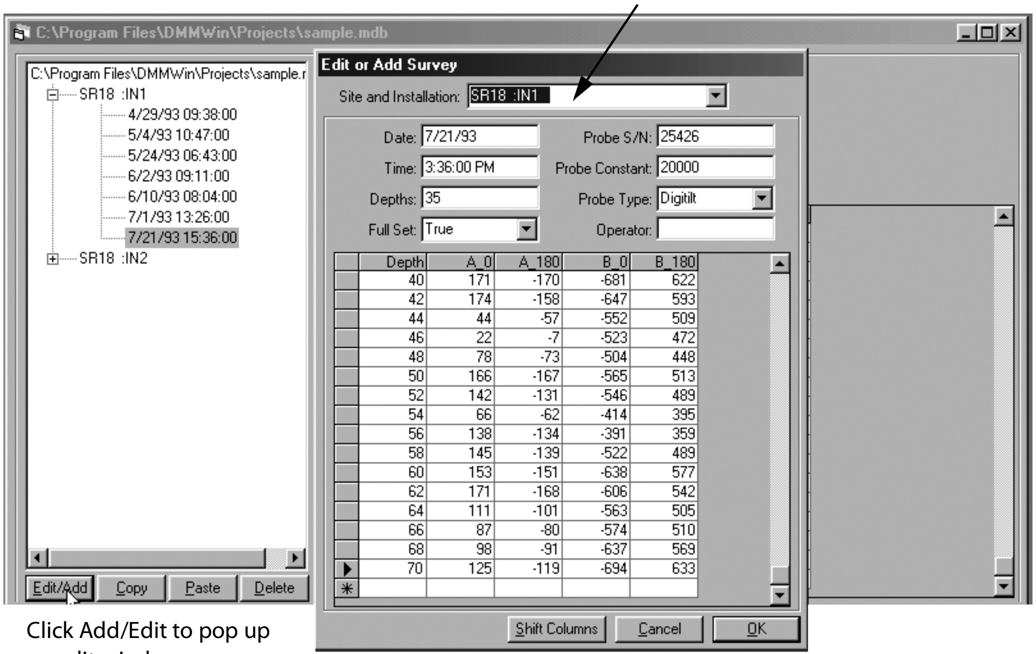
Click Add/Edit to pop up an edit window.

The edit window shows the selected installation and allows you to make changes.

Editing Surveys

Select a survey, then click the Edit/Add button.

Use this field to move a survey to a different installation.



Site and Installation: SR18 :IN1
Date: 7/21/93
Time: 3:36:00 PM
Depths: 35
Full Set: True
Probe S/N: 25426
Probe Constant: 20000
Probe Type: Digitilt
Operator:

Depth	A_0	A_180	B_0	B_180
40	171	-170	-681	622
42	174	-158	-647	593
44	44	-57	-552	509
46	22	-7	-523	472
48	78	-73	-504	448
50	166	-167	-565	513
52	142	-131	-546	489
54	66	-62	-414	395
56	138	-134	-391	359
58	145	-139	-522	489
60	153	-151	-638	577
62	171	-168	-606	542
64	111	-101	-563	505
66	87	-80	-574	510
68	98	-91	-637	569
70	125	-119	-694	633

Click Add/Edit to pop up an edit window

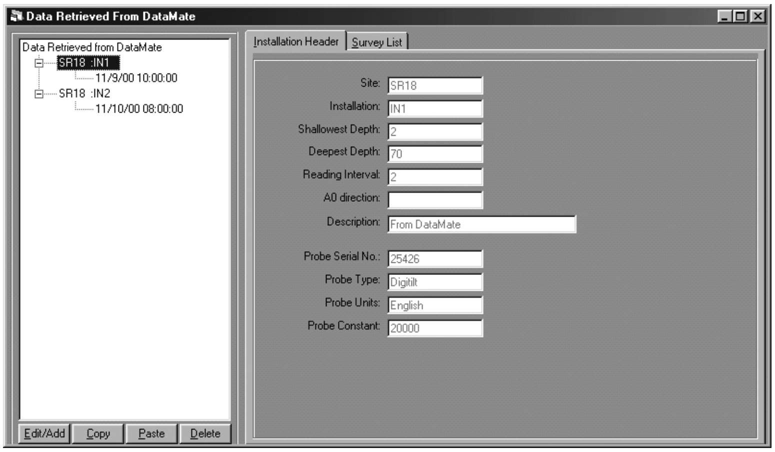
The edit window shows the selected survey and allows you to make changes.

Retrieving Data from the DataMate

1. Connect the DataMate to your PC.
2. Run DMM and choose DataMate-Retrieve All or Retrieve New from the menu. DMM displays the retrieved data in a window.

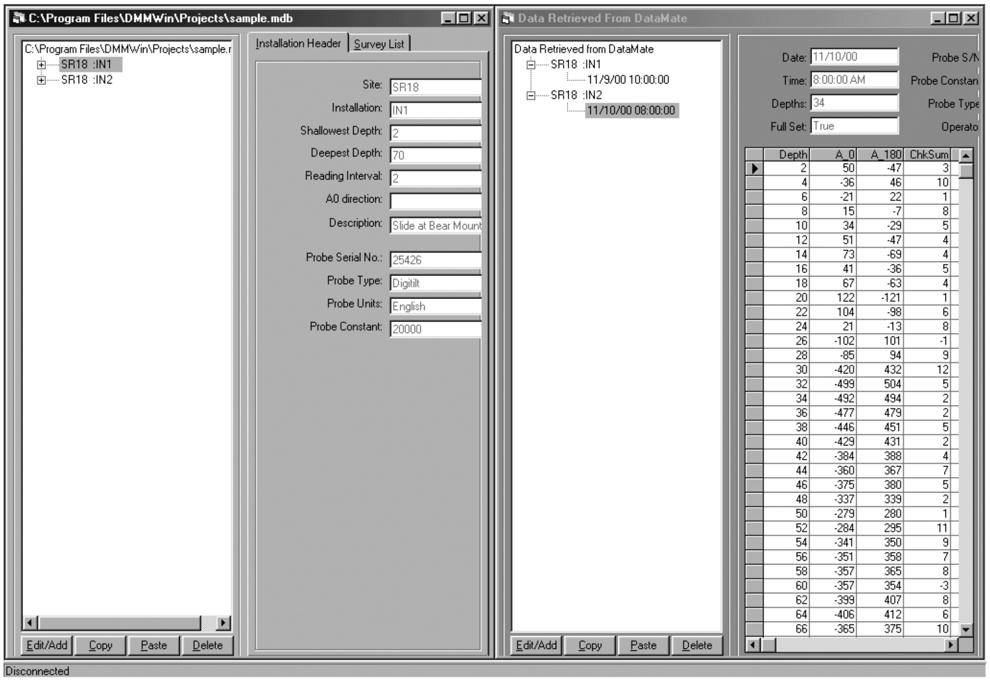
This window is called: "Data retrieved from DataMate".

You will drag and drop surveys from this window into your project database.



Site: SR18
Installation: IN1
Shallowest Depth: 2
Deepest Depth: 70
Reading Interval: 2
A0 direction:
Description: From DataMate
Probe Serial No.: 25426
Probe Type: Digitilt
Probe Units: English
Probe Constant: 20000

3. Open a project database to receive the data. Place the two windows side by side using the Windows-Tile command.



Site: SR18
Installation: IN1
Shallowest Depth: 2
Deepest Depth: 70
Reading Interval: 2
A0 direction:
Description: Slide at Bear Mount
Probe Serial No.: 25426
Probe Type: Digitilt
Probe Units: English
Probe Constant: 20000

Date: 11/10/00
Time: 8:00:00 AM
Depths: 34
Full Set: True
Probe S/N
Probe Constan
Probe Type
Operato

Depth	A_0	A_180	ChkSum
2	50	-47	3
4	-36	46	10
6	-21	22	1
8	15	-7	8
10	34	-29	5
12	51	-47	4
14	73	-69	4
16	41	-36	5
18	67	-63	4
20	122	-121	1
22	104	-98	6
24	21	-13	8
26	-102	101	-1
28	-85	94	9
30	-420	432	12
32	-499	504	5
34	-492	494	2
36	-477	479	2
38	-446	451	5
40	-429	431	2
42	-384	388	4
44	-360	367	7
46	-375	380	5
48	-337	339	2
50	-279	280	1
52	-284	295	11
54	-341	350	9
56	-351	358	7
58	-357	365	8
60	-357	354	-3
62	-399	407	8
64	-406	412	6
66	-365	375	10

Project Database

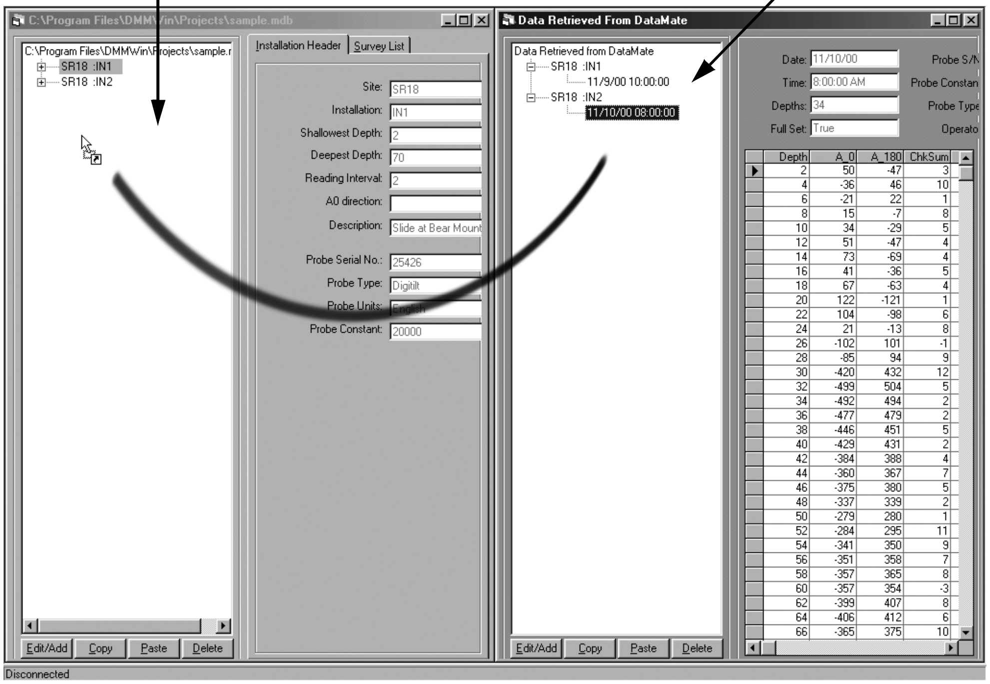
Data Retrieved from DataMate Window

Retrieving Data continued

4. Click, drag, and drop surveys one by one. Click on the survey to select it. Then drag and drop it into the project database. It is not necessary to drop the survey on the installation. You can also use the copy and paste buttons: copy from the temporary database, and paste into the project database.

First, click on a survey to select it.

Then drag and drop the survey anywhere in this window.



C:\Program Files\DMMWin\Projects\sample.mdb

C:\Program Files\DMMWin\Projects\sample.m
- SR18 :IN1
- SR18 :IN2

Site: SR18
Installation: IN1
Shallowest Depth: 2
Deepest Depth: 70
Reading Interval: 2
A0 direction:
Description: Slide at Bear Mount
Probe Serial No.: 25426
Probe Type: Digitilt
Probe Units: English
Probe Constant: 20000

Data Retrieved From DataMate

Data Retrieved from DataMate
- SR18 :IN1
  - 11/9/00 10:00:00
- SR18 :IN2
  - 11/10/00 08:00:00

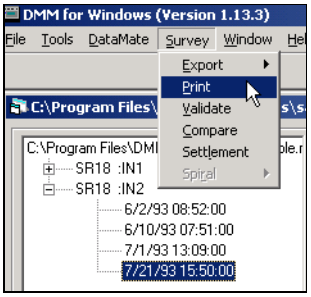
Date: 11/10/00
Time: 8:00:00 AM
Depths: 34
Full Set: True

Depth	A_0	A_180	ChkSum
2	50	-47	3
4	-36	46	10
6	-21	22	1
8	15	-7	8
10	34	-29	5
12	51	-47	4
14	73	-69	4
16	41	-36	5
18	67	-63	4
20	122	-121	1
22	104	-98	6
24	21	-13	8
26	-102	101	-1
28	-85	94	9
30	-420	432	12
32	-499	504	5
34	-492	494	2
36	-477	479	2
38	-446	451	5
40	-429	431	2
42	-384	388	4
44	-360	367	7
46	-375	380	5
48	-337	339	2
50	-279	280	1
52	-284	295	11
54	-341	350	9
56	-351	358	7
58	-357	365	8
60	-357	354	-3
62	-399	407	8
64	-406	412	6
66	-365	375	10

Disconnected

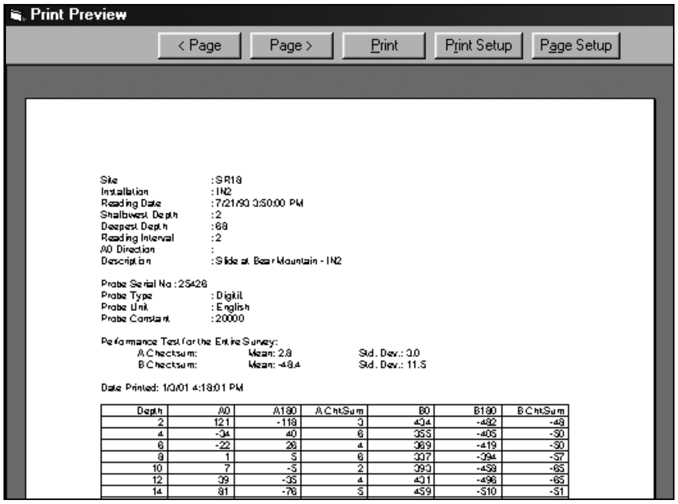
Printing a Survey

1. Choose Survey-Print from the menu bar.



2. The print preview screen appears.

Zooming To zoom in, double-click the left mouse button. To zoom out, double-click the right mouse button.



Site : SR18
Installation : IN2
Reading Date : 7/21/93 3:50:00 PM
Shallowest Depth : 2
Deepest Depth : 68
Reading Interval : 2
A0 Direction :
Description : Slide at Bear Mountain - IN2

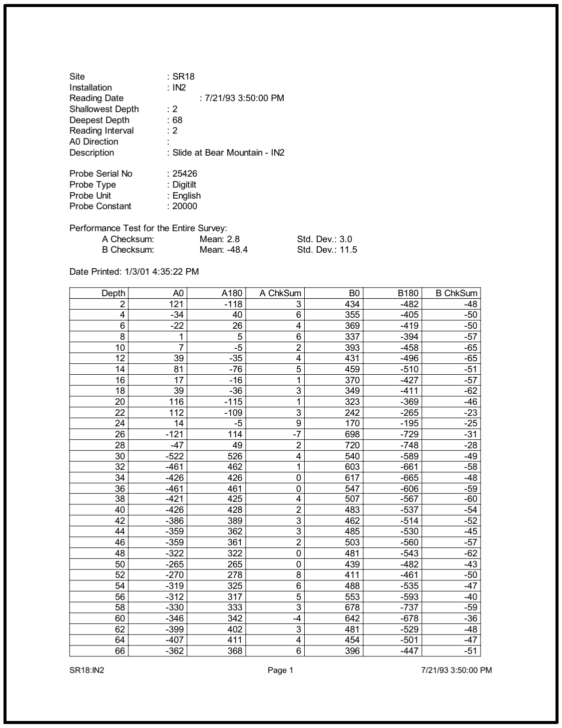
Probe Serial No : 25426
Probe Type : Digitilt
Probe Unit : English
Probe Constant : 20000

Performance Test for the Entire Survey:
A Checksum: Mean: 2.8 Std. Dev.: 3.0
B Checksum: Mean: -48.4 Std. Dev.: 11.5

Date Printed: 1/3/01 4:18:01 PM

Depth	A0	A180	A ChkSum	B0	B180	B ChkSum
2	121	-118	3	434	-482	-48
4	-34	40	6	355	-405	-50
6	-22	26	4	369	-419	-50
8	1	5	6	337	-394	-57
10	7	-5	2	393	-458	-65
12	39	-35	4	431	-496	-65
14	81	-76	5	459	-510	-51

3. The printed page looks like this:



Site : SR18
Installation : IN2
Reading Date : 7/21/93 3:50:00 PM
Shallowest Depth : 2
Deepest Depth : 68
Reading Interval : 2
A0 Direction :
Description : Slide at Bear Mountain - IN2

Probe Serial No : 25426
Probe Type : Digitilt
Probe Unit : English
Probe Constant : 20000

Performance Test for the Entire Survey:
A Checksum: Mean: 2.8 Std. Dev.: 3.0
B Checksum: Mean: -48.4 Std. Dev.: 11.5

Date Printed: 1/3/01 4:35:22 PM

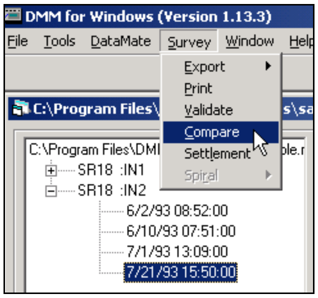
Depth	A0	A180	A ChkSum	B0	B180	B ChkSum
2	121	-118	3	434	-482	-48
4	-34	40	6	355	-405	-50
6	-22	26	4	369	-419	-50
8	1	5	6	337	-394	-57
10	7	-5	2	393	-458	-65
12	39	-35	4	431	-496	-65
14	81	-76	5	459	-510	-51
16	17	-16	1	370	-427	-57
18	39	-36	3	349	-411	-62
20	116	-115	1	323	-369	-46
22	112	-109	3	242	-265	-23
24	14	-5	9	170	-195	-25
26	-121	114	-7	698	-729	-31
28	-47	49	2	720	-748	-28
30	-522	526	4	540	-589	-49
32	-461	462	1	603	-661	-58
34	-426	426	0	617	-665	-48
36	-461	461	0	547	-606	-59
38	-421	425	4	507	-567	-60
40	-426	428	2	483	-537	-54
42	-386	389	3	462	-514	-52
44	-359	362	3	485	-530	-45
46	-359	361	2	503	-560	-57
48	-322	322	0	481	-543	-62
50	-265	265	0	439	-482	-43
52	-270	278	8	411	-461	-50
54	-319	325	6	488	-535	-47
56	-312	317	5	553	-593	-40
58	-330	333	3	678	-737	-59
60	-346	342	-4	642	-678	-36
62	-399	402	3	481	-529	-48
64	-407	411	4	454	-501	-47
66	-362	368	6	396	-447	-51

SR18:IN2 Page 1 7/21/93 3:50:00 PM

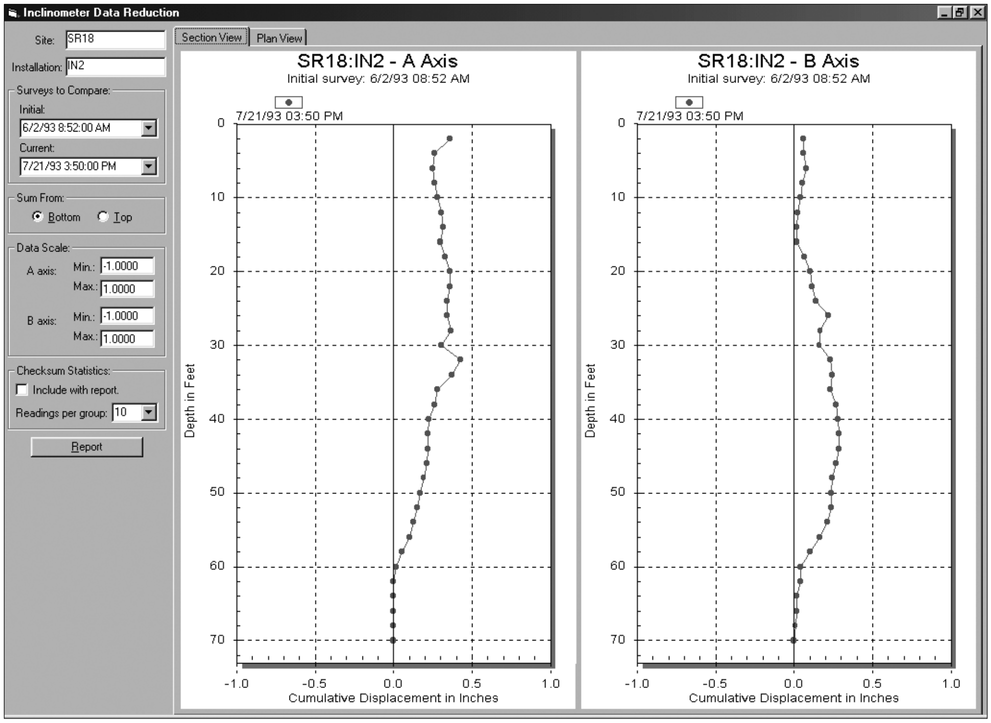
Plotting Survey Data

DMM has a convenient plotting routine that lets you compare two surveys.

1. Click on a survey, then choose Survey - Compare from the menu bar.



2. DMM displays a graph of cumulative displacement.



Site: SR18

Installation: IN2

Surveys to Compare:

Initial: 6/2/93 8:52:00 AM

Current: 7/21/93 3:50:00 PM

Sum From: ● Bottom ○ Top

Data Scale:

A axis: Min.: -1.0000 Max.: 1.0000

B axis: Min.: -1.0000 Max.: 1.0000

Checksum Statistics:

☐ Include with report.

Readings per group: 10

3. Now that you've seen DMM's main features, please take a look at the rest of the manual.

Menu Summary

File

Use this menu to create, save, open, and close databases.

Open: Offers a choice of project database or setup database. A project database contains your inclinometer surveys. A setup database contains a list of installations that you send to the DataMate.

New: Creates a new project database in its own window.

Close: Closes the database in the active window. All changes are saved. There is no explicit "Save" command.

Import: Imports surveys from RPP, PCSLIN, and GTILT. See Appendix 5, Importing Data.

Save As: Offers a choice of a project database or a setup database. Used to copy a database or create a setup database.

Recent Files: Shows the path and name of the most recently opened databases. Click on a database to open it.

Exit: Closes the DMM program.

Tools

Compact Database: Removes empty spaces left in the database after heavy editing.

Convert HDR to MDB: Starts the HDR2MDB utility to convert a DOS database to a Windows database. See Appendix 3.

DataMate

Use this menu to communicate with the DataMate.

Retrieve New: Retrieves only new surveys and displays them in a special window called "Data Retrieved from DataMate." In DataMate terms, "New" means a survey that is not stamped with a ^. The ^ stamp indicates that the survey has been retrieved at least once. If there are no new surveys, this command retrieves only a list of installations.

Retrieve All: Retrieves all surveys and displays data in a special window called "Data Retrieved from DataMate." This command always retrieve surveys, new and old, if there are any in the DataMate.

Send Setup: Used to transfer a setup database to the DataMate. Erases the DataMate's memory, then transfers the contents of the active database to the DataMate. This command is normally used to send a setup database to the DataMate, but it can be used to send a project database to the DataMate (within limits of memory).

DataMate Menu, Continued

Erase Memory: Erases installations and surveys from the DataMate and leaves the memory blank.

Options: Used to set the communications port. Also used to change the background color of the DataMate Window.

Survey

This menu becomes active when you have selected a survey. The same commands appear on a right-click menu, as well.

Export: Offers choice of exporting to RPP, Tab-Delimited ASCII, or PCSLIN. See Appendix 7.

Print: Prints the current survey along with checksum statistics.

Validate: Prints checksum statistics for the current survey.

Compare: Reduces data and displays a displacement graph of the A-axis and B-axis. Provides a "report" function that prints printing of the graphs along with data and statistics. See the chapter on data reduction and graphing for details.

Settlement: Generates a survey that is adjusted for settlement. See Appendix 10.

Spiral: Generates an interpolated spiral survey used for spiral corrections in DigiPro. This command becomes active only if there is a spiral survey found in the database. See Appendix 9.

Right-Click Survey Menu

The menu items above also appear on a right click menu. To display the menu, select a survey, then click the right button of your mouse.

Window

Use the Window menu to arrange windows on your screen. This is useful when you retrieve data from the DataMate.

Cascade: Stacks windows on top of each other, leaving only title bars visible, except for the window in front.

Tile Vertical: Arranges windows side by side. Useful for dragging surveys from the DataMate window to the project database window.

Tile Horizontal: Arranges windows side by side, using the full width of each window.

Help: Displays the version number of the program. The version number is also visible on the title bar.

Creating a Project Database

What's a Project Database?

The project database stores a list of inclinometer installations and the inclinometer surveys recorded for each installation.

Installation: This is a term used by Slope Indicator to refer to installed inclinometer casing. Other commonly used names are "inclinometer," "well," or "borehole." The project database holds the name of the installation, its depth, and measurement intervals.

Survey: This is a term used by Slope Indicator to refer to readings that are recorded for an installation. Other commonly used terms are "reading set" or "data set."

Creating a New Project Database

1. Start DMM.
2. Choose File-New.
3. Enter a name for the project, choose a folder, and click Save.
4. The new database is empty. The next steps explain how to add installations.

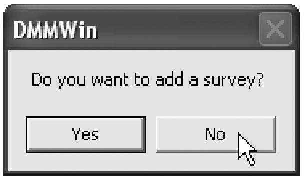
Overview of Adding Installations

There are several ways to add installations to the new database.

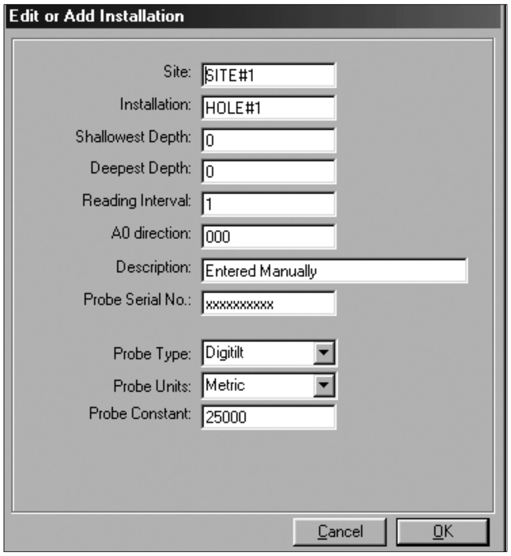
- You can add installations manually, as discussed next.
- You can retrieve data from the DataMate. This adds both installations and surveys. See "Retrieving Surveys."
- You can drag and drop installations from other DMM databases into the new database. This brings surveys as well. See "How To - Make a Composite Database."
- You can import data from legacy formats. This brings in both installations and surveys. See Appendix 1.

Adding Installations Manually

1. Click Edit/Add.
2. Enter the required information. Each field is explained below.
3. Click OK.
4. Click No to the prompt asking if you want to add a survey.



Do you want to add a survey?



Site: SITE#1
Installation: HOLE#1
Shallowest Depth: 0
Deepest Depth: 0
Reading Interval: 1
A0 direction: 000
Description: Entered Manually
Probe Serial No.: xxxxxxxxxx
Probe Type: Digitilt
Probe Units: Metric
Probe Constant: 25000

Installation Fields

Site & Installation: Every installation has a two-part identifier: “site” and “installation.” Enter up to 6 characters for each part.

Shallowest Depth: Typically, 0.5 for metric-unit systems or 2 for English-unit systems. Unit labels are not used.

Deepest Depth: Enter the appropriate value. With English-systems, it is best to use an even number so that 2-foot intervals coincide with cable markings. Unit labels are not used.

Reading Interval: Typically, 0.5 for metric-unit systems and 2 for English unit systems. Unit labels are not used.

A0 direction: Optional field of 3 characters for entering the compass heading of the A grooves. Not used for any calculation.

Description: Optional field up to 35 characters long.

Probe Serial No: Enter the serial number of the probe assigned to this installation.

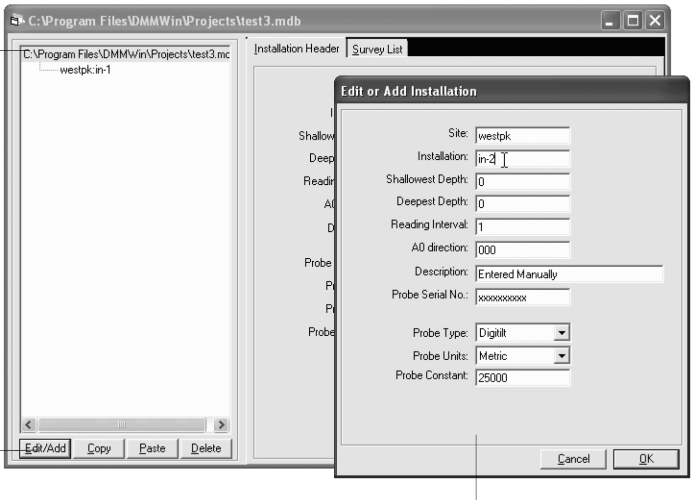
Probe Type: Choose Digitilt for inclinometers.

Probe Units: Choose Metric or English. If you don’t know, check the distance between the upper and lower wheels of the probe: 0.5 m for metric systems; 2 feet for English-unit systems.

Probe Constant: Enter 25000 for metric-unit systems and 20000 for English-unit systems.

Add Another Installation

1. Click on the name of the database at the top of the column.
2. Click Edit/Add.
3. Enter the required information and click OK.



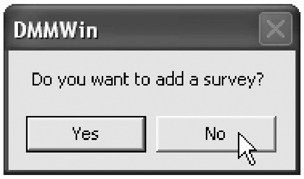
Site: westpk
Installation: in-2
Shallowest Depth: 0
Deepest Depth: 0
Reading Interval: 1
A0 direction: 000
Description: Entered Manually
Probe Serial No.: xxxxxxxxxx
Probe Type: Digitilt
Probe Units: Metric
Probe Constant: 25000

1. Click the database name

2. Click Edit/Add

3. Enter the information and click OK

4. Answer No to the “Add Surveys” prompt.



Do you want to add a survey?

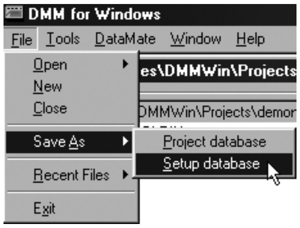
Setting Up the DataMate

Create a Setup Database

1. Open your project database.
2. Choose File-Save As Setup Database.

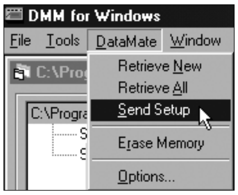
   DMM copies installations from the project database into a setup database. No surveys are copied.

   The default name for the setup database is “setup for [name of your project database].” The default folder is “Setups” and is located in the DMM folder. You can use a different name and folder for your setups.

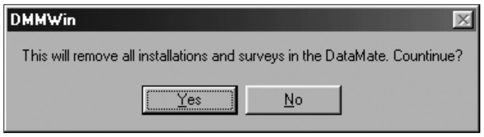


Send the Setup to the DataMate

1. Connect the DataMate to your serial port. Switch on the DataMate and select Comm. The DataMate displays: Waiting for PC.
2. Choose File-Open-Setup Database, if necessary. The setup database must be displayed.
3. Choose DataMate-Send Setup.



4. Sending a new setup removes any data that is in the DataMate. This is normally what you want, so click Yes.



This will remove all installations and surveys in the DataMate. Countinue?

   If you are not sure, click No. Then retrieve all surveys that are in the DataMate. You can store the retrieved surveys in a temporary project database, if necessary, and sort it out later.

5. DMM then sends the setup database to the DataMate. If you see an error message, try the troubleshooting steps listed on the next page.
6. When the database has been sent, check that the DataMate contains the required installations, then switch the DataMate off.

Note

You can also send a project database to the DataMate, using the Send Setup command. Sending a project database sends the surveys as well, so check that you have not completely filled the memory.

Trouble-Shooting Communications

Error 1: No response from device.

- If you see this error message, DMM may be using the wrong comm port. Choose DataMate-Options. DMM then scans for available comm ports and displays a list. Choose a different comm port and try again. Use this method even if you have a DataMate II, which uses USB communications.
- If DMM does not display a comm port that you think should be available, check if an “Active Sync” or “Hot Link” program is running and disable it. Such programs, supplied with Palm or Windows CE palmtop computers take control of the serial port and do not allow other devices to operate through it.
- All DataMates manufactured before the DataMate II use RS-232 serial communications. Most new notebook computers and many desktop computers no longer offer a serial port, so you can’t connect the interface cable to the PC. (Note that serial port has 9 pins. Do not confuse it with a monitor port, which has 15 pins).

  You can solve this problem by purchasing a Serial to USB adaptor at your local computer store. One end connects to the USB port on your PC. The other end connects to the serial interface cable supplied with the DataMate. You must also install the USB drivers supplied with the adaptor. It is always a good idea to check the manufacturer’s web site to download the most recent drivers.

More about Setup Databases

- The “File-Save As-Setup Database” command makes a copy of your project database, but removes survey data, so that only installation information remains.
- You can add installations from other project databases or other setup databases to your setup database. See the “How To” section for suggestions.
- When you send a setup database to the DataMate, it clears the entire data memory of the DataMate. If you share your DataMate, you may not want to erase installations and data that belong to someone else. In this case, add new installations using the DataMate’s keypad.
- The original DataMate holds up to 40 installations. The DataMate II can hold 160. Your setup database must not have more installations than these maximums.
- The project database and the setup database are not linked. Thus, if you make changes to installation information in the project database, you should update your setup database or overwrite it with the Save-As Setup command.

Retrieving Surveys

Overview

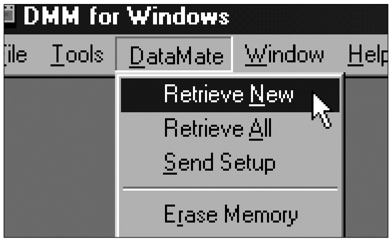
Retrieving surveys is a two step process.

1. Retrieve the surveys.
2. Copy the surveys into your project database.

Retrieve the Surveys

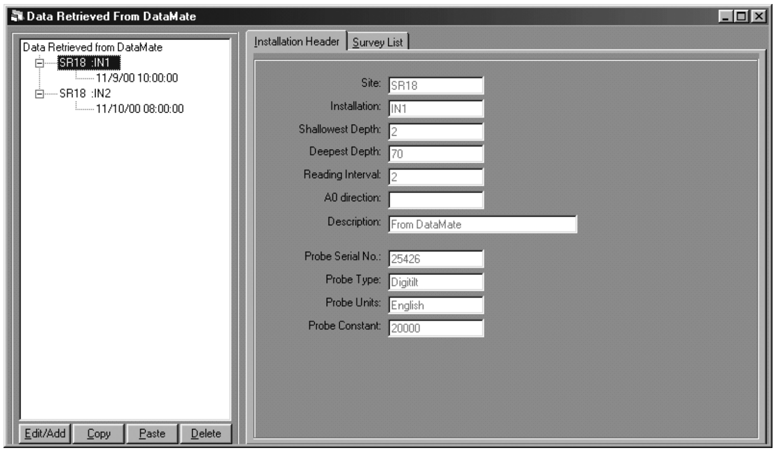
1. Connect the DataMate to your PC. Select Comm.
   The DataMate displays: Waiting for PC.
2. Run DMM. Choose DataMate - Retrieve All (or Retrieve New).

   If you choose Retrieve All, DMM displays all surveys. If you choose Retrieve New, DMM displays only new surveys (that have not been retrieved before).



   DMM retrieves the surveys from the DataMate. You can see its progress at the bottom left of the screen. If you have communications problems, see the troubleshooting steps in the previous chapter.

3. DMM displays the retrieved surveys in a temporary database window. This window is titled "Data Retrieved from DataMate" and is a slightly darker color. You can change the color of the window to make it easier to identify: Choose DataMate-Options. The color-change takes effect the next time that you retrieve surveys.



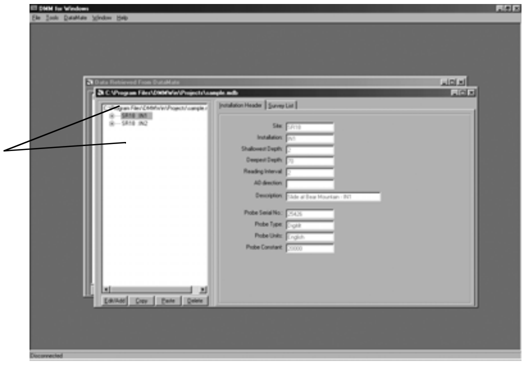
Site: SR18
Installation: IN1
Shallowest Depth: 2
Deepest Depth: 70
Reading Interval: 2
A0 direction:
Description: From DataMate
Probe Serial No.: 25426
Probe Type: Digitilt
Probe Units: English
Probe Constant: 20000

Data retrieved from DataMate is displayed in a temporary database.

You can change the color of this window to make it easy to identify.

Copy Surveys to your Project Database

1. Open a project database to receive the data. If your DataMate holds surveys from different projects, you can open other project databases at the same time.



Site: SR18
Installation: IN1
Shallowest Depth: 2
Deepest Depth: 70
Reading Interval: 2
AD direction:
Description: Slide at Bear Mountain - IN1
Probe Serial No.: 25426
Probe Type: Digitilt
Probe Units: English
Probe Constant: 20000

The project database window opens in front of the DataMate window.

To transfer surveys, you must see both windows, as shown below.

2. To position the windows side by side for easy drag and drop, Choose Windows - Tile Vertical.

Date: 11/10/00
Time: 0:00:00 AM
Depths: 34
Full Set: True

Use the Windows Tile command or press Ctrl-T to place the windows side by side.

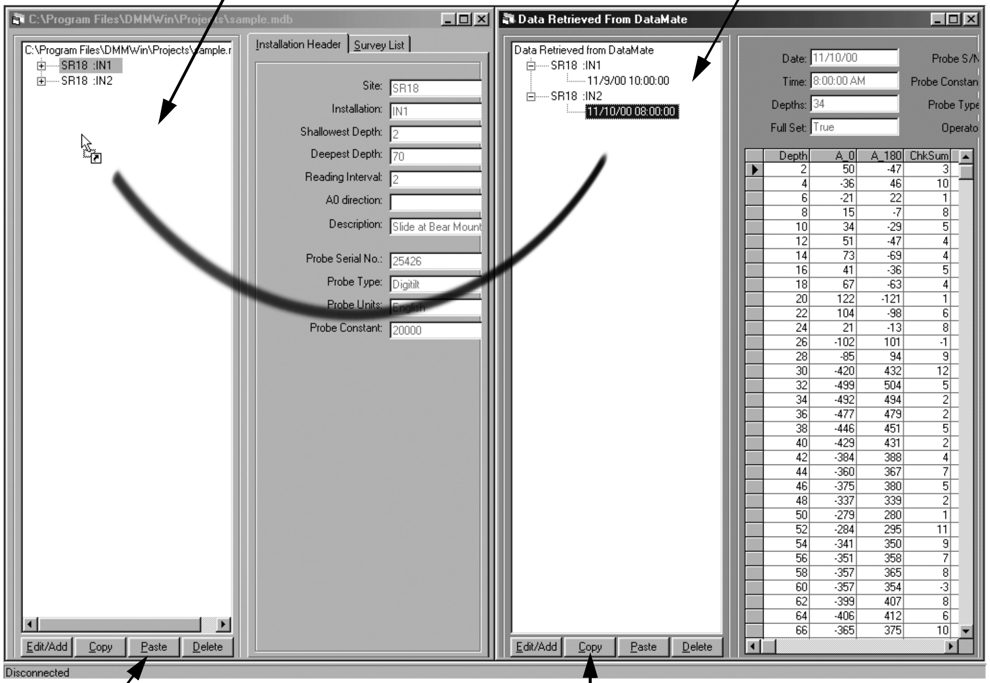
Project Database Data Retrieved from DataMate

Retrieve Data continued

3. Click, drag, and drop surveys one by one from the DataMate window to the project window. It is not necessary to drop the survey on the installation. If you have difficulty copying surveys, you are probably trying to drag the survey before you select it. Instead of drag and drop, think: “Click, Drag, and Drop.

   You can also use the copy and paste buttons to copy from the temporary database and paste into the project database.

Click, drag, and drop: Click on a survey to select it, then drag the survey to the project window and drop it.



Site: SR18
Installation: IN1
Shallowest Depth: 2
Deepest Depth: 70
Reading Interval: 2
A0 direction:
Description: Slide at Bear Mount
Probe Serial No.: 25426
Probe Type: Digitilt
Probe Units: English
Probe Constant: 20000

Date: 11/10/00
Time: 8:00:00 AM
Depths: 34
Full Set: True

Depth	A_0	A_180	ChkSum
2	50	-47	3
4	-36	46	10
6	-21	22	1
8	15	-7	8
10	34	-29	5
12	51	-47	4
14	73	-69	4
16	41	-36	5
18	67	-63	4
20	122	-121	1
22	104	-98	6
24	21	-13	8
26	-102	101	-1
28	-85	94	9
30	-420	432	12
32	-499	504	5
34	-492	494	2
36	-477	479	2
38	-446	451	5
40	-429	431	2
42	-384	388	4
44	-360	367	7
46	-375	380	5
48	-337	339	2
50	-279	280	1
52	-284	295	11
54	-341	350	9
56	-351	358	7
58	-357	365	8
60	-357	354	-3
62	-399	407	8
64	-406	412	6
66	-365	375	10

Using Copy and Paste: Click on a survey, click on the Copy button, and then click on the Paste button in the project window.

Data Reduction and Graphing

Introduction

Slope Indicator offers two programs for reducing inclinometer data: DMM for Windows and DigiPro for Windows.

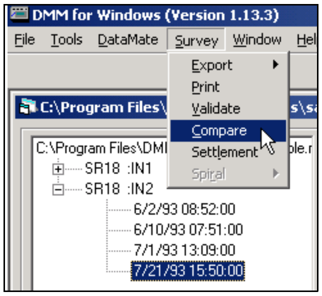
DMM for Windows can calculate checksum statistics, deviations, and displacements, and it can also create a graph of cumulative deviation or cumulative displacement (two surveys only).

DigiPro for Windows offers full graphing capabilities, more graph types, the ability to add titles, and a error correction routines. You can download a run-limited, full working version of DigiPro and the DigiPro manual from www.slopeindicator.com.

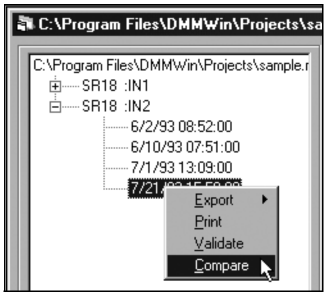
Data Reduction in DMM

DMM's data reduction functions are on the Survey menu or a right click menu. You must select a survey to activate the menus.

1. In the navigation window, click on the + next to an installation. Now you can see a list of surveys.
2. Select a survey.
3. Now click Surveys on the menu bar or click the right button on your mouse.



Select a survey, then click Survey on the menu bar.



The Right-Click Survey Menu

Print: DMM prints readings and checksums for the selected survey.

Validate: DMM displays the mean and standard deviation of checksums for the selected survey.

Compare: DMM compares the selected survey against an initial survey and displays graphs for the A and B axes. You can print a report that includes readings, graphs, and optionally, checksum statistics.

Printing Data

1. Select the survey that you want to print.
2. Click “Survey” on the menu bar.
3. Choose Print. DMM displays a print preview. It provides the following functions:

   Page: Page forward or backward through the preview.

   Print Setup: Choose a printer.

   Page Setup: Choose paper size and margins.

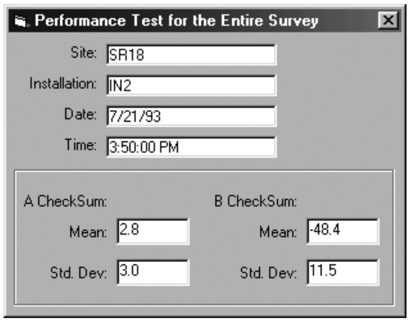
   Print: Print the data. You can print pages selectively.

   Left-Click: Double-click the left mouse button to zoom in. Drag the mouse to move the image.

   Right-click: Double-click the right mouse button to zoom out.

Validating Data

1. Select the survey that you want to validate.
2. Click “Survey” on the menu bar.
3. Choose Validate. DMM displays a table of checksum statistics. Click the X to close the table.



Site: SR18
Installation: IN2
Date: 7/21/93
Time: 3:50:00 PM

A CheckSum:
Mean: 2.8
Std. Dev: 3.0

B CheckSum:
Mean: -48.4
Std. Dev: 11.5

About Checksums

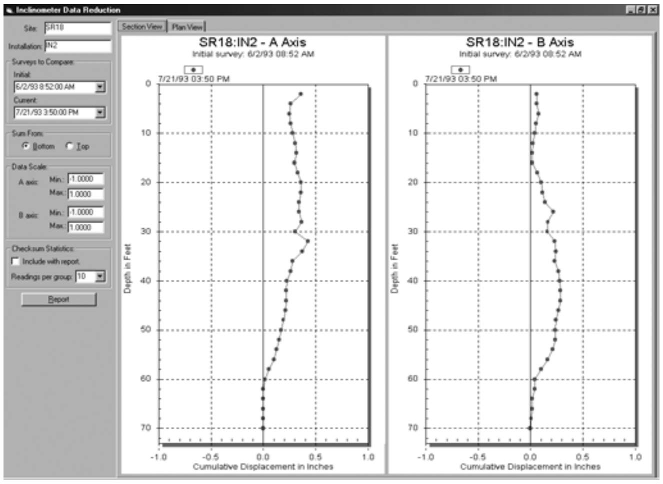
Checksums are one way to measure of the quality of your readings, but don’t place too much importance on them. The consistency of checksums from survey to survey is more important than the actual value of the checksums. The standard deviation value is useful for comparing surveys.

Look at the checksums in DMM’s display of survey data, especially if you have imported data or entered data manually. Very high checksums often reveal an omitted + or - sign.

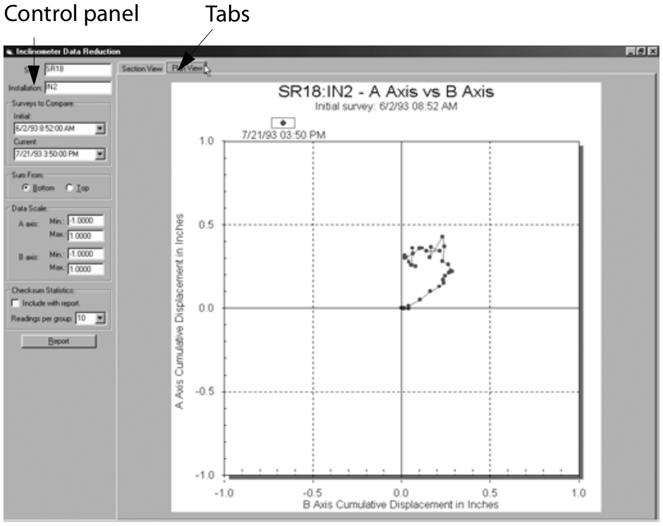
Look for a trend of checksums within a survey. A trend of decreasing checksums from bottom to top can be caused by omitting a warm up period for the probe. Trends of increasing or decreasing checksums within a survey may also indicate a problem with the probe.

Graphing

1. Select the survey that you want to compare.
2. Click “Survey” on the menu bar.
3. Choose Compare.
4. DMM displays a graph of cumulative displacement (movement). Note that DMM compares only two surveys.
5. Click on the tabs to show different views. Use the control panel to change options for the graphs and the printed report.

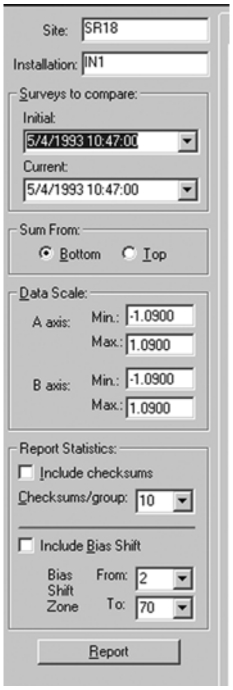


Section View: This view shows standard displacement graphs. A and B data are plotted against depth and shown in separate graphs.



Plan View: This view combines A and B-axis data by plotting the A value vs the B value at each depth.

Control Panel



Site: SR18
Installation: IN1
Surveys to compare:
Initial: 5/4/1993 10:47:00
Current: 5/4/1993 10:47:00
Sum From: ● Bottom ○ Top
Data Scale:
A axis: Min.: -1.0900 Max.: 1.0900
B axis: Min.: -1.0900 Max.: 1.0900
Report Statistics:
☐ Include checksums
Checksums/group: 10
☐ Include Bias Shift
Bias Shift Zone From: 2 To: 70
Report

Use the fields and buttons panel on the left side of the screen to control the graph.

Initial: Select a different initial survey. By default, DMM selects the earliest survey. You can also select “none” to force DMM to display a graph of cumulative deviation (the borehole profile).

Current: Select a different survey for comparison.

Sum From: Select top or bottom. Vertical inclinometers normally use sum from bottom since the bottom of casing is installed in stable ground.

Data Scale: We recommend that you use the scales set by DMM. You can enter other values, if necessary.

Printing a Report

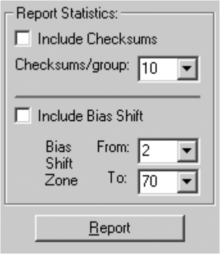
Report Button: When you click the Report button, DMM produces a report consisting of readings, graphs, and optional data. The report is displayed on screen as a print preview. You can page through the print preview and print all pages, the current page, or a range of pages. Some additional pages are added when you include checksum statistics and bias shift analysis.

Plain Report

With no checksum or bias shift information, the report contains:

- A-Axis readings, deviations & displacements in table form.
- B-Axis readings, deviations & displacements in table form.
- Graphs containing A-axis and B-axis displacement plots.
- Graphs of A-axis vs B-axis.

Include Checksums



Report Statistics:

☐ Include Checksums

Checksums/group: 10

☐ Include Bias Shift

Bias Shift Zone From: 2

To: 70

To include checksum information with your report, click in the checkbox. (A check shows that checksum information will be included). Checksum statistics include a mean checksum and standard deviation of checksums for all readings in the survey. If the installation is deep, you may want to see statistics for smaller number of readings. To do this, enter a value from 1 to 10 in the groups field. Checksum information adds these pages to the report.

- A-axis readings, checksums, and change in checksums.
- A-axis checksum statistics.
- B-axis readings, checksums, and change in checksums.
- B-axis checksum statistics.
- A-axis readings, differences, and changes in digi units.
- B-axis readings, differences, and changes in digi units.

Include Bias Shift

The bias shift report, explained in Appendix 8, adds one page to the report:

- Differences and shifts for A and B axes.

How To . . .

Move a survey

This is useful if your survey is stored in the wrong place. For example, you chose the wrong installation when you started the survey and now you want to move the data to the correct installation.

1. Select the misplaced survey.
2. Click Edit Add to pop up the edit window.
3. Choose the correct installation from the drop down list at the top of the edit window, and click OK. This makes a copy of the survey and places it under the correct installation.
4. Finally, clean up the database. The original survey - the one you copied - is still there. Select it and click the delete button to remove it from the database.

Rename an Installation

1. Select the installation that you want to rename.
2. Click on Edit/Add to open the edit window.
3. Change the name of the installation and click OK. DMM adds a new installation to your database. There are no surveys under the installation.
4. Copy surveys one by one from the old installation to the new installation using the “misplaced survey” technique above.
5. After the surveys are copied, delete the old installation.

Enter Data Manually

Detailed instructions appear in Appendix 6, but here’s an overview.

- Click on an installation, then click Edit/Add. If there are no surveys, DMM asks if you want to add a survey. Answer yes.
- If there are already surveys for that installation, you click on an existing survey and click Edit/Add to modify the existing survey. This saves you the time of entering header information and depths. Modify the survey as required, changing the date and time first, then entering the appropriate readings. When you click OK, the new survey is added.

Copy a Database

This is useful for making backup-copies of your database.

1. Open a project database.
2. Choose File - Save As.
3. Enter a name and location for the database, and click OK.

Split a Database

1. Open a project database.
2. Choose File - New to create a new project database.
3. Drag and drop installations from the original database to the new database. Surveys are dragged along with the installations.
4. Delete installations from the original database.

Send New Readings to the Head Office

Sometimes there are two project databases, one at the field office and one at the home office. The field office must maintain its own database and send new readings to the head office.

1. When you retrieve surveys from the DataMate, choose "DataMate - Retrieve New." DMM retrieves new readings and displays the temporary DataMate database.
2. Copy the new readings into your field database as usual.
3. Now, while the temporary DataMate database is still open,
4. Choose File - Save As. Enter a name and location for a database that will contain the new readings, and click OK. This saves the new readings in a database that you can send. Close the new database and update your local project database as usual.
5. Then, copy the new database onto disk or email it as an attachment. It will be fairly small because it contains only the new readings. You can use Winzip to make the file even smaller.
6. The DMM user at the head office then copies readings from the database that you sent to the permanent project database.

Delete a line of Data

1. Select the survey and click Edit/Add.
2. Click in the gray box to the left of the line of data. This selects the line.
3. Press the Delete key.

Make a Composite Setup Database

Suppose you have several projects and want the DataMate to hold inclinometers from each of those projects. You may also want the DataMate to hold a previous survey for each of those inclinometers.

To send installations and datasets (surveys) to the DataMate, you make a "setup" database. To make a setup database, simply save your project database as a setup database. DMM makes a copy of the database and then strips out any data, so all that remains is installation information.

To add a previous survey to the setup database, view your project database and setup database side by side (Use the Ctrl-T Tile command) and click-drag-and-drop the needed surveys from the project database to the setup database. Just drop the survey anywhere in the white window. It will find its own way home. Now you can close the project database, but keep your setup database open.

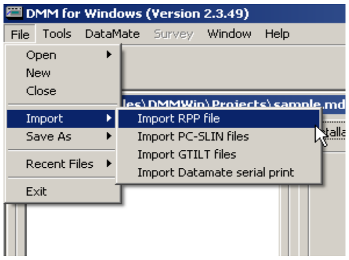
Now, open another project database and tile it side by side with your setup database. You'll be doing click-drag-and-drop operations again. Click-drag-and-drop surveys that you want in the DataMate. The surveys will bring installation information automatically. (Watch out: if you drag an installation, the installation will bring along all of its surveys. So drag a survey, not an installation).

Repeat this for any other installations that you need. Keep in mind that the DataMate has a 40 installation limit and the Datamate II has a 160 installation limit. If more than the maximum is installed, they will be arbitrarily truncated when sent to the DataMate. An alternative to this is to download the contents, save them, modify them (add new setups) and send them back to the DataMate

When the setup database holds the installations and surveys that you need, send the setup to the DataMate. This will cause the DataMate to delete everything that is in its memory and replace it with the contents of the setup database. So be sure that you have retrieved anything that you want from the DataMate before you send the setup.

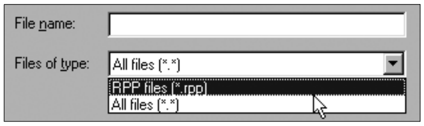
Appendix 1: Importing Data

Importing Data



1. Create a project database.
2. Choose File - Import.
3. Choose the type of import. These are explained below. There is no import routine for spreadsheets.
4. Specify the file to import.
5. Click OK.

RPP Import Notes



- The import routine looks for an extension of RPP. If your RPP file has a different extension, click in the Files of Type field to show All Files.
- The first line of the RPP file must be a date. If DMM gives you an error message, open your RPP file with an ASCII editor such as notepad, and delete any lines above the date line
- If you have trouble importing, check that the date and time formats in the file match the date and time formats of your Windows computer.

The first line of the file must be time and date in this format.

Project and Hole # become Site and Installation. Check that these names are consistent in all surveys for this installation.

Check for missing equals (=).

```
TIME = 09:38:00   29 APR 1993
DIGITILT/SPIRAL = D
ENGLISH/METRIC = E
HOLE # = IN1
PROJECT = SR18
JOB DESC = Slide at Bear Mountain - IN1
DIR CODE =
PROBE SER # = 1
OPERATOR =
START DEPTH = +70.0
END DEPTH = +2.0
INCREMENT = 2.0
INSTR CONST = 20000
ROTATIONAL CORR A = 0.0000
ROTATIONAL CORR B = 0.0000
CALIBRATION CORR A = 0
CALIBRATION CORR B = 0


+2.00   A0   -472   B0    239
      A180    479 B180   -282
+4.00   A0   -265   B0    -17
      A180    273 B180    -13
```

PCSLIN Import Notes

- The import routine looks for an extension of PRN. If your PCSLIN file has a different extension, click in the Files of Type field to change to All Files.
- The first line of the file must start with the word “QUESTIONS.” If there is an error, open the PCSLIN file with an ASCII editor such as Notepad and delete any lines before the word “QUESTIONS.”

“QUESTIONS” must appear on the first line of the file.

Project No and Hole No become Site and Installation.

The import routine ignores reading set numbers.

Check that the equals (=) are always lined up. If necessary, shorten entries.

```
QUESTIONS
PCSLIN          = DATA FILE NAME
SR18            = PROJECT NO
Slide at Bear Mountain - IN1
IN1             = HOLE NO.
    1           = READING SET NO.
04/29/1993      = DATE
09:38           = TIME
       20.,     = STATISTICS INTERVAL
12345           = INSTRUMENT NO.
         0,     = HALF OR COMPLETE SET OF DATA
      .000,     = A-ROTATION ERROR CORRECTION
      .000,     = B-ROTATION ERROR CORRECTION
    20000.,     = INSTRUMENT CONSTANT
                = A+ COMPASS DIRECTION
                = A- COMPASS DIRECTION
                = B+ COMPASS DIRECTION
                = B- COMPASS DIRECTION
         0,     = SHIFT ANALYSIS PRINT
         0,     = A COMPONENT SHIFT
         0,     = B COMPONENT SHIFT
      400.,     = CHANGE IN READING SCALE
        2.,     = DEFLECTION SCALE
READINGS  ,   35
     2.000,      -472,       479,       239,      -282
     4.000,      -265,       273,       -17,       -13
```

GTilt Import Notes

The Gtilt import routine looks for an extension of GTL. If your file has a different extension, click in the Files of Type field to change to All Files.

Metric files are assigned an instrument constant of 25000 and a reading interval of 0.5 m. English files are assigned an instrument constant of 20000 and a reading interval of 2 feet.

This is truncated to 6 characters and becomes Installation.

This is truncated to 6 characters and becomes Site.

```
SAMPLE1
NORTH PORTAL SLOPE
Urban Transit Authority
North Slope Investigation
E
4
2.25
37
M
637.0
45
10000
 5
*
07061998
1327
1400
Top of cable clamp
31.2
EDM
EDM
EDM
6.45
6.21
TAJ
TAJ


-150  131 -216  236
-54  36 -180  187
 69 -85 -204  218
```

DataMate Serial Print

This import function is included mostly for diagnostics. The DataMate can print a survey to a serial device. There are very few serial printers these days, so a terminal program, such as Hyperterm, is used to capture the output of the DataMate and save it as a text file. This import utility provides a way to import that text file.

```
Site     :SR18
Survey   :IN1
A0 dir   :
Operator :
Sensor # :25426
Axes     :DIGITILT
Units    :ENGLISH
Ins const:20000.0
Start    :70.0
End      :2.0
Interval :2.0
Time     :93/05/04

Depth     A0      A180    B0     B180
  2.0    -475     477     235    -286
  4.0    -270     274      -7     -14
  6.0     334    -329    -206     161
  8.0     393    -390    -129      78
 10.0     298    -293    -223     159
 12.0     246    -235    -258     210
 14.0     170    -167    -301     260
 16.0     123    -114    -363     321
 18.0      57     -56    -438     387
 20.0      -5      10    -421     374
 22.0      77     -72    -500     447
 24.0     174    -167    -418     376
 26.0     242    -238    -434     384
 28.0     173    -167    -406     352
 30.0      91     -88    -422     398
 32.0      85     -77    -615     586
 34.0     110    -103    -697     644
 36.0     193    -189    -669     615
 38.0     212    -208    -690     627
 40.0     172    -168    -683     622
 42.0     174    -155    -651     594
 44.0      47     -54    -559     510
 46.0      27     -11    -537     482
 48.0      86     -78    -511     462
 50.0     171    -167    -569     517
 52.0     152    -135    -566     511
 54.0      75     -72    -437     411
 56.0     146    -139    -389     369
 58.0     155    -147    -526     499
 60.0     155    -153    -645     590
```

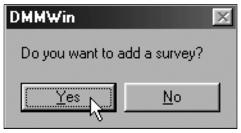
Appendix 2: Manual Entry of Data

Create a Database and Add Installations

1. Create or open a project database.
2. Enter installation information. Both of these tasks are described in “Creating a Project Database.”

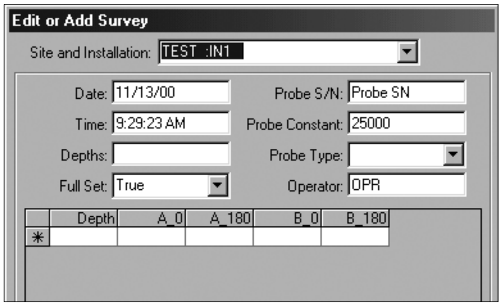
Enter the First Survey

1. .Click on the installation, then click on the Edit/Add button. DMM asks if you want to enter survey data. Click Yes.



Do you want to add a survey?

2. The edit window appears. Enter the survey header information as explained below.



Site and Installation: TEST :IN1

Date: 11/13/00

Time: 9:29:23 AM

Depths:

Full Set: True

Probe S/N: Probe SN

Probe Constant: 25000

Probe Type:

Operator: OPR

	Depth	A_0	A_180	B_0	B_180
*					

Site and Installation: Verify that the site and installation are correct. If not, choose a different installation from the drop-down menu.

Date and Time: Enter the date and time of the survey. DMM displays the current date and time so that you can see the proper format. The actual format will change according to your Windows’ short-date setting.

Depths: Skip this field. It will be entered automatically after you have entered readings.

Full Set: Enter True if you have readings for both the 0 and the 180 directions. Enter False if you have only the 0 readings. The Full-Set value is used in calculations later.

Probe S/N: Enter the serial number of the inclinometer probe.

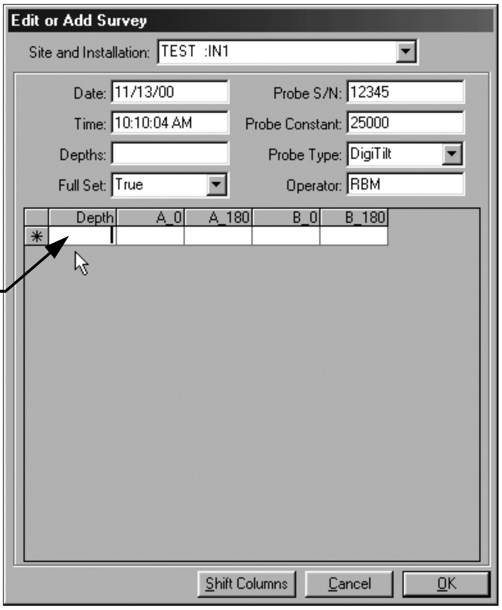
Probe Constant: Enter 25000 for metric-unit probes or 20000 for English-unit probes. This value is used in calculations

Probe Type: Enter Digitilt or Spiral. This value is used in calculations.

Operator: Enter initials of the operator (3 characters).

Enter the First Survey Continued

1. Enter depths, starting with the shallowest.
2. Enter the readings for each depth. When you are done, click OK.



Site and Installation: TEST :IN1

Date: 11/13/00

Time: 10:10:04 AM

Depths:

Full Set: True

Probe S/N: 12345

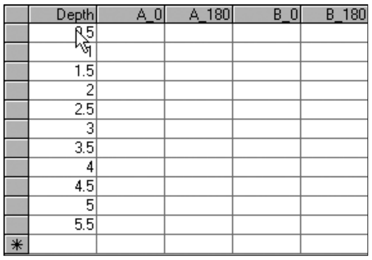
Probe Constant: 25000

Probe Type: DigiTilt

Operator: RBM

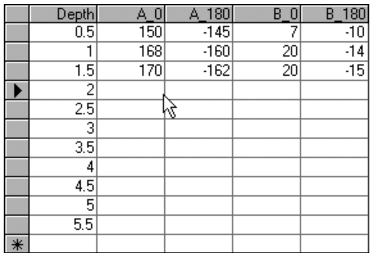
	Depth	A_0	A_180	B_0	B_180
*					

Click here to enter a depth. Start with the shallowest depth.



	Depth	A_0	A_180	B_0	B_180
	0.5				
	1				
	1.5				
	2				
	2.5				
	3				
	3.5				
	4				
	4.5				
	5				
	5.5				
*					

Enter the depths first. Check that you have not missed any depths.



	Depth	A_0	A_180	B_0	B_180
	0.5	150	-145	7	-10
	1	168	-160	20	-14
	1.5	170	-162	20	-15
▶	2				
	2.5				
	3				
	3.5				
	4				
	4.5				
	5				
	5.5				
*					

Enter readings for each depth. Press the arrow keys or tab to move from field to field.

Enter Subsequent Surveys

To enter other surveys for the same installation, you make a copy of the first survey (so that you do not have to enter depths again).

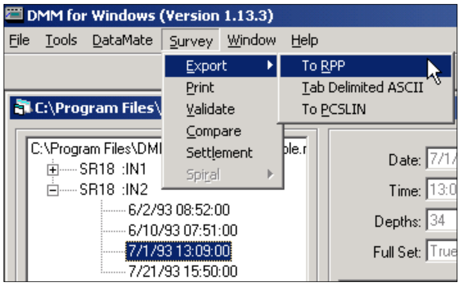
1. Select the first survey.
2. Click on Edit/Add. The edit window appears.
3. Correct the time and date for this survey.
4. Enter the readings and click OK.

Note: If there are many readings, you might want to save your work occasionally. To save your work simply click the OK button. To reopen the survey, select it (check the time and date), and click the Edit Add button.

Appendix 3: Exporting Data

Overview

1. Open a project database (or retrieve data from the DataMate).
2. Click on the + next to an installation. This makes surveys visible.
3. Select the survey that you want to export.
4. Click “Survey” on the menu bar and choose a format: RPP, Tab Delimited ASCII, or PCSLIN.
5. Specify a location and a name for the file and click OK.



RPP Format

This format includes header information, such as the installation ID and depth, the probe serial number, etc, followed by columns of data in fixed widths.

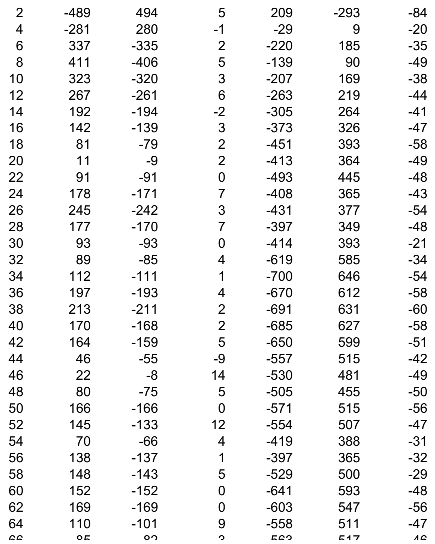
```
TIME = 10:00:00   09 Nov 2000
DIGITILT/SPIRAL = D
ENGLISH/METRIC = E
HOLE # = IN1
PROJECT = SR18
JOB DESC = From DataMate
DIR CODE =
PROBE SER # = 25426
OPERATOR =
START DEPTH = 70
END DEPTH = 2
INCREMENT = 2
INSTR CONST = 20000
ROTATIONAL CORR A = 0.0000
ROTATIONAL CORR B = 0.0000
SENSITIVITY FACTOR A = +0
SENSITIVITY FACTOR B = +0


+2.0     A0    -489    B0    209
      A180     494  B180   -293
+4.0     A0    -281    B0    -29
      A180     280  B180      9
+6.0     A0     337    B0   -220
      A180    -335  B180    185
+8.0     A0     411    B0   -139
      A180    -406  B180     90
+10.0    A0     323    B0   -207
      A180    -320  B180    169
+12.0    A0     267    B0   -263
      A180    -261  B180    219
+14.0    A0     192    B0   -305
      A180    -194  B180    264
+16.0    A0     142    B0   -373
```

Tab-delimited ASCII Format

This format includes column labels and tab-delimited values. It also includes checksums for both A and B readings.

Column labels can be excluded on import to the spreadsheet, as shown here.



2	-489	494	5	209	-293	-84
4	-281	280	-1	-29	9	-20
6	337	-335	2	-220	185	-35
8	411	-406	5	-139	90	-49
10	323	-320	3	-207	169	-38
12	267	-261	6	-263	219	-44
14	192	-194	-2	-305	264	-41
16	142	-139	3	-373	326	-47
18	81	-79	2	-451	393	-58
20	11	-9	2	-413	364	-49
22	91	-91	0	-493	445	-48
24	178	-171	7	-408	365	-43
26	245	-242	3	-431	377	-54
28	177	-170	7	-397	349	-48
30	93	-93	0	-414	393	-21
32	89	-85	4	-619	585	-34
34	112	-111	1	-700	646	-54
36	197	-193	4	-670	612	-58
38	213	-211	2	-691	631	-60
40	170	-168	2	-685	627	-58
42	164	-159	5	-650	599	-51
44	46	-55	-9	-557	515	-42
46	22	-8	14	-530	481	-49
48	80	-75	5	-505	455	-50
50	166	-166	0	-571	515	-56
52	145	-133	12	-554	507	-47
54	70	-66	4	-419	388	-31
56	138	-137	1	-397	365	-32
58	148	-143	5	-529	500	-29
60	152	-152	0	-641	593	-48
62	169	-169	0	-603	547	-56
64	110	-101	9	-558	511	-47

PCSLIN

This format includes a header followed by space delimited columns of data.

```
QUESTIONS
PCSLIN          = DATA FILE NAME
SR18            = PROJECT NO
Slide at Bear Mountain - IN1
IN1             = HOLE NO.
    1           = READING SET NO.
04/29/1993      = DATE
09:38           = TIME
       20.,     = STATISTICS INTERVAL
12345           = INSTRUMENT NO.
         0,     = HALF OR COMPLETE SET OF DATA
      .000,     = A-ROTATION ERROR CORRECTION
      .000,     = B-ROTATION ERROR CORRECTION
    20000.,     = INSTRUMENT CONSTANT
                = A+ COMPASS DIRECTION
                = A- COMPASS DIRECTION
                = B+ COMPASS DIRECTION
                = B- COMPASS DIRECTION
         0,     = SHIFT ANALYSIS PRINT
         0,     = A COMPONENT SHIFT
         0,     = B COMPONENT SHIFT
      400.,     = CHANGE IN READING SCALE
        2.,     = DEFLECTION SCALE
READINGS  ,   35
     2.000,      -472,       479,       239,      -282
     4.000,      -265,       273,       -17,       -13
```

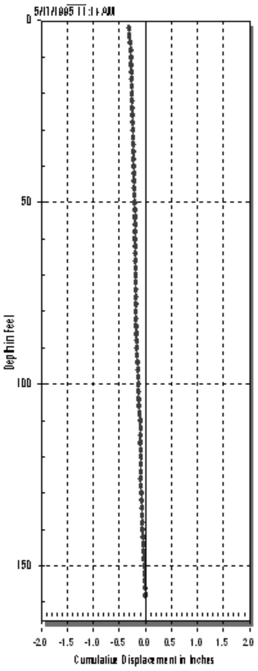
Appendix 4: Bias-Shift Analysis

What is Bias Shift

Bias: If you hold your inclinometer probe absolutely vertical and check the reading, you will typically see a non-zero value. This is the probe's bias. The bias value is normally eliminated in the data reduction process when the 0 readings are combined with the 180 readings.

Bias-Shift Error: If the bias value changes during a survey, the data reduction process cannot eliminate all of the bias. The remaining value is error that is embedded in the reduced data.

The straight, but leaning plot at right is the result of bias-shift error.



Identifying Bias Shift

Appearance: A straightened, but leaning cumulative displacement plot is a signature of bias shift error. The embedded error grows larger at each interval, so the plot leans to the left or right.

Unlikely Behavior: The graph above shows rotation of the entire 150 foot span of soil or rock. This unlikely behavior suggests error in the data.

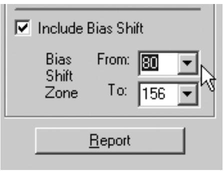
Site Knowledge: The plot shows movement where there should be no movement. Typically, the bottom 5 depths (or more) of the casing are anchored in stable ground. Any movement appearing there is generally error. In our example, we know that the casing entered rock below 80 feet, and that no movement has occurred from 80 feet downwards. This again suggests error in the data.

More information on bias-shift can be found in the training section of Slope Indicator's website: www.slopeindicator.com. Click on the link for Sample Chapters. Then click on "Bias Shift Error."

Quantifying Bias Shift Error

DMM provides a routine for quantifying bias shift error. The routine provides an average bias shift value that can be used as a correction value in DigiPro (but not in DMM).

1. Right click on the survey. Choose Compare.
2. Click the checkbox to include a bias shift analysis. Use the From and To drop boxes to limit the analysis to depths that you know are stable. This is important so choose the depths carefully. In our example, the casing is stable below 80 feet, so we enter 80 to exclude readings above 80 feet.



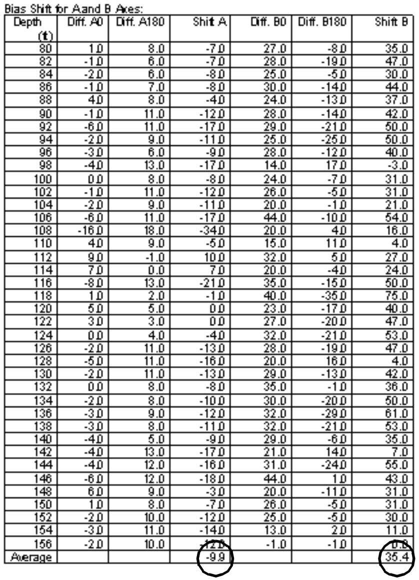
☑ Include Bias Shift

Bias Shift Zone From: 80

To: 156

3. Click the report button. Then page through the report to find the bias-shift page.
4. The analysis routine finds the difference between current and initial A0 readings and the difference between current and initial A180 readings. This is reported in the Diff column. Since movement affects the A0 and A180 passes in the same way, the values in the A0 column should match the values in the A180 column.

   The Shift column shows the difference between the A0 column and the A180 column. If you have limited the analysis to depths where no movement is likely to occur, the value in the Shift column represents bias shift error (plus some possible random error).
5. An average error appears at the bottom of the column. This is the correction value that you can enter into DigiPro.



Bias Shift for A and B Axes:

Depth (ft)	Diff. A0	Diff. A180	Shift A	Diff. B0	Diff. B180	Shift B
80	1.0	8.0	-7.0	27.0	-8.0	35.0
82	-1.0	6.0	-7.0	28.0	-19.0	47.0
84	-2.0	6.0	-8.0	25.0	-5.0	30.0
86	-1.0	7.0	-8.0	30.0	-14.0	44.0
88	4.0	8.0	-4.0	24.0	-13.0	37.0
90	-1.0	11.0	-12.0	28.0	-14.0	42.0
92	-6.0	11.0	-17.0	29.0	-21.0	50.0
94	-2.0	9.0	-11.0	25.0	-25.0	50.0
96	-3.0	6.0	-9.0	28.0	-12.0	40.0
98	-4.0	13.0	-17.0	14.0	17.0	-3.0
100	0.0	8.0	-8.0	24.0	-7.0	31.0
102	-1.0	11.0	-12.0	26.0	-5.0	31.0
104	-2.0	9.0	-11.0	20.0	-1.0	21.0
106	-6.0	11.0	-17.0	44.0	-10.0	54.0
108	-16.0	18.0	-34.0	20.0	4.0	16.0
110	4.0	9.0	-5.0	15.0	11.0	4.0
112	9.0	-1.0	10.0	32.0	5.0	27.0
114	7.0	0.0	7.0	20.0	-4.0	24.0
116	-8.0	13.0	-21.0	35.0	-15.0	50.0
118	1.0	2.0	-1.0	40.0	-35.0	75.0
120	5.0	5.0	0.0	23.0	-17.0	40.0
122	3.0	3.0	0.0	27.0	-20.0	47.0
124	0.0	4.0	-4.0	32.0	-21.0	53.0
126	-2.0	11.0	-13.0	28.0	-19.0	47.0
128	-5.0	11.0	-16.0	20.0	16.0	4.0
130	-2.0	11.0	-13.0	29.0	-13.0	42.0
132	0.0	8.0	-8.0	35.0	-1.0	36.0
134	-2.0	8.0	-10.0	30.0	-20.0	50.0
136	-3.0	9.0	-12.0	32.0	-29.0	61.0
138	-3.0	8.0	-11.0	32.0	-21.0	53.0
140	-4.0	5.0	-9.0	29.0	-6.0	35.0
142	-4.0	13.0	-17.0	21.0	14.0	7.0
144	-4.0	12.0	-16.0	31.0	-24.0	55.0
146	-6.0	12.0	-18.0	44.0	1.0	43.0
148	6.0	9.0	-3.0	20.0	-11.0	31.0
150	1.0	8.0	-7.0	26.0	-5.0	31.0
152	-2.0	10.0	-12.0	25.0	-5.0	30.0
154	-3.0	11.0	-14.0	13.0	2.0	11.0
156	-2.0	10.0	-12.0	-1.0	-1.0	0.0
Average			-9.9			35.4

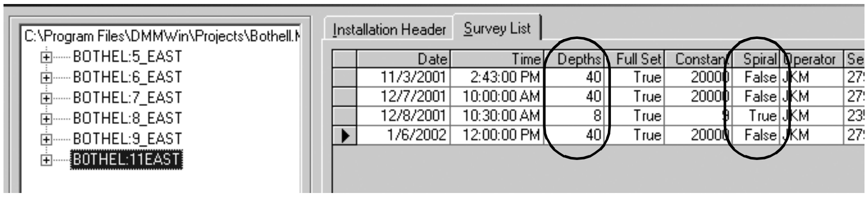
Averaged bias shift values

Appendix 5: Expanding Spiral Surveys

Spiral Surveys

Spiral surveys are obtained with a special-purpose spiral sensor. Please refer to the spiral sensor manual for instructions on conducting a spiral survey.

Spiral surveys are stored with inclinometer surveys in the project database. A typical spiral survey has depths and two or four columns of data, one column of data for each pass through the casing. The spiral survey can be identified as explained below:



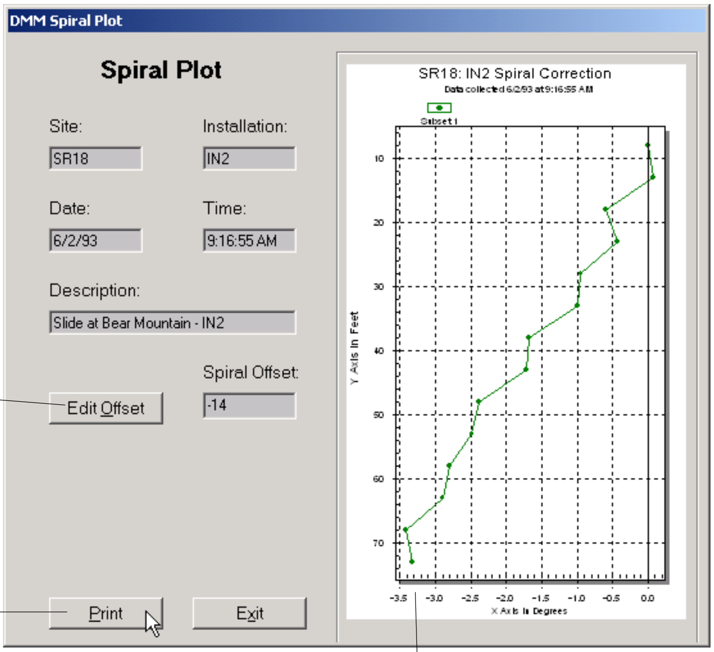
	Date	Time	Depths	Full Set	Constan	Spiral	Operator	Se
	11/3/2001	2:43:00 PM	40	True	20000	False	JKM	27
	12/7/2001	10:00:00 AM	40	True	20000	False	JKM	27
	12/8/2001	10:30:00 AM	8	True	9	True	JKM	23
▶	1/6/2002	12:00:00 PM	40	True	20000	False	JKM	27

The spiral survey has fewer reading depths than an inclinometer survey. Also, it is marked True in the Spiral column.

Plotting Spiral Data

DMM can generate a plot from the spiral data. The spiral plot shows the magnitude of the spiral in the casing. If the accumulated spiral is small (<20 degrees), you may decide to ignore spiral.

1. Select the spiral survey.
2. Click Survey on the menu bar, then choose Spiral - Plot Spiral.



Site: SR18
Installation: IN2
Date: 6/2/93
Time: 9:16:55 AM
Description: Slide at Bear Mountain - IN2
Spiral Offset: -14

Click this button to enter an offset for the spiral sensor. See the spiral manual for detail.

You can print the spiral plot.

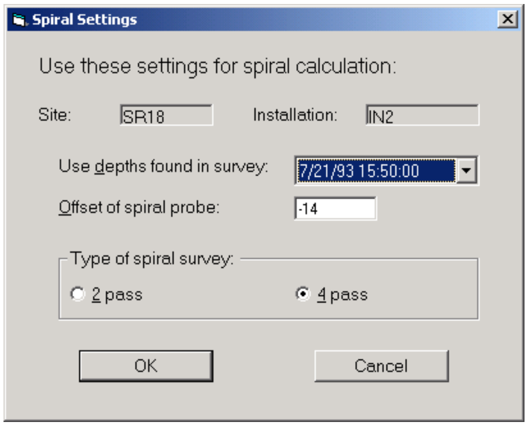
Spiral values are accumulated from top to bottom, so the maximum value appears at the bottom.

Expanding Spiral Data

To correct inclinometer surveys for Spiral, the DigiPro program requires a spiral value for each depth in the inclinometer survey.

DMM's spiral expansion routine reads the spiral survey and generates a new survey with values for each inclinometer depth. Later when you use DigiPro to graph inclinometer data, you simply switch on spiral correction and DigiPro automatically finds the expanded spiral survey and applies the data.

1. Select the unexpanded spiral set.
2. Click on Survey, and choose Spiral - Expand Spiral.
3. Specify which survey has the proper number of depths.
4. Enter the spiral sensor offset. (See the Spiral Manual).
5. Choose the number of data columns in the spiral survey (2 or 4).
6. Click OK. DMM then generates a new spiral survey. It has the same date as the original spiral survey, but the time is changed by one second. In addition, the operator field is marked EXP.


Spiral Settings

Use these settings for spiral calculation:

Site: SR18 Installation: IN2

Use depths found in survey: 7/21/93 15:50:00

Offset of spiral probe: -14

Type of spiral survey:

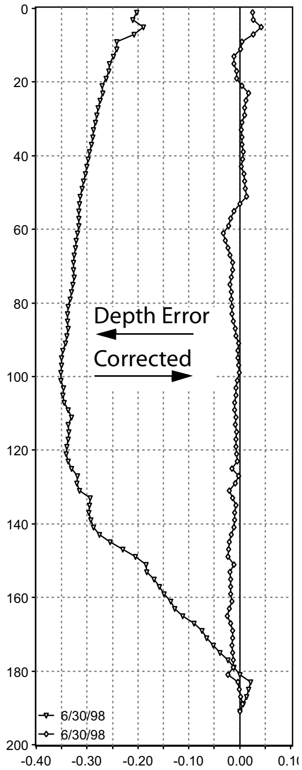
○ 2 pass ● 4 pass

Appendix 6: Settlement Corrections

Depth Error

The accuracy of an inclinometer system depends on repeatable positioning of the inclinometer probe. When the probe is positioned consistently at each depth in the survey, readings can be compared reliably. If the reading changes, movement has occurred. If the reading stays the same, no movement has occurred.

However, if the probe is positioned above or below the proper depth, the reading will change, even if there is no movement. This changed reading is a depth error. In casing that is very straight, the change in reading is small, and can typically be ignored. But in casing that is "wavy," the change can result in obvious error, as shown in the DigiPro plot at right.



Sources of Depth Error

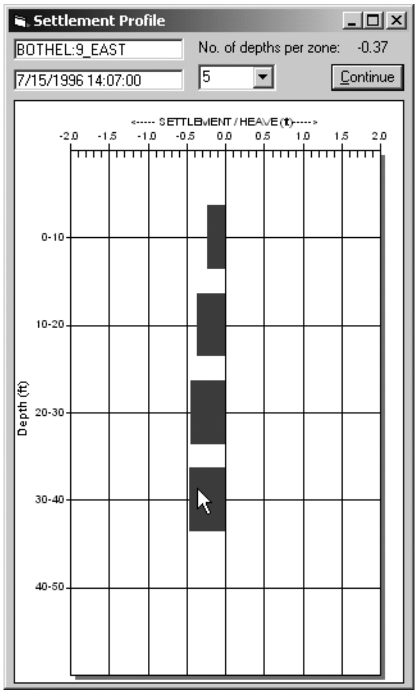
Changed reference: The operator positions the probe by aligning depth markers on the cable to a reference at the top of the casing. If the reference changes, every reading in the survey is affected. This can be corrected by DMM's settlement correction.

Change in casing length: If the casing is compressed by settlement, the probe will be positioned deeper in the casing. Readings are affected at and below the zone of settlement. This can be adjusted by DMM's settlement correction.

Change in cable length: Control cables may shrink or stretch over time. Cables may be interchanged with other cables that are not the same length. Repairs and splicing of cable may result in changed length. Readings are affected where differences in cable become active. This can be adjusted by DMM's settlement correction

Random positioning: A distracted operator accidently positions the probe at the wrong depth and take a reading. This cannot be adjusted by DMM's settlement correction. Edit the data instead.

Generating a Corrected Survey



BOTHEL:9_EAST

7/15/1996 14:07:00

No. of depths per zone: 5

-0.37

1. Select the affected survey. Click on Survey. Choose Settlement.
2. Determine whether the depth error is settlement or heave (see explanation below).

Settlement	**Heave**
Reference is lower than before	Reference is higher than before
Casing is shorter than before	Casing is longer than before
Cable has stretched	Cable has shrunk

3. To enter a value, click on the zone line. A bar appears. You can see the numeric value of the bar in the upper right corner. Enter settlements on the left side and heave on the right side. Units are in feet or meters.

   If you reduce Sondex or Magnet extensometer readings as suggested in the manuals, your final calculations are changes for each ring or magnet. The values entered into DMM should be the complement of these changes (total settlement minus change).

   In the example below, the change for magnet 5 represents total settlement (the change in the distance between the datum magnet and the top magnet). You can see the required calculation. Although the values for DMM are positive, you should still enter them on the settlement side of the dialog.

Magnet	Change (feet)	Total Settlement - Change	Value for DMM
5	0.23	0.23 - 0.23	0
4	0.17	0.23- 0.17	.06
3	0.11	0.23 - 0.11	0.12
2	0.06	0.23 - 0.06	0.17
1	0.02	0.23 - 0.02	0.21

4. When you are done, click the Continue button. DMM generates a new survey, with the same date, but time changed to 23:59:59.

Appendix 7: Updating MDB Databases

Introduction

DigiPro for Windows version 1.26 and earlier had an automatic database conversion utility that copied data from a DOS "hdr" database into a Windows "mdb" database. The conversion was not perfect, so if you open these files with DMM for Windows, DMM will ask you to update the database.

To Update a MDB Database

1. Start DMM for Windows.
2. Navigate to your existing MDB database. They have the same name and are in the same location as your hdr databases, the ones created by the DOS version of DMM.
3. Open the mdb database.
4. Choose File-Save As and enter a new name for the database. After a short delay, DMM displays the new, updated database in its own window. From now on, you should use this new database. You may want to delete the old mdb database.

   Note: When you use the save-as command, DMM automatically assigns a file name using the words "copy of....." It also uses the default folder (Program Files\DMMWin\Project\). You will probably want to specify a different name. You may want to specify a different folder as well. If you save the program into the same folder, you must use a different name. DMM will not overwrite the existing database.
5. Check each installation record. If you use an English-unit system, check that you have English units and an instrument constant of 20,000 entered into the installation record.

   If you have metric-unit database, you must correct any decimal entry: shallowest depth, deepest depth, reading interval. You must also check that you have chosen metric units and have entered an instrument constant of 25,000.

   Note that these corrections affect only the installation information. Data is not affected and requires no corrections.

Appendix 8: Converting DOS DMM Databases

Introduction

- DMM for Windows uses an ".mdb" database. It replaces the old ".hdr" database used by the DOS version of DMM.
- If you use DigiPro for Windows, you already have an ".mdb" database, but you must update it with DMM. See the previous page.
- To convert "hdr" databases directly to mdb databases without going through DigiPro, use the utility program called HDR2MDB.EXE.

Using the Hdr2Mdb Utility

This program is installed in your DMM for Windows folder. It is used to convert DMM DOS databases to the DMM Windows format.

1. Start the Hdr2Mdb program.
2. Open an hdr database.
3. Specify a name and location for the mdb database, and click OK. After a short delay, the program announces a successful conversion.

   The program will prompt you if it cannot determine the serial number of your probe or whether it is a metric-unit or English-unit probe.

Work-Around for Double-Byte Windows

The Hdr2Mdb program does not work properly with double-byte Windows systems, such as Chinese, Japanese, and Korean Windows. We are sorry for this inconvenience. Here are two work-arounds:

- Install HDR2MDB on a computer that is running a US version of Windows. Do the conversion, then copy the new mdb database to your double-byte version of Windows.
- Use DMM DOS to export your surveys in RPP format, then import the surveys with DMM for Windows.

Appendix 9: Windows vs DOS DMM

Introduction

If you used the DOS version of DMM, you'll want to know what is different in the Windows version:

System Requirements

- DMM for Windows requires Windows 95/98/ME/NT4/2000.
- DMM for Windows does not run on DOS or Windows 3.1.

Project Database

- DMM for Windows uses an ".mdb" database. It replaces the old ".hdr" database used by the DOS version of DMM.
- You can convert your DOS hdr files to mdb files using DigiPro for Windows or the utility program called HDR2MDB.EXE.

DataMate Setup

- DMM for Windows creates a "setup database" to load installations (and surveys) into the DataMate. (There is no equivalent to the setup database in DMM for DOS.)
- The setup database lets you create an installation list from separate databases and is also used to manage the DataMate's memory.

Retrieving Data

- Datasets are called "surveys" in DMM for Windows.
- DMM lets you retrieve all surveys or new surveys. (In DMM DOS, you tagged each survey and then retrieved them).
- DMM holds retrieved surveys in a temporary database. You then drag and drop surveys into one or more project databases. (In DMM DOS, you retrieved surveys directly into the project database)

Managing DataMate Memory

- DMM provides two ways to clear the DataMate's memory. You can send a setup to the DataMate or you can use the erase memory command provided in DMM.
- To delete individual surveys, you must use the DataMate itself.

Managing the Database

- You can move misplaced datasets.
- You can shift columns of readings.
- You can easily copy installations and datasets between databases.
- You can easily create a database of new readings for emailing.

APPENDIX C-5
DIGIPRO FOR WINDOWS MANUAL

DigiPro
for Windows

This equipment should be installed, maintained, and operated by technically qualified personnel. Any errors or omissions in data, or the interpretation of data, are not the responsibility of Slope Indicator Company. The information herein is subject to change without notification.

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Contents

Introduction

Read This

- Even if you hate manuals, it is important that you read this introduction and the Quick Tour pages.
- If you have DigiPro version 1.26 or earlier on your computer, we suggest that you remove it before installing later versions. This will not affect your data files or your unlocking key.
- If you are working on an NTFS system (Windows NT 4, 2000, XP, or later), you may find that administrator rights are required to install DigiPro. See your IT person for help.

What is DigiPro?

DigiPro software is used to process and plot inclinometer data. It creates high-resolution graphs and provides advanced routines for identifying and correcting systematic errors.

DigiPro works with the project databases created by DMM for Windows. If your inclinometer readings are not in this format, see Appendix A.

DigiPro is not free software. It must be purchased. However, when you first install DigiPro, purchased or not, it will run 45 times, so you can get some work done without worrying about licensing. Read “About Unlocking Keys” on the next page.

Installing DigiPro from a Resource CD

1. Remove any earlier version of DigiPro first. Doing this will not affect your data or your unlocking key.
2. Insert the Resource CD in your CD-ROM drive. The CD will start automatically on some computers. On other computers, you have to open and close the CD-ROM drive a second time to make Autostart work.
3. The browser window appears: click on Software.
4. The software page appears: click on DigiPro for Windows.
5. The DigiPro page appears: click on “Download DigiPro.”
6. The File-Download dialog appears: choose "Run this program from its current location" and click OK. You may see an security warning. Click Yes to continue the install.
7. Follow on-screen instructions. You may be asked to restart your computer more than once.

Installing DigiPro from a Setup File.

If you downloaded DigiPro from www.slopeindicator.com, you have a setup file named “setupdpwin.exe” on your hard disk.

1. Remove any earlier version of DigiPro first. Doing this will not affect your data or your unlocking key.
2. Click the Start button and choose Run.
3. The Run dialog appears: click the Browse button to navigate to the setup file that you downloaded.
4. Select the setup file (setupdpwin.exe) and click Open.
5. Click OK when the Run dialog reappears.
6. Follow on-screen instructions. You may be asked to restart your computer more than once.

About Unlocking Keys

After DigiPro is installed, it will run 45 times. After that, it will stop running. To remove the run-limitation, you must purchase DigiPro and request an unlocking key (a coded number). If you have already purchased DigiPro, we have your company and city in our database, but you must contact us for the key. Follow the steps below:

To obtain a key

1. Find your DigiPro serial number. Start DigiPro. When the start screen appears, click on the "License" button. A dialog appears with the serial number.
2. Use one of the methods below to contact us. We need your serial number, name, company, and city.

- Visit www.slopeindicator.com. Click on “Support,” then click on “Get a DigiPro Key” and fill out the form.
- Call Slope Indicator or your local distributor.
- Fax Slope Indicator or your local distributor.

3. We will generate a key to match your serial number and give it to you.

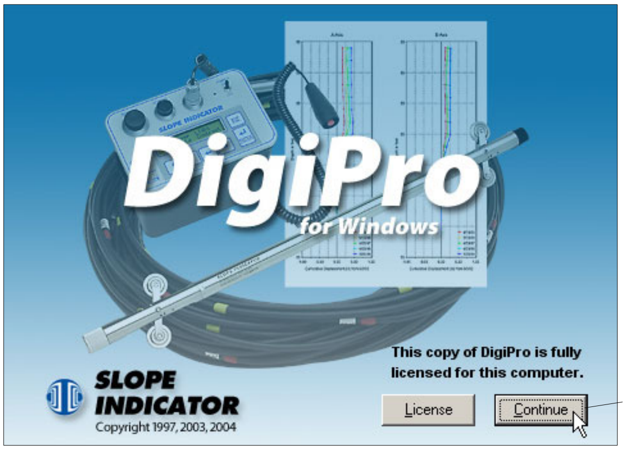
To enter the key

1. Start DigiPro. The start screen appears. Click on License.
2. Check that your serial number is the one that you sent us, then click on Modify.
3. Enter your the unlocking key, and click OK.
4. You should see the message: “This copy of DigiPro is fully licensed for this computer.”

Quick Tour

Start DigiPro

Click on the DigiPro shortcut, or go to:
Start > Programs > DigiPro > DigiPro.exe. Click Continue.

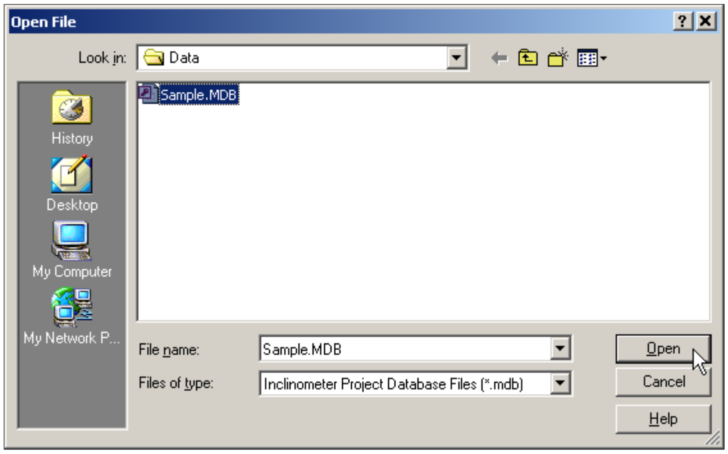


This copy of DigiPro is fully licensed for this computer.

Click on the Continue button.

Open a Database

DigiPro displays the Open File dialog. Choose "Sample.MDB." If you don't see it, navigate to C:\Program Files\DigiPro\Data.



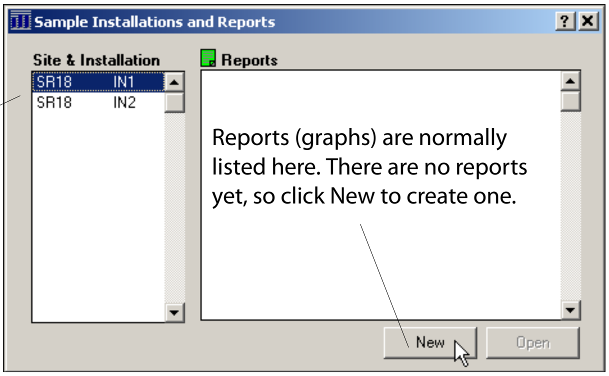
Look in: Data

File name: Sample.MDB

Files of type: Inclinometer Project Database Files (*.mdb)

Choose an Installation and Create a Report

DigiPro displays a list of the installations in the database. Select the top one, SR18 IN1, and click New to create a report.

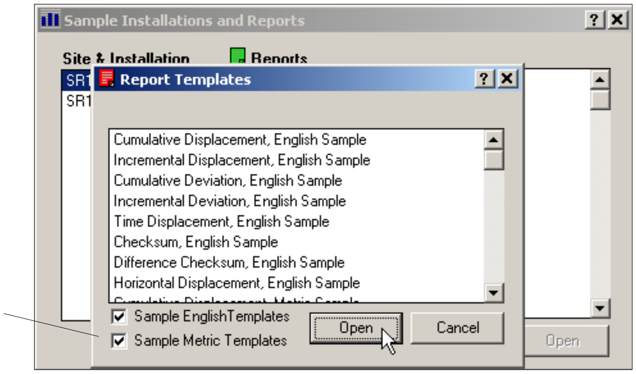


Installation List

Reports (graphs) are normally listed here. There are no reports yet, so click New to create one.

Choose a Report Template

DigiPro displays a list of report templates. Each template offers a different type of graph. Choose “Cumulative Displacement, English Sample.” Click Open.



Sample Installations and Reports

Report Templates

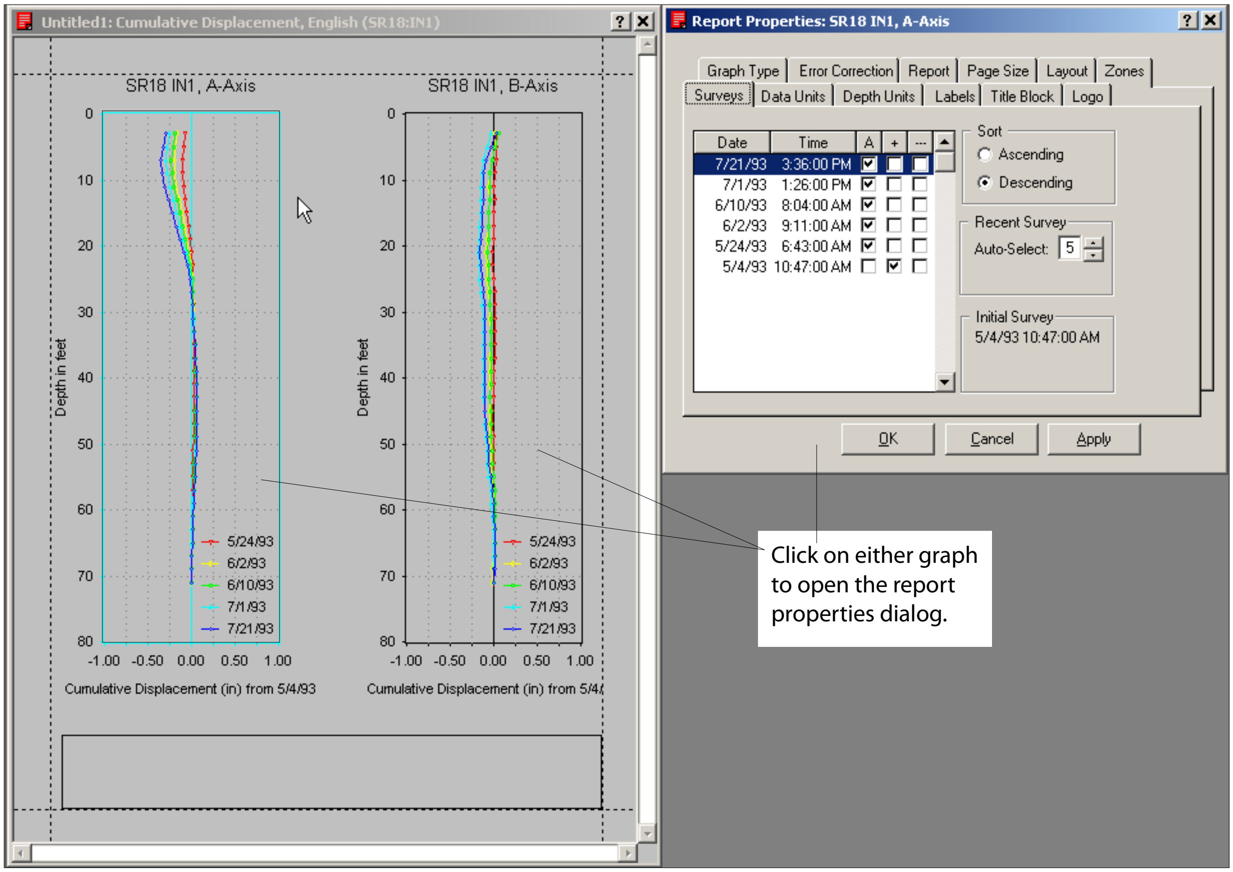
Cumulative Displacement, English Sample
Incremental Displacement, English Sample
Cumulative Deviation, English Sample
Incremental Deviation, English Sample
Time Displacement, English Sample
Checksum, English Sample
Difference Checksum, English Sample
Horizontal Displacement, English Sample

☑ Sample EnglishTemplates
☑ Sample Metric Templates

If you use metric data, you can hide the english-unit templates, and vice versa. You can also make your own templates.

View and Modify the Report

The report appears with two graphs. Click on either graph to open the report properties dialog. Using the report properties dialog, you can select different surveys, modify scales and labels, add text to the title block, and make other changes.



Untitled1: Cumulative Displacement, English (SR18:IN1)

Report Properties: SR18 IN1, A-Axis

Date	Time	A	+	---
7/21/93	3:36:00 PM	☑	☐	☐
7/1/93	1:26:00 PM	☑	☐	☐
6/10/93	8:04:00 AM	☑	☐	☐
6/2/93	9:11:00 AM	☑	☐	☐
5/24/93	6:43:00 AM	☑	☐	☐
5/4/93	10:47:00 AM	☐	☑	☐

Sort
○ Ascending
● Descending

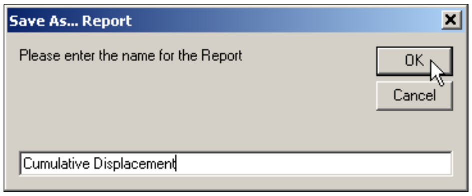
Recent Survey
Auto-Select: 5

Initial Survey
5/4/93 10:47:00 AM

Click on either graph to open the report properties dialog.

Save the Report

Click the disk icon or choose File > Save As >Report. Enter a name, and click OK. DigiPro stores the graph type and all the settings for the graphs.

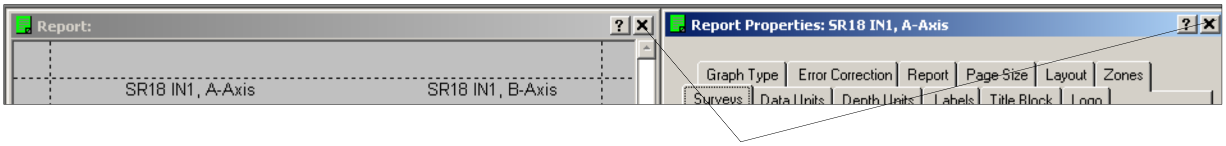


Please enter the name for the Report

Cumulative Displacement

Close the Report

Click the X in the upper right corner of the graph. Close the report properties dialog too.

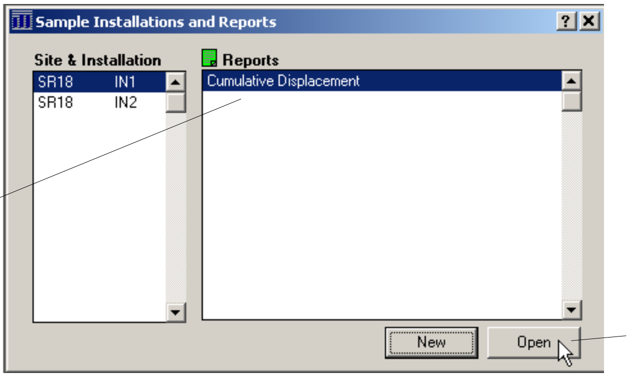


To close the dialog or graph, click the X box.

Open the Report to Recreate the Graphs

Select the report and click Open. DigiPro recreates your graphs. In addition, DigiPro automatically includes any new surveys that were added to the database, so the graphs are updated too.

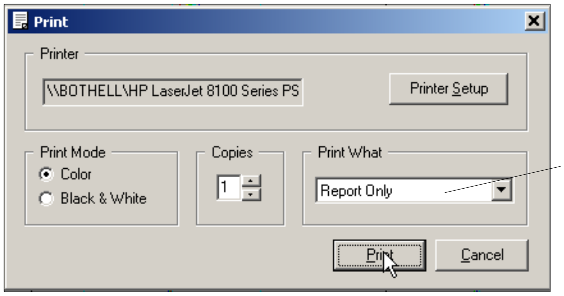
Reports are listed in the reports window. To recreate a graph, select a report and click Open.



Click Open to open a report.

Print the Report

When the graph appears on screen, click on the printer icon, or choose Print from the File menu.



Printer: \\BOTHELL\HP LaserJet 8100 Series PS

Print Mode: ● Color ○ Black & White

Copies: 1

Print What: Report Only

This prints just the graph. You can also print a listing of the current survey.

Creating Reports

Overview of Reports

- It’s easy to make reports: simply open a report template and save the resulting graph.
- Reports save time. You can reproduce or update a graph with just two mouse clicks.
- Reports can be customized. For example, you can specify two different types of graph for the report.
- You can create as many reports as you need.
- You can save the report as a template.

Creating a Report

These basic steps are explained in detail on the following pages.

1. Open a database.
2. Select an installation.
3. Choose a report template.
4. Save the report.

Open a Database

1. Start DigiPro, and click the Continue button.
2. The Open File dialog appears. DigiPro displays the most recently opened folder.
3. Select your database, and click Open.

How to find your database

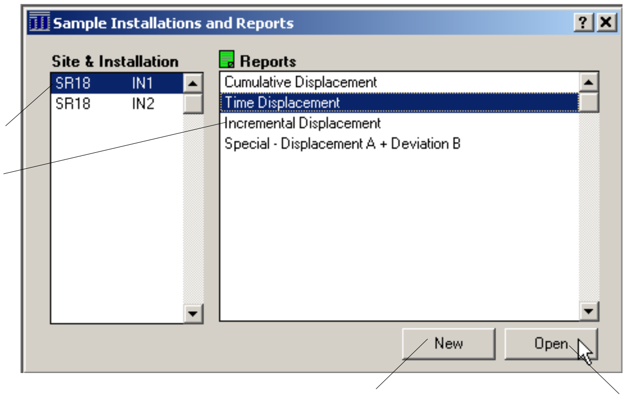
- If you can't see your database, click in the "Look-in" field to navigate to a different folder or drive.
- The default location used by DMM for Windows is: C:\Program Files\ DMMWin\Projects.
- DigiPro keeps a list of the last five databases that you opened. To see this list, click on the File menu (Close the Open File dialog first). The databases are listed at the bottom of the menu.

How to create a database

If you don't have a database, you must create one with DMM for Windows. DMM can also convert and import data. DMM is a free download from www.slopeindicator.com. See Appendix A for more information.

Select an Installation

After you open a project database, DigiPro displays the "Installations and Reports" dialog. The left side of this dialog shows a list of installations. Click on the installation of interest.



Selected installation

List of reports for this installation

New creates a new report.

Open displays an existing report.

New vs Open

After you select an installation, you can choose to create a new report or open an existing report.

- To create a new report, click New.
- To open an existing report, select it and click Open.

Choose a Report Template

If you clicked New in the previous step, DigiPro displays a list of report templates. Each template offers a different type of graph. Graph types are explained on the following page.

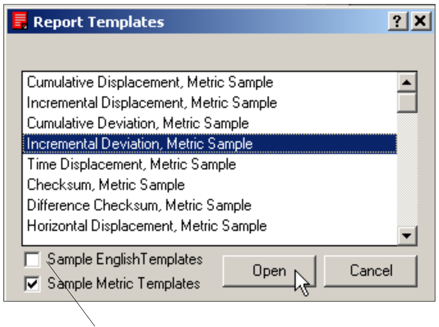
English-Units or Metric-Units?

1. Select a template. Note that there are English-unit templates and metric-unit templates.

   It is important to choose correctly because this controls how readings are processed.

- Choose English if you use an English-unit probe.
- Choose metric if you use a metric-unit probe.

2. Click Open.



Cumulative Displacement, Metric Sample
Incremental Displacement, Metric Sample
Cumulative Deviation, Metric Sample
Incremental Deviation, Metric Sample
Time Displacement, Metric Sample
Checksum, Metric Sample
Difference Checksum, Metric Sample
Horizontal Displacement, Metric Sample

☐ Sample EnglishTemplates
☑ Sample Metric Templates

If your data is metric, you don't need English unit templates. Remove the checkmark to hide them.

Note: DigiPro allows you to change the displayed units later, if necessary, but at this point, you must choose according to your probe units.

Creating Templates

You may find it convenient to make your own templates. For example, you may want templates that have:

- A title block with your company's name and logo.
- Standard depths.
- Different types of graph in the same report.

To Create a Custom Template

1. Open a report. Modify it as needed.
2. Choose File > Save As > Template.
3. The new template will appear in the Report Templates dialog.

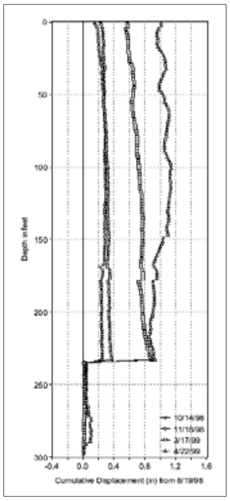
Note: DigiPro's templates are stored in the "templates.mdb" file in the DigiPro\System folder. You can copy this file to other computers.

Graphs for Analyzing Movement

These graphs are the standard graphs used to analyze the behavior of the ground.

Cumulative Displacement

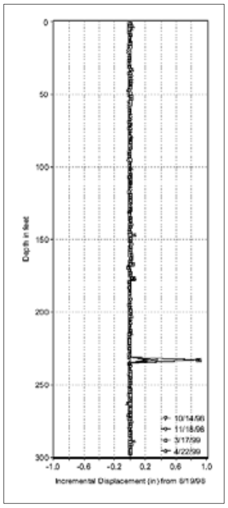
Displacements are changes in the position of the casing and are assumed to be equivalent to ground movement. A displacement graph requires at least two surveys: an initial survey and a current survey. The initial survey does not appear on the graph.



In a cumulative displacement graph, the plotted point at any depth is the sum of incremental displacements from the reference point (typically the bottom). The graph shows how subsurface movement relates to movement at the surface. Shear movements are easily seen.

Incremental Displacement

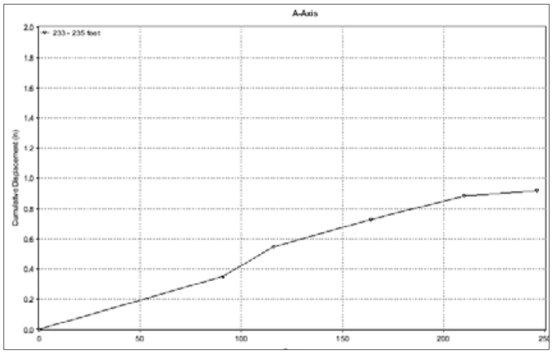
This graph shows displacements at discrete depths. A growing “spike” indicates movement. The graph at right uses the same data as the cumulative displacement plot above.



No summing is involved, so systematic error is minimized.

Time Displacement:

This graph shows the rate of movement at one or more zones. A steepening slope represents accelerating movements.



The plotted value for each zone is the difference between the displacement value at the top of the zone and the displacement value at the bottom of the zone. Zones are set in the “zone” tab of the report properties dialog.

Graphs for Diagnosing Systematic Error

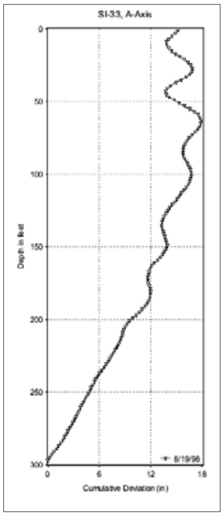
These graphs are generally used for troubleshooting or verifying that graphs represent movements accurately.

Cumulative Deviation

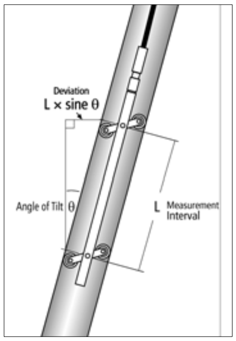
This graph shows the profile of the casing relative to vertical. Drillers can use this graph to see borehole drift.

The plotted point at any depth is the sum of incremental deviations up to and including that depth. (Deviations are defined below).

In error analysis, this graph is used to show the potential for systematic error due to cross-axis tilt and a rotation of the sensitive axis of the inclinometer probe.

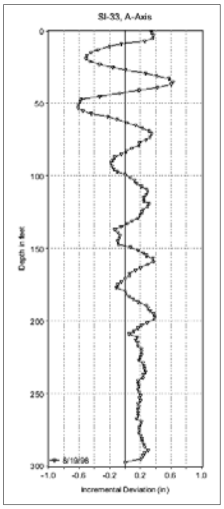


Incremental Deviation



This graph shows the deviation at each depth. This represents the curvature of the casing. The drawing at left shows deviation. The angle of tilt is measured by the inclinometer, the hypotenuse is the measurement interval (typically the distance between the wheels) and the side opposite the angle is the deviation.

In error analysis, this graph is used to show the potential for systematic error due to casing curvature and settlements or inaccurate depth control.

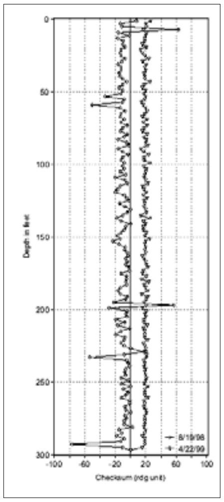


Checksum and Difference Checksum

Checksums are the sum of the "0" and "180" readings at each depth.

In error analysis, this graph provides an indication of the potential for systematic error due to bias shift. A tilted plot may indicate problems with the electronics of the sensor.

The difference-checksum graph shows changes in checksum, and removes variations that are due solely to characteristics of the installed casing.



Save the Report

After you have selected a template and clicked Open, DigiPro displays the new report.

1. Choose File>Save from the menu or click the disk icon.
2. The Save As dialog appears. Enter a name for the report and click OK.

Naming a Report

- A simple name, such as “Cumulative Displacement” is sufficient, since it indicates the kind of graph that the report will produce.
- There is no need to make unique names for reports. Each installation has its own list of reports. For example, you can have a report named “cumulative displacement” for each of your installations. In fact, this is recommended.
- To rename a report, right-click on the report name and choose “Rename” from the pop-up menu.

Modifying Reports

Overview

The basic steps required to modify a report are:

1. Open the report.
2. Open the Report Properties dialog.
3. Modify the properties for each graph.
4. The settings that you have changed are saved with the report and are automatically retrieved the next time you open the report.

Open a Report

1. Start DigiPro.
2. Open a project database.
3. Choose an installation.
4. Click on the report that you want to modify.
5. Click on the Open button.

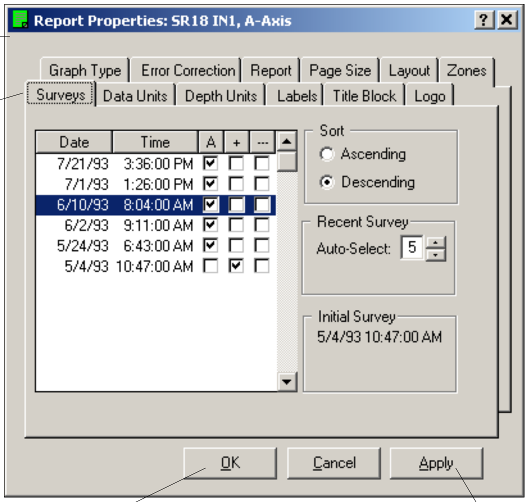
Open the Report Properties Dialog

1. Click on either graph. The report properties dialog appears.
2. The title bar shows which graph is active. To make the other graph active, just click on it.

The title bar shows which graph is active and can be modified.

Report properties are organized by tabs. Click on a tab to display its properties.

When you change a property, click Apply to see the effect.



Report Properties: SR18 IN1, A-Axis

Date	Time	A	+	---
7/21/93	3:36:00 PM	☑	☐	☐
7/1/93	1:26:00 PM	☑	☐	☐
6/10/93	8:04:00 AM	☑	☐	☐
6/2/93	9:11:00 AM	☑	☐	☐
5/24/93	6:43:00 AM	☑	☐	☐
5/4/93	10:47:00 AM	☐	☑	☐

Sort
○ Ascending
● Descending

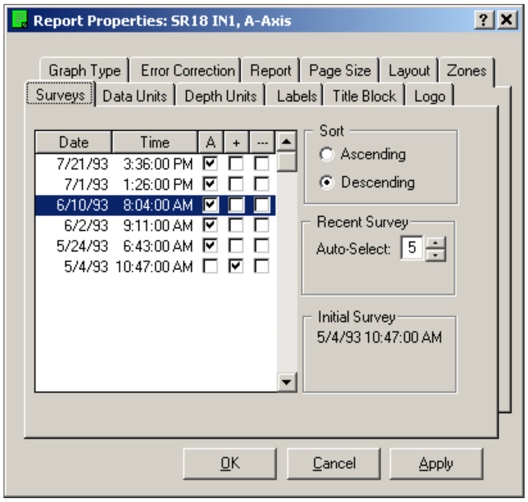
Recent Survey
Auto-Select: 5

Initial Survey
5/4/93 10:47:00 AM

Click OK to close the dialog. OK applies any remaining changes.

Click Apply to see the effect of your changes. The dialog stays open so that you can make more changes.

Surveys



Date	Time	A	+	–
7/21/93	3:36:00 PM	☑	☐	☐
7/1/93	1:26:00 PM	☑	☐	☐
6/10/93	8:04:00 AM	☑	☐	☐
6/2/93	9:11:00 AM	☑	☐	☐
5/24/93	6:43:00 AM	☑	☐	☐
5/4/93	10:47:00 AM	☐	☑	☐

Sort
○ Ascending
● Descending

Recent Survey
Auto-Select: 5

Initial Survey
5/4/93 10:47:00 AM

What is a Survey?

A survey is the data from one inclinometer survey. Each survey is identified by date and time.

Survey Selection

DigiPro graphs only surveys that have been selected. Check boxes for each survey indicate its selection status.

- A check mark in the A column indicates that the survey is auto-selected. New surveys are auto-selected so that DigiPro can update graphs automatically. The Recent Surveys field controls the number of auto-selected surveys.
- A check mark in the + column indicates that the survey is selected permanently. It will be used every time you run a report. Click the box to check or uncheck.
- A check mark in the – column indicates that the survey is excluded permanently. Click the box to check or uncheck.
- Surveys with no checkmark are not selected. When you have many surveys, most of them will have this status.

Sort

Sorts the order of the surveys in the Selection window.

- Ascending displays oldest survey first.
- Descending displays newest survey first.

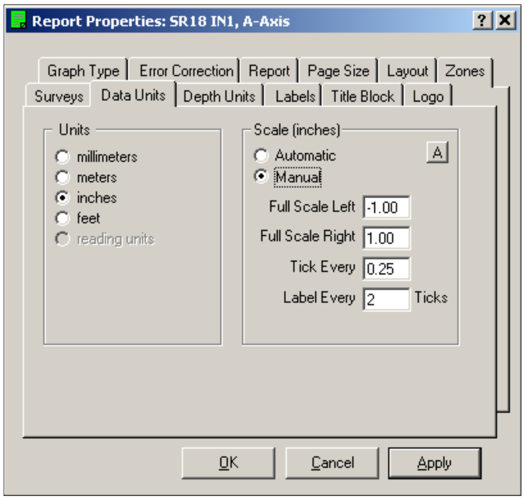
Recent Survey Auto-Select

Specifies the number of new surveys to be automatically selected for the report. To change the number, click the up and down arrows next to the number. Then click apply.

Initial Survey

Shows which survey is used as the initial. DigiPro automatically selects the oldest survey as the initial and puts a check mark in the + column. To choose a different initial survey, scroll the window until you can see it. Then right click on the + box and choose “Mark as Initial Survey” from the pop-up menu. Note that earlier surveys are ignored.

Data Units



Report Properties: SR18 IN1, A-Axis

Units
○ millimeters
○ meters
● inches
○ feet
○ reading units

Scale (inches)
○ Automatic
● Manual
Full Scale Left -1.00
Full Scale Right 1.00
Tick Every 0.25
Label Every 2 Ticks

Unit Conversion

The Unit conversion setting is provided for US users who need metric-unit reports from their English-unit inclinometer systems. These users should use the standard English-unit templates and make the conversion here by clicking the radio button for mm.

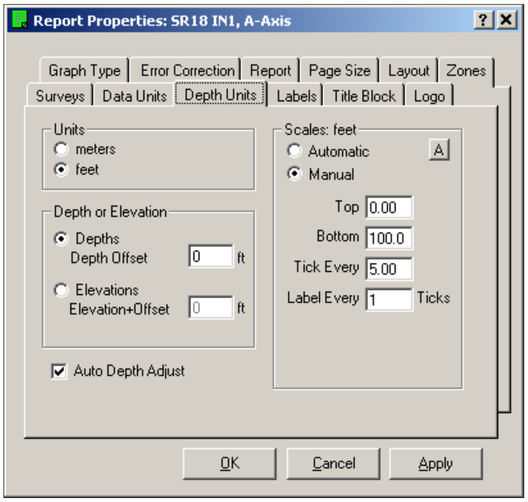
Other users will probably not need this setting because templates provide appropriate units automatically. Be sure to choose metric templates for metric inclinometer systems and English templates for English-unit inclinometer systems.

Troubleshooting Note: If you have used the correct templates but your units and values appear strange, don't try to correct the problem with the units conversion setting. Instead, go back to the Installation and Reports dialog, right-click on the installation, and choose "properties" from the pop up menu. Check that Units is properly set to English or Metric (the same units as your inclinometer system).

Scales

- Automatic: Sets full scale left and right to accommodate the maximum values found in the surveys.
- Manual: Allows manual control over the settings. Click on the Manual button to show the fields below:
- Full Scale Left: Enter a value to be used for full scale left.
- Full Scale Right: Enter the value to be used for full scale right.
- Tick every: Ticks are graduations on the data scale. For example, if you want a graduation every 10 mm, enter 10.
- Label every nth tick: DigiPro will label every nth tick. For example, enter a 2 to label every second tick. For example, if ticks are 10 mm apart, labels will appear every 20 mm.

Depth Units



Units
○ meters
● feet

Depth or Elevation
● Depths
Depth Offset 0 ft
○ Elevations
Elevation+Offset 0 ft

☑ Auto Depth Adjust

Scales: feet
○ Automatic
● Manual
Top 0.00
Bottom 100.0
Tick Every 5.00
Label Every 1 Ticks

Unit Conversion

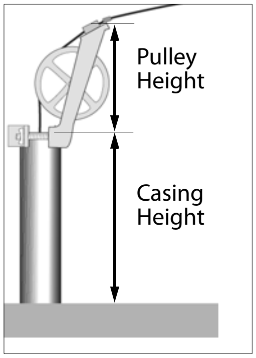
The Unit conversion setting is provided for US users who need metric-unit reports from their English-unit inclinometer systems. These users should use the standard English-unit templates and make the conversion here by clicking the radio button for m.

Other users will probably not need this setting because templates provide appropriate units automatically. Be sure to choose metric templates for metric inclinometer systems and English templates for English-unit inclinometer systems.

Depth or Elevation

You can show depth-axis labels as depths or elevations. Click the appropriate radio button. If you choose elevations, you must also enter the elevation at the top of the casing. See depth offset and elevation offset below.

Depth Offset



During a survey, depths are read from the control cable, which is referenced to the top of the casing or (preferably) to the top of the pulley assembly. If you want the depth-axis labels referenced to ground level, enter an offset:

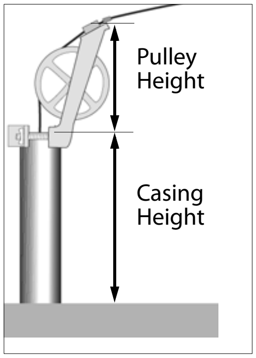
Depth Offset = casing height + pulley height

Casing height is the height of the casing above ground level. Pulley height is 1 foot or 0.3 meters.

Metric Example: The top of the casing is 0.5 meters above ground level. The pulley assembly adds 0.3 meters. Enter 0.8 meters for the depth offset. Now the depth-axis label scale will be referenced to ground level.

English Example: The top of the casing is 14 inches (1.17 ft.) above ground level. The pulley assembly adds 1 foot. Enter 2.17 feet for the depth offset.

Elevation + Offset



If you want the depth-axis label referenced to elevations, first click the radio button for elevations, then enter an offset:

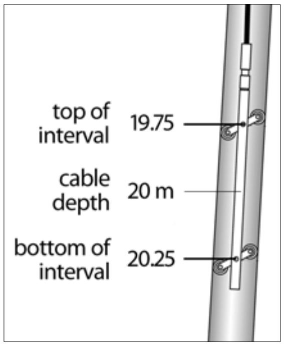
Elevation Offset = ground elevation + casing height + pulley height

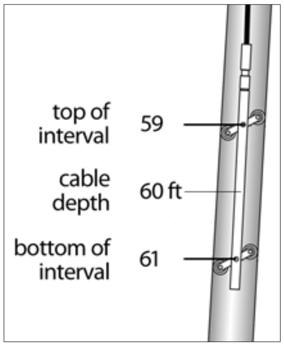
Casing height is the height of the casing above ground level. The pulley assembly adds 0.3 meters (1 foot).

Metric Example: Ground elevation is 200 meters above sea level. The top of the casing is 0.4 meters above ground level. The pulley assembly adds 0.3 meters. Enter 200.7 meters for the elevation offset. Labels will be referenced to ground elevation.

English Example: Ground elevation is 1200 feet above sea level. The top of the casing is 1.5 feet above ground level. The pulley assembly adds 1 foot. Enter 1202.5 feet for the elevation offset.

Auto Depth Adjustment





With auto-depth adjustment turned on, DigiPro correctly plot data points at the top (or bottom) of the measurement interval. Auto-depth is turned on by default.

Why is an adjustment provided? Depth marks on Digitilt control cable are measured from the middle of the inclinometer probe, but deviations and displacements are calculated for the top (or bottom) of an interval.

Metric example: The depth stored with the inclinometer reading is the cable depth of 20 meters, but the top of the interval is actually at 19.75 meters. With auto-depth adjust turned on, the plotted point will be placed correctly on the graph at 19.75 meters, not at the cable depth of 20 meters.

English example: The depth stored with the inclinometer reading is the cable depth of 60 feet, but the top of the interval is actually at 59 feet. With auto-depth adjust turned on, the plotted point will be placed on the graph at 59 feet, not at the cable depth of 60 feet.

On the graph, these adjustments are visually quite small, but if you print out the data, you will see the adjusted depths.

Scales

DigiPro sets the depth axis scales automatically, or lets you specify values for the top and bottom of the depth-axis scale.

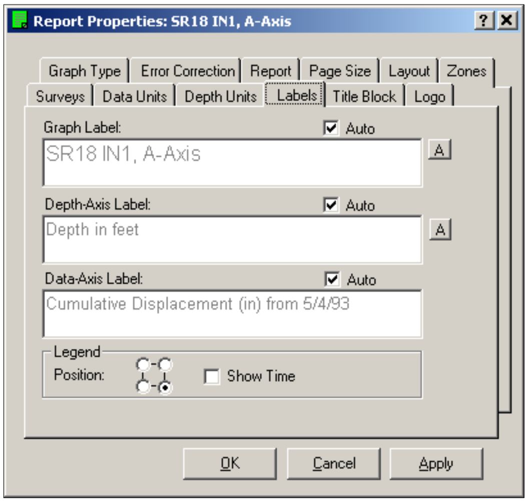
Automatic: Automatically displays the entire depth-axis and applies labels and ticks at multiples of 10.

Manual: Allows manual control of scales. Click on the Manual button and enter the desired values in each field. If your report shows elevations rather than depths, be sure to enter elevations for top and bottom. Click Apply when finished.

- Top: Enter a value for the top of the depth-axis scale.
- Bottom: Enter a value for the bottom of the depth-axis scale.
- Tick every: Ticks are graduations on the depth-axis scale. If you want a graduation every 5 meters, enter 5.
- Label every nth tick: DigiPro will label every nth tick. For example, enter 2 to label every second tick. For example, if ticks are 5 meters apart, labels will appear every 10 meters.

Tip: If you frequently zoom in to inspect a particular zone, you might find it useful to make a report that shows only that zone. Use manual scales to specify the top and bottom of the zone, then save the result as a new report.

Labels Tab



Graph Label: ☑ Auto
SR18 IN1, A-Axis

Depth-Axis Label: ☑ Auto
Depth in feet

Data-Axis Label: ☑ Auto
Cumulative Displacement (in) from 5/4/93

Legend
Position: ○ ○ ○ ● ☐ Show Time

Editing a Label

DigiPro creates graph labels and legends automatically. This dialog lets you change the automatic labels. If you want these labels changed for all subsequent reports, save the report as a template (See page 8).

1. Click to remove the check mark from the Auto box above the Label field. When the check is removed, you can edit the text.
2. Enter text in the Label field. The Graph Label field accepts up two lines of text. The Depth-Axis and Data-Axis fields accept one line of text. The A button lets you choose a font.
3. Click Apply to see your changes.

Note: If your Windows display is set for Large Fonts, text appears larger on-screen than it prints on paper. Print the report to see the true effect, then modify as needed.

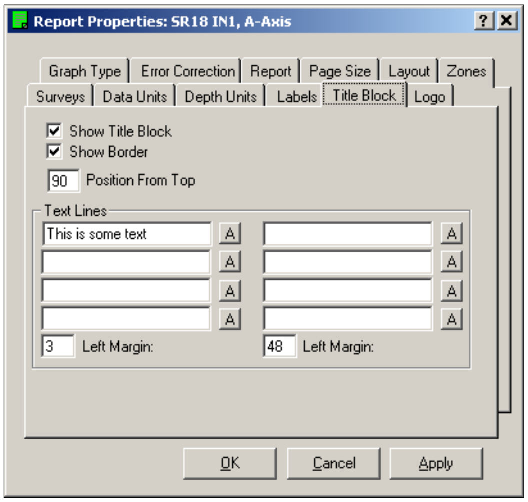
Legend Position

DigiPro can place the legend in one of the four corners of the graph. For example, if you click the upper right button in the square, the legend will appear in the upper right corner of the graph when you click Apply.

Show Time

DigiPro can append time to the date in the legend. Normally time is not required, but if you need it, click in the checkbox.

Title Block



Report Properties: SR18 IN1, A-Axis

☑ Show Title Block
☑ Show Border
90 Position From Top

Text Lines
This is some text
3 Left Margin:
48 Left Margin:

Function

The title block provides a place to enter information about the graph. You can also include a company name, address, and company logo in the title block. If you want to add a logo to the title block, use the Logo tab before setting the title block text.

Text Lines

DigiPro provides eight cells for text arranged into two columns. Click in one of the eight fields to enter text. When finished, tab to the next field. Click Apply to see the result on screen.

Note: The screen display of text is not accurate, especially if your display is set for Large Fonts. Print the report to see the true appearance of the text.

Tip: Save the report as a template so you can base future reports on the same style with very little additional work. (See page 8).

Left Margin

There are two left margin fields, one for each column of text. Enter a percentage value, estimated from the left side of the page. Then click Apply.

Show Title Block

When the box is unchecked, DigiPro shows the title block. If you hide the title block, you can enlarge your graphs using the Layout tab.

Show Border

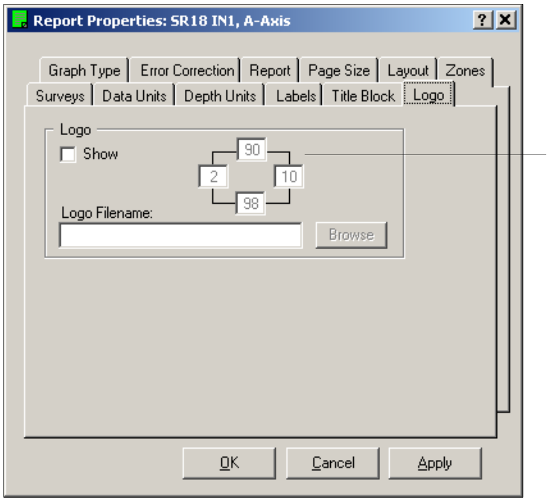
When the box is checked, DigiPro draws a line around the title block. You may find that hiding the rule provides a neater result.

Position from Top

Enter an estimated percentage value. By default, the title block appears at the bottom of the page. However, if you set the value to zero, it will print at the top of the page.

Note: If you change the position of the title block, you must move the graphs down using the Layout tab.

Logo



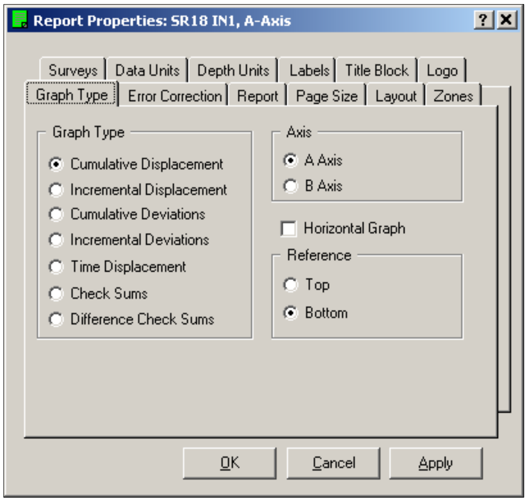
Displaying a Logo

DigiPro has a simple facility to print a bitmap (.bmp) image of your logo on the report.

1. Click (check) the Show check box.
2. Enter the path and file name of your logo. You can use the browse button to do this for you.
3. The position settings are percentages. They change the boundaries of the logo box and also the position of the logo box. You will probably need to make several adjustments to find the right setting.

Note: We recommend that you place the logo file in DigiPro's BMP folder so that it will not be accidentally lost during routine disk cleanups. The path will appear like this: C:\Program Files\DigiPro\BMP\myLogo.bmp.

Graph Type



Graph Type
- ● Cumulative Displacement
- ○ Incremental Displacement
- ○ Cumulative Deviations
- ○ Incremental Deviations
- ○ Time Displacement
- ○ Check Sums
- ○ Difference Check Sums

Axis
- ● A Axis
- ○ B Axis

☐ Horizontal Graph

Reference
- ○ Top
- ● Bottom

Overview

This useful feature lets you change the type of graphs shown in the report. For example, you could place a graph of time displacement next to a graph of cumulative displacement. You could also show two versions of the same graph, one with error correction turned on and one with error correction turned off.

Graph Type

Graph types are explained in “Creating a Report.” The radio button shows the type of graph currently displayed. To change, click a different radio button. When you click Apply, the graph is redrawn.

Axis

The sample templates use A-axis data for the left graph and B-axis data for the right graph, but you are not limited by this. You can show two A axis graphs or two B axis graphs, etc.

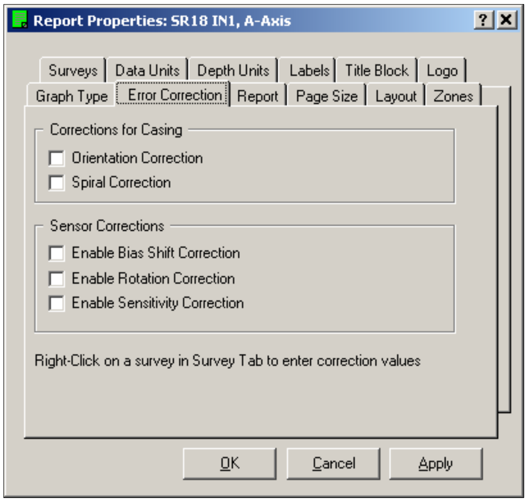
Horizontal

It is easier to use the Horizontal template to create a horizontal graph, but this checkbox is here for completeness.

Reference

Select top or bottom of the casing as the starting point for calculations of cumulative displacement and cumulative deviation. Bottom reference is the default.

Error Correction



Corrections for Casing

☐ Orientation Correction

☐ Spiral Correction

Sensor Corrections

☐ Enable Bias Shift Correction

☐ Enable Rotation Correction

☐ Enable Sensitivity Correction

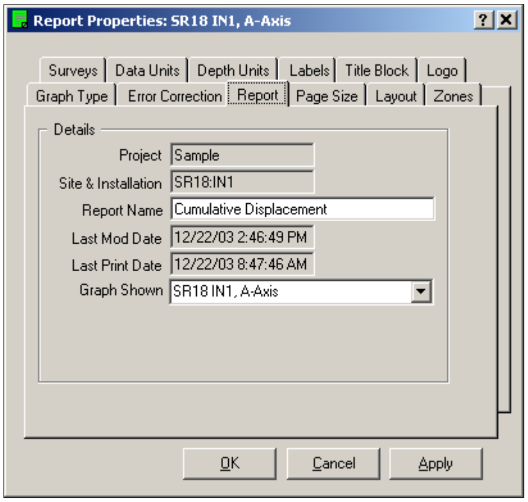
Right-Click on a survey in Survey Tab to enter correction values

Overview

This dialog lets you enable and disable correction routines. Except for the orientation correction, values used by the routines are entered elsewhere. For information on corrections, see the chapter on error correction.

- To enable a correction routine, put a check in its checkbox.
- To disable a correction routine, remove the checkmark.

Report



Details

Project: Sample

Site & Installation: SR18:IN1

Report Name: Cumulative Displacement

Last Mod Date: 12/22/03 2:46:49 PM

Last Print Date: 12/22/03 8:47:46 AM

Graph Shown: SR18 IN1, A-Axis

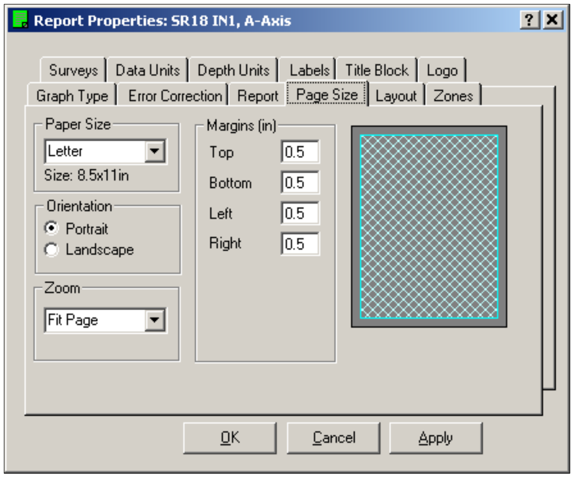
Overview

This dialog is generally not used. Only two fields can be manipulated: report name and graph shown.

Report Name: You can rename a report here. Note that you can also rename a report by right clicking on the report in the installations and reports dialog.

Graph Shown: This can be used to show a graph that was previously hidden.

Page Size



Paper Size: Letter
Size: 8.5x11in

Orientation
● Portrait
○ Landscape

Zoom: Fit Page

Margins (in)
Top: 0.5
Bottom: 0.5
Left: 0.5
Right: 0.5

Overview

Page size and orientation are generally set by report templates. Global defaults are controlled by settings in the File > Options and Defaults dialog. The settings here affect only the current report.

Paper Size

Controls paper size.

Orientation

Controls the page orientation for the report. Choices are portrait (long side is vertical) or landscape (long side is horizontal).

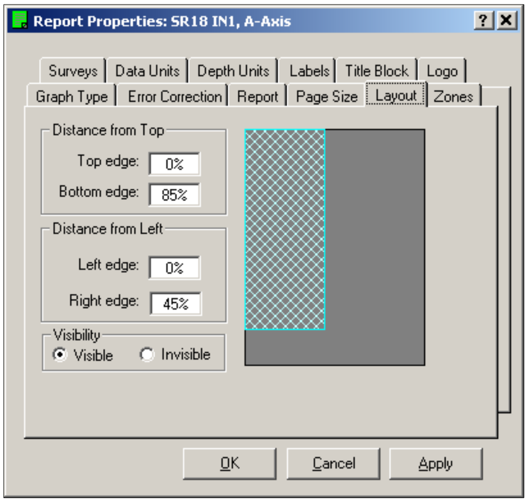
Margins

Controls the page margins for the report. The default margin values are in inches. If you select the A4 or B4 paper sizes, the margin values automatically convert to centimeters.

Zoom

Controls the screen size of the report. The default is “Fit Page,” which allows the report and report properties to be displayed on-screen simultaneously (with no overlap) on a monitor set to a resolution of 800x600 or better.

Layout



Distance from Top
Top edge: 0%
Bottom edge: 85%

Distance from Left
Left edge: 0%
Right edge: 45%

Visibility
● Visible ○ Invisible

Overview

Layout settings determine the placement and size of each graph.

Distance from Top

This controls the vertical size and placement of a graph.

1. Click on a graph. An image of the graph appears in the dialog box.
2. Enter values for the top and bottom edges of the graph in percent from top of page.

Distance from Left

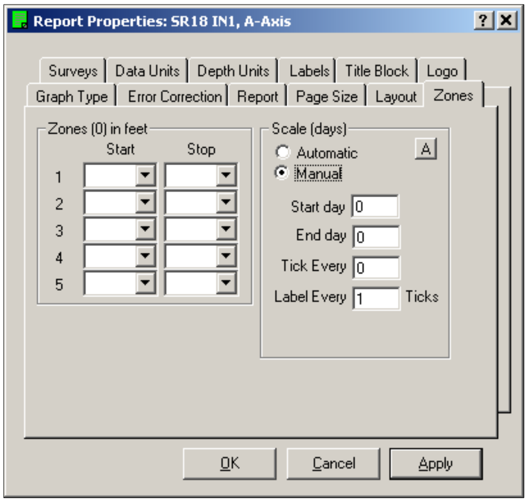
This controls the horizontal size and placement of the graph.

1. Click on a graph. An image of the graph appears in the dialog box.
2. Enter values for the left and right edges of the graph in percent from left side of page.

Visibility

This controls whether a graph is visible or not. For example, if you want only one graph on the page, you can hide the other graph and then adjust size and placement of the visible graph as needed.

Zones



Scale (days)
○ Automatic
● Manual
Start day 0
End day 0
Tick Every 0
Label Every 1 Ticks

Overview

The zone tab is used to select zones for time-displacement graphs.

Zones

You can graph up to five zones by specifying a start and stop depth for each zone. Click the drop list to choose a valid depth or elevation. The stop depth must be deeper than the start depth.

The value that DigiPro plots is the difference between cumulative displacement at the start depth and cumulative displacement value at the stop depth.

Scales

The automatic setting shows the number of days from the initial survey. The manual setting lets you choose a start and an end day to show only a portion of the available time span. You can also set the frequency of tick marks (in days) and labels (numbers). The current version of DigiPro does not allow display of dates.

Printing a Report

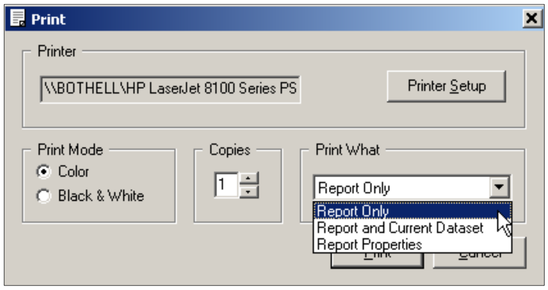
Overview

DigiPro offers the following options

- Print report only or report with current survey data.
- Print plotted data
- Write plotted data to a file

Printing a Report

1. Open a report.
2. Choose File>Print from the file menu, or click on the printer icon located on the tool bar. The Print dialog appears.



Printer: \\BOTHELL\HP LaserJet 8100 Series PS

Print Mode: ● Color ○ Black & White

Copies: 1

Print What: Report Only

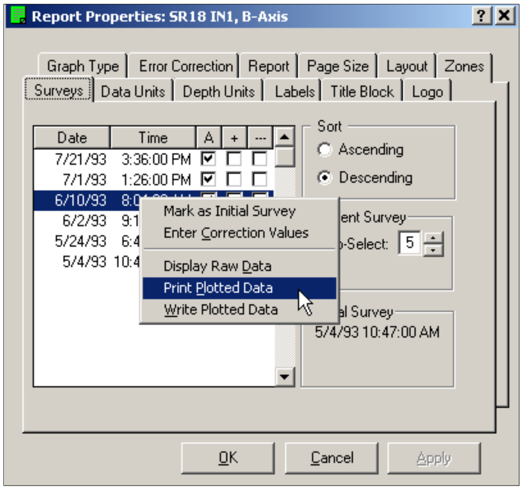
3. Click in the “Print What” field. Choose Report Only or Report with Current Survey.
4. Check the Printer window to be sure it displays the printer you want. To change printers or adjust the printer setup, click on the Printer Setup button.

   Note: If you change the printer in DigiPro’s Print dialog, the new printer becomes the Windows default printer.
5. Click in the Copies field and enter the number of copies you want.
6. Select a print mode: color or black and white. (If you are using a black and white printer but choose the color print mode, the report will print in grayscale.)
7. Click Print to print the report.

Note: You can change the colors that DigiPro uses, if some plots are hard to see. Choose File>Options and Defaults>Preferences. You will see a band of eight colors. click on the color that you want to change and choose a different color from the pop up menu.

Printing Plotted Data

Plotted data are the data points plotted on the graph. DigiPro can print a maximum of 8 columns of data.



Date	Time	A	+	---
7/21/93	3:36:00 PM	☑	☐	☐
7/1/93	1:26:00 PM	☑	☐	☐
6/10/93	8:0			
6/2/93	9:1			
5/24/93	6:4			
5/4/93	10:4			

Sort: ○ Ascending ● Descending

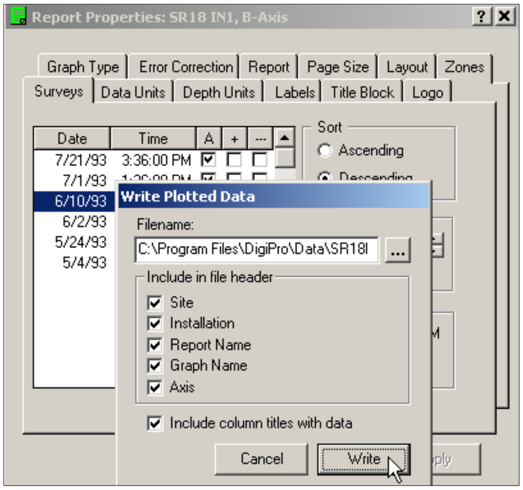
-Select: 5

5/4/93 10:47:00 AM

1. Open a report and click to open the report properties dialog.
2. Place the pointer in the Survey window and right click.
3. Choose Print Plotted Data from the pop-up menu.

Writing Plotted Data

You can write plotted data to a file for use in a spreadsheet. You can write a maximum of 8 columns of data



Filename: C:\Program Files\DigiPro\Data\SR18I

Include in file header

☑ Site
☑ Installation
☑ Report Name
☑ Graph Name
☑ Axis

☑ Include column titles with data

1. Open a report and click to open the report properties dialog
2. When the Report Properties dialog appears, click in the survey window.
3. A menu appears. Choose Write Plotted Data.
4. A submenu appears. Choose the items that you want to appear in the file header. You can also specify a filename and location if the default filename is not suitable.
5. Click Write to write the data to the file. The file is placed in the same folder as your project database. It has a .txt extension.

Error Correction

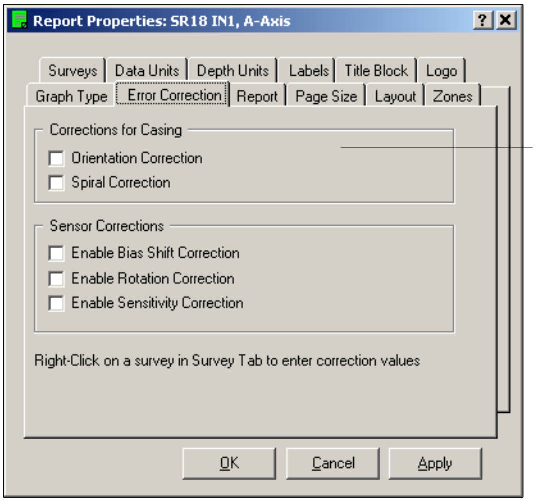
Introduction

The error correction routines that are built into DigiPro were requested by expert users. Error correction is not a simple subject, and applying corrections appropriately requires knowledge and experience.

In this chapter, we provide an brief introduction to some aspects of error correction. Those who need to know more should consider attending Slope Indicator's short course on Data Reduction and Error Correction. The course schedule is listed in the Training section at www.slopeindicator.com.

Enable or Disable Corrections

Correction values are stored separately from readings and are applied on-the-fly when the graphs are generated. Thus corrections can be enabled and disabled at any time



Report Properties: SR18 IN1, A-Axis

Corrections for Casing
☐ Orientation Correction
☐ Spiral Correction

Sensor Corrections
☐ Enable Bias Shift Correction
☐ Enable Rotation Correction
☐ Enable Sensitivity Correction

Right-Click on a survey in Survey Tab to enter correction values

Use the report properties dialog to enable or disable corrections.

- Correction routines are disabled by default.
- If you want to use correction routines, use the report properties dialog to enable them.
- Correction routines apply at the graph level. Thus a report can show one graph with corrections turned on and another graph with corrections turned off.
- Corrections values for casing are entered once for each installation and are applied to any survey selected for the graph.
- Corrections values for sensors (inclinometer probes) are entered for each survey that requires them. A special dialog is used for this.

Corrections for Casing

Corrections for casing are accessed with the report properties dialog.

Orientation Correction

If casing grooves are not oriented to the direction of movement, you can use DigiPro to mathematically rotate the orientation of the measurement axes into the direction of interest.

1. Enable the Orientation Correction. An entry field appears.
2. Enter an orientation correction in degrees. For example, enter 10 to rotate the orientation 10 degrees clockwise.
   Enter -10 to rotate orientation 10 degrees counterclockwise.

Spiral Correction

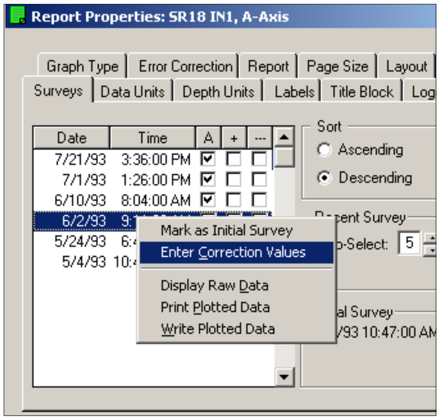
A spiral survey, obtained with a spiral sensor, provides measurements that can be used to correct for spiraled (twisted) casing. The spiral survey is processed and placed in the database by DMM for Windows. DigiPro has no entry fields for spiral data.

DigiPro automatically recognizes the spiral survey if it is present. If DigiPro cannot find a spiral survey, the checkbox is grayed out and cannot be enabled.

Corrections for Sensors

These corrections must be entered for each survey.

1. Enable the correction.
2. Click on the Surveys tab.
3. Right click on the survey that requires correction. A dialog appears.
4. Choose Enter Correction Values. The Correction Values dialog appears.
5. Enter a value in the appropriate field.
6. Click Apply to see the effect on the graph.
7. Repeat steps 5 and 6 until the correction value is correct.

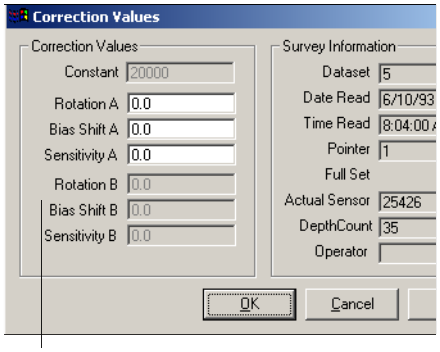


Date	Time	A	+	---
7/21/93	3:36:00 PM	☑	☐	☐
7/1/93	1:26:00 PM	☑	☐	☐
6/10/93	8:04:00 AM	☑	☐	☐
6/2/93	9:			
5/24/93	6:			
5/4/93	10:			

Sort
○ Ascending
● Descending

R cent Survey
o-Select: 5

al Survey
/93 10:47:00 AM



Correction Values
Constant 20000
Rotation A 0.0
Bias Shift A 0.0
Sensitivity A 0.0
Rotation B 0.0
Bias Shift B 0.0
Sensitivity B 0.0

Survey Information
Dataset 5
Date Read 6/10/93
Time Read 8:04:00
Pointer 1
Full Set
Actual Sensor 25426
DepthCount 35
Operator

To enter values for the B axis, you must click on the B-axis graph.

Bias-Shift Error

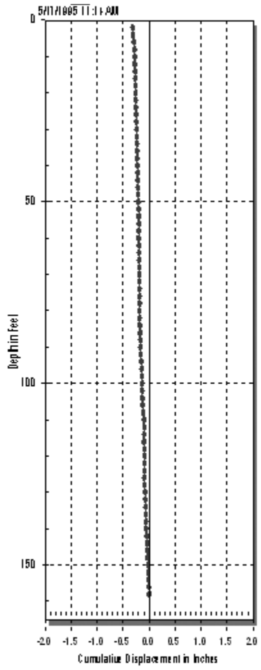
Bias shift values are entered in reading units. Here is a simple introduction to bias shift error. More information can be found in the “Training” section of www.slopeindicator.com.

What is Bias Shift

Bias: If you hold your inclinometer probe absolutely vertical and check the reading, you will typically see a non-zero value. This is the probe’s bias. The bias value is normally eliminated in the data reduction process when the 0 readings are combined with the 180 readings.

Bias-Shift Error: If the bias value changes during a survey, the data reduction process cannot eliminate all of the bias. The remaining value is error that is embedded in the reduced data.

The straight, but leaning plot at right is the result of bias-shift error.



Identifying Bias Shift Error

Appearance: A straightened, but leaning cumulative displacement plot is a signature of bias shift error. The embedded error grows larger at each interval, so the plot leans to the left or right.

Unlikely Behavior: The graph above shows rotation of the entire 150 foot span of soil or rock. This unlikely behavior suggests error in the data.

Site Knowledge: The plot shows movement where there should be no movement. Typically, the bottom 5 depths (or more) of the casing are anchored in stable ground. Any movement appearing there is generally error. In our example, we know that the casing entered rock below 80 feet, and that no movement has occurred from 80 feet downwards. This again suggests error in the data.

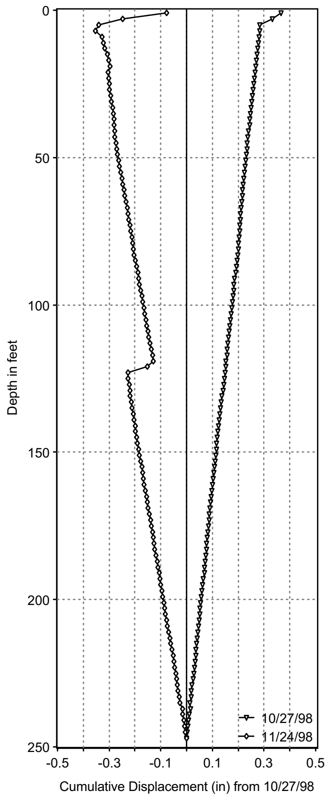
Quantifying Bias Shift Error

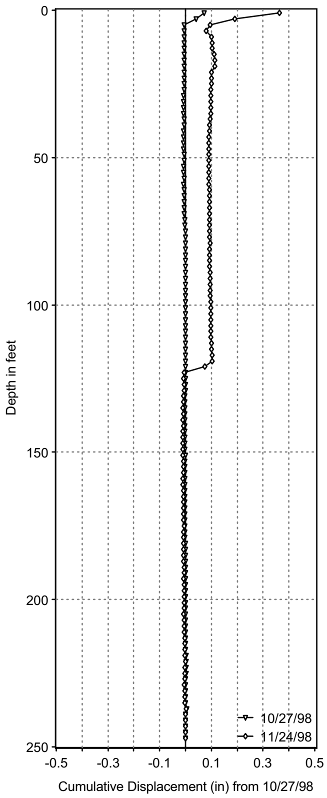
DMM for Windows has a routine for quantifying bias shift error. It suggests an value that you can enter in DigiPro’s correction routine. Refer to the DMM manual for details.

Visual Correction

You can also arrive at an correction value visually.

1. Display a cumulative displacement graph.
2. Identify displacements that are produced by bias-shift error. For example, if you know that the bottom 20 feet of the casing are installed in rock, then any displacement seen there is probably error. If the error appears as a straight line tilted away from vertical, then it is probably due to bias-shift.
3. Enable bias-shift corrections. Then right click on one of the surveys, and choose Enter Correction Values.
4. In the Corrections Value dialog, enter a value, typically less than 20. If the tilt is to the right, enter a positive value. If the tilt is to the left, enter a negative value.
5. Click Apply and observe the graph. The tilted line should be vertical when the error has been corrected. Experiment with different values until you have found the correct one.





This example shows uncorrected and corrected graphs. You can see the typical linear pattern of bias-shift error. The second survey was obtained on the same day as the initial survey, so any movement is certainly false. The second survey was taken a month later and apparent displacement is in the wrong direction. When corrected, both surveys make sense and we can see that some real movement has occurred at about 125 feet.

Rotation

Rotation corrections are entered in radians. Here is a simple introduction to “rotation” error. More information can be found in the “Training” section of www.slopeindicator.com.

What is Rotation Error?

Rotation is a small change in the alignment of the measurement axis of the inclinometer probe. The change is usually less than one degree.

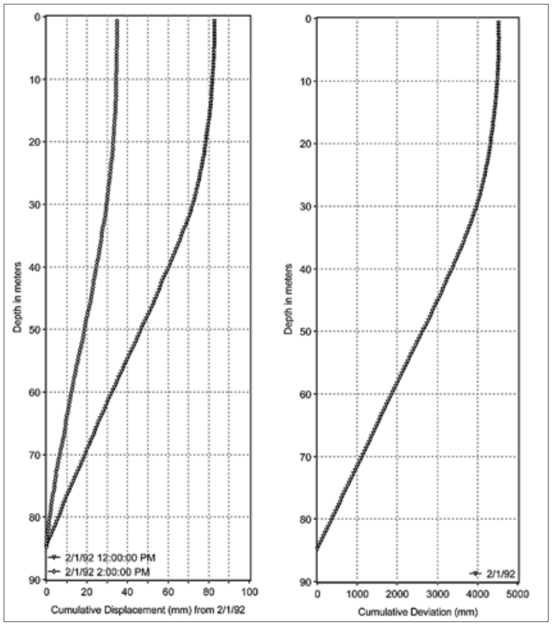
Ideally, the mechanicals of the probe are aligned so that the A-axis accelerometer measures tilt only in the A-plane. If the mechanicals of the probe are rotated slightly towards the B-plane, the A-axis accelerometer becomes slightly sensitive to tilts in the B-plane, too.

Rotation error is the cross-axis component in a reading, for example, the B-axis tilt in the A-axis reading. Rotation error becomes noticeable when two conditions combine:

- There is significant inclination in the cross axis.
- The change in the alignment of the probe occurs after the initial set was taken.

Identifying Rotation Error

- The cumulative displacement plot shows a curved line, when the line should really be straight.
- The cumulative deviation plot shows significant tilt in the cross axis.
- The two plots have a similar shape, as shown below.

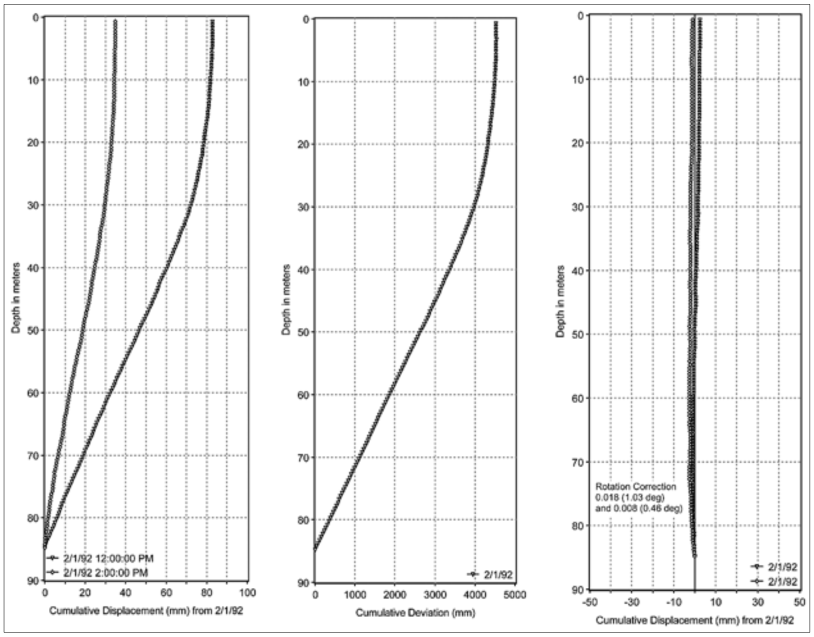


Cumulative Displacement A-Axis

Cumulative Deviation B-Axis

Correcting Rotation Error

1. Display a cumulative displacement graph. Use surveys that contain the error.
2. Identify displacements that are produced by rotation error. Find the depth of the maximum error.
3. Display a cumulative deviation plot of the cross axis. Find the deviation value at the same depth noted above.
4. Divide the displacement value by the deviation value. The result is a starting value for correcting rotation.
5. In DigiPro, enable rotation corrections and enter the rotation value.
6. Apply the correction and inspect the redrawn plot. The curve in the line should straighten..



Cumulative Displacement A-Axis

Cumulative Deviation B-Axis

Cumulative Displacement Corrected

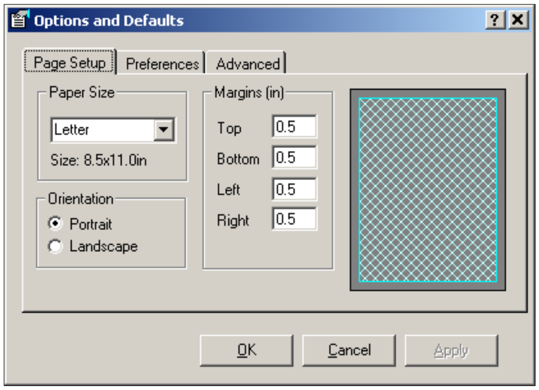
This example was a comparison test of three inclinometer probes. Readings from two probes are plotted against the third probe. All readings were taken on the same day. The casing was tilted about 4 degrees in the B-axis. The similarity between the A displacements and the B profile signals rotation error. The corrected displacement are shown at right.

Options and Defaults

Overview

Some of DigiPro's default settings can be changed by using options and defaults dialog: File > Options and Defaults.

Page Setup



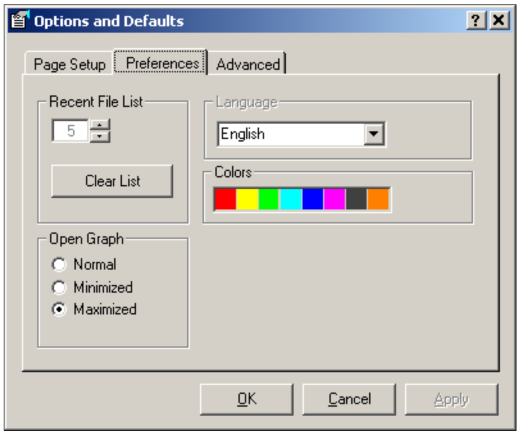
Paper Size
Letter
Size: 8.5x11.0in

Orientation
● Portrait
○ Landscape

Margins (in)
Top 0.5
Bottom 0.5
Left 0.5
Right 0.5

Paper Size	Set the default paper size for all new reports.
Orientation	Normally, you will allow report templates to take care of this.
Margins	Set page margins. Choose paper size first.

Preferences



Recent File List
5

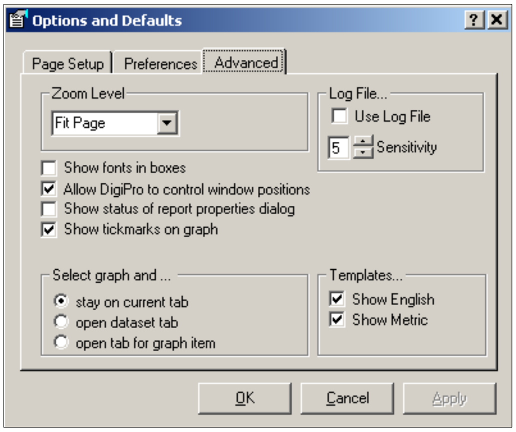
Language
English

Colors
🟥🟨🟩🟦🟦🟪⬛🟧

Open Graph
○ Normal
○ Minimized
● Maximized

Recent File List	Sets the number of recent files displayed on the File menu.
Language	Currently, the only choice is English. Sorry.
Colors	Set colors for DigiPro graphs by clicking on a color patch and choosing a different color from the pop-up pallet.
Open Graph	Sets DigiPro's window: normal is resizable, minimized is a task on the task bar, maximized is full screen.

Advanced Tab



Zoom Level
Fit Page

Log File...
☐ Use Log File
5 Sensitivity

☐ Show fonts in boxes
☑ Allow DigiPro to control window positions
☐ Show status of report properties dialog
☑ Show tickmarks on graph

Select graph and ...
● stay on current tab
○ open dataset tab
○ open tab for graph item

Templates...
☑ Show English
☑ Show Metric

Zoom Level

Sets the initial size of all displayed reports. We recommend using the default "Fit Page."

Show Fonts in Boxes

If unchecked, the text fields in the Title Block and Labels tabs will display text in DigiPro's default display font (Arial 10). If the box is checked, the text fields will display text in the font you select using the A button.

Allow DigiPro to Control Window Positions

Starts the report window in the upper left corner of the screen and the Report Properties dialog to the top edge of the screen.

If the box is not checked, the Windows system controls placement. This may be the preferred setting if you open multiple windows.

Show Status of Report Properties

If this box is checked, a grid appears at the bottom of the Report Properties dialog. The grid lists the tabs in which changes have been made. When you click Apply, the grid resets.

Show Tickmarks on Graph

When this box is checked, DigiPro displays tick marks on the borders of the graphs. When the box is unchecked, the tick marks do not appear. You can set the tick mark positions in the Data Units and Depth Units tabs of the Report Properties dialog.

Select Graph and...

Sets what happens when report properties dialog is closed and then reopened.

- Stay on Current Tab: This is the default. Report Properties displays the same tab as you switch back and forth between graphs.
- Open Survey Tab: Report Properties shows the Survey tab each time you switch between graphs.

Open Tab for Graph Item: Report Properties opens to the tab that corresponds to the part of the graph that you clicked on.

Appendix A: Project Databases

What is a Project Database?

Slope Indicator's project databases contain:

- Information about inclinometer installations, such as their ID and depth. The database can contain any number of installations.
- Surveys of the installations above. The database can contain any number of surveys.
- Reports created by DigiPro. A report is a collection of parameters that tell DigiPro how to create a graph. The database can contain any number of reports.

Use DMM to Create the Database

Project databases are created by DMM for Windows. DMM also imports or converts older data formats. DigiPro simply uses the data in the database.

If you don't have DMM for Windows, you can download it from Slope Indicator's website: www.slopeindicator.com or install it from Slope Indicator's Resource CD. DMM for Windows is free.

Use DMM to Convert or Import Data

Project databases created by DMM for Windows have a ".mdb" extension. If you have been using the Windows version of DMM, your data are already in this format, so no conversion is necessary.

Converting .hdr Databases

Project databases created by DMM for DOS consisted of a number of files. The main file had an ".hdr" extension. DMM for Windows provides a utility to quickly convert any of your old .hdr files to the .mdb Windows format. See Appendix 3 of the DMM manual: "Converting DOS DMM databases."

Importing GTilt, RPP, and PCSLIN Files

DMM for Windows can import RPP, PCSLIN, or GTilt files. It will also accept manually-entered data. See Appendix 5 and 6, "Importing Data" and "Manual Entry of Data."

If you are switching from some other inclinometer system to Slope Indicator's system, you can usually export your data in one of these formats.

Note: DMM does not import spreadsheet files.

APPENDIX D
PIEZOMETERS

APPENDIX D-1
PIEZOMETER SUMMARY AND DATA FORMS

APPENDIX D-1
Piezometer Summary

Vibrating Wire Piezometer Information

Boring ID	VW Piezometer Serial Number	Date Completed	Estimated Ground Surface Elevation (ft)[1]	Piezometer Depth Below Ground Surface (ft)	GW at time of Drilling (ft bgs)
GB-1	98943	5/29/09	145	80	-[2]
GB-2	98944	5/27/09	133	50	-[2]
GB-3	10-2580	4/30/10	129	72	-[2]
GB-4	10-2582	5/5/10	113	56	-[2]
GB-5	10-2581	5/4/10	113	30	-[2]

Notes:

[1] Elevation datum NAVD 88; estimated from ground surface elevation on base map or survey information where available.

[2] Groundwater not encountered during drilling

Open-Standpipe Piezometer Information

Boring ID	Date Completed	Estimated Ground Surface Elevation[2] (ft)	Casing Stick-up Above Ground Surface[3] (ft)	Measuring Point Elevation (ft)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	GW at time of drilling (ft bgs)
DH-7P[1]	1995	103	1.2	101.8	17	27	-
HC-2	7/18/2007	99	-0.5	98.5	92	102	63
HC-3	7/23/2007	95	-0.25	94.75	95	105	60
HC-5	7/25/2007	89	-0.25	89.75	85	95	56
HC-6	7/27/2007	84	-0.1	83.9	88	98	53
HC-7	7/30/2007	84	-0.25	83.75	86	96	53
B-1	5/7/2008	125	-0.3	124.7	15	25	9.5
B-2	5/7/2008	125	-0.3	124.7	20	30	10
B-3	5/7/2008	125	-0.3	124.7	8	18	9.5

Notes:

[1] Piezometer installed by Palmer and Gerstel (1997). Boring ID not noted in report, identified as 5 ft west of boring DH-7. No boring log was provided for piezometer boring.

[2] Elevation datum NAVD 88; estimated from ground surface elevation on base map or survey information where available.

[3] A negative casing stick-up is reported for piezometers where the top of the casing is below the ground surface

Vibrating Wire Piezometer GB-1

Governor's Mansion

S/N 98943

Note: Fill in data in yellow cells, depth to GW calculated automatically .

Pressure = C0 + (C1+Hz)+(C2*T)+(C3*Hz^2)+(C4*Hz*T)+(C5*T^2)

(C0 through C5 are factors on the Vibrating Wire Piezometer Calibration Certificate)

C0	C1	C2	C3	C4	C5
148.0399000000	-0.0030328030	0.0083471770	-0.0000164629	0.0000079014	-0.0003587562

Date	Hz	T (°C)	Pressure at VWP (psi)	H$_2$0 above VWP (ft)	Depth to GW (ft bgs)
5/29/2009	2921.0	15.3	-0.89	-2.04	Water Below VWP
8/27/2009	2923.8	12.2	-1.23	-2.84	Water Below VWP
12/2/2009	2923.5	12.2	-1.20	-2.78	Water Below VWP
11/15/2010	2921.7	12.1	-1.03	-2.37	Water Below VWP

VWP installed at 80 ft bgs

Ground surface elevation = 145 feet; estimated from base map topography, NAVD 88

Vibrating Wire Piezometer GB-2

Pritchard Building

S/N 98944

Note: Fill in data in yellow cells, depth to GW calculated automatically .

Pressure = $C0 + (C1+Hz)+(C2*T)+(C3*Hz^2)+(C4*Hz*T)+(C5*T^2)$

(C0 through C5 are factors on the Vibrating Wire Piezometer Calibration Certificate)

C0	**C1**	**C2**	**C3**	**C4**	**C5**
163.7161000000	-0.0124605400	0.0081541840	-0.0000162910	0.0000087237	-0.0004216918

Date	Hz	T °C	Pressure at sensor (psi)	H_20 above sensor (ft)	Depth to GW (ft bgs)
5/29/2009	2828.2	14.7	-1.44	-3.32	Water Below VWP
8/6/2009	2827.9	13.3	-1.44	-3.32	Water Below VWP
8/27/2009	2826.6	13.3	-1.30	-3.01	Water Below VWP
12/2/2009	2825.3	13.2	-1.17	-2.70	Water Below VWP
11/15/2010	2821.7	13.1	-0.80	-1.84	Water Below VWP

VWP installed at 50 ft bgs

Ground surface elevation = 132.93 surveyed by Triad 2011, NAVD 88

Vibrating Wire Piezometer GB--3

O'Brien Building

S/N 10-2580

Note: Fill in data in yellow cells, depth to GW calculated automatically .

Pressure = C0 + (C1+Hz)+(C2*T)+(C3*Hz^2)+(C4*Hz*T)+(C5*T^2)

(C0 through C5 are factors on the Vibrating Wire Piezometer Calibration Certificate)

C0	**C1**	**C2**	**C3**	**C4**	**C5**
1.172901E+02	1.134003E-03	1.680212E-02	-1.544609E-05	6.375818E-06	-4.493193E-04

Date	Hz	T (°C)	Pressure at sensor (psi)	H_20 above sensor (ft)	Depth to GW (ft bgs)
11/8/2010	2796	12.4	0.1	0.1	71.9
11/15/2010	2793	12.4	0.3	0.7	71.3

VWP installed at 72 ft bgs

Ground surface elevation = 128.51 surveyed by PMX 2010, NAVD 88

Vibrating Wire Piezometer GB-4

Crest of slope, west edge of Mansion Parking Lot

S/N 10-2582

Note: Fill in data in yellow cells, depth to GW calculated automatically .

Pressure = C0 + (C1+Hz)+(C2*T)+(C3*Hz^2)+(C4*Hz*T)+(C5*T^2)

(C0 through C5 are factors on the Vibrating Wire Piezometer Calibration Certificate)

C0	**C1**	**C2**	**C3**	**C4**	**C5**
1.328829E+02	-1.752421E-03	9.942980E-03	-1.577769E-05	6.073282E-06	-3.249673E-04

Date	**Hz**	**T (°C)**	**Pressure at sensor (psi)**	**H_20 above sensor (ft)**	**Depth to GW (ft bgs)**
11/8/2010	2849	13.4	0.1	0.3	55.7

VWP installed at 56 ft bgs

Ground surface elevation = 113.45 surveyed by PMX 2010, NAVD 88

Vibrating Wire Piezometer GB-5

North edge of Mansion parking Lot

S/N 10-2581

Note: Fill in data in yellow cells, depth to GW calculated automatically .

Pressure = C0 + (C1+Hz)+(C2*T)+(C3*Hz^2)+(C4*Hz*T)+(C5*T^2)

(C0 through C5 are factors on the Vibrating Wire Piezometer Calibration Certificate)

C0	**C1**	**C2**	**C3**	**C4**	**C5**
1.308914E+02	8.543572E-04	1.699248E-02	-1.589137E-05	3.273344E-06	-3.431190E-04

Date	Hz	T (°C)	Pressure at sensor (psi)	$H_2$0 above sensor (ft)	Depth to GW (ft bgs)
5/4/2010 15:30	2859	13.9	3.8	8.7	21.3
11/8/2010	2913	14.5	-1.2	-2.7	Water Below VWP

Note: 5/4/10 Reading taken during installation of vibrating wire piezometer and is not representative of groundwater conditions

VWP installed at 30 ft bgs

Ground surface elevation = 112.85 surveyed by PMX 2010, NAVD 88

Standpipe Piezometer DH-7P

Greenhouse

Approximate Ground Surface Elevation :	102 ft
Approximate Casing Stick-up:	1.2 ft

Notes: Depth to GW is measured from the top of the PVC casing
Fill in yellow cells

Date	Elevation of Measuring Point (ft)	Measured Depth to GW from top of PVC Casing (Measuring Point) (ft)	Depth of GW below Ground Surface (ft)	Elevation of GW (ft)
12/2/2009	103.2	23.3	22.1	79.9
9/1/2010	103.2	20.8	19.6	82.4
	103.2			
	103.2			
	103.2			
	103.2			
	103.2			
	103.2			
	103.2			
	103.2			
	103.2			
	103.2			
	103.2			
	103.2			
	103.2			
	103.2			
	103.2			
	103.2			
	103.2			

No information about screen
Ground surface elevation = 102.13 surveyed by Triad 2011, NAVD 88

Standpipe Piezometer HC-2

GA Building

Approximate Ground Surface Elevation : 99 ft
Approximate Casing Stick-up: -0.5 ft

Notes: Depth to GW is measured from the top of the PVC casing
Fill in yellow cells

Date	Elevation of Measuring Point (ft)	Measured Depth to GW from top of PVC Casing (Measuring Point) (ft)	Depth of GW below Ground Surface (ft)	Elevation of GW (ft)
12/2/2009	98.5	64.1	64.6	34.4
9/1/2010	98.5	63.3	63.8	35.2
	98.5			
	98.5			
	98.5			
	98.5			
	98.5			
	98.5			
	98.5			
	98.5			
	98.5			
	98.5			
	98.5			
	98.5			
	98.5			
	98.5			
	98.5			
	98.5			
	98.5			

Screened from 92 to 102 feet bgs
Ground surface elevation estimated from base map topography, NAVD 88

Standpipe Piezometer HC-3

GA Building

Approximate Ground Surface Elevation : 95 ft
Approximate Casing Stick-up: -0.3 ft

Notes: Depth to GW is measured from the top of the PVC casing
Fill in yellow cells

Date	Elevation of Measuring Point (ft)	Measured Depth to GW from top of PVC Casing (Measuring Point) (ft)	Depth of GW below Ground Surface (ft)	Elevation of GW (ft)
12/2/2009	94.7	61.0	61.3	33.7
9/1/2010	94.7	60.3	60.6	34.5
	94.7			
	94.7			
	94.7			
	94.7			
	94.7			
	94.7			
	94.7			
	94.7			
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	94.7			
	94.7			
	94.7			

Screened from 95 to 105 feet bgs
Ground surface elevation estimated from base map topography, NAVD 88

Standpipe Piezometer HC-5

GA Building

Approximate Ground Surface Elevation :	89 ft
Approximate Monument Stick-up:	-0.3 ft

Notes: Depth to GW is measured from the top of the PVC casing

Fill in yellow cells

Date	Elevation of Measuring Point (ft)	Measured Depth to GW from top of PVC Casing (Measuring Point) (ft)	Depth of GW below Ground Surface (ft)	Elevation of GW (ft)
12/2/2009	88.7	57.3	57.6	31.4
9/1/2010	88.7	56.7	57.0	32.0
	88.7			
	88.7			
	88.7			
	88.7			
	88.7			
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	88.7			

Screened from 85 to 95 feet bgs

Ground surface elevation estimated from base map topography, NAVD 88

Standpipe Piezometer HC-6

GA Building

Approximate Ground Surface Elevation : 84 ft
Approximate Monument Stick-up: -0.1 ft

Notes: Depth to GW is measured from the top of the PVC casing
Fill in yellow cells

Date	Elevation of Measuring Point (ft)	Measured Depth to GW from top of PVC Casing (Measuring Point) (ft)	Depth of GW below Ground Surface (ft)	Elevation of GW (ft)
12/2/2009	83.9	54.3	54.4	29.6
9/1/2010	83.9	53.9	54.0	30.0
	83.9			
	83.9			
	83.9			
	83.9			
	83.9			
	83.9			
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	83.9			

Screened from 88 to 98 feet bgs
Ground surface elevation estimated from base map topography, NAVD 88

Standpipe Piezometer HC-7

GA Building

Approximate Ground Surface Elevation :	84	ft
Approximate Monument Stick-up:	-0.3	ft

Notes: Depth to GW is measured from the top of the PVC casing
Fill in yellow cells

Date	Elevation of Measuring Point (ft)	Measured Depth to GW from top of PVC Casing (Measuring Point) (ft)	Depth of GW below Ground Surface (ft)	Elevation of GW (ft)
12/2/2009	83.7	53.8	54.1	29.9
9/1/2010	83.7	53.6	53.9	30.1
	83.7			
	83.7			
	83.7			
	83.7			
	83.7			
	83.7			
	83.7			
	83.7			
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	83.7			
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	83.7			
	83.7			
	83.7			
	83.7			
	83.7			
	83.7			

Screened from 86 to 96 feet bgs
Ground surface elevation estimated from base map topography, NAVD 88

Standpipe Piezometer B-1

West of Insurance Building

Approximate Ground Surface Elevation : 125 ft
Approximate Casing Stick-up: -0.5 ft

Notes: Depth to GW is measured from the top of the PVC casing
Fill in yellow cells

Date	Elevation of Measuring Point (ft)	Measured Depth to GW from top of PVC Casing (Measuring Point) (ft)	Depth of GW below Ground Surface (ft)	Elevation of GW (ft)
9/1/2010	124.5		0.5	124.5
	124.5			
	124.5			
	124.5			
	124.5			
	124.5			
	124.5			
	124.5			
	124.5			
	124.5			
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	124.5			
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	124.5			
	124.5			
	124.5			
	124.5			
	124.5			
	124.5			

Screened from 15 to 25 feet bgs
Ground surface elevation estimated from base map topography, NAVD 88

Standpipe Piezometer B-2

East of Insurance Building

Approximate Ground Surface Elevation : 125 ft
Approximate Casing Stick-up: -0.3 ft

Notes: Depth to GW is measured from the top of the PVC casing
Fill in yellow cells

Date	Elevation of Measuring Point (ft)	Measured Depth to GW from top of PVC Casing (Measuring Point) (ft)	Depth of GW below Ground Surface (ft)	Elevation of GW (ft)
9/1/2010	124.7	29.5	29.8	95.2
	124.7			
	124.7			
	124.7			
	124.7			
	124.7			
	124.7			
	124.7			
	124.7			
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	124.7			
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	124.7			
	124.7			
	124.7			
	124.7			

Screened from 20 to 30 feet bgs
Ground surface elevation estimated from base map topography, NAVD 88

Standpipe Piezometer B-3

South of Insurance Building

Approximate Ground Surface Elevation :	125 ft
Approximate Casing Stick-up:	-0.3 ft

Notes: Depth to GW is measured from the top of the PVC casing
Fill in yellow cells

Date	Elevation of Measuring Point (ft)	Measured Depth to GW from top of PVC Casing (Measuring Point) (ft)	Depth of GW below Ground Surface (ft)	Elevation of GW (ft)
9/1/2010	124.7	16.8	17.1	108.0
	124.7			
	124.7			
	124.7			
	124.7			
	124.7			
	124.7			
	124.7			
	124.7			
	124.7			
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	124.7			
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	124.7			
	124.7			
	124.7			
	124.7			

Screened from 8 to 18 feet bgs
Ground surface elevation estimated from base map topography, NAVD 88

APPENDIX D-2
VWP CALIBRATION SHEETS

SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 98943
Range : 50 psi
Cable Length: 30 m
Date of Calibration: 3/24/2009

Part #: 52611024
Cable Part # : 50613524
Calibrated by: KB
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.135142E-4	-2.010944E-2	1.020999E+3
psi	-1.646385E-5	-2.916628E-3	1.480834E+2

Pressure in kPa/psi = $(A \times Hz^2) + (B \times Hz) + C$, where Hz is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.020735E+3	-2.091118E-2	5.755379E-2	-1.135120E-4	5.448025E-5	-2.473624E-3
psi	1.480399E+2	-3.032803E-3	8.347177E-3	-1.646294E-5	7.901414E-6	-3.587562E-4

Pressure in kPa/psi = $C0 + (C1 \times Hz) + (C2 \times T) + (C3 \times Hz^2) + (C4 \times Hz \times T) + (C5 \times T^2)$

Where Hz is the frequency reading in Hertz and T is the Thermistor reading in degrees C.

TI factors are calculated from temperatures at 5.0, 15.0 and 25.0 degrees C.

Applied pressure and temperature are NIST traceable.

Summary of Test Results at 15°C

Thermistor reading is 14.3 °C.

Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (psi)	Equivalent (kPa)	Frequency (Hz)	Calculated (psi)	(kPa)	Error (%FS)
0.00	0.0	2911.7	0.01	0.1	-0.02
5.00	34.5	2860.8	5.00	34.5	0.01
10.00	68.9	2809.0	9.98	68.8	0.03
15.00	103.4	2756.0	14.99	103.4	0.01
20.00	137.9	2702.0	20.00	137.9	-0.01
25.00	172.4	2647.1	25.00	172.4	0.00
30.00	206.8	2590.9	30.01	206.9	-0.02
35.00	241.3	2533.7	35.00	241.3	0.00
40.00	275.8	2475.1	40.00	275.8	-0.01
45.00	310.3	2415.2	45.00	310.3	0.00
50.00	344.7	2353.9	49.99	344.7	0.01

SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 98944
Range : 50 psi
Cable Length: 30 m
Date of Calibration: 3/24/2009

Part #: 52611024
Cable Part # : 50613524
Calibrated by: KB
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.120889E-4	-8.626748E-2	1.130550E+3
psi	-1.625712E-5	-1.251204E-2	1.639724E+2

Pressure in kPa/psi $= (A \times Hz^2) + (B \times Hz) + C$, where Hz is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.128823E+3	-8.591542E-2	5.622310E-2	-1.123264E-4	6.015012E-5	-2.907565E-3
psi	1.637161E+2	-1.246054E-2	8.154184E-3	-1.629099E-5	8.723730E-6	-4.216918E-4

Pressure in kPa/psi $= C0 + (C1 \times Hz) + (C2 \times T) + (C3 \times Hz^2) + (C4 \times Hz \times T) + (C5 \times T^2)$

Where Hz is the frequency reading in Hertz and T is the Thermistor reading in degrees C.

TI factors are calculated from temperatures at 5.0, 15.0 and 25.0 degrees C.

Applied pressure and temperature are NIST traceable.

Summary of Test Results at 15°C

Thermistor reading is 14.2 °C.

Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (psi)	Equivalent (kPa)	Frequency (Hz)	Calculated (psi)	Calculated (kPa)	Error (%FS)
0.00	0.0	2814.2	0.01	0.1	-0.02
5.00	34.5	2765.9	5.00	34.5	0.01
10.00	68.9	2716.7	10.00	68.9	0.01
15.00	103.4	2666.8	14.99	103.4	0.02
20.00	137.9	2616.0	19.99	137.8	0.03
25.00	172.4	2564.1	25.01	172.4	-0.01
30.00	206.8	2511.4	30.01	206.9	-0.03
35.00	241.3	2457.9	35.01	241.4	-0.01
40.00	275.8	2403.3	40.00	275.8	-0.01
45.00	310.3	2347.7	44.99	310.2	0.01
50.00	344.7	2290.8	50.00	344.7	0.01

SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 10-2580	Part #: 52611024
Range : 50 psi	Cable Part # : 50613524
Cable Length: 30 m	Calibrated by: KB
Date of Calibration: 4/7/2010	Note:

ABC Calibration Factors

	A	B	C
kPa	-1.063706E-4	7.909962E-3	8.102911E+2
psi	-1.542775E-5	1.147243E-3	1.175228E+2

Pressure in kPa/psi = $(A \times Hz^2) + (B \times Hz) + C$, where Hz is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	8.087152E+2	7.818951E-3	1.158506E-1	-1.065008E-4	4.396127E-5	-3.098057E-3
psi	1.172901E+2	1.134003E-3	1.680212E-2	-1.544609E-5	6.375818E-6	-4.493193E-4

Pressure in kPa/psi = $C0 + (C1 \times Hz) + (C2 \times T) + (C3 \times Hz^2) + (C4 \times Hz \times T) + (C5 \times T^2)$

Where Hz is the frequency reading in Hertz and T is the Thermistor reading in degrees C.

TI factors are calculated from temperatures at 5.0, 15.0 and 25.0 degrees C.

Applied pressure and temperature are NIST traceable.

Summary of Test Results at 15°C

Thermistor reading is 14.5 °C.

Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied	Equivalent	Frequency	Calculated		Error
(psi)	(kPa)	(Hz)	(psi)	(kPa)	(%FS)
0.00	0.0	2797.3	0.01	0.1	-0.02
5.00	34.5	2738.2	4.99	34.4	0.02
10.00	68.9	2677.5	9.99	68.9	0.01
15.00	103.4	2615.4	14.99	103.4	0.01
20.00	137.9	2551.7	20.00	137.9	0.01
25.00	172.4	2486.3	25.01	172.4	-0.01
30.00	206.8	2419.3	30.00	206.8	0.00
35.00	241.3	2350.2	35.00	241.3	-0.01
40.00	275.8	2279.1	40.00	275.8	0.00
45.00	310.3	2205.6	45.00	310.3	0.00
50.00	344.7	2129.6	50.00	344.7	0.00

SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 10-2581
Range : 50 psi
Cable Length: 30 m
Date of Calibration: 4/7/2010

Part #: 52611024
Cable Part # : 50613524
Calibrated by: KB
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.096364E-4	6.527204E-3	9.033152E+2
psi	-1.590142E-5	9.466909E-4	1.310148E+2

Pressure in kPa/psi $= (A \times Hz^2) + (B \times Hz) + C$, where Hz is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	9.024962E+2	5.890793E-3	1.171631E-1	-1.095710E-4	2.256971E-5	-2.365806E-3
psi	1.308914E+2	8.543572E-4	1.699248E-2	-1.589137E-5	3.273344E-6	-3.431190E-4

Pressure in kPa/psi $= C0 + (C1 \times Hz) + (C2 \times T) + (C3 \times Hz^2) + (C4 \times Hz \times T) + (C5 \times T^2)$

Where Hz is the frequency reading in Hertz and T is the Thermistor reading in degrees C.

TI factors are calculated from temperatures at 5.0, 15.0 and 25.0 degrees C.

Applied pressure and temperature are NIST traceable.

Summary of Test Results at 15°C

Thermistor reading is 14.3 °C.

Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied	Equivalent	Frequency	Calculated		Error
(psi)	(kPa)	(Hz)	(psi)	(kPa)	(%FS)
0.00	0.0	2900.4	-0.01	-0.1	0.01
5.00	34.5	2844.9	5.01	34.5	-0.02
10.00	68.9	2788.6	10.00	68.9	0.00
15.00	103.4	2731.0	15.00	103.4	0.00
20.00	137.9	2672.2	20.00	137.9	0.00
25.00	172.4	2612.0	25.00	172.4	0.00
30.00	206.8	2550.5	29.99	206.8	0.02
35.00	241.3	2487.3	34.99	241.2	0.01
40.00	275.8	2422.2	40.01	275.9	-0.03
45.00	310.3	2355.5	45.02	310.4	-0.04
50.00	344.7	2287.3	49.99	344.7	0.02

SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 10-2582
Range : 50 psi
Cable Length: 30 m
Date of Calibration: 4/7/2010

Part #: 52611024
Cable Part # : 50613524
Calibrated by: KB
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.088361E-4	-1.131268E-2	9.166193E+2
psi	-1.578534E-5	-1.640766E-3	1.329444E+2

Pressure in kPa/psi = $(A \times Hz^2) + (B \times Hz) + C$, where Hz is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	9.162276E+2	-1.208294E-2	6.855685E-2	-1.087872E-4	4.187528E-5	-2.240650E-3
psi	1.328829E+2	-1.752421E-3	9.942980E-3	-1.577769E-5	6.073282E-6	-3.249673E-4

Pressure in kPa/psi = $C0 + (C1 \times Hz) + (C2 \times T) + (C3 \times Hz^2) + (C4 \times Hz \times T) + (C5 \times T^2)$

Where Hz is the frequency reading in Hertz and T is the Thermistor reading in degrees C.
TI factors are calculated from temperatures at 5.0, 15.0 and 25.0 degrees C.
Applied pressure and temperature are NIST traceable.

Summary of Test Results at 15°C

Thermistor reading is 14.2 °C.

Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied	Equivalent	Frequency	Calculated		Error
(psi)	(kPa)	(Hz)	(psi)	(kPa)	(%FS)
0.00	0.0	2850.5	0.01	0.1	-0.01
5.00	34.5	2795.5	5.00	34.5	0.00
10.00	68.9	2739.5	9.98	68.8	0.03
15.00	103.4	2682.0	15.00	103.4	0.00
20.00	137.9	2623.3	20.01	138.0	-0.02
25.00	172.4	2563.4	25.01	172.4	-0.03
30.00	206.8	2502.3	30.00	206.8	0.00
35.00	241.3	2439.5	35.00	241.3	0.00
40.00	275.8	2375.2	39.99	275.7	0.01
45.00	310.3	2309.0	45.00	310.3	0.01
50.00	344.7	2240.9	50.00	344.7	0.00

APPENDIX D-3
VW DATA RECORDER MANUAL

VW Data Recorder

52613599

This equipment should be installed, maintained, and operated by technically qualified personnel. Any errors or omissions in data, or the interpretation of data, are not the responsibility of Slope Indicator Company. The information herein is subject to change without notification.

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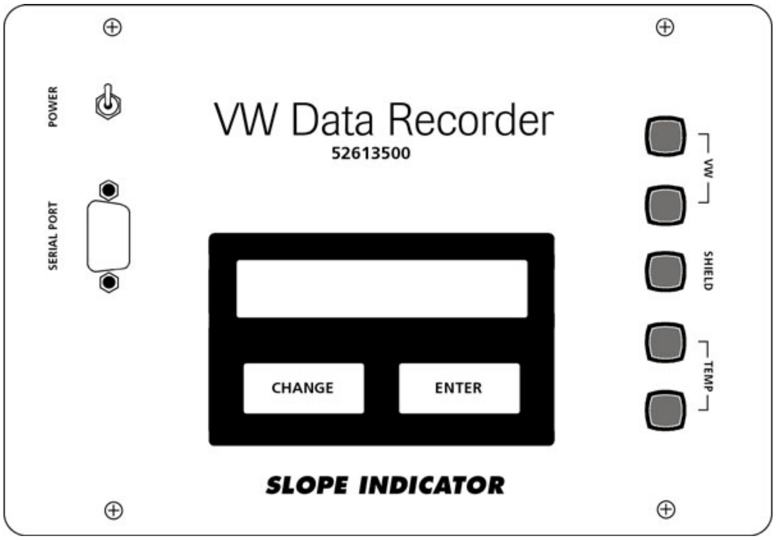
Contents

The VW Data Recorder

Introduction

The VW Data Recorder is a recording readout for vibrating wire sensors. The VW Data Recorder Manager program, which is supplied on CD with the Recorder, is used to transfer readings from the Recorder to a PC.

Controls & Connectors



Power Switch

The power switch toggles power on and off.

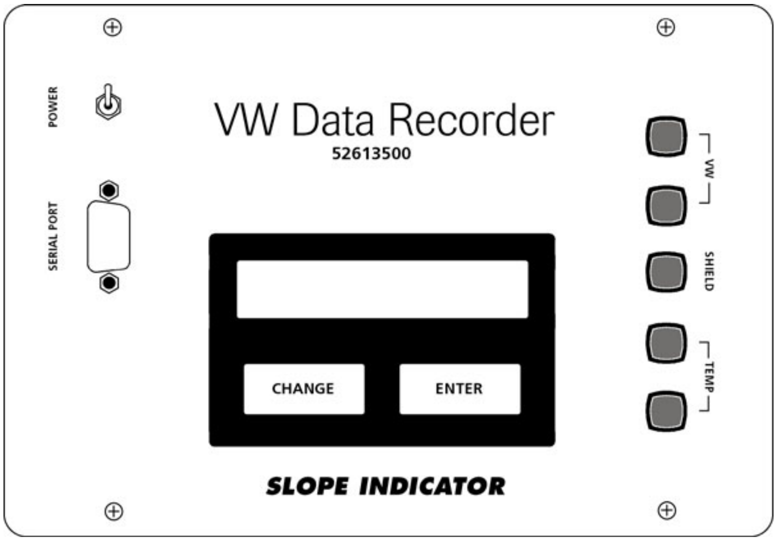
If no keys are pressed for a period of time, the Recorder goes into standby mode. To restore full power, press any key, or switch the Recorder off and on. When you are finished taking readings, switch the recorder off.

Serial Port and Serial Interface Cable

The serial port is used for communication with a PC. Use the supplied serial interface cable to connect the serial port on the Recorder to the serial port on your computer.

The cable is a standard "modem" cable that can be found at any computer supply store. Slope Indicator's part number for the cable is 50306869.

Controls & Connectors Continued



Binding Posts

Connect signal cable from the sensor directly to the binding posts on the right side of the front panel. The table below shows the wire colors for Slope Indicator's standard signal cable:

Binding Posts	Wire Color	Alt Wire Color
VW	Orange	Red
VW	White & Orange	Black
Temp	Blue	White
Temp	White & Blue	Green
Shield (Drain)	Bare wire	Bare wire

Optional Jumper Cable with Alligator Clips

If you have the optional jumper (52613550) with alligator clips, connect the jumper to the binding posts on the panel. Then connect the clips to the signal cable from the sensor.

Binding Posts	Jumper Wires	Clip Colors	Signal Cable
VW	Orange	Red	Orange
VW	White & Orange	Red	White & Orange
Temp	Blue	Black	Blue
Temp	White & Blue	Black	White & Blue
Shield (Drain)	Bare Wire	Green	Bare Wire

Keypad and Display

Change: Displays different options.

Enter: Accepts the option.

To show that an option is available, the Recorder displays a prompt and a colon (:). Examples of option prompts are:

Type:, Sweep:, and Save As:

When you see an option prompt, press the Change key to display the various options. When you see the option that you want, press Enter.

Batteries

The Data Recorder requires two D-cell alkaline batteries. The Recorder displays battery voltage when you switch it on. Replace the batteries when voltage falls below 2V:

1. Remove the four screws from the panel.
2. Place your hand on the panel, then turn the Recorder over, so that the panel drops out of the box to rest on your hand.
3. Remove the batteries from the battery holder and
4. Replace with fresh batteries. The battery holder indicates the proper orientation of the batteries.

Taking Readings

Overview

The steps in taking a reading are:

1. Connect sensor signal cable to the recorder.
2. Choose frequency units and temperature sensor.
3. Choose a sweep frequency, if necessary
4. Observe the reading.
5. Record the reading.

Connect Signal Cable

Connect signal cable from the sensor to the binding posts on the front panel. Connect the shield wire if the reading is unstable.

Strip off about 75 mm (3”) of the outer jacket of the cable so that wires are long enough to connect to the posts. The table below shows wire colors for Slope Indicator’s standard signal cables:

Binding Posts	Wire Color	Alt Wire Color
VW	Orange	Red
VW	White & Orange	Black
Temp	Blue	White
Temp	White & Blue	Green
Shield (Drain)	Bare Wire	Bare Wire

Choose Type

Switch on the Recorder and press Enter. At the Type prompt, choose the appropriate frequency and temperature settings. Press Change to display a different combination. Press Enter to select the option that is displayed.

Hz + Thermistor: The usual choice for Slope Indicator sensors.

Hz2 + Thermistor: The displayed is actually Hz^2 / 1000.

VWSG: uStrain + Thermistor: Microstrain units for Slope Indicator’s spot-weldable strain gauge. Not suitable for any other strain gauge. Use Hz or Hz^2 for other strain gauges.

Hz + RTD: For Slope Indicator sensors before 1998.

Hz2 + RTD: The value displayed is actually Hz^2 / 1000.

VWSG: uStrain + RTD: Microstrain units for Slope Indicator’s spot-weldable strain gauge. Not suitable for any other strain gauge. Use Hz or Hz^2 for other strain gauges. If temperature reading is strange, try uStrain + Thermistor setting.

Choose a Sweep Frequency

By exciting the sensor with a sweep of frequencies rather than a single pluck, the Recorder decreases the chance of error due to harmonics. However, it is necessary to choose the correct sweep range.

Check your sensor calibration sheet to find the highest and lowest frequencies in the calibration. Then choose the sweep that includes those frequencies.

Sweep	Starting Freq	Ending Freq
Sweep A	450	1125
Sweep B	800	2000
Sweep C	1400	3500
Sweep D	2300	6000

Typical sweep ranges for Slope Indicator sensors are listed in the table below. Note that most sensors work with sweep C:

Sensor Name	**Part**	**Recommended Sweep**
Crackmeter	5263602x, 5263604x	Sweep C or B.
Displacement Sensor, Extensometer	5263602x, 5263604x	Sweep C or B
Jointmeter, for Mass Concrete	52632260	Sweep C or B
Jointmeter, for Reinforced Concrete	52636124	Sweep C or B
Jointmeter, Submersible	526321xx	Sweep C or B.
Load Cell, VW	6xxxx	Sweep C
Piezometer	526110, 526210xx	Sweep C
Rebar Stressmeter	526309xx	Sweep C or B
Settlement Cell, 50 or 100 psi	526120xx, 51419524	Sweep C
Strain Gauge, Arc-Weldable	52640306	Sweep B or A
Strain Gauge, Embedment	5264 0126	Sweep B or A
Strain Gauge, for Concrete Surfaces	526403xx	Sweep B or A
Strain Gauge, Spot-Weldable	5260210x	Sweep B (compression) Sweep C (tension)
Stress Station, VW Transducers	526081xx, 526114xx	Sweep C
Total Pressure Cell	526082xx, 5260828x	Sweep C
Total Pressure Cell, Radial	5260826x	Sweep C
Total Pressure Cell, Tangential	5260827x	Sweep C

Observe the Reading

The Recorder excites the sensor at two second intervals and displays the VW reading and the temperature reading (degrees C).

Reading Stability

You may see some variation in the decimal digit due to sensor performance, site conditions, electromagnetic noise, and the actual resolution of the recorder. Variations of up to ±0.3 Hz are not considered significant, since values within this range maintain the stated accuracy for VW sensors.

Questionable Readings

The Recorder performs a "quality" test on each reading and displays a question mark (?) in front of readings that fail the test. If the reading varies more than ±0.3 Hz or if you see a question mark, try the following steps to obtain a more stable reading:

- Connect the shield wire.
- Change the sweep frequency.

Record the Reading

When you save a reading, the Recorder tags the reading with an ID number, the date, and the time. You must choose an ID number from a fixed set of numbers (1 to 99).

The Recorder remembers the most recently used ID. This lets you record a second reading with the same ID or advance to the next ID with a single press of the Change key.

This ID system eliminates the need to pre-program the recorder with sensor serial numbers or other IDs. However, it does require some planning on your part because later, when you process the data, you must match these IDs to the actual sensor serial numbers and calibration records.

1. Press Enter when you want to save a reading. The Recorder prompts Save as: n. (n is an ID for the sensor that you are reading).
2. Choose an ID number from 1 to 99. Press Change to increment the number. Press Change + Enter together to decrement the number.
3. Press Enter to save the reading.
4. Press Enter again to continue.

Special IDs

When you save a questionable reading, the Recorder adds 100 to the sensor ID that you chose, so that the reading is clearly identified as questionable. For example, if you save a questionable reading as #4, the Recorder stores it as #104.

The Manager Program

Introduction

The Manager program is used to transfer readings from the Recorder to a PC. It is also used to change some of the Recorder's default settings.

The VW Data Recorder Manager program can be found on the Resource CD that is supplied with the recorder. Updates can be downloaded from www.slopeindicator.com.

Installation

1. Close all programs.
2. Place the Resource CD in your CD-ROM drive. Wait for a menu to appear.
3. Choose Software.
4. Click on VW Data Recorder Manager.
5. Choose "Run this program from its current location." This starts the setup program. Follow on screen directions.
6. Afterwards, you will find the manager program on your start menu under "VWRecorder" and on your hard disk under Program Files\VWR.

Alternative Installation

If you downloaded the setup file or if autorun is disabled on your computer, run the Resource CD as explained below.

1. Start your Browser.
2. Choose File Open and navigate to your CD ROM drive.
3. Click on "Start CD." Then follow instructions above.
4. Click the Start button.

Testing Communications

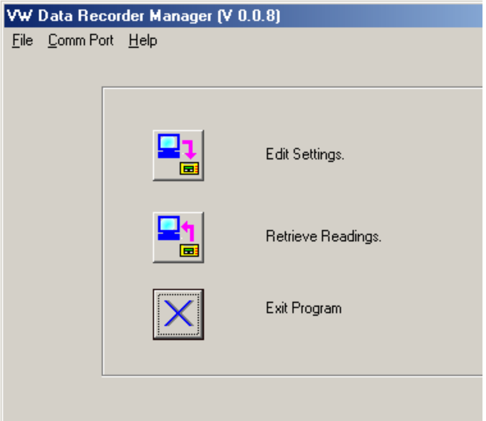
The Manager program communicates with the Recorder through a serial connection. The steps below tell how to check the connection.

Connect the Data Recorder to your PC

1. Find the serial port on your PC. It will have a 9-pin or a 25-pin connector. Desktop PCs typically have two or more serial ports. Laptops typically have one.
2. Connect the interface cable (supplied) to the serial port. The interface cable is a “modem cable” that is available at any computer supply store.
3. Connect the other end of the interface cable to the serial port on the front panel of the Recorder.
4. Switch on the Recorder.

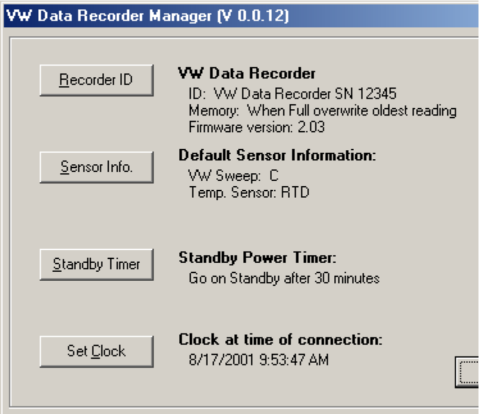
Start the Program

1. Click the Start button. Choose Programs from the Start menu.
2. Click on VW Data Recorder Manager.
3. The manager program appears.
4. Click on the Edit Settings button.



Trouble Shooting

The Edit Settings screen should appear. If you see an error message, click OK to clear the message, and then these actions:



VW Data Recorder
ID: VW Data Recorder SN 12345
Memory: When Full overwrite oldest reading
Firmware version: 2.03

Default Sensor Information:
VW Sweep: C
Temp. Sensor: RTD

Standby Power Timer:
Go on Standby after 30 minutes

Clock at time of connection:
8/17/2001 9:53:47 AM

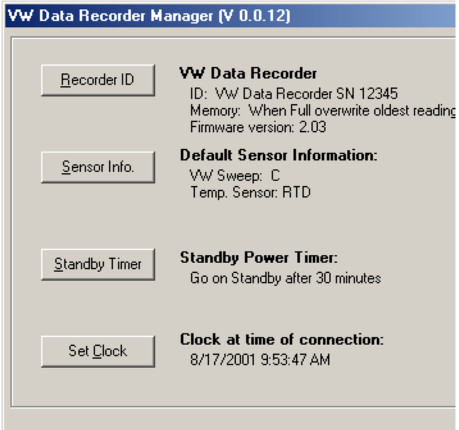
- Try choosing a different comm port: Click “Comm Port” on the menu bar and choose a different port from the drop-down list.
- Check that the cables are firmly connected to the Data Recorder and to the computer.
- If you are using Hot Sync or a similar serial communications program with a palm top computer, try disabling the program temporarily.

Changing Default Settings

Overview

The Manager program lets you edit some of the Recorder's default settings. The most important of these is the Recorder's clock, since it is used to time-stamp recorded readings.

1. Connect the Recorder to your PC.
2. Start the Manager Program.
3. Click on the "Edit Settings" button. A screen similar to the one at right appears.
4. Click on any of the four buttons to edit a setting. Text to the right of each button shows the current values of the settings.



VW Data Recorder Manager (V 0.0.12)

VW Data Recorder
ID: VW Data Recorder SN 12345
Memory: When Full overwrite oldest reading
Firmware version: 2.03

Default Sensor Information:
VW Sweep: C
Temp. Sensor: RTD

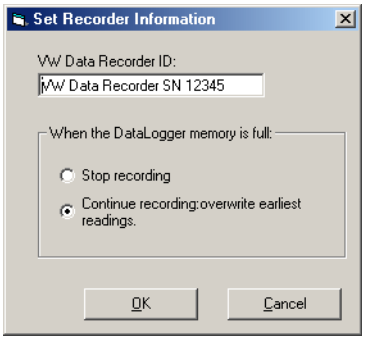
Standby Power Timer:
Go on Standby after 30 minutes

Clock at time of connection:
8/17/2001 9:53:47 AM

Recorder ID

Recorder ID: Enter an identifier for the Recorder. This ID does not appear in the data file.

When Memory is Full: You can record more than 2000 readings before memory is full, so this parameter is not critical.



Set Recorder Information

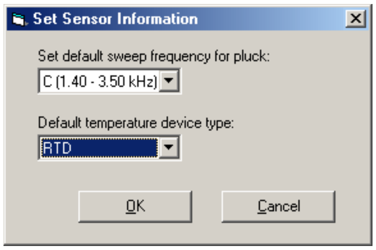
VW Data Recorder ID:
VW Data Recorder SN 12345

When the DataLogger memory is full:
○ Stop recording
● Continue recording:overwrite earliest readings.

When "stop recording" is selected, the Recorder will record readings until its memory is full and will then stop and wait for you to retrieve the readings. No readings are overwritten.

When "continue recording" is selected, the Recorder will store readings normally until memory is full. Then it will continue to record new readings, overwriting the earliest readings.

Sensor Info


Set Sensor Information

Set default sweep frequency for pluck: C (1.40 - 3.50 kHz)

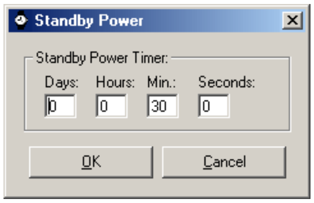
Default temperature device type: RTD

This dialog lets you set a default sweep frequency and temperature device. Note that both settings can be changed via the Recorder's keypad.

Sweep Frequency: Choose a default sweep frequency. Most sensors use the "C" sweep, but yours may not. You can find a list of sensors and recommended sweep frequencies in "Taking Readings."

Default temperature device: Choose Thermistor or RTD. This choice affects the Type menu. Choosing Thermistor makes Hz, Hz2, and uStrain with Thermistor appear first. If you choose RTD, the RTD series appears first.

Standby Delay


Standby Power

Standby Power Timer:

Days: 0

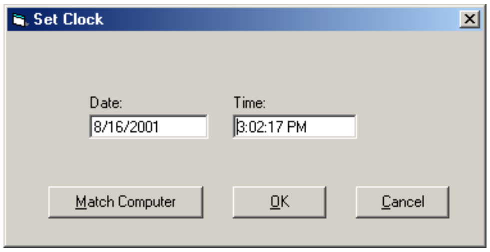
Hours: 0

Min.: 30

Seconds: 0

This setting controls how long the Recorder waits before going into standby mode. For example, if you choose 30 minutes, the Recorder will wait 30 minutes after the last key press before going into standby mode. Note that the standby mode still requires power, so when you are finished taking readings, always switch the Recorder off.

Set Clock


Set Clock

Date: 8/16/2001

Time: 3:02:17 PM

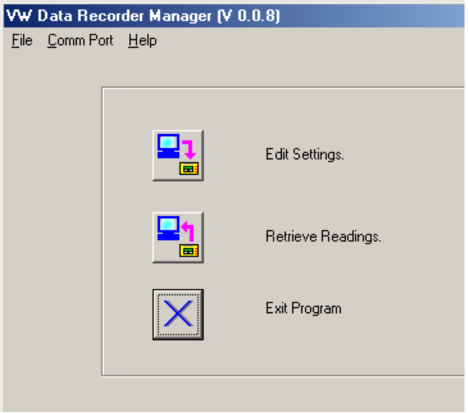
Click the "Match Computer" button to synchronize the Recorder's clock with your computer's clock.

To set a different time, click in the date and time fields, type in values, and click OK. The date display format in the dialog is controlled by the short date setting in Windows (Control Panel > Regional Settings > Date).

Retrieving Readings

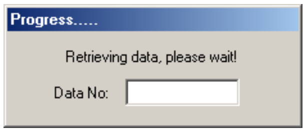
Overview

1. Connect the Data Recorder to your PC.
2. Start the Manager program.
3. Choose Retrieve Readings.
4. Save the data in a file.
5. Clear the Data Recorder's memory.



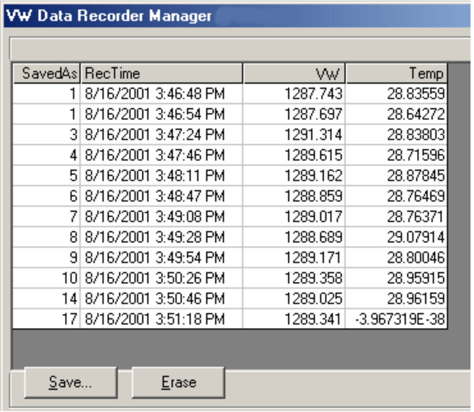
Retrieve Data

1. Click the "Retrieve Readings" button. The Manager program performs some checks and then displays a progress counter.



Retrieving data, please wait!

2. The Manager program then displays the retrieved readings in tabular form.
3. Click the "Save" button to open the Save dialog. Specify a location and file name, then click the dialog's Save button. The Manager program confirms when the readings are saved.



SavedAs	RecTime	VW	Temp
1	8/16/2001 3:46:48 PM	1287.743	28.83559
1	8/16/2001 3:46:54 PM	1287.697	28.64272
3	8/16/2001 3:47:24 PM	1291.314	28.83803
4	8/16/2001 3:47:46 PM	1289.615	28.71596
5	8/16/2001 3:48:11 PM	1289.162	28.87845
6	8/16/2001 3:48:47 PM	1288.859	28.76469
7	8/16/2001 3:49:08 PM	1289.017	28.76371
8	8/16/2001 3:49:28 PM	1288.689	29.07914
9	8/16/2001 3:49:54 PM	1289.171	28.80046
10	8/16/2001 3:50:26 PM	1289.358	28.95915
14	8/16/2001 3:50:46 PM	1289.025	28.96159
17	8/16/2001 3:51:18 PM	1289.341	-3.967319E-38

Clear Memory

Click the Erase button to clear the Recorder's memory.

APPENDIX E
SURVEY MONITORING REPORTS

Capitol Campus Hillside Monitoring Survey Documentation Report, Parametrix, June 2010

Capitol Campus Hillside Monitoring Monumentation Report, Parametrix, February 15, 2011

Capitol Campus Hillside Monitoring Survey Documentation Report

Golder Associates Inc.
and
Dept. of General Administration

June 2010

Parametrix

Capitol Campus

Hillside Monitoring

Survey Monumentation Report

June 14, 2010

GA Project Number - 08-076
Parametrix Project Number – 247-2588-002

Prepared for:
Golder Associates Inc.
18300 NE Union Hill Road
Suite 200
Redmond, WA 98052-3333
Contact: Katy Cottingham

and

Dept. of General Administration
Olympia, WA 98504
Contact: Vikki Poitra

Prepared by:

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6/23/10

BLAIR E. PRIGGE
STATE OF WASHINGTON
29278
REGISTERED
PROFESSIONAL LAND SURVEYOR

Capitol Campus

Hillside Monitoring

Survey Monumentation Report

Background

Parametrix was sub contracted by Golder Associates to set monuments at strategic locations along the Capitol Campus hillside for slope movement monitoring. Parametrix worked with Katy Cottingham - Golder, Frank Shuri - Golder, Vikki Poitra - GA and Nathaniel Jones - GA to determine the placement of the monuments. Eight of the monuments are survey prism reflectors mounted to strategic locations on the buildings near the hillside. A total of 25 monitoring points exist.

Parametrix used conventional survey equipment to complete a high accuracy control loop through the campus to locate (n, e, and el) on each of the monitoring points. Levels were completed through all of the ground based monuments.

Methodology (procedures)

Parametrix reviewed a number of methods for measuring the location and possible movement of the settlement monitoring points. We used a closed traverse loop with levels for elevation approach because of the accuracies being requested. The accuracy requested is 0.02 feet maximum.

Primary Starting Points – The primary starting points for the survey would be Parametrix points 108 and 106. Point 108 is a Thurston County monument set in the curb line near the Winged Victory Statue, and point 106 is a control point Parametrix set while completing an earlier project for General Administration. The coordinates for these points can be found in Appendix B - Control Map.

A closed loop was completed, starting at point 108, back sighting 106, traversing through 1,2,3,5,6,7,9,10,11,12,13,14,15,16, back to 108, and closing the angle to point 1. From these main control points the settlement monitoring points were located turning one set of angles (bffb).

The above work was completed with a Leica TCRA 1103 PLUS Robotic Total Station, Serial No. 252798. The levels were completed with a Leica NA 2002 Digital Level, Serial No. 93526.

Results

Traverse #1

The closure for the first traverse was 1:120,000 raw closure. This is a closing error of 0.032 feet over 3,900 lineal feet of traverse. The level loop closure was 0.006 feet.

Traverse #2

The closure for the second traverse was 1:73,000 raw closure. This is a closing error of 0.053 feet over 3,900 lineal feet of traverse. A level loop was not completed this time. A comparison was completed between levels and trig elevations and the maximum difference observed was 0.015 feet.

The coordinates for both loops are shown in the appendices as well as their differences, which are very small.

Appendix A
Monument Descriptions

Appendix A –

Monument Descriptions

The following are the descriptions of the monuments set for the settlement monitoring points:

S-1
Set stationary prism under second ledge from the ground on the west face, at the northwest corner of the General Administration Building. PMX point number 1001.

S-2
Set 3-½ inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. The pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. The cap is stamped S-2. Location is top of hillside, 25 feet north 27° west of west end of handrail of steps at west side of parking area at west entrance to General Administration Building. PMX point number 1002.

S-3
Set 3-½ inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. The pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. The cap is stamped S-3. Location is 2.2 feet east of west fence line, +/-35 feet south of angle point on the west side of the General Administration Building. PMX point number 1003.

S-4
Set 3-½ inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. The pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. The cap is stamped S-4. Location is 0.4 feet north of north edge of pavement and +/- 30 feet west of northwest fence corner of GA Maintenance Shop. PMX point number 1004.

S-5
Set 3-½ inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. The pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. The cap is stamped S-5. Location is 0.5 feet east of west edge of pavement, 3 feet south of northwest corner of westerly fence line at GA Maintenance Shop. PMX point number 1005.

S-6
Set stationary prism under flood light on west face of building at northwest corner of GA Maintenance Shop. PMX point number 1006.

S-7
Set stationary prism +/- 3 feet below gutterline on west face of northwest corner of Green House. PMX point number 1007.

S-8
Set stationary prism in easterly corner of northerly second floor window at the northeast corner of Temple of Justice building. PMX point number 1008.

S-9

Set stationary prism in easterly corner of northerly second floor window at the northwest corner of Temple of Justice building. PMX point number 1009.

S-10

Set "L" shaped bracket just below the marble cap on the north face of the Law Enforcement Memorial. Monument is aluminum bracket with drilled point. Parametrix point number 1010.

S-11

Set 3-½ inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. The pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. The cap is stamped S-11. Location is 9 feet behind the north back of curb in line with westerly stripe of first parking stall west of handicap stalls at northeast corner of westerly parking lot. PMX point number 1011.

S-12

Set 3-½ inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. The pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. The cap is stamped S-12. Location is 0.8 feet north of north back of walk in line with the centerline of north bound drive lane in westerly parking lot. PMX point number 1012.

S-13

Set 3-½ inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. The pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. The cap is stamped S-13. Location is 1.5 feet north of the north edge of concrete, 2.5 feet east of the top stair of stairway to steam plant. Monument is 0.5 feet exposed. PMX point number 1013.

S-14

Set 12-foot long, 3-inch-square aluminum pole four feet into the ground on west bank of hillside above the powerhouse and south of S-13. Aluminum pole has prism mounted on the top. PMX point number 1014.

S-15

Set stationary prism above flood light and below gable end vent on north side of Governor's garage. PMX point number 1015.

S-16

Set 3-½ inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. The pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. The cap is stamped S-16. Location is +/-5 feet northeasterly of top of hillside, 6.4 feet North 54° East from 30 inch diameter Maple multi-trunk tree, off the west side of the O'Brien Building. PMX point number 1016.

S-17

Set stationary prism on the west face of second floor at southwest corner of O'Brien Building, one foot above second floor ledge. PMX point number 1017.

S-18

Epoxied 2 inch diameter brass disk to northeast side of manhole collar. Manhole located near the middle of the southwest side of the O'Brien Building. Collar is roughly 6 inches below the lid. PMX point number 1018.

S-19
Set stationary prism under roof eve at the southwesterly corner of the Pritchard (Library) Building. PMX point number 1019.

S-20
Set 2-inch-diameter brass disk in sidewalk, 0.4 feet east of west edge of concrete at southwesterly corner of Pritchard (Library) Building. PMX point number 1020.

S-21
Set stationary prism on westerly face of Pritchard (Library) Building, southerly section of the building at the southwesterly corner, +/- 15 feet above the ground. PMX point number 1021.

S-22
Set 2-inch-diameter brass disk in foundation of Temple of Justice Building at northwest corner. PMX point number 1022.

S-23
Set 2 inch diameter brass disk in foundation of Temple of Justice Building at northeast corner. PMX point number 1023.

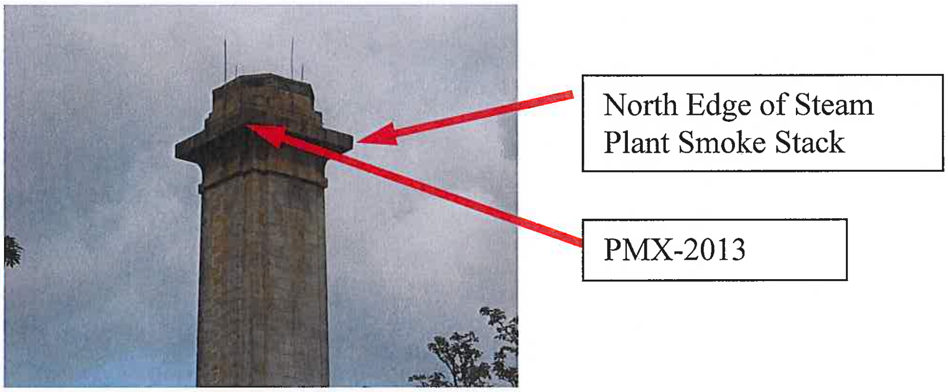
S-24
Found 2-inch brass disk 0.6 feet east of the southerly garage door track in concrete floor of GA Maintenance Shop. PMX point number 1024.

S-25
Found 2-inch brass disk 0.4 feet east of the northeast corner of the Green House Addition. PMX point number 1025.

South Edge of Steam Plant Smoke Stack as observed from PMX-8.

North Edge of Steam Plant Smoke Stack as observed from PMX-8.

PMX-2013
Located bottom edge easterly corner of Steam Plant Smoke Stack.



The following are the descriptions of the monuments used for locating the settlement monitoring points:

PMX-108
Found 3½-inch brass disk set in the east side of Winged Victory circular curb line. This is Thurston County GPS STA SOLDIERS. PMX point number 108.

PMX-106
Found 3½-inch brass disk marked "Capitol Campus Survey Control, June 2008, #106" on the north side of the North Diagonal, 9 feet north of a catch basin and 31 feet west of a light pole. PMX point number 106.

PMX-1
Set 2-inch-diameter brass disk 0.5 feet south of the northerly edge of concrete walk at the northerly entrance to Rose garden. Monument is stamped PMX 1. PMX point number 1.

PMX-2
Set 3½-inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. Pipe is set in the ground with 60 a pound sack of concrete, then backfilled with native material. Cap is stamped PMX-2. Located west of the west edge of sidewalk and +/- 15 feet west of 28-inch-diameter cedar tree that is across the street from the GA Maintenance Shop. PMX point number 2.

PMX-3
Set 2-inch-diameter aluminum monument on 5/8-inch rebar driven in the asphalt parking lot, 22 feet north 28° east of Catch Basin in back of GA Maintenance Shop. Monument is stamped PMX-3. PMX point number 3.

PMX-4
Set a 2-inch-long Mag Nail, 1.2 feet east of center post at west side of concrete walk off the west side of the GA Building. Nail is stamped PMX-4. PMX point number 4.

PMX-5
Set 2-inch-diameter aluminum monument on 5/8 inch rebar set 9.5 feet south of the face of curb on north side of parking between assigned parking spaces TJ 106 and TJ 107. Monument is stamped PMX-5. PMX point number 5

PMX-6
Set 2-inch-diameter aluminum monument on 5/8 inch rebar 0.4 feet east of east edge of cross walk and 9 feet north of south curb line at cross walk at northwest corner of Temple of Justice Building. Monument is stamped PMX-6. PMX point number 6.

PMX-7
Set 2-inch-diameter brass disk at the centerline of north bound lane of parking lot and 4 feet south of parking stripe to the north. Disk is stamped PMX-7. PMX point number 7.

PMX-8
Set 2-inch-diameter brass disk 1 foot south and 1 foot east of northwest corner of concrete compost pad. Disk is stamped PMX-8. PMX point number 8.

PMX-9
Set 2-inch-diameter brass disk 5.5 feet northeast of center of westerly curb return at easterly entrance to State Patrol parking. Disk is stamped PMX-9. PMX point number 9.

PMX-10
Found previously set monument #103, set June 2008, 0.5 feet southeast of southeast curb return and 5 feet west of west edge of cross walk. Monument is stamped PMX-10. PMX point number 10.

PMX-11
Set 2-inch-diameter brass disk in concrete walk +/- 23 feet south of stairs to Governor's Mansion and 7 feet west of curb face. Disk is stamped PMX-11. PMX point number 11.

PMX-12
Also known as S-16 and also stamped as PMX-12.

PMX-13
Set 3½-inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. Pipe is set in the ground with a 60 pound sack of concrete, then backfilled with native material. Cap is stamped PMX-13. Located +/- 11 feet, south 25° east from the southeast corner of smoking area covered shelter at northwest corner of Library. PMX point number 13.

PMX-14
Set 2-inch-diameter brass disk in concrete walk +/- 10 feet west of west corner of sundial monument. Disk is stamped PMX-14. PMX point number 14.

PMX-15
Set temporary Mag Nail in walk. Removed after survey. PMX point number 15.

PMX-16
Set temporary Mag Nail in walk. Removed after survey. PMX point number 16.

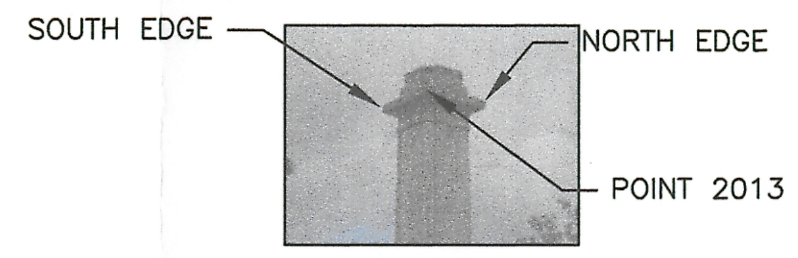
Appendix B
Hillside Monitoring Control Map

Point	Northing	Easting	Elevation	Description
S1	631068.2881	1041324.6440	95.441	Set stationary prism under second ledge from the ground on the west face, at the northwest corner of the General Administration Building. PMX point number 1001.
S2	630986.0711	1041239.4030	91.798	Set 3 ½ inch diameter aluminum cap on 30 inch long, 2 inch diameter aluminum pipe with flared ends. Pipe is set in the ground with 60lb sack of concrete then backfilled with native material. Cap is stamped S-2. Location is top of hillside, 25 feet North 27° West of west end of handrail of steps at west side of parking area at west entrance to General Administration Building. PMX point number 1002.
S3	630842.8343	1041227.2300	93.005	Set 3 ½ inch diameter aluminum cap on 30 inch long, 2 inch diameter aluminum pipe with flared ends. Pipe is set in the ground with 60lb sack of concrete then backfilled with native material. Cap is stamped S-3. Location is 2.2 feet east of west fence line, +/-35 feet south of angle point on the west side of the General Administration Building. PMX point number 1003.
S4	630769.9786	1041190.3190	97.780	Set 3 ½ inch diameter aluminum cap on 30 inch long, 2 inch diameter aluminum pipe with flared ends. Pipe is set in the ground with 60lb sack of concrete then backfilled with native material. Cap is stamped S-4. Location is 0.4 feet north of north edge of pavement and +/- 30 feet west of northwest fence corner of GA Maintenance Shop. PMX point number 1004.
S5	630737.1383	1041145.4130	98.646	Set 3 ½ inch diameter aluminum cap on 30 inch long, 2 inch diameter aluminum pipe with flared ends. Pipe is set in the ground with 60lb sack of concrete then backfilled with native material. Cap is stamped S-5. Location is 0.5 feet east of west edge of pavement, 3 feet south of northwest corner of westerly fence line at GA Maintenance Shop. PMX point number 1005.
S6	630720.9176	1041220.7850	109.974	Set stationary prism under flood light on west face of building at northwest corner of GA Maintenance Shop. PMX point number 1006.
S7	630585.9741	1041139.2470	115.061	Set stationary prism +/- 3 feet below gutterline on west face of northwest corner of Green House. PMX point number 1007.
S8	630466.0420	1041011.9920	128.768	Set stationary prism in easterly corner of northerly 2nd floor window at the northeast corner of Temple of Justice building. PMX point number 1008.
S9	630473.4463	1040766.9390	128.790	Set stationary prism in easterly corner of northerly 2nd floor window at the northwest corner of Temple of Justice building. PMX point number 1009.
S10	630597.6792	1040891.1560	108.430	Set "L" shaped bracket just below the mable cap on the north face of the Law Enforcement Memorial. Monument is aluminum bracket with drilled point. Parametrix point number 1010.
S11	630587.4658	1040538.3440	110.526	Set 3 ½ inch diameter aluminum cap on 30 inch long, 2 inch diameter aluminum pipe with flared ends. Pipe is set in the ground with 60lb sack of concrete then backfilled with native material. Cap is stamped S-11. Location is 9 feet behind the north back of curb inline with westerly stripe of first parking stall west of handicap stalls at northeast corner of westerly parking lot. PMX point number 1011.
S12	630581.2783	1040412.8720	112.594	Set 3 ½ inch diameter aluminum cap on 30 inch long, 2 inch diameter aluminum pipe with flared ends. Pipe is set in the ground with 60lb sack of concrete then backfilled with native material. Cap is stamped S-12. Location is 0.8 feet north of north back of walk in line with the centerline of north bound drive lane in westerly parking lot. PMX point number 1012.
S13	630416.8041	1040172.5240	99.115	Set 3 ½ inch diameter aluminum cap on 30 inch long, 2 inch diameter aluminum pipe with flared ends. Pipe is set in the ground with 60lb sack of concrete then backfilled with native material. Cap is stamped S-13. Location is 1.5 feet north of the north edge of concrete, 2.5 feet east of the top stair of stairway to steam plant. Monument is 0.5 feet exposed. PMX point number 1013.
S14	630325.6231	1040147.3030	102.776	Set 12 foot long 3 inch square aluminum pole four feet into the ground on west bank of hillside above the powerhouse and south of S-13. Aluminum pole has prism mounted on the top. PMX point number 1014.
S15	630084.3683	1040271.9020	142.906	Set stationary prism above flood light and below gable end vent on north side of Governor's garage. PMX point number 1015.
S16	629690.2359	1040474.4640	130.460	Set 3 ½ inch diameter aluminum cap on 30 inch long, 2 inch diameter aluminum pipe with flared ends. Pipe is set in the ground with 60lb sack of concrete then backfilled with native material. Cap is stamped S-16. Location is +/-5 feet northeasterly of top of hillside, 6.4 feet North 54°East from 30 inch diameter Maple multitrunk tree, off the west side of the O'Brien Building. PMX point number 12 (1016).
S17	629669.0672	1040563.7860	147.039	Set stationary prism west face of second floor at southwest corner of O'Brien Building, one foot above second floor ledge. PMX point number 1017.
S18	629616.0732	1040578.3560	127.540	Epoxied 2 inch diameter brass disk to northeast side of manhole collar. Manhole located near the middle of the southwest side of the O'Brien Building. Collar is roughly 6 inches below the lid. PMX point number 1018.
S19	629462.6466	1040753.6910	157.904	Set stationary prism under roof eve at the southwesterly corner of the Library Building. PMX point number 1019.
S20	629461.1497	1040749.8850	132.047	Set 2 inch diameter brass disk in sidewalk, o.4 feet east of west edge of concrete at southwesterly corner of Library Building. PMX point number 1020.
S21	629414.9114	1040804.4330	150.517	Set stationary prism on westerly face of Library Building, southerly section of the building at the southwesterly corner, +/- 15' above the ground. PMX point number 1021.
S22	630477.0363	1040752.8010	115.665	Set 2 inch diameter brass disk in foundation of Temple of Justice Building at northwest corner. PMX point number 1022.
S23	630468.5109	1041022.4550	115.537	Set 2 inch diameter brass disk in foundation of Temple of Justice Building at northeast corner. PMX point number 1023.
S24	630710.8599	1041222.3150	98.776	Found 2 inch brass disk 0.6 feet east of the southerly garage door track in concrete floor of GA Maintenance Shop. PMX point number 1024.
S25	630594.2975	1041197.0910	102.573	Found 2 inch brass disk 0.4 feet east of the northeast corner of the Green House Addition. PMX point number 1025.

NOTES

INSTRUMENT	BACKSIGHT	ANGLE RIGHT	DESCRIPTION
POINT 8	POINT 7	249°48'52"	SIGHTED SOUTH EDGE OF STEAM PLANT SMOKE STACK. (SEE DETAIL BELOW.)
POINT 8	POINT 7	255°53'06"	SIGHTED NORTH SIDE OF STEAM PLANT SMOKE STACK. (SEE DETAIL BELOW.)
POINT 8	POINT 7	POINT 2013	N 630391.4619, E 1040080.1631, ELEV. 186.715

DETAIL
STEAM PLANT SMOKE STACK
NOT TO SCALE



V1
SH 1 OF 1

OLYMPIA, WASHINGTON
CAPITOL CAMPUS
HILLSIDE MONITORING
CONTROL MAP

CONTRACT #: 08-076	TOWNSHIP: 18 N.	RANGE: 2 W.	SECTION: 22 & 23
PRINTED BY:	HRZ DATUM: WA STATE PLANE SOUTH ZONE		VERT DATUM: NAVD88
beaupada Jun 21, 2010	PARCEL: 09850005000		DRAWING SCALE: 1"=100'

GA General Administration
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MARK:	REVISION:	BY:	APPROVED:	DATE:

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Appendix C
Hillside Monitoring Results

Appendix C –

Hillside Monitoring Results

Loop 1					
Date:	May-10	Crew:	DS/BS		
Number	Northing	Easting	Elevation	Description	
1	630510.848	1041264.192	108.700	MON 1	
2	630723.074	1041303.474	97.530	MON 2	
3	630742.546	1041197.847	97.850	MON 3	
4	630948.856	1041274.414	89.530	MON 4	
5	630538.426	1041002.494	109.940	MON 5	
6	630526.824	1040738.284	110.160	MON 6	
7	630557.482	1040410.999	112.730	MON 7	
8	630332.834	1040217.963	116.050	MON 8	
9	630315.255	1040398.075	119.310	MON 9	
10	630221.635	1040644.089	116.440	MON 10	
11	629855.041	1040647.933	125.380	MON 11	
12	629690.236	1040474.464	130.460	MON 12	
13	629511.792	1040705.636	130.610	MON 13	
14	629619.926	1040846.609	132.480	MON 14	
15	629859.646	1041095.385	125.660	MON 15	
16	630137.499	1041106.850	117.450	MON 16	
106	630430.900	1041523.690	108.930	MON 106	
108	630225.460	1041291.650	118.090	MON 108	
1001	631068.305	1041324.622	95.450	PRISM S_1	
1002	630986.083	1041239.385	91.820	MON S_2	
1003	630842.834	1041227.230	93.020	MON S_3	
1004	630769.979	1041190.319	97.800	MON S_4	
1005	630737.138	1041145.414	98.660	MON S_5	
1006	630720.918	1041220.785	109.970	PRISM S_6	
1007	630585.974	1041139.247	115.060	PRISM S_7	
1008	630466.042	1041011.992	128.760	PRISM S_8	
1009	630473.446	1040766.939	128.800	PRISM S_9	
1010	630597.679	1040891.156	108.420	MON S_10	
1011	630587.466	1040538.345	110.530	MON 11	
1012	630581.278	1040412.872	112.610	MON S_12	
1013	630416.781	1040172.523	99.120	MON S_13	
1014	630325.599	1040147.306	102.760	PRISM S_14	
1015	630084.368	1040271.902	142.910	PRISM S_15	
1017	629669.067	1040563.785	147.040	PRISM S_17	
1018	629616.073	1040578.355	127.560	MON S_18	
1019	629462.647	1040753.692	157.910	PRISM S_19	
1020	629461.150	1040749.885	132.070	MON S_20	
1021	629414.912	1040804.433	150.530	PRISM S_21	
1022	630477.036	1040752.801	115.680	MON S_22	
1023	630468.511	1041022.455	115.530	MON S_23	
1024	630710.860	1041222.315	98.790	MON S_24	
1025	630594.298	1041197.092	102.570	MON S_25	

Loop 2				
Date:	May-10	Crew:	DS/BS	
Number	Northing	Easting	Elevation	Description
1	630510.841	1041264.192	108.720	MON 1
2	630723.062	1041303.484	97.550	MON 2
3	630742.541	1041197.860	97.880	MON 3
4	630948.842	1041274.429	89.520	MON 4
5	630538.429	1041002.500	109.950	MON 5
6	630526.830	1040738.284	110.180	MON 6
7	630557.500	1040411.004	112.750	MON 7
8	630332.855	1040217.960	116.090	MON 8
9	630315.270	1040398.073	119.330	MON 9
10	630221.644	1040644.084	116.450	MON 10
11	629855.047	1040647.934	125.380	MON 11
12	629690.229	1040474.473	130.470	MON 12
13	629511.796	1040705.651	130.610	MON 13
14	629619.931	1040846.617	132.470	MON 14
15	629859.647	1041095.390	125.650	MON 15
16	630137.496	1041106.853	117.440	MON 16
106	630430.900	1041523.690	108.930	MON 106
108	630225.460	1041291.650	118.090	MON 108
1001	631068.290	1041324.638	95.450	PRISM S_1
1002	630986.062	1041239.393	91.810	MON S_2
1003	630842.821	1041227.249	93.030	MON S_3
1004	630769.975	1041190.331	97.820	MON S_4
1005	630737.133	1041145.430	98.680	MON S_5
1006	630720.914	1041220.798	109.990	PRISM S_6
1007	630585.965	1041139.242	115.070	PRISM S_7
1008	630466.046	1041011.991	128.780	PRISM S_8
1009	630473.456	1040766.940	128.820	PRISM S_9
1010	630597.693	1040891.162	108.440	MON S_10
1011	630587.458	1040538.344	110.540	MON 11
1012	630581.292	1040412.883	112.620	MON S_12
1013	630416.821	1040172.523	99.160	MON S_13
1014	630325.619	1040147.306	102.790	PRISM S_14
1015	630084.389	1040271.894	142.930	PRISM S_15
1017	629669.067	1040563.789	147.050	PRISM S_17
1018	629616.081	1040578.376	127.570	MON S_18
1019	629462.651	1040753.704	157.920	PRISM S_19
1020	629461.147	1040749.898	132.070	MON S_20
1021	629414.916	1040804.449	150.530	PRISM S_21
1022	630477.044	1040752.805	115.690	MON S_22
1023	630468.515	1041022.463	115.550	MON S_23
1024	630710.856	1041222.327	98.800	MON S_24
1025	630594.295	1041197.095	102.600	MON S_25

Comparisons

Number	Delta Loop 1-Loop 2 Northing	Delta Loop 1-Loop 2 Easting	Horizontal Dist
1	-0.007	0.000	0.007
2	-0.012	0.010	0.016
3	-0.004	0.013	0.014
4	-0.014	0.015	0.020
5	0.003	0.006	0.006
6	0.005	0.000	0.005
7	0.018	0.004	0.019
8	0.021	-0.003	0.021
9	0.014	-0.002	0.014
10	0.008	-0.005	0.010
11	0.006	0.000	0.006
12	-0.007	0.009	0.011
13	0.003	0.015	0.015
14	0.005	0.008	0.010
15	0.001	0.005	0.005
16	-0.003	0.003	0.004
106	0.000	0.000	0.000
108	0.000	0.000	0.000
1001	-0.015	0.016	0.021
1002	-0.021	0.008	0.022
1003	-0.013	0.019	0.023
1004	-0.003	0.012	0.012
1005	-0.005	0.016	0.017
1006	-0.004	0.012	0.013
1007	-0.009	-0.005	0.010
1008	0.004	-0.001	0.004
1009	0.009	0.001	0.009
1010	0.014	0.006	0.015
1011	-0.008	-0.001	0.008
1012	0.013	0.011	0.017
1013	0.040	0.000	0.040
1014	0.020	0.000	0.020
1015	0.021	-0.008	0.022
1017	0.000	0.003	0.003
1018	0.008	0.021	0.022
1019	0.005	0.012	0.013
1020	-0.003	0.012	0.013
1021	0.005	0.016	0.017
1022	0.008	0.004	0.009
1023	0.004	0.008	0.009
1024	-0.004	0.012	0.013
1025	-0.003	0.003	0.004

DB=2588 Control Loop 2

FB = LOOP 2.FbK

```
                         loop2 Raw Closure.trv
Angular error       = 0-00-05
Angular error/set   = 0-00-00 Over
Elevation error : -0.0054
Error North     : 0.0463
Error East      : -0.0260
Absolute error  : 0.0532
Error Direction : N 29-19-50 W
Perimeter       : 3895.2832
Precision       : 1 in 73275.2862
Number of sides : 15
Area            : 591245.6 sq. ft. , 13.5731 Acres


Closure at other Traverse Points -----
Attention is called to maxima-minima separations
Point      Separation Distance
108           0.0532
1             0.0565
2             0.0607
3             0.0589
5             0.0517
6             0.0466
7             0.0419
9             0.0368
10            0.0395
11            0.0341
12            0.0282
13            0.0323
14            0.0365
15            0.0446
16            0.0479
108           0.0532
Angular error (if any) most probable at point 12
```

```
                              loop2 Balanced Angles.trv
                  RAW   TRAVERSE       No RULE - Balanced Angles
       Point        Coordinates            Coordinates                Delta
       108       N    630225.4600      N    630225.4600          0.0000
                 E   1041291.6500      E   1041291.6500
N 05-29-43 W  Dist:286.7028
       1         N    630510.8451      N    630510.8451          0.0000
                 E   1041264.1937      E   1041264.1937
N 10-29-13 E  Dist:215.8294
       2         N    630723.0692      N    630723.0693          0.0004
                 E   1041303.4776      E   1041303.4773
N 79-33-20 W  Dist:107.4056
       3         N    630742.5402      N    630742.5399          0.0005
                 E   1041197.8517      E   1041197.8513
S 43-44-32 W  Dist:282.5386
       5         N    630538.4190      N    630538.4177          0.0014
                 E   1041002.4992      E   1041002.4998
S 87-29-07 W  Dist:264.4631
       6         N    630526.8167      N    630526.8136          0.0032
                 E   1040738.2907      E   1040738.2914
N 84-38-57 W  Dist:328.7148
       7         N    630557.4739      N    630557.4680          0.0059
                 E   1040411.0086      E   1040411.0091
S 03-03-13 W  Dist:242.5730
       9         N    630315.2456      N    630315.2395          0.0067
                 E   1040398.0837      E   1040398.0866
S 69-09-55 E  Dist:263.2275
       10        N    630221.6201      N    630221.6170          0.0051
                 E   1040644.0979      E   1040644.1020
S 00-36-04 E  Dist:366.6179
       11        N    629855.0223      N    629855.0193          0.0095
                 E   1040647.9396      E   1040647.9487
S 46-28-00 W  Dist:239.2752
       12        N    629690.2178      N    629690.2121          0.0129
                 E   1040474.4690      E   1040474.4805
S 52-20-06 E  Dist:292.0354
       13        N    629511.7674      N    629511.7657          0.0147
                 E   1040705.6403      E   1040705.6549
N 52-30-38 E  Dist:177.6689
       14        N    629619.8970      N    629619.8979          0.0126
                 E   1040846.6163      E   1040846.6289
N 46-03-46 E  Dist:345.4775
       15        N    629859.6082      N    629859.6142          0.0097
                 E   1041095.3998      E   1041095.4075
N 02-21-48 E  Dist:278.0872
       16        N    630137.4587      N    630137.4649          0.0064
                 E   1041106.8728      E   1041106.8744
N 64-32-49 E  Dist:204.6663
       108       N    630225.4137      N    630225.4243          0.0107
                 E   1041291.6760      E   1041291.6754
Angular error      = 0-00-00
Angular error/set  = 0-00-00 Under
Elevation error : -0.0054
Error North     : 0.0357
Error East      : -0.0254
Absolute error  : 0.0438
Error Direction : N 35-30-06 W
Perimeter       : 3895.2832
Precision       : 1 in 88887.3502
Number of sides : 15
Area            : 591240.1 sq. ft. , 13.5730 Acres
```

```
                                        loop2.lso
                    RAW   TRAVERSE        COMPASS RULE - Balanced Angles
      Point           Coordinates              Coordinates              Delta
      108           N     630225.4600     N     630225.4600  108        0.0000
                    E    1041291.6500     E    1041291.6500
N 05-29-45 W   Dist:286.7056
        1           N     630510.8451     N     630510.8477  1          0.0032
                    E    1041264.1937     E    1041264.1918
N 10-29-12 E   Dist:215.8310
        2           N     630723.0692     N     630723.0739  2          0.0059
                    E    1041303.4776     E    1041303.4740
N 79-33-19 W   Dist:107.4064
        3           N     630742.5402     N     630742.5455  3          0.0069
                    E    1041197.8517     E    1041197.8473
S 43-44-34 W   Dist:282.5380
        5           N     630538.4190     N     630538.4259  5          0.0086
                    E    1041002.4992     E    1041002.4940
S 87-29-09 W   Dist:264.4647
        6           N     630526.8167     N     630526.8242  6          0.0102
                    E    1040738.2907     E    1040738.2839
N 84-38-55 W   Dist:328.7172
        7           N     630557.4739     N     630557.4817  7          0.0121
                    E    1040411.0086     E    1040410.9994
S 03-03-15 W   Dist:242.5708
        9           N     630315.2456     N     630315.2554  9          0.0129
                    E    1040398.0837     E    1040398.0753
S 69-09-57 E   Dist:263.2251
       10           N     630221.6201     N     630221.6352  10         0.0176
                    E    1040644.0979     E    1040644.0889
S 00-36-03 E   Dist:366.6145
       11           N     629855.0223     N     629855.0409  11         0.0196
                    E    1040647.9396     E    1040647.9333
S 46-28-02 W   Dist:239.2748
       12           N     629690.2178     N     629690.2359  12         0.0189
                    E    1040474.4690     E    1040474.4636
S 52-20-07 E   Dist:292.0323
       13           N     629511.7674     N     629511.7921  13         0.0251
                    E    1040705.6403     E    1040705.6360
N 52-30-35 E   Dist:177.6690
       14           N     629619.8970     N     629619.9260  14         0.0299
                    E    1040846.6163     E    1040846.6088
N 46-03-44 E   Dist:345.4780
       15           N     629859.6082     N     629859.6455  15         0.0400
                    E    1041095.3998     E    1041095.3852
N 02-21-46 E   Dist:278.0897
       16           N     630137.4587     N     630137.4987  16         0.0460
                    E    1041106.8728     E    1041106.8502
N 64-32-47 E   Dist:204.6659
      108           N     630225.4137     N     630225.4600  108        0.0532
                    E    1041291.6760     E    1041291.6500
Area             : 591223.2 sq. ft. , 13.5726 Acres
```

loop2 Vertical Adjustment.trv

	RAW	LENGTH WEIGHTED DISTRIBUTION RULE	
Point	Elevation	Elevation	Delta
108	118.0900	118.0900	0.0000
1	108.7047	108.7043	-0.0004
2	97.5262	97.5255	-0.0007
3	97.8553	97.8545	-0.0008
5	109.9381	109.9368	-0.0012
6	110.1618	110.1602	-0.0016
7	112.7346	112.7325	-0.0021
9	119.3160	119.3137	-0.0024
10	116.4406	116.4378	-0.0028
11	125.3785	125.3752	-0.0033
12	130.4657	130.4622	-0.0036
13	130.6110	130.6070	-0.0040
14	132.4847	132.4805	-0.0042
15	125.6630	125.6583	-0.0047
16	117.4569	117.4518	-0.0051
108	118.0954	118.0900	-0.0054

DB = 2588 Control Loop

FB = LOOP1.FBK

```
Angular error       = -0-00-01
Angular error/set   = 0-00-00 Under
Elevation error : -0.0485
Error North     : -0.0189
Error East      : -0.0265
Absolute error  : 0.0325
Error Direction : S 54-33-38 W
Perimeter       : 3895.2669
Precision       : 1 in 119694.7408
Number of sides : 15
Area            : 591218.3 sq. ft. , 13.5725 Acres


Closure at other Traverse Points -----
Attention is called to maxima-minima separations
Point      Separation Distance
108           0.0325
1             0.0308
2             0.0298
3             0.0292
5             0.0295
6             0.0285
7             0.0272
9             0.0287
10            0.0301
11            0.0325
12            0.0330
13            0.0349
14            0.0346
15            0.0340
16            0.0323
108           0.0325
Possible distance error in leg : 13 - 14
Angular error (if any) most probable at point 7
```

```
                           loop1 control Balanced Angles.trv
                  RAW   TRAVERSE        NO RULE - Balanced Angles
      Point          Coordinates              Coordinates              Delta
       108        N     630225.4600      N     630225.4600            0.0000
                  E    1041291.6500      E    1041291.6500
N 05-29-43 W   Dist:286.6995
        1         N     630510.8418      N     630510.8418            0.0000
                  E    1041264.1940      E    1041264.1940
N 10-29-23 E   Dist:215.8289
        2         N     630723.0637      N     630723.0637            0.0001
                  E    1041303.4871      E    1041303.4872
N 79-33-01 W   Dist:107.4041
        3         N     630742.5437      N     630742.5437            0.0001
                  E    1041197.8643      E    1041197.8644
S 43-44-41 W   Dist:282.5359
        5         N     630538.4320      N     630538.4323            0.0004
                  E    1041002.5058      E    1041002.5056
S 87-29-11 W   Dist:264.4684
        6         N     630526.8333      N     630526.8342            0.0009
                  E    1040738.2918      E    1040738.2916
N 84-38-45 W   Dist:328.7117
        7         N     630557.5045      N     630557.5062            0.0017
                  E    1040411.0141      E    1040411.0140
S 03-03-19 W   Dist:242.5745
        9         N     630315.2748      N     630315.2765            0.0019
                  E    1040398.0856      E    1040398.0848
S 69-09-53 E   Dist:263.2263
       10         N     630221.6510      N     630221.6519            0.0014
                  E    1040644.0991      E    1040644.0980
S 00-36-07 E   Dist:366.6158
       11         N     629855.0554      N     629855.0563            0.0027
                  E    1040647.9524      E    1040647.9498
S 46-27-49 W   Dist:239.2754
       12         N     629690.2381      N     629690.2397            0.0036
                  E    1040474.4935      E    1040474.4903
S 52-20-16 E   Dist:292.0317
       13         N     629511.8068      N     629511.8073            0.0041
                  E    1040705.6748      E    1040705.6707
N 52-30-30 E   Dist:177.6660
       14         N     629619.9435      N     629619.9433            0.0035
                  E    1040846.6418      E    1040846.6382
N 46-03-44 E   Dist:345.4759
       15         N     629859.6624      N     629859.6607            0.0027
                  E    1041095.4157      E    1041095.4135
N 02-21-46 E   Dist:278.0866
       16         N     630137.5126      N     630137.5108            0.0018
                  E    1041106.8790      E    1041106.8786
N 64-32-43 E   Dist:204.6661
       108        N     630225.4789      N     630225.4759            0.0030
                  E    1041291.6765      E    1041291.6767
Angular error      = 0-00-00
Angular error/set  = 0-00-00 Over
Elevation error : -0.0485
Error North     : -0.0159
Error East      : -0.0267
Absolute error  : 0.0310
Error Direction : S 59-15-11 W
Perimeter       : 3895.2669
Precision       : 1 in 125476.9054
Number of sides : 15
Area            : 591219.8 sq. ft. , 13.5725 Acres
```

```
                               loop1 control.lso
                RAW   TRAVERSE       COMPASS RULE - Balanced Angles
     Point        Coordinates             Coordinates              Delta
      108        N     630225.4600     N     630225.4600           0.0000
                 E    1041291.6500     E    1041291.6500
N 05-29-45 W  Dist:286.6985
        1        N     630510.8418     N     630510.8406           0.0023
                 E    1041264.1940     E    1041264.1920
N 10-29-21 E  Dist:215.8278
        2        N     630723.0637     N     630723.0616           0.0039
                 E    1041303.4871     E    1041303.4838
N 79-33-02 W  Dist:107.4048
        3        N     630742.5437     N     630742.5412           0.0047
                 E    1041197.8643     E    1041197.8603
S 43-44-42 W  Dist:282.5380
        5        N     630538.4320     N     630538.4287           0.0071
                 E    1041002.5058     E    1041002.4995
S 87-29-11 W  Dist:264.4703
        6        N     630526.8333     N     630526.8295           0.0090
                 E    1040738.2918     E    1040738.2837
N 84-38-46 W  Dist:328.7139
        7        N     630557.5045     N     630557.5001           0.0112
                 E    1040411.0141     E    1040411.0038
S 03-03-21 W  Dist:242.5755
        9        N     630315.2748     N     630315.2695           0.0137
                 E    1040398.0856     E    1040398.0729
S 69-09-52 E  Dist:263.2250
       10        N     630221.6510     N     630221.6437           0.0165
                 E    1040644.0991     E    1040644.0843
S 00-36-06 E  Dist:366.6173
       11        N     629855.0554     N     629855.0466           0.0206
                 E    1040647.9524     E    1040647.9337
S 46-27-49 W  Dist:239.2773
       12        N     629690.2381     N     629690.2291           0.0229
                 E    1040474.4935     E    1040474.4725
S 52-20-15 E  Dist:292.0309
       13        N     629511.8068     N     629511.7955           0.0264
                 E    1040705.6748     E    1040705.6509
N 52-30-29 E  Dist:177.6646
       14        N     629619.9435     N     629619.9308           0.0277
                 E    1040846.6418     E    1040846.6172
N 46-03-44 E  Dist:345.4732
       15        N     629859.6624     N     629859.6468           0.0299
                 E    1041095.4157     E    1041095.3902
N 02-21-45 E  Dist:278.0854
       16        N     630137.5126     N     630137.4958           0.0307
                 E    1041106.8790     E    1041106.8533
N 64-32-43 E  Dist:204.6644
      108        N     630225.4789     N     630225.4600           0.0325
                 E    1041291.6765     E    1041291.6500
Area             : 591225.6 sq. ft. , 13.5727 Acres
```

Capitol Campus
Hillside Monitoring
Survey Monumentation Report

Golder Associates

Washington State Department of
General Administration

3/10/11

BLAIR E. PRIGGE
STATE OF WASHINGTON
29278
REGISTERED
PROFESSIONAL LAND SURVEYOR

February 15, 2011

Parametrix

Capitol Campus Hillside Monitoring Survey Monumentation Report

Prepared for

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and

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February 15, 2011 | 247-2588-003

CITATION

Parametrix. 2011. Capitol Campus, Hillside Monitoring Survey Monumentation Report. Prepared by Parametrix, Puyallup, Washington. February 15, 2011.

TABLE OF CONTENTS

1. BACKGROUND

June 2010

Parametrix (PMX) was subcontracted by Golder Associates to set monuments at strategic locations along the Capitol Campus hillside for slope movement monitoring. Parametrix worked with Katy Cottingham (Golder), Frank Shuri (Golder), Vikki Poitra (Department of General Administration [GA]) and Nathaniel Jones (GA) to determine the placement of the monuments. Eight of the monuments are survey prism reflectors mounted to strategic locations on the buildings near the hillside. A total of 25 monitoring points exist.

Parametrix used conventional survey equipment to complete a high accuracy control loop through the campus to locate (n, e, and el) on each of the monitoring points. Levels were completed through all of the ground based monuments.

January 2011

Parametrix was subcontracted by Golder Associates to measure previously set monuments and reset monuments which were destroyed or disturbed.

2. METHODOLOGY (PROCEDURES)

Parametrix reviewed a number of methods for measuring the location and possible movement of the settlement monitoring points. We used a closed traverse loop with levels for elevation approach because of the accuracies being requested. The accuracy requested is 0.02 foot maximum.

Primary Starting Points – The primary starting points for the survey would be Parametrix Points 108 and 106. Point 108 is a Thurston County monument set in the curb line near the Winged Victory Statue, and Point 106 is a control point Parametrix set while completing an earlier project for General Administration. The coordinates for these points can be found in Appendix B (Hillside Monitoring Control Map).

A closed loop was completed, starting at Point 108, back sighting 106, traversing through 1, 2, 3, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, back to 108, and closing the angle to Point 1.

From these main control points the settlement monitoring points were located turning one set of angles (bffb).

June 2010

The above work was completed with a Leica TCRA 1103 PLUS Robotic Total Station, Serial No. 252798. The levels were completed with a Leica NA 2002 Digital Level, Serial No. 93526.

January 2011

The above work was completed with a Leica TCRA 1103 PLUS Robotic Total Station, Serial No. 252798. The levels were completed with a Trimble DINI 12 Digital Level.

3. RESULTS

Traverse No. 1

The closure for the first traverse was 1:120,000 raw closure. This is a closing error of 0.032 foot over 3,900 linear feet of traverse. The level loop closure was 0.006 foot.

Traverse No. 2

The closure for the second traverse was 1:73,000 raw closure. This is a closing error of 0.053 foot over 3,900 linear feet of traverse. A level loop was not completed this time. A comparison was completed between levels and trig elevations, and the maximum difference observed was 0.015 foot.

The coordinates for both loops are shown in the appendices as well as their differences, which are very small.

January 2011

The closure for the January 2011 traverse was 1:107,000 raw closure. This is a closing error of 0.034 foot over 3,900 linear feet of traverse. A level loop closure was 0.02 foot.

APPENDIX A

Monument Descriptions

MONUMENT DESCRIPTIONS

The following are the descriptions of the monuments set for the settlement monitoring points:

S-1

Set stationary prism under second ledge from the ground on the west face, at the northwest corner of the General Administration Building. PMX Point No. 1001.

S-2

Set 3-1/2-inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. The pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. The cap is stamped S-2. Location is top of hillside, 25 feet north 27 degrees west of west end of handrail of steps at west side of parking area at west entrance to General Administration Building. PMX Point No. 1002.

S-3

Set 3-1/2-inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. The pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. The cap is stamped S-3. Location is 2.2 feet east of west fence line, +/-35 feet south of angle point on the west side of the General Administration Building. PMX Point No. 1003.

S-3I

Set chiseled "x" with punch in south end of "I" beam, which is part of the soldier pile wall. "I" beam is closest one to S-3.

S-4

Set 3-1/2-inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. The pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. The cap is stamped S-4. Location is 0.4 foot north of north edge of pavement and +/-30 feet west of northwest fence corner of GA Maintenance Shop. PMX Point No. 1004.

S-4I

Set chiseled "x" with punch in south end of "I" beam which is part of the soldier pile wall. "I" beam is closest one to S-3.

S-5

Set 3-1/2-inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. The pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. The cap is stamped S-5. Location is 0.5 foot east of west edge of pavement, 3 feet south of northwest corner of westerly fence line at GA Maintenance Shop. PMX Point No. 1005.

S-6

Set stationary prism under floodlight on west face of building at northwest corner of GA Maintenance Shop. PMX Point No. 1006.

S-7

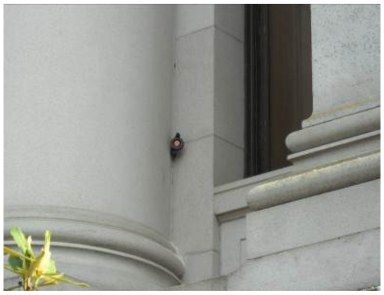
Set stationary prism +/-3 feet below gutterline on west face of northwest corner of Green House. PMX Point No. 1007.

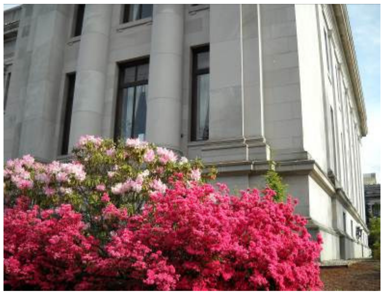
S-8

Set stationary prism in easterly corner of northerly second floor window at the northeast corner of Temple of Justice building. PMX Point No. 1008.

S-9

Set stationary prism in easterly corner of northerly second floor window at the northwest corner of Temple of Justice building. PMX Point No. 1009.





S-10

Set "L" shaped bracket just below the marble cap on the north face of the Law Enforcement Memorial. Monument is aluminum bracket with drilled point. PMX Point No. 1010.

S-11

Set 3-1/2-inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. The pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. The cap is stamped S-11. Location is 9 feet behind the north back of curb in line with westerly stripe of first parking stall west of handicap stalls at northeast corner of westerly parking lot. PMX Point No. 1011.



S-12

Set 3-1/2-inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. The pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. The cap is stamped S-12. Location is 0.8 foot north of north back of walk in line with the centerline of northbound drive lane in westerly parking lot. PMX Point No. 1012.


S-13

Set 3-1/2-inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. The pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. The cap is stamped S-13. Location is 1.5 feet north of the north edge of concrete, 2.5 feet east of the top stair of stairway to steam plant. Monument is 0.5 foot exposed. PMX Point No. 1013.


S-14

Set 12-foot long, 3-inch-square aluminum pole 4 feet into the ground on west bank of hillside above the powerhouse and south of S-13. Aluminum pole has prism mounted on the top. PMX Point No. 1014.

S-15

Set stationary prism above floodlight and below gable end vent on north side of Governor's garage. PMX Point No. 1015.

S-16

Set 3-1/2-inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. The pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. The cap is stamped S-16. Location is +/-5 feet northeasterly of top of hillside, 6.4 feet north 54 degrees east from 30-inch-diameter maple multi-trunk tree, off the west side of the O'Brien Building. PMX Point No. 1016.

S-17

Set stationary prism on the west face of second floor at southwest corner of O'Brien Building, 1 foot above second floor ledge. PMX Point No. 1017.



S-18

Epoxied 2-inch-diameter brass disk to northeast side of manhole collar. Manhole located near the middle of the southwest side of the O'Brien Building. Collar is roughly 6 inches below the lid. PMX Point No. 1018.



S-19

Set stationary prism under roof eve at the southwesterly corner of the Pritchard (Library) Building. PMX Point No. 1019.


S-20

Set 2-inch-diameter brass disk in sidewalk, 0.4 foot east of west edge of concrete at southwesterly corner of Pritchard (Library) Building. PMX Point No. 1020.



S-21

Set stationary prism on westerly face of Pritchard (Library) Building, southerly section of the building at the southwesterly corner, +/-15 feet above the ground. PMX Point No. 1021.

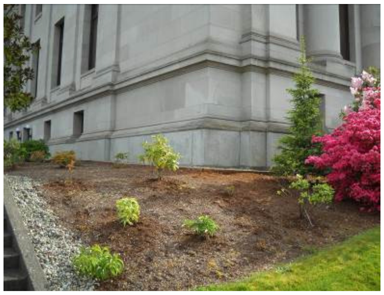

S-22

Set 2-inch-diameter brass disk in foundation of Temple of Justice building at northwest corner. PMX Point No. 1022.



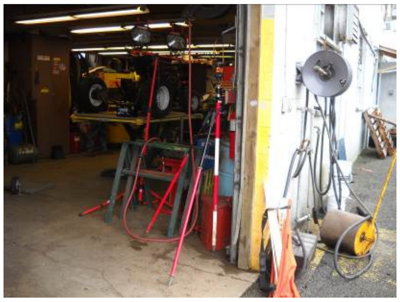
S-23

Set 2 inch diameter brass disk in foundation of Temple of Justice building at northeast corner. PMX Point No. 1023.

S-24

Found 2-inch brass disk 0.6 foot east of the southerly garage door track in concrete floor of GA Maintenance Shop. PMX Point No. 1024.

S-25

Found 2-inch brass disk 0.4 foot east of the northeast corner of the Green House Addition. PMX Point No. 1025.

South edge of steam plant smokestack as observed from PMX-8.

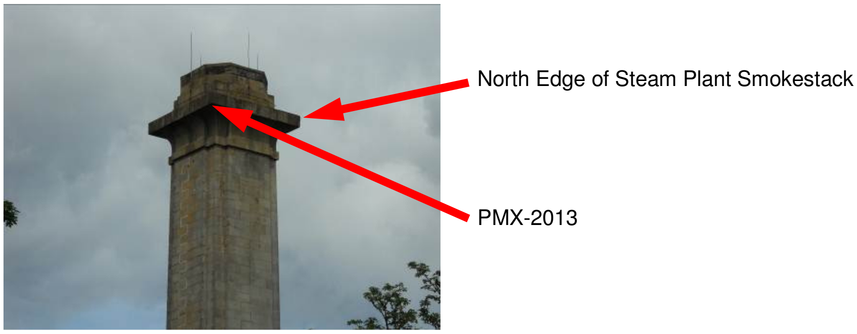
North edge of steam plant smokestack as observed from PMX-8.

S-26

Set mag nail and washer in edge of concrete pad for gas valves.

PMX-2013

Located bottom edge easterly corner of steam plant smokestack.



The following are the descriptions of the monuments used for locating the settlement monitoring points.

PMX-108

Found 3-1/2-inch brass disk set in the east side of Winged Victory circular curb line. This is Thurston County GPS STA SOLDIERS. PMX Point No. 108.

PMX-106

Found 3-1/2-inch brass disk marked “Capitol Campus Survey Control, June 2008, #106” on the north side of the North Diagonal, 9 feet north of a catch basin and 31 feet west of a light pole. PMX Point No. 106.

PMX-1

Set 2-inch-diameter brass disk 0.5 foot south of the northerly edge of concrete walk at the northerly entrance to Rose garden. Monument is stamped PMX 1. PMX Point No. 1.

PMX-2

Set 3-1/2-inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. Pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. Cap is stamped PMX-2. Located west of the west edge of sidewalk and +/-15 feet west of 28-inch-diameter cedar tree that is across the street from the GA Maintenance Shop. PMX Point No. 2. (Destroyed by construction. January 2011. Set new Point PMX 17.)

PMX-3

Set 2-inch-diameter aluminum monument on 5/8-inch rebar driven in the asphalt parking lot, 22 feet north 28 degrees east of catch basin in back of GA Maintenance Shop. Monument is stamped PMX-3. PMX Point No. 3.

PMX-4

Set a 2-inch-long Mag Nail, 1.2 feet east of center post at west side of concrete walk off the west side of the GA Building. Nail is stamped PMX-4. PMX Point No. 4.

PMX-5

Set 2-inch-diameter aluminum monument on 5/8-inch rebar set 9.5 feet south of the face of curb on north side of parking between assigned parking spaces TJ 106 and TJ 107. Monument is stamped PMX-5. PMX Point No. 5.

PMX-6

Set 2-inch-diameter aluminum monument on 5/8-inch rebar 0.4 foot east of east edge of crosswalk and 9 feet north of south curb line at crosswalk at northwest corner of Temple of Justice building. Monument is stamped PMX-6. PMX Point No. 6.

PMX-7

Set 2-inch-diameter brass disk at the centerline of north bound lane of parking lot and 4 feet south of parking stripe to the north. Disk is stamped PMX-7. PMX Point No. 7.

PMX-8

Set 2-inch-diameter brass disk 1 foot south and 1 foot east of northwest corner of concrete compost pad. Disk is stamped PMX-8. PMX Point No. 8.

PMX-9

Set 2-inch-diameter brass disk 5.5 feet northeast of center of westerly curb return at easterly entrance to State Patrol parking. Disk is stamped PMX-9. PMX Point No. 9. (Destroyed during construction. January 2011. Set new Point PMX 18.)

PMX-10

Found previously set monument No. 103, set June 2008, 0.5 foot southeast of southeast curb return and 5 feet west of west edge of crosswalk. Monument is stamped PMX-10. PMX Point No. 10. (Destroyed during construction. January 2011. Set new Point PMX 19.)


PMX-11

Set 2-inch-diameter brass disk in concrete walk +/-23 feet south of stairs to Governor's Mansion and 7 feet west of curb face. Disk is stamped PMX-11. PMX Point No. 11.


PMX-12

Also known as S-16 and also stamped as PMX-12.


PMX-13

Set 3-1/2-inch-diameter aluminum cap on 30-inch-long, 2-inch-diameter aluminum pipe with flared ends. Pipe is set in the ground with a 60-pound sack of concrete, then backfilled with native material. Cap is stamped PMX-13. Located +/-11 feet, south 25 degrees east from the southeast corner of smoking area covered shelter at northwest corner of Library. PMX Point No. 13.

PMX-14

Set 2-inch-diameter brass disk in concrete walk +/-10 feet west of west corner of sundial monument. Disk is stamped PMX-14. PMX Point No. 14.

PMX-15

Set temporary Mag Nail in walk. Removed after survey. PMX Point No. 15.

PMX-16

Set temporary Mag Nail in walk. Removed after survey. PMX Point No. 16.

PMX-17

Set 2-inch aluminum monument on rebar in concrete. Set at NE corner of walkway across from GA Maintenance Shop. Disk is stamped PMX-17. PMX Point No. 17.

PMX-18

Set 2-inch aluminum monument on rebar in concrete. Set in south side of west parking lot, 6 feet east of catch basin north of State Patrol Parking area. Disk is stamped PMX-18. PMX Point No. 18.

PMX-19

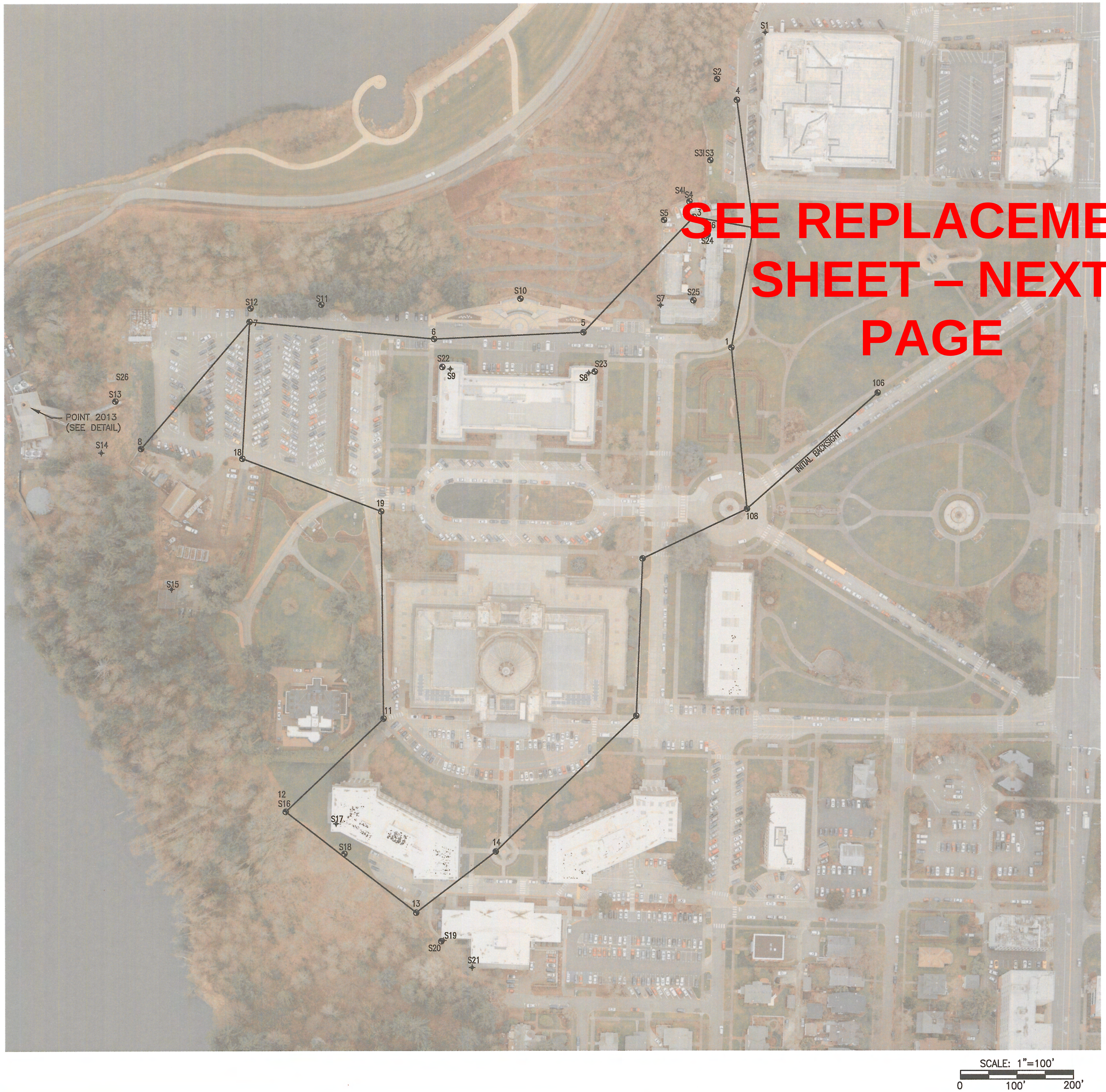
Set 2-inch aluminum monument on rebar in concrete. Set in center of landscape area at southeast quadrant of Governor’s Mansion, south parking lot, Temple of Justice parking lot and Legislative Building. Disk is stamped PMX-19. PMX Point No. 19.

PMX-20, PMX-21, PMX-22

Set temporary PK Nails to close traverse.

APPENDIX B

Hillside Monitoring Control Map Sheet V1 Dated June 21, 2010



Point	Northing	Easting	Elevation	Description
S1	631068.2881	1041324.6440	95.441	Set stationary prism under second ledge from the ground on the west face, at the northwest corner of the General Administration Building. PMX point number 1001.
S2	630986.0711	1041239.4030	91.798	Set 3 ½ inch diameter aluminum cap on 30 inch long, 2 inch diameter aluminum pipe with flared ends. Pipe is set in the ground with 60lb sack of concrete then backfilled with native material. Cap is stamped S-2. Location is top of hillside, 25 feet North 27° West of west end of handrail of steps at west side of parking area at west entrance to General Administration Building. PMX point number 1002.
S3	630842.8343	1041227.2300	93.005	Set 3 ½ inch diameter aluminum cap on 30 inch long, 2 inch diameter aluminum pipe with flared ends. Pipe is set in the ground with 60lb sack of concrete then backfilled with native material. Cap is stamped S-3. Location is 2.2 feet east of west fence line, +/-35 feet south of angle point on the west side of the General Administration Building. PMX point number 1003.
S4	630769.9786	1041190.3190	97.780	Set 3 ½ inch diameter aluminum cap on 30 inch long, 2 inch diameter aluminum pipe with flared ends. Pipe is set in the ground with 60lb sack of concrete then backfilled with native material. Cap is stamped S-4. Location is 0.4 feet north of north edge of pavement and +/- 30 feet west of northwest fence corner of GA Maintenance Shop. PMX point number 1004.
S5	630737.1383	1041145.4130	98.646	Set 3 ½ inch diameter aluminum cap on 30 inch long, 2 inch diameter aluminum pipe with flared ends. Pipe is set in the ground with 60lb sack of concrete then backfilled with native material. Cap is stamped S-5. Location is 0.5 feet east of west edge of pavement, 3 feet south of northwest corner of westerly fence line at GA Maintenance Shop. PMX point number 1005.
S6	630720.9176	1041220.7850	109.974	Set stationary prism under flood light on west face of building at northwest corner of GA Maintenance Shop. PMX point number 1006.
S7	630585.9741	1041139.2470	115.061	Set stationary prism +/- 3 feet below gutterline on west face of northwest corner of Green House. PMX point number 1007.
S8	630466.0420	1041011.9920	128.768	Set stationary prism in easterly corner of northerly 2nd floor window at the northeast corner of Temple of Justice building. PMX point number 1008.
S9	630473.4463	1040766.9390	128.790	Set stationary prism in easterly corner of northerly 2nd floor window at the northwest corner of Temple of Justice building. PMX point number 1009.
S10	630597.6792	1040891.1560	108.430	Set "L" shaped bracket just below the mable cap on the north face of the Law Enforcement Memorial. Monument is aluminum bracket with drilled point. Parametrix point number 1010.
S11	630587.4658	1040538.3440	110.526	Set 3 ½ inch diameter aluminum cap on 30 inch long, 2 inch diameter aluminum pipe with flared ends. Pipe is set in the ground with 60lb sack of concrete then backfilled with native material. Cap is stamped S-11. Location is 9 feet behind the north back of curb inline with westerly stripe of first parking stall west of handicap stalls at northeast corner of westerly parking lot. PMX point number 1011.
S12	630581.2783	1040412.8720	112.594	Set 3 ½ inch diameter aluminum cap on 30 inch long, 2 inch diameter aluminum pipe with flared ends. Pipe is set in the ground with 60lb sack of concrete then backfilled with native material. Cap is stamped S-12. Location is 0.8 feet north of north back of walk in line with the centerline of north bound drive lane in westerly parking lot. PMX point number 1012.
S13	630416.8041	1040172.5240	99.115	Set 3 ½ inch diameter aluminum cap on 30 inch long, 2 inch diameter aluminum pipe with flared ends. Pipe is set in the ground with 60lb sack of concrete then backfilled with native material. Cap is stamped S-13. Location is 1.5 feet north of the north edge of concrete, 2.5 feet east of the top stair of stairway to steam plant. Monument is 0.5 feet exposed. PMX point number 1013.
S14	630325.6231	1040147.3030	102.776	Set 12 foot long 3 inch square aluminum pole four feet into the ground on west bank of hillside above the powerhouse and south of S-13. Aluminum pole has prism mounted on the top. PMX point number 1014.
S15	630084.3683	1040271.9020	142.906	Set stationary prism above flood light and below gable end vent on north side of Governor's garage. PMX point number 1015.
S16	629690.2359	1040474.4640	130.460	Set 3 ½ inch diameter aluminum cap on 30 inch long, 2 inch diameter aluminum pipe with flared ends. Pipe is set in the ground with 60lb sack of concrete then backfilled with native material. Cap is stamped S-16. Location is +/-5 feet northeasterly of top of hillside, 6.4 feet North 54°East from 30 inch diameter Maple multitrunk tree, off the west side of the O'Brien Building. PMX point number 12 (1016).
S17	629669.0672	1040563.7860	147.039	Set stationary prism west face of second floor at southwest corner of O'Brien Building, one foot above second floor ledge. PMX point number 1017.
S18	629616.0732	1040578.3560	127.540	Epoxied 2 inch diameter brass disk to northeast side of manhole collar. Manhole located near the middle of the southwest side of the O'Brien Building. Collar is roughly 6 inches below the lid. PMX point number 1018.
S19	629462.6466	1040753.6910	157.904	Set stationary prism under roof eve at the southwesterly corner of the Library Building. PMX point number 1019.
S20	629461.1497	1040749.8850	132.047	Set 2 inch diameter brass disk in sidewalk, o.4 feet east of west edge of concrete at southwesterly corner of Library Building. PMX point number 1020.
S21	629414.9114	1040804.4330	150.517	Set stationary prism on westerly face of Library Building, southerly section of the building at the southwesterly corner, +/- 15' above the ground. PMX point number 1021.
S22	630477.0363	1040752.8010	115.665	Set 2 inch diameter brass disk in foundation of Temple of Justice Building at northwest corner. PMX point number 1022.
S23	630468.5109	1041022.4550	115.537	Set 2 inch diameter brass disk in foundation of Temple of Justice Building at northeast corner. PMX point number 1023.
S24	630710.8599	1041222.3150	98.776	Found 2 inch brass disk 0.6 feet east of the southerly garage door track in concrete floor of GA Maintenance Shop. PMX point number 1024.
S25	630594.2975	1041197.0910	102.573	Found 2 inch brass disk 0.4 feet east of the northeast corner of the Green House Addition. PMX point number 1025.

NOTES

INSTRUMENT	BACKSIGHT	ANGLE RIGHT	DESCRIPTION
POINT 8	POINT 7	249°48'52"	SIGHTED SOUTH EDGE OF STEAM PLANT SMOKE STACK. (SEE DETAIL BELOW.)
POINT 8	POINT 7	255°53'06"	SIGHTED NORTH SIDE OF STEAM PLANT SMOKE STACK. (SEE DETAIL BELOW.)
POINT 8	POINT 7	POINT 2013	N 630391.4619, E 1040080.1631, ELEV. 186.715

N

DETAIL
STEAM PLANT SMOKE STACK
NOT TO SCALE

V1
SH 1 OF 1

CONTRACT #: 08-076
PRINTED BY:
riplesce Mar 10, 2011

OLYMPIA, WASHINGTON
CAPITOL CAMPUS
HILLSIDE MONITORING
CONTROL MAP

TOWNSHIP: 18 N. | RANGE: 2 W. | SECTION: 22 & 23
HRZ DATUM: WA STATE PLANE SOUTH ZONE | VERT DATUM: NAVD88
PARCEL: 09850005000 | DRAWING SCALE: 1"=100'

GA General Administration STATE OF WASHINGTON
210 – 11TH AVENUE SW
P.O. BOX 41000
OLYMPIA, WA 98504-1000
360-902-7244

BLAIR E. PRIGGE
29278
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8770 TALLON LANE N.E.
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P. 360.459.3609 F. 360.459.0154
www.parametrix.com

MARK:	REVISION:	BY:	APPROVED:	DATE:

SCALE: 1"=100'
0 100' 200'

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S24	630710.8599	1041222.3150	98.776	Found 2 inch brass disk 0.6 feet east of the southerly garage door track in concrete floor of GA Maintenance Shop. PMX point number 1024.
S25	630594.2975	1041197.0910	102.573	Found 2 inch brass disk 0.4 feet east of the northeast corner of the Green House Addition. PMX point number 1025.
S26	630452.1733	1040172.4042	105.858	Set mag nail and washer in edge of concrete pad for gas valves. PMX point number 1026.
S3I	630844.7766	1041223.34	92.749	Set chiseled "x" with punch in south end of "I" beam which is part of the soldier pile wall. "I" beam is closest one to S-3. PMX point number 2003.
S4I	630772.2668	1041193.083	98.255	Set chiseled "x" with punch in south end of "I" beam which is part of the soldier pile wall. "I" beam is closest one to S-4. PMX point number 2004.

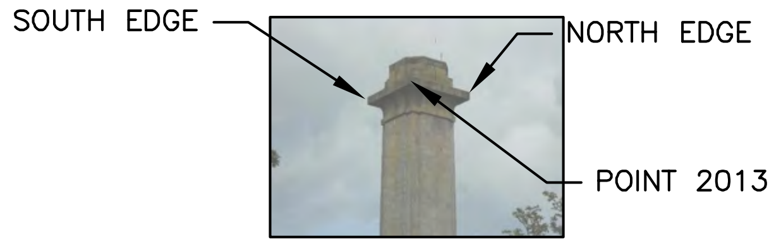
NOTES

INSTRUMENT	BACKSIGHT	ANGLE RIGHT	DESCRIPTION
POINT 8	POINT 7	249°48'52"	SIGHTED SOUTH EDGE OF STEAM PLANT SMOKE STACK. (SEE DETAIL BELOW.)
POINT 8	POINT 7	255°53'06"	SIGHTED NORTH SIDE OF STEAM PLANT SMOKE STACK. (SEE DETAIL BELOW.)
POINT 8	POINT 7	POINT 2013	N 630391.4619, E 1040080.1631, ELEV. 186.715

S1–S25 ORIGINALLY SURVEYED – MAY 2010
S3I, S4I AND S26 ORIGINALLY SURVEYED – JANUARY 2011

N

DETAIL
STEAM PLANT SMOKE STACK
NOT TO SCALE



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OLYMPIA, WASHINGTON
CAPITOL CAMPUS
HILLSIDE MONITORING
CONTROL MAP

TOWNSHIP: 18 N. | RANGE: 2 W. | SECTION: 22 & 23
HRZ DATUM: WA STATE PLANE SOUTH ZONE | VERT DATUM: NAVD88
PARCEL: 09850005000 | DRAWING SCALE: 1"=100'

V1
SH 1 OF 1
CONTRACT #: 08–076
PRINTED BY:
Priggbla Mar 25, 2011

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APPENDIX C

Hillside Monitoring Results

HILLSIDE MONITORING RESULTS

Loop 1

Date: May-10 **Crew: DS/BS**

Number	Northing	Easting	Elevation (Levels)	Description
1	630510.848	1041264.192	108.700	MON 1
2	630723.074	1041303.474	97.530	MON 2
3	630742.546	1041197.847	97.850	MON 3
4	630948.856	1041274.414	89.530	MON 4
5	630538.426	1041002.494	109.940	MON 5
6	630526.824	1040738.284	110.160	MON 6
7	630557.482	1040410.999	112.730	MON 7
8	630332.834	1040217.963	116.050	MON 8
9	630315.255	1040398.075	119.310	MON 9
10	630221.635	1040644.089	116.440	MON 10
11	629855.041	1040647.933	125.380	MON 11
12	629690.236	1040474.464	130.460	MON 12
13	629511.792	1040705.636	130.610	MON 13
14	629619.926	1040846.609	132.480	MON 14
15	629859.646	1041095.385	125.660	MON 15
16	630137.499	1041106.850	117.450	MON 16
106	630430.900	1041523.690	108.930	MON 106
108	630225.460	1041291.650	118.090	MON 108
1001	631068.305	1041324.622	95.450	PRISM S_1
1002	630986.083	1041239.385	91.820	MON S_2
1003	630842.834	1041227.230	93.020	MON S_3
1004	630769.979	1041190.319	97.800	MON S_4
1005	630737.138	1041145.414	98.660	MON S_5
1006	630720.918	1041220.785	109.970	PRISM S_6
1007	630585.974	1041139.247	115.060	PRISM S_7
1008	630466.042	1041011.992	128.760	PRISM S_8
1009	630473.446	1040766.939	128.800	PRISM S_9
1010	630597.679	1040891.156	108.420	MON S_10
1011	630587.466	1040538.345	110.530	MON 11
1012	630581.278	1040412.872	112.610	MON S_12
1013	630416.781	1040172.523	99.120	MON S_13
1014	630325.599	1040147.306	102.760	PRISM S_14
1015	630084.368	1040271.902	142.910	PRISM S_15
1016	629690.236	1040474.464	130.460	MON S_16
1017	629669.067	1040563.785	147.040	PRISM S_17
1018	629616.073	1040578.355	127.560	MON S_18
1019	629462.647	1040753.692	157.910	PRISM S_19
1020	629461.150	1040749.885	132.070	MON S_20
1021	629414.912	1040804.433	150.530	PRISM S_21
1022	630477.036	1040752.801	115.680	MON S_22
1023	630468.511	1041022.455	115.530	MON S_23
1024	630710.860	1041222.315	98.790	MON S_24
1025	630594.298	1041197.092	102.570	MON S_25

Loop 2

Date: May-10 **Crew: DS/BS**

Number	Northing	Easting	Elevation (Levels)	Description
1	630510.841	1041264.192	108.720	MON 1
2	630723.062	1041303.484	97.550	MON 2
3	630742.541	1041197.860	97.880	MON 3
4	630948.842	1041274.429	89.520	MON 4
5	630538.429	1041002.500	109.950	MON 5
6	630526.830	1040738.284	110.180	MON 6
7	630557.500	1040411.004	112.750	MON 7
8	630332.855	1040217.960	116.090	MON 8
9	630315.270	1040398.073	119.330	MON 9
10	630221.644	1040644.084	116.450	MON 10
11	629855.047	1040647.934	125.380	MON 11
12	629690.229	1040474.473	130.470	MON 12
13	629511.796	1040705.651	130.610	MON 13
14	629619.931	1040846.617	132.470	MON 14
15	629859.647	1041095.390	125.650	MON 15
16	630137.496	1041106.853	117.440	MON 16
106	630430.900	1041523.690	108.930	MON 106
108	630225.460	1041291.650	118.090	MON 108
1001	631068.290	1041324.638	95.450	PRISM S_1
1002	630986.062	1041239.393	91.810	MON S_2
1003	630842.821	1041227.249	93.030	MON S_3
1004	630769.975	1041190.331	97.820	MON S_4
1005	630737.133	1041145.430	98.680	MON S_5
1006	630720.914	1041220.798	109.990	PRISM S_6
1007	630585.965	1041139.242	115.070	PRISM S_7
1008	630466.046	1041011.991	128.780	PRISM S_8
1009	630473.456	1040766.940	128.820	PRISM S_9
1010	630597.693	1040891.162	108.440	MON S_10
1011	630587.458	1040538.344	110.540	MON 11
1012	630581.292	1040412.883	112.620	MON S_12
1013	630416.821	1040172.523	99.160	MON S_13
1014	630325.619	1040147.306	102.790	PRISM S_14
1015	630084.389	1040271.894	142.930	PRISM S_15
1016	629690.229	1040474.473	130.470	MON S_16
1017	629669.067	1040563.789	147.050	PRISM S_17
1018	629616.081	1040578.376	127.570	MON S_18
1019	629462.651	1040753.704	157.920	PRISM S_19
1020	629461.147	1040749.898	132.070	MON S_20
1021	629414.916	1040804.449	150.530	PRISM S_21
1022	630477.044	1040752.805	115.690	MON S_22
1023	630468.515	1041022.463	115.550	MON S_23
1024	630710.856	1041222.327	98.800	MON S_24
1025	630594.295	1041197.095	102.600	MON S_25

Comparisons

Number	Delta Loop1-Loop2 Northing	Delta Loop1-Loop2 Easting	Horizontal Distance
1	-0.007	0.000	0.007
2	-0.012	0.010	0.016
3	-0.004	0.013	0.014
4	-0.014	0.015	0.020
5	0.003	0.006	0.006
6	0.005	0.000	0.005
7	0.018	0.004	0.019
8	0.021	-0.003	0.021
9	0.014	-0.002	0.014
10	0.008	-0.005	0.010
11	0.006	0.000	0.006
12	-0.007	0.009	0.011
13	0.003	0.015	0.015
14	0.005	0.008	0.010
15	0.001	0.005	0.005
16	-0.003	0.003	0.004
106	0.000	0.000	0.000
108	0.000	0.000	0.000
1001	-0.015	0.016	0.021
1002	-0.021	0.008	0.022
1003	-0.013	0.019	0.023
1004	-0.003	0.012	0.012
1005	-0.005	0.016	0.017
1006	-0.004	0.012	0.013
1007	-0.009	-0.005	0.010
1008	0.004	-0.001	0.004
1009	0.009	0.001	0.009
1010	0.014	0.006	0.015
1011	-0.008	-0.001	0.008
1012	0.013	0.011	0.017
1013	0.040	0.000	0.040
1014	0.020	0.000	0.020
1015	0.021	-0.008	0.022
1016	-0.007	0.009	0.011
1017	0.000	0.003	0.003
1018	0.008	0.021	0.022
1019	0.005	0.012	0.013
1020	-0.003	0.012	0.013
1021	0.005	0.016	0.017
1022	0.008	0.004	0.009
1023	0.004	0.008	0.009
1024	-0.004	0.012	0.013
1025	-0.003	0.003	0.004

Re-Observation S_4, S_5, and S_6

Date: November 11, 2010	**Crew: DS/Robotic Instrument**			
Number	**Northing**	**Easting**	**Elevation**	**Description**
2	630723.070	1041303.479	97.530	MON 2
3	630742.541	1041197.850	97.855	MON 3
1004	630769.999	1041190.301	97.768	MON S_4
1005	630737.137	1041145.408	98.637	MON S_5
1006	630720.912	1041220.790	109.980	PRISM S_6

During this Re-Observation effort, original Point 1, established in June 2010, was found at its original location both horizontally and vertically.

Mon 5 was not re-observed vertically and does not appear to have moved horizontally.

Comparisons from the Original Observation to Re-Observation S_4, S_5, and S_6

Date: November 11, 2010	**Crew: DS/BS**			
Number	**Delta Loop 1–Loop 4 Northing**	**Delta Loop 1–Loop 4 Easting**	**Horizontal Distance**	**Vertical Difference**
2	0.004	-0.005	0.006	0.000
3	0.005	-0.003	0.005	-0.005
1004	-0.020	0.018	0.027	0.032
1005	0.001	0.006	0.006	0.023
1006	0.006	-0.005	0.007	-0.010

Note: Original observation completed in June 2010.
Re-Observation completed on November 11, 2010.

Mon S_4 had the most movement; moving 0.027 horizontally and 0.032 vertically.

Loop 4

Date: January-11 **Crew: DS/BS**

Number	Northing	Easting	Elevation (Levels)	Description
1	630510.847	1041264.194	108.714	MON 1
3	630742.5392	1041197.853	97.869	MON 3
4	630948.8485	1041274.414	89.5303	MON 4
5	630538.4263	1041002.501	109.957	MON 5
6	630526.8194	1040738.284	110.173	MON 6
7	630557.4834	1040411.0081	112.743	MON 7
8	630332.838	1040217.963	116.082	MON 8
11	629855.0367	1040647.9465	125.37	MON 11
12	629690.2226	1040474.4735	130.475	MON 12_S16
13	629511.7876	1040705.6578	130.603	MON 13
17	630708.0668	1041303.4027	98.581	MON 17 Reset 2
18	630315.4194	1040404.3927	119.448	MON 18 Reset 9
19	630219.8741	1040645.8372	116.547	MON 19 Reset 10
20	629617.7659	1040851.2264	132.79	MON 20
21	629857.0885	1041094.6783	125.646	MON 21
22	630137.4849	1041106.8528	117.45	MON 22
1001	631068.3012	1041324.617	95.4551	PRISM S1
1002	630986.0725	1041239.37	91.817	MON S2
1003	630842.8328	1041227.216	93.014	MON S3
1004	630769.9994	1041190.302	97.74	MON S4
1005	630737.1191	1041145.413	98.652	MON S5
1006	630720.9091	1041220.794	109.9749	PRISM S6
1007	630585.9714	1041139.267	115.0821	PRISM S7
1008	630466.0371	1041012.002	128.7906	PRISM S8
1009	630473.4425	1040766.945	128.8168	PRISM S9
1010	630597.6614	1040891.153	108.442	MON S10
1011	630587.4777	1040538.354	110.546	MON S11
1012	630581.2872	1040412.869	112.606	MON S12
1013	630416.7837	1040172.546	99.135	MON S13
1014	630325.6043	1040147.298	102.7829	PRISM S14
1015	630084.3753	1040271.903	142.9202	PRISM S15
1017	629669.0611	1040563.8	147.0436	PRISM S17
1018	629616.0693	1040578.394	127.552	MON S18
1019	629462.6484	1040753.717	157.9275	PRISM S19
1020	629461.1393	1040749.923	132.053	MON S20
1021	629414.9091	1040804.461	150.533	PRISM S21
1022	630477.022	1040752.806	115.673	MON S22
1025	630594.2733	1041197.098	102.584	MON S25
1026	630452.1733	1040172.404	105.858	MON S26
2003	630844.7766	1041223.34	92.749	MON S3I
2004	630772.2668	1041193.083	98.255	MON S4I
2013	630391.4295	1040080.188	186.7483	CONC SE_COR_STACK
2014	630403.0256	1040077.395	186.7648	CONC N_COR_STACK

Comparisons

Date: January-11 **Crew: DS/BS**

Number	Delta Loop1-Loop4 Northing	Delta Loop1-Loop4 Easting	Horizontal Distance	Vertical Difference
1	0.001	-0.002	0.002	-0.014
3	0.006	-0.005	0.008	-0.019
4	0.008	0.000	0.008	0.000
5	0.000	-0.007	0.007	-0.017
6	0.005	0.000	0.005	-0.013
7	-0.002	-0.009	0.009	-0.013
8	-0.004	0.000	0.004	-0.032
11	0.004	-0.013	0.014	0.010
12	0.013	-0.010	0.017	-0.015
13	0.005	-0.022	0.022	0.007
1001	0.004	0.005	0.006	-0.005
1002	0.010	0.015	0.018	0.003
1003	0.002	0.013	0.013	0.006
1004	-0.021	0.017	0.027	0.060
1005	0.019	0.001	0.019	0.008
1006	0.008	-0.009	0.012	-0.005
1007	0.003	-0.020	0.020	-0.022
1008	0.005	-0.010	0.011	-0.031
1009	0.004	-0.005	0.007	-0.017
1010	0.018	0.003	0.018	-0.022
1011	-0.012	-0.009	0.015	-0.016
1012	-0.009	0.003	0.009	0.004
1013	-0.003	-0.023	0.023	-0.015
1014	-0.006	0.008	0.010	-0.023
1015	-0.007	-0.001	0.007	-0.010
1017	0.006	-0.015	0.016	-0.004
1018	0.004	-0.039	0.039	0.008
1019	-0.002	-0.025	0.025	-0.018
1020	0.010	-0.037	0.039	0.017
1021	0.002	-0.027	0.028	-0.003
1022	0.014	-0.006	0.015	0.007
1025	0.024	-0.007	0.025	-0.014
2013	0.032	-0.025	0.041	-0.028

APPENDIX F
DATA CD

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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